

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING
CHEG 2308 ECONOMIC ANALYSIS WITH TECHNICAL APPLICATION,
Fall 2021**

INSTRUCTOR: Safwat H. Shakir

- I. COURSE DESCRIPTION IN ABET FORMAT**
- II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS**
Program Outcomes Assessed in Course
Assessment Summary of Class Semester Averages for Outcomes
End of Semester Course Outcomes Assessment Reports
- III. TESTS – Mid-Term Test – and Final Exam**
Summary of Topics covered by Test
Original Test Questions & Master Solution/grading scheme used
(Summary of topics can be a separate page or include on the assignment itself)
 - Above Average (Graded original work)**
 - Average (Graded original work)**
 - Below Average (Graded original work)**
- IV. HOMEWORK ASSIGNMENTS**
Summary of Topics covered by Homework
Original Homework Questions & Master Solution/grading scheme used
 - Above Average (Graded original work)**
 - Average (Graded original work)**
 - Below Average (Graded original work)**
- V. PROJECT**
Summary of Topics Covered by Project
Project Problem Statement and Grading Scheme
 - Above Average (Graded original work)**
 - Average (Graded original work)**
 - Below Average (Graded original work)**
- VI. HANDOUT COURSE MATERIALS**

Course Description in ABET Format

Chemical ENGINEERING DEPARTMENT

CHEG 2308- ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS

1.	Course number and name:	CHEG 2308- ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS
2.	Credit and contact hours:	3 credit hours
3.	Instructor's Name	Dr. Safwat H. Shakir
4.	Text Book: Title	ENGINEERING ECONOMIC ANALYSIS
	Author:	Donald G.Newn, Jrome P Lavelle and Ted G. Eschenbach
	Publisher, Year & Edition	OXFORD Press - Fourteenth Edition 2019 ISBN- 978-0-19-093191-9
	Other Supplemental Materials	1. Basics of Engineering Economy" By Leland Blank and Anthony Tarquin. 2014. McGraw-Hill Higher Education. ISBN 978-0-07-340129- 2. Sullivan, W.G., Wicks and Koelling, J.A. Engineering Economy, 14th Edition, 2009, Prentice-Hall. ISBN -10-0136142974. 3. 2. C. S. Park, Contemporary Engineering Economics, 4th Ed. 2007, Prentice-Hall. ISBN- 0-13-187628. 4. 3. "Fundamentals of Engineering Economic Analysis" by John A. White; Kellie S. Grasman, Kenneth E. Case, Kim LaScola Needy and David B. Partt. First Edition- Wiley, 2013 ISBN 978-1-118-41470-5.
5	Specific Course Information	
	a. Brief description of the content of the course (Catalog Description)	CHEG 2308. Economic Analysis and Technical Applications. (3-0) Credit 3 semester hours. Fundamental concepts of economic principles. Evaluation of technical alternatives, economic significance of technical proposals; interest, description, analysis, and forecasting.
	b. Prerequisite or Co-requisite	Prerequisites or co-requisites: MATH 1124
	c. Indicate whether a required, elective, or selected elective (as per definition provided) course in the program	Required
6	Specific goals for the course	Students will be able to:
	a. Specific outcomes of instruction	1. Understand the economic principals, and economic terms. 2. Understand the economic and mathematical equations used in the economic analysis. 3. Understand the economic costs, methodologies of assessing the costs, cost estimation and cost concepts. 4. Understand the time value and project cash flow in engineering economy 5. Understand the comparison of alternative for different projects in form of present worth, future worth and annual worth. 6. Understand Breakeven Analysis, sensitivity analysis, income tax, risk analysis and depreciation methodologies 7. Understand capital investment in engineering projects. 8. Understand rate of return and calculations. 9. Cost Benefit Analysis of engineering projects. 10. Projects assessment cases.
	b. Explicitly indicate which of the student outcomes are addressed by the course	This Course addresses: Outcome 8: An ability to identify, formulate, and solve problems, engineering problems by applying principles of engineering science and mathematics

7	Brief list of topics to be covered	❖ Chapter 1: Foundations of Engineering Economy and making Economic decision, cost and benefits and Estimating Cost 3 hours
		❖ Chapter 2: Factors: How Time and Interest Affect Money, and interest equivalence 3 hours
		❖ Chapter 3 Nominal and Effective Interest Rates 3 hours
		❖ Chapter 4: Present Worth Analysis 2 hours
		❖ Chapter 4: Continue Present Worth Analysis 1 hour
		❖ Chapter 5: Annual Worth Analysis 2 hours
		❖ Chapter 6: Rate of Return Analysis 4 hours
		❖ Chapter 7: Benefit/Cost Analysis and Public Sector Projects. 3 hours
		❖ Chapter 8: Breakeven, Sensitivity, and Payback Analysis. 3 hours
		❖ Chapter 9: Replacement and Retention Decisions 3 hours
		❖ Chapter 10: Effects of Inflation and Price Change 3 hours
		❖ Chapter 11: Minimum Attractive Rate of Return 3 hours
		❖ Chapter 12: Depreciation Methods 3 hours
		❖ Chapter 13: After-Tax Economic Analysis 3 hours
		❖ Case study 6 hours
		❖ Review Materials 3 hours

I. Course Description in ABET Format

Chemical ENGINEERING DEPARTMENT CHEG 2308- ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS

1.	Course number and name:	CHEG 2308- ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS
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3.	Instructor's Name	Dr. Safwat H. Shakir
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	b. Prerequisite or Co-requisite	Prerequisites or co-requisites: MATH 1124
	c. Indicate whether a required, elective, or selected elective (as per definition provided) course in the program	Required
6	Specific goals for the course	Students will be able to:
	a. Specific outcomes of instruction	1. Understand the economic principals, and economic terms. 2. Understand the economic and mathematical equations used in the economic analysis (Outcome 8 in the Department is representing OutCome 1 in ABET). An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. 3. Understand the economic costs, methodologies of assessing the costs, cost estimation and cost concepts. 4. Understand the time value and project cash flow in engineering economy 5. Understand the comparison of alternative for different projects in form of present worth, future worth and annual worth. 6. Understand Breakeven Analysis, sensitivity analysis, income tax, risk analysis and depreciation methodologies 7. Understand capital investment in engineering projects. 8. Understand rate of return and calculations. 9. Cost Benefit Analysis of engineering projects. 10. Projects assessment cases.
	b. Explicitly indicate which of the student outcomes are	This Course addresses: <u>Outcome 8:</u> An ability to identify, formulate, and solve problems, engineering problems by applying principles of engineering science and mathematics.

	addressed by the course	<u>Outcome 3:</u> An ability to function on multi-disciplinary Teams. Also, Ability to understand the impact of technology solutions in a global and societal context. (this is for ABET and Core Curriculum) <u>Outcome 4:</u> The broad education Necessary the impact of engineering Solution in Global and Societal Context
7	Brief list of topics to be covered	❖ Chapter 1: Foundations of Engineering Economy and making Economic decision, cost and benefits and Estimating Cost 3 hours
		❖ Chapter 2: Factors: How Time and Interest Affect Money, and interest equivalence 3 hours
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		❖ Chapter 12: Depreciation Methods 3 hours
		❖ Chapter 13: After-Tax Economic Analysis 3 hours
		❖ Case study 6 hours
		❖ Review Materials 3 hours

**End of Semester Course Assessment Reports Fall
2019, Spring 2020, Fall 2020, Spring 2021 and Fall
2021 Assessment Periods**

Each Summary Contains the Following Information

1. Performance Statistics

- Total number of students in class
- The class average performance (**stated as %**) in each course outcome assessed
- in this class and the **two previous times course was assessed.**
- The acceptable class average for the class in each outcome area as set by your Department.
- Percentage of students who scored below the expected average in each

2. Implementation Summary

- Brief summary of plans implemented during the semester based on last assessment report.

3. Perceived Problems

- Instructor's **critical evaluation** of perceived problems that affected students' performance. **Realistic problems should be identified throughout the semester and summarized in this section of the report.**

4. New Plans for Addressing Problems

- Instructor's plans for addressing the perceived problems the next time the class is taught. **These should be specific enough for another instructor to implement. Most of these should be things that, you, the instructor can implement to help students to improve. Be creative.**

5. Overall Trend over last three assessment periods

- Instructors summary of overall performance trend for each outcome measured over the last three periods.

6. Were expectation met

- Answer **YES** if the **class average was above the expected average and the stated percentage of students** scored at or above the expected average, else answer NO.

End of Semester Course Assessment Reports Fall 2019, Spring 2020, Fall 2020,
Spring 2021 and Fall 2021 Assessment Periods
Each Summary Contains the Following Information

1. Performance Statistics

- Total number of students in class
- The class average performance (**stated as %**) in each course outcome assessed
- in this class and the **two previous times course was assessed.**
- The acceptable class average for the class in each outcome area as set by your Department.
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5. Overall Trend over last three assessment periods

- Instructors summary of overall performance trend for each outcome measured over the last three periods.

6. Were expectation met

- Answer **YES** if the **class average was above the expected average** and **the stated percentage of students** scored at or above the expected average, else answer NO.

Program Outcomes Assessed in this Course

An ability to identify, formulate, and solve problems, engineering problems by applying principles of engineering science and mathematics.

Creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information, Effective development, interpretation and expression of ideas through written, oral and visual communication, Manipulation and analysis of numerical data or observable facts resulting in informed conclusions, and: Intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities

Ability to apply knowledge of math, science and engineering; ability to identify and formulate solutions to technical problems, an ability to function on multi-disciplinary Teams, the broad education Necessary the impact of engineering Solution in Global and Societal Context. Ability to understand the impact of technology solutions in a global and societal context. (This is for ABET and Core Curriculum).

CHEG 2308 ECONOMIC ANALYSIS WITH TECHNICAL APPLICATION

Report Prepared by: Dr. Safwat H. Shakir

Report Date: December 16, 2022			
Outcomes	Outcome 8	Outcome 3	Outcome 4
	Ability to apply knowledge of mathematics, science, & engineering, Formulate and solving Engineering Problems An ability to identify, Formulate, and Solve engineering problem.	Ability to Organize, Plan, Design/Prepare and Use Appropriate Visual Aids for communication/Prese ntation to a range of audiences (executives, technical and non-technical	Broad education necessary to Understand the impact of engineering solution in global and social context
Semester	Class Average	Class Average	Class Average
Fall 2019 Class-1	74.5	71	76
Fall 2019 Class-2	76.4	72	74
Spring 2020 Class 4	76.2	75.2	76
Spring 2020 Class 1	72.4	73.0	72
Fall 2020- Class 1	73.2	70..5	71.6
Spring 2021 Class 1	61.8	70.3	70.3
Fall 2021 Class 1	68.5	65.0	70.2

Expected Semester Class Average = 70%

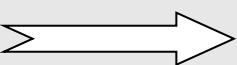
Table 2.1 END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT

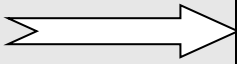
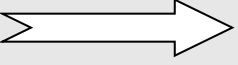
CHEG 2003 ECINOMIC ANALYSIS WITH TECHNICAL APPLICATION

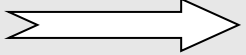
Fall 2019-Fall 2021

Report Prepared by: Dr. Safwat H. Shakir

Report Date: December 20-2021

Semester	Analysis Type	Number of Students	Outcome 8			Outcome 3			Outcome 4		
			Ability to apply knowledge of mathematics, science, & engineering, Formulate and solving Engineering Problems An ability to identify, Formulate, and Solve engineering problem.			Ability to Organize, Plan, Design/Prepare and Use Appropriate Visual Aids for communication/Presentation to a range of audiences (executives, technical and non-technical)			Broad education necessary to Understand the impact of engineering solution in global and social context.		
			Expected Average	Class Average	% Students Above The Expected Average and in The Average Range	Expected Average	Class Average	% Students Above The Expected Average and in The Average Range	Expected Average %	Class Average %	% Students Above The Expected Average and in The Average Range of 70%
Fall 2019 Class-1	Direct	17	70	74.5	65.0%	70	71	70%	70	76	72%
Fall 2019 Class-2	Direct	31	70	76.4	70.9%	70	72	70%	70	74	71%
Spring 2020 Class 4	Direct	17	70	76.2	50%	70	75.2	60%	70	76	60%
Spring 2020 Class 1	Direct	17	70	72.4	59%	70	73.0	64%	70	72	70.6
Fall 2020- Class 1	Direct	9	70	73.2	66%	70	71.6	66%	70	70.5	65%
Spring 2021 Class 1	Direct	30	70	61.8	50.0%	70	70.3	72.0%	70	70.3	76.0%
FALL 2021 Class Section 1 and Section 2	DIRECT	32	70	%68.5	75%	70	65.0%	75.0%	70	70.2%	72.0%
Implementation Summary			➤ Students were made aware of the importance of basic mathematics and in particularly algebra, geometric series; algebraic expressions were derived for compound series factor for different scenarios such as capital recovery or sinking fund. ➤ Closed form analytical solution for inverse problems of finding out the interest rate i. More terms in the mathematical and geometric series were explained and yielded more accurate results ➤ In the beginning of the course, Summary notes were developed to show the students the materials. Also, excel spreadsheet was discussed in the class to show how to use this tool in economical analyses.			Practice sessions in class on how to rephrase procedure, for the analyses of the problems and understanding the concept to understand the problems and to formulizing the problems in discussion format to allow getting the concept of solving the problem. sample analyses done in the class and answers compared to that obtained by instructor at class and office hours, and where time was a constrain, instructor performed analysis using first data point and provided the correct answers to students to use to check their analysis data on e-course module supported by the university. The students were trained in the class room on how to make presentation on the topic that they are practice. To give the audience more precisely information.			Economic engineering and money values, engineering alternatives and impacts domestically and globally were discussed in the class. Informal problems given that concentrated in formulation of problems. Power point presentations were given to the students. In addition, solution to the assignment and homework were presented to the students on Power Point presentations. It is very important to monitor the students' interests to the practical applications of engineering economic. In addition, I noticed that providing students with real practical applications from the industry allowed the motivation of the students to concentrate. I provided the students with applicable problems from the real world environment		

Perceived Problems		Students' mathematical abilities still is not good and are coming to the classes unprepared even they are passing some of mathematical classes. The main problem is that the students were not given attention in high schools for math subject. However even I am able to produce the average and met the required expected average, I feel that the students have a room for improvement. The students are still week. The students informed me that in the math classes, they were not exposed to any solving problems in how to think to use the knowledge in applying for solving problems. However, this improvement is in continuous mode because our efforts in the recitation that have great impact on the students grasping the materials well	The students were exposed to the subject of money and how to assess the importance of money for their life. What are the impacts of money on the communities, society, nation and globally. This semester and last semester of pandemic COVID virus are un-usual semesters	Students sometimes are copying from each other's or copying from internet website called CHEGG. CHGG WEBSITE offers the students real-time answers to the questions in return the students are participating in monthly payment. Further, at the time of COVID-19, you cannot monitor the students during exams or homework because the exams cannot be conducted in the classroom. This issue was forwarded to the administration and the students complaints for their privacy issue. Therefore, the homework assignments percentages were reduced to 20% of the total grade of the class. Currently homework's percentages were reduced to 0% and the 10% were given for attendance of the class according to the student's % of attendance. In spite of the improvement, I am feeling that the continuous improvement of listening and comprehending in the class give the better results. In this respect, I feel that the students have the ability to do more to improve their skills.
Plans for Addressing Problems		The followings are recommended for implementation. 1. Recommendation is being made for the department to develop a plan with Math department to determine the root cause of the poor mathematical ability and to address it. 2. Instructor should continue and prepare basic materials for calculus review and a few assignments on differentiation, integration and algebraic manipulations. 3. Instructor should prepare a summary of pre-requisite topics to be reviewed by students with some homework in those areas. 4. Use many sessions of recitation for using MS. Excel Software to be effective tool for understanding the math problems in Engineering Economy. 5. Continue the practice of requiring students to perform one sample calculation during the class period. The results will be checked by instructor to ensure the analyses are correct before writing the solution. 6. Needs to continue providing tutoring assistance to interested students. 7. It is important to get more special tutoring sessions outside class room to strengthen class conducted by graduate students to support recitation of the materials. 8. I am still struggling with the students to get the concept in their minds. I have spent lot of time out of the class in my office and after recitation to the extent that some of students are staying with me for more than two hours to grasp the materials. 9. It is still a problem with math and algebra. The students have week math background even we are teaching them math in different classes.		The instructor should: ➤ Even though the instructor reduces the time spent on giving notes on the board by making copies of notes for students, it is recommended that this be continued in subsequent semesters. However, instructor should use some of the Lab time to assist students in analyzing homework problems. ➤ Need to continue providing tutoring assistance to interested students ➤ It is important to get more special tutorial sessions outside classroom as strengthen class conducted by graduate students to support recitation of the materials. ➤ I am giving the students real global, nation, and community and personal for the economic problem they are facing. As an example I gave the students real problem such as interest rate % changing from lower to higher percent or the opposite and they are discussing the impacts of interest rate on local, nation, global economy and their well beings.

Overall Trend over Periods		Further improvements in % of students scoring above average targeted. The scores were improved and still needed more work with the students – I introduced extra sessions for reviewing the materials in the class. However, the current semester Fall 2019, there is a minor improvement. The students need more attention from the Mathematical Department to enforce the learning of how to solve problems. Furthermore, CHGG web site is providing the students with real-time answering the questions. Additionally, the students are paying the CHGG Web Site monthly fees to get real-time answering their homework, tests and this is causing the students to access these materials. The real problem in this regards is that the students are accessing the old-test but real-time answering exams. This semester and past semester of pandemic COVID virus are un-usual semesters to deal with. In addition, other recommendation is to stop the CHGG website for distributing the real answers and stop charging the students money. This is happening in all classes and not only in engineering economy but for all other courses of curriculum in particularly in science and engineering.		Further improvements in % of students scoring above average targeted. The scores were improved and still needed more work with the students – I will introduce extra sessions for reviewing the materials in the class. In the current semester (Spring 2021) improvement of students were not enough and the suggestion is to introduce an extra hour to the class in the Fall 2021 as a lab hour and it is mandatory for the students to attend. In this lab hour the student will be given case studies to support their work and given an assignment to be solved in the lab hour. In the fall 2018, the students have improve greatly and there is a room for improvement. However, in This semester and last semester of pandemic COVID virus are un-usual semesters. Also, the most important problem that the university is to take action for stopping accepting students without score in TAS, SAT or other standard tests.
Were Expectations Met?	Average≥70%	N0	No	YES

Test

TESTS - Mid-Term Test and Final Exam

CHEG 2308 ECONOMIC ANALYSIS WITH TECHNICAL APPLICATION
Fall 2021

TITLE OF ASSIGNMENT: TEST 1
TOPICS COVERED IN TEST 1

- 1) Introduction to Engineering Economy**
- 2) Application and understanding of Future Values Formulas**
- 3) Application and understanding of Annual Values formulas**
- 4) Application and understanding of Present Values formulas**

TEST 1-Engineering Economy CHEG 2308: Date September 23, 2021- Section 1-12:30-2:00

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting, otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please use the factor table that was given to you.

- 1) A concept car that will get 100 miles per gallon and carry 4 persons would have a carbon-fiber and aluminum composite frame with a 900 cc three cylinders turbodiesel/electric hybrid power plant. The extra cost of these technologies is estimated to be \$11,000. If gasoline savings over a comparable conventional car would be \$900 in year 1, increasing by 10% each year, what is the present worth of the savings over a 10-year period at an interest rate of 8% per year?
- 2) For the cash flows shown, determine the future worth in year 5 at an interest rate of 10% per year.

Year	1	2	3	4	5
Cash Flow	\$300,000	\$275,000	\$250,000	\$225,000	\$200,000

3)

The TT Racing and Performance Motor Corporation wishes to evaluate two alternative machines for NASCAR motor tune-ups. Use the best method at 9% per year to select the better alternative.

	Machine R	Machine S
First cost, \$	-250,000	-370,500
Annual operating cost, \$ per year	-40,000	-50,000
Life, years	3	5
Salvage value, \$	20,000	20,000

4. How much interest is *payable each year* on a loan of \$2,000 if the interest rate is 10% per year when half of the loan principal will be repaid as a lump sum at the 1st of four years and the *other half* will be repaid in one lump-sum amount at the end of eight years? How much Interest will be paid over the eight-year period?

5. You invest \$25,000 in a stock-based mutual fund. This fund should earn (on average) 10% per year over a long period of time. How much should your investment be worth in 25 years?

Above Average

TEST 1-Engineering Economy CHEG 2308: Date September 23, 2021- Section 2-3:30-5:00pm

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting. otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please use the factor table that was given to you.

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5. You invest \$25,000 in a stock-based mutual fund. This fund should earn (on average) 10% per year over a long period of time. How much should your investment be worth in 25 years?

$$1) \quad P = A_1 \left[\frac{1 - \left(\frac{1+g}{1+i} \right)^n}{i-g} \right] = 900 \left[\frac{1 - \left(\frac{1+.1}{1+.08} \right)^n}{.08-.1} \right]$$

$$= 900 \left[\frac{1 - 1.2014}{-.02} \right] = 45000 [2.014] = \$9,063$$

✓ 10%

$$2) \quad PW = A(P/A, i, n) - G(P/G, i, n)$$

$$= 300,000 (3.7908) - 25,000 (6.8618)$$

$$= 1,137,240 - 171,545$$

$$= 965,695$$

$$FW = PW(F/P, i, n)$$

$$= 965,695 (F/P, 10\%, 5)$$

$$= 965,695 (1.6105)$$

$$FW = \$1,555,251.7975$$

✓ 10%

$$4) \quad P = \$2000 \quad + = \text{time}$$

$$r = 10\%$$

$$i = \frac{P+r}{100}$$

$$\text{year 1: } i = \frac{2000 \times 1 \times 10}{100} = 200$$

$$\text{year 2: } i = \frac{2000 \times 1 \times 10}{100} = 200$$

$$\text{year 3: } i = 200$$

$$\text{year 4: } i = 200$$

Hand!

4) After year 4

$$P = \frac{2000}{2} = \$1000$$

$$\text{year 5: } i = \frac{1000 \times 1 \times 10}{100} = \$100$$

$$\text{year 6: } i = \$100$$

$$\text{year 7: } i = \$100$$

$$\text{year 8: } i = \$100$$

Total amount of interest paid

$$= (200 \times 4) + (100 \times 4)$$

$$= \$1200$$

5) $PW = \$25,000$

$$r = .10$$

$$n = 25 \text{ years}$$

$$FW = PW(1+r)^n$$

$$= 25,000(1+.10)^{25}$$

$$= 25,000 \times 1.10^{25}$$

$$= 25,000 \times 10.8347$$

$$FW = 270,867.65$$



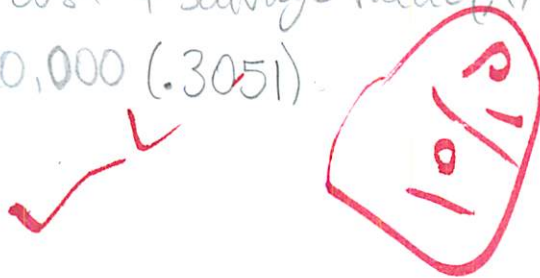
3) machine R

$$A = \text{first cost } (A/P, i, n) + \text{Annual cost} + \text{Salvage value } (A/F, i, n)$$

$$= -250,000(.3951) - 40,000 + 20,000(.3051)$$

$$= -98,775 - 40,000 + 6,102$$

$$= -132,673$$



Machine S

$$\begin{aligned}A &= -370,500 (A/P, 9\%, 5) - 50,000 + 20,000 (A/F, 9\%, 5) \\&= -370,500 (.2571) - 50,000 + 20,000 (.1671) \\&= -95,255.55 - 50,000 + 3,342 \\&= -141,913.55 \quad \checkmark\end{aligned}$$

Machine R is a better alternative

Kevin Giddens #6

38
50

TEST 1-Engineering Economy CHEG 2308: Date September 23, 2021- Section 1-12:30-2:00

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5. You invest \$25,000 in a stock-based mutual fund. This fund should earn (on average) 10% per year over a long period of time. How much should your investment be worth in 25 years?

1

$$P = A \uparrow \left[\frac{1 - \left(\frac{1+G}{1+i} \right)^n}{i - G} \right]$$

$\begin{matrix} 0.1 \\ \downarrow \\ n=10 \\ \leftarrow \end{matrix}$
 $\begin{matrix} i=0.08 \\ \leftarrow \end{matrix}$

$$P = 900 \left[\frac{1 - \left(\frac{1+0.1}{1+0.08} \right)^{10}}{0.08 - 0.1} \right]$$

$$P = 900 \left[\frac{1 - 1.2014}{-0.02} \right] \quad \checkmark (16)$$

$$45000 [\text{over } 0.2014]$$

$$= \$9,063$$

2

~~over 0.2014~~

$\begin{matrix} 1 & 2 & 3 & 4 & 5 \\ 300K & 275K & 250K & 225K & 200K \end{matrix}$

$$PW = A \left(\frac{P}{A, i, n} \right) - G \left(\frac{P}{G, i, n} \right)$$

$$300K (3.7908) - 25K (6.8618)$$

$$A = 300K$$

$$G = \text{over } 25K$$

$$i = 0.10$$

$$n = 5 \text{ years}$$

$$FW = PW \left(\frac{F}{P}, i, n \right)$$

$$FW = 965,695 \left(\frac{F}{P}, 10\%, 5 \right)$$

$$965,695 (1.6105)$$

$$1,555,251.8$$

$$1,137,240 - 171,545$$

$$965,695 = PW$$

$$\checkmark (16)$$

~~over 0.2014~~

3

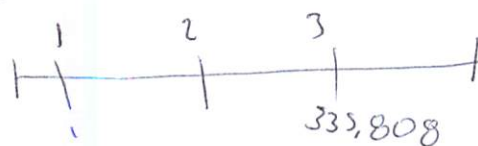
for
R

$$PW = R = 250,000 + 40,000 \times PVIFA(9\%, 3) - 20,000 \times PVIF(9\%, 3)$$

$$250,000 + 40,000 \times 2.5313 - 20,000 \times 0.7722$$

$$250,000 + 101,252 - 15,444$$

$$= 335,808$$



for
S

$$PW = S = 370,500 + 50,000 \times PVIFA(9\%, 5) - 20,000 \times PVIF(9\%, 5)$$

$$370,500 + 50,000 \times 3.8897 - 20,000 \times 0.6499$$

$$= 370,500 + 194,485 - 12,998$$

$$= 551,987$$

6/10



R is lower
cost so R should
be chosen

interest Payable

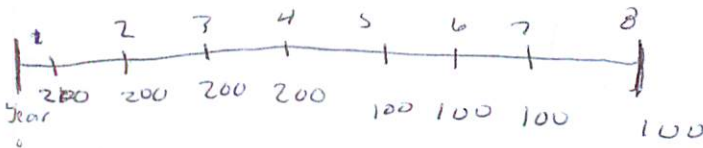
$$= \frac{2000 \times 0.1}{2} = \frac{200}{2}$$

$$\text{half} = 1000 \times 0.1 = 100$$

$$8 \text{ years} = 200 \times 4 + 100 \times 4 = 1200$$

$$800 + 400 = 1200$$

is this
Interest Simple
or Compound?



$$FV = PV(1+r)^n$$

$$\text{Present value} = 25,000$$

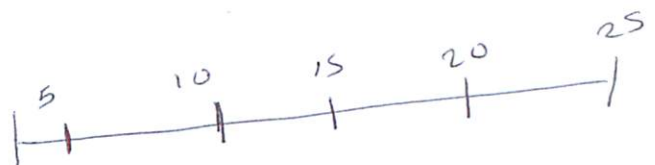
$$\text{Rate of Interest} = 0.10$$

$$N \text{ years} = 25$$

$$FV = 25,000 \times (1 + 0.10)^{25}$$

$$25,000 \times (1.10)^{25} = 25,000 \times 10.8347$$

$$FV = 270,867.5$$



TEST 1-Engineering Economy CHEG 2308: Date September 23, 2021- Section 2-3:30-5:00pm

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5. You invest \$25,000 in a stock-based mutual fund. This fund should earn (on average) 10% per year over a long period of time. How much should your investment be worth in 25 years?

$$1) \quad P = A_1 \left[\frac{1 - \left(\frac{1+g}{1+i} \right)^n}{i-g} \right] = 900 \left[\frac{1 - \left(\frac{1+.1}{1+.08} \right)^n}{.08-.1} \right]$$

$$= 900 \left[\frac{1 - 1.2014}{-.02} \right] = 45000 [2.014] = \$9,063$$

✓ 10%

$$2) \quad PW = A(P/A, i, n) - G(P/G, i, n)$$

$$= 300,000 (3.7908) - 25,000 (6.8618)$$

$$= 1,137,240 - 171,545$$

$$= 965,695$$

$$FW = PW(F/P, i, n)$$

$$= 965,695 (F/P, 10\%, 5)$$

$$= 965,695 (1.6105)$$

$$FW = \$1,555,251.7975$$

✓ 10%

$$4) \quad P = \$2000 \quad + = \text{time}$$

$$r = 10\%$$

$$i = \frac{P+r}{100}$$

$$\text{year 1: } i = \frac{2000 \times 1 \times 10}{100} = 200$$

$$\text{year 2: } i = \frac{2000 \times 1 \times 10}{100} = 200$$

$$\text{year 3: } i = 200$$

$$\text{year 4: } i = 200$$

Hand!

4) After year 4

$$P = \frac{2000}{2} = \$1000$$

$$\text{year 5: } i = \frac{1000 \times 1 \times 10}{100} = \$100$$

$$\text{year 6: } i = \$100$$

$$\text{year 7: } i = \$100$$

$$\text{year 8: } i = \$100$$

Total amount of interest paid

$$= (200 \times 4) + (100 \times 4)$$

$$= \$1200$$

5) $PW = \$25,000$

$$r = .10$$

$$n = 25 \text{ years}$$

$$FW = PW(1+r)^n$$

$$= 25,000(1+.10)^{25}$$

$$= 25,000 \times 1.10^{25}$$

$$= 25,000 \times 10.8347$$

$$FW = 270,867.65$$



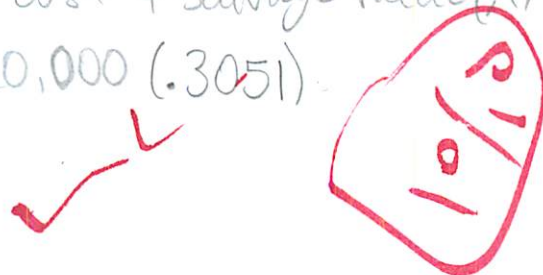
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$$= -132,673$$



Machine S

$$\begin{aligned}A &= -370,500 (A/P, 9\%, 5) - 50,000 + 20,000 (A/F, 9\%, 5) \\&= -370,500 (.2571) - 50,000 + 20,000 (.1671) \\&= -95,255.55 - 50,000 + 3,342 \\&= -141,913.55 \quad \checkmark\end{aligned}$$

Machine R is a better alternative

Average

TEST I-Engineering Economy CHEG 2308: Date September 23, 2021- Section 2-3:30-5:00pm

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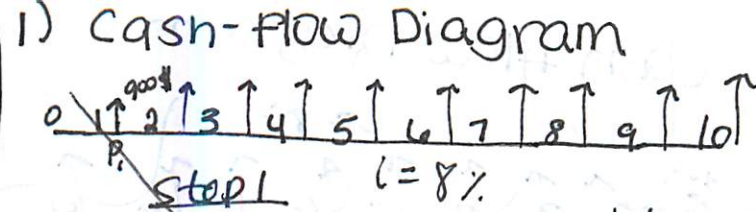
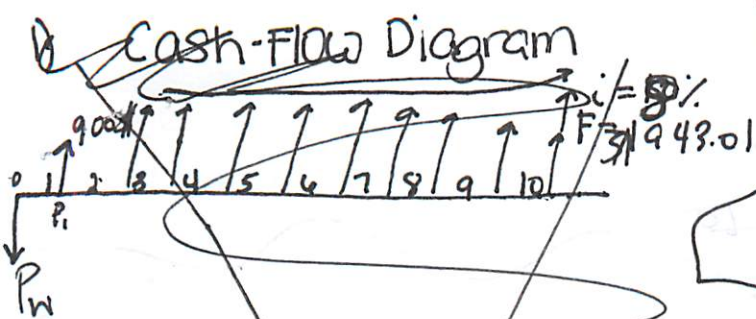
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Step 1 Find F for 10 years

$$F = P_1 (F/P, 8\%, 10)$$

$$= 900 (2.1589)$$

$$= \$1943.01$$

$P_1 = 900$ Year 1

Solve for F ~~which~~ which is the future amount that is the present worth at 10 years.

$$F = P_1 (F/P, 8\%, 10)$$

$$900 (2.1589)$$

$$P_2 = \$1943.01$$

$$P_0 = P_1 + P_2$$

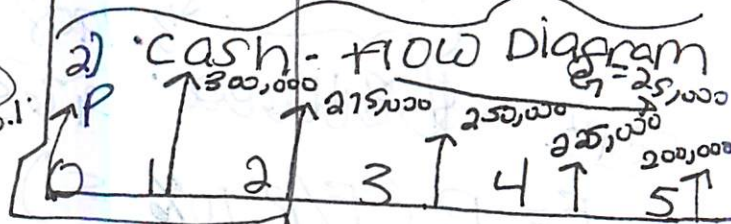
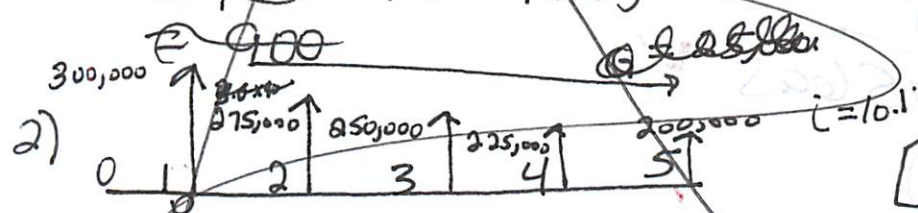
Final step Find Pw the present worth

$$P_w = F (P/F, 8\%, 10)$$

$$= 1943.01 (0.4632)$$

$$= 900$$

Present worth \$2843.01



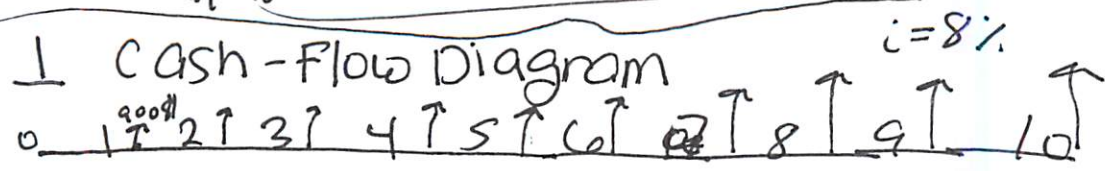
Step 1 solve for F

$$F = P (F/P, 10\%, 5)$$

$$= 300,000 (1.6105) - 250,000$$

$$= \$483,150$$

Step 1 Find P



$$P = A_1 \left[\frac{1 - (1+s)^n (1+i)^{-n}}{i - s} \right]$$

$n = 10$
 $g =$

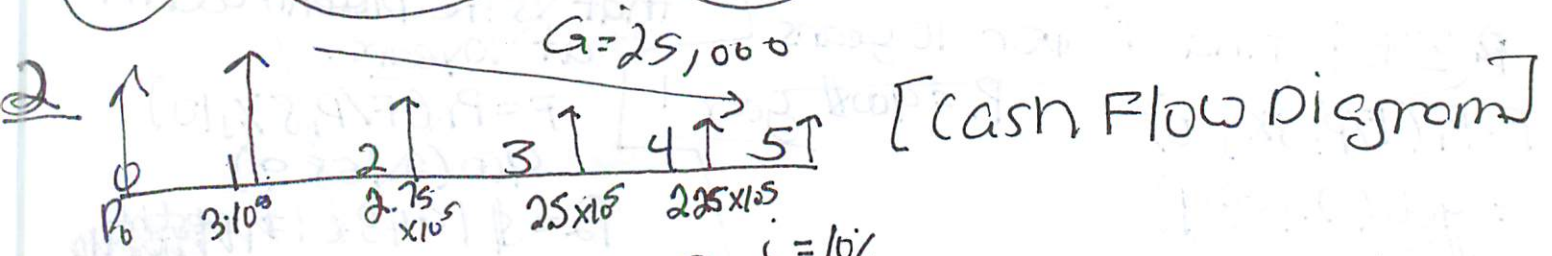
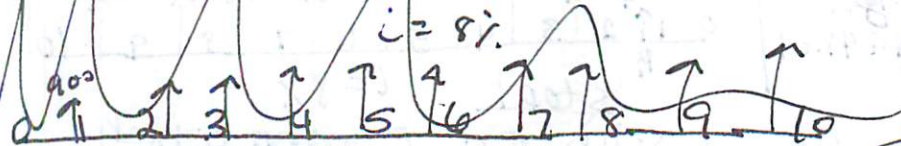
$$900 \left[\frac{(1 - (1+0.10)^1 (1+0.08)^{-10})}{0.08 - 0.10} \right]$$

$$= \$22071.922$$

$$= 9,063$$

10/10

Cash Flow Diagram



Step 1 Find P $i = 10\%$

$$P_0 = A(P/A, 10\%, 5) - G(P/G, 10\%, 5)$$

$$= 300,000(4.16105) - 25,000(6.8618)$$

$$= 1,248,315 - 171,545$$

$$= 1,076,770$$

Step 2

$$F = P(F/P, 10\%, 5)$$

$$= 1,076,770(1.6105)$$

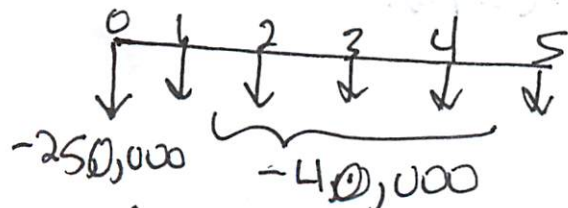
$$= 1,733,251.79$$

$$= \$1,555,251.79$$

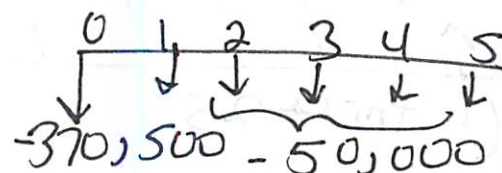
1.6

3. machine K Cash Flow Diagram machine S

$i = 9\%$



Salvage value. $\$ = 20,000$



$\frac{2}{1.5}$

$$FV = PV(1 + r)^n =$$

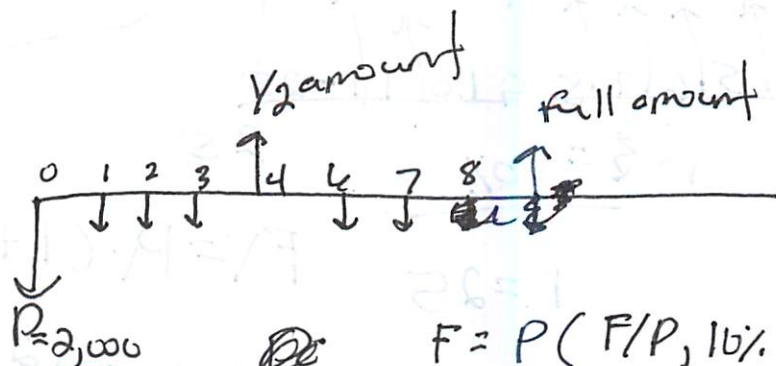
$$= 250,000(1 + 0.09)^5$$

$$= 350,000$$

~~270,867.65~~

What is the formula! What is the Answer!

4. $i = 10\%$



Pay $\frac{1}{2}(2928.2)$
 $P_{new} = 1464.1$

$$F = P(F/P, 10\%, 4)$$

$$= 2,000(1.4641)$$

$$= 2928.2$$

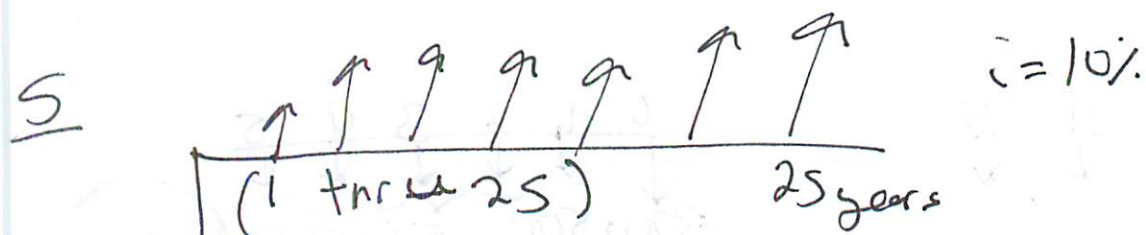
$\frac{5}{10}$

$$F = P_{new}(F/P, 10\%, 8)$$

$$P_2 = 1464.1(2.1436)$$

$$= 3138.476$$

First 4 years = 2928.2
 interest paid
 8 years = 1138.44
 interest paid



$$FV = PV(1+r)^n$$

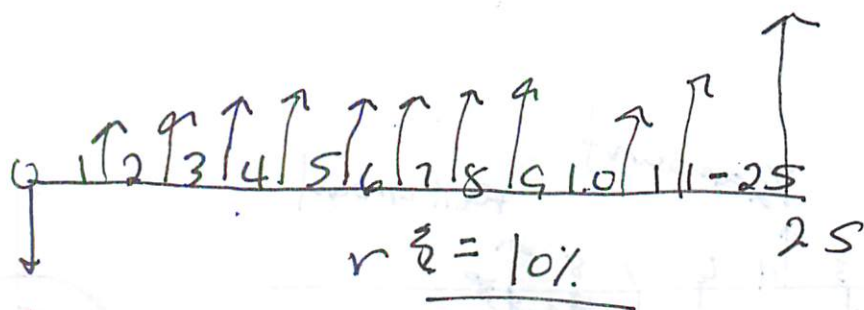
$$25,000 \times \frac{(1+0.10)^{25} - 1}{0.10}$$

=

$$= 270,867.65$$

Better
new

Cash Flow Diagram



$$FV = PV(1+r)^n$$

$$25,000(1+0.10)^{25}$$

$$= 270,867.65$$

★ ★



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$$1. 900 \left[\frac{1 - \left(\frac{1+.1}{1+.08} \right)^{10}}{.08-.1} \right] = 900 \left[\frac{1-.2014}{-.02} \right] = 45000(.2014) \quad \boxed{9063}$$

what is the present value

Year	1	2	3	4	5
cashflow	300000	275000	250000	225000	200000
future value Years	439230	366025	302500	247500	200000
Sum of future	1555255				

$$3. \frac{1(1+i)^n}{(1+i)^n - 1} - 250000 \left[\frac{.09(1+.009)^3}{(1+.009)^3 - 1} \right] = 250000(.3950) = \boxed{-98,750}$$

4. ~~what is the present value~~

$$2000(1+i/100)^8 = 1000(1+10/100)^4 + 1000(1+10/100)^8 = 1607.688$$

$$(1.1)^4 + (1.1)^8 = 1.5 + 2.1 = 3.6 \quad i = 100(.07) = 7\% = \boxed{1607.688}$$

5. PV = 25000
Rate = 10
years 25

$$FV = PV(1+r)^n$$

$$25000(1+.10)^{25}$$

$$25000(1.10)^{25}$$

$$25000(10.83) = \boxed{270867.65}$$

$$\frac{.09}{(1+.09)^3 - 1} \quad \text{Machine R} \quad 201000(.050) = 10050$$

$$-370,500(.257) = -95218.5 \quad \text{initial cost + machine S}$$

$$-95218.5 + 10000 - 50000 = \boxed{-46218}$$

$$94218.5$$

$$+ 50000$$

$$= 144218.5$$

Machine R

what are you trying to do?

Below Average

Daniel Nwankwo

13/11

12/50

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5)

$$P = \$25,000$$

$$i = 10\%$$

$$n = 25 \text{ years}$$

$$FV = ?$$

$$FV = P(1+i)^n$$

$$FV = 25,000(1+10)^{25}$$

$$= 25,000(1.10)^{25}$$

$$= \$270867.65$$

10/15

$$FV = ?$$

$$i = 10\%$$



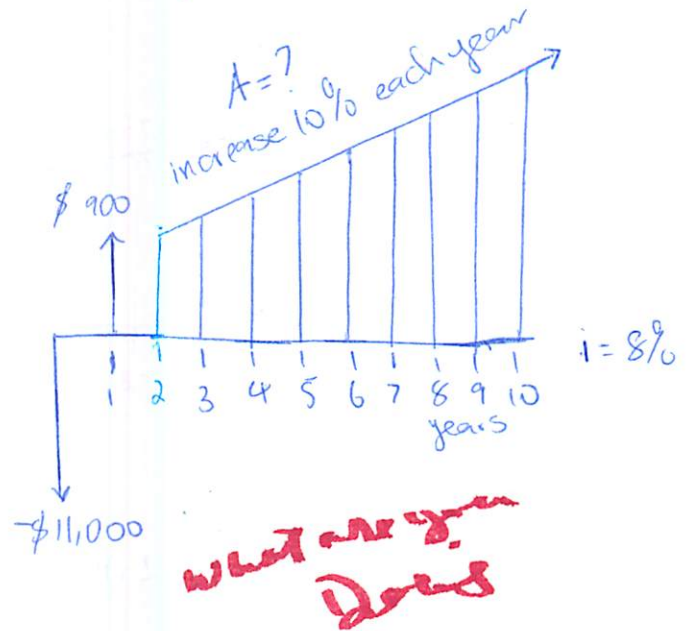
1) $PW = ?$ $PW(\text{Presentworth}) = PV(\text{total})$

$n = 10 \text{ years}$

$i = 8\% = 0.08$

$PV_1 \neq PV_{2-10}$

(A) $FV = ?$, $A_1 \$900$



$A_2 = 900 \times \frac{10}{100} = 90, 900 + 90 = 990(\$)$

$A_3 = 990 + 99 = 1089$

$A_4 = \$1197.9$

$A_5 = \$1317.69$

$A_6 = \$1449.46$

$A_7 = \$1594.41$

$A_8 = \$1753.85$

$A_9 = \$1929.24$

$A_{10} = \$2122.16$

$PV_1 = \frac{A}{(1+i)^n} = \frac{900}{(1+0.08)^1} = \833.33

$PV_{2-10} = \left(\frac{990}{(1+0.08)^2} + \frac{1089}{1.08^3} + \frac{1197.9}{1.08^4} + \frac{1317.67}{1.08^5} + \dots + \frac{2122.16}{1.08^{10}} \right)$

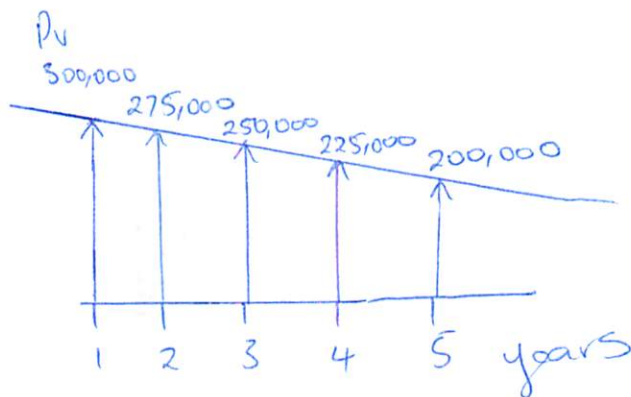
$PV_{2-10} = \$ (48.77 + 814.48 + 880.49 + 896.80 + 913.41 + 930.32 + 947.55 + 965.10 + 982.97)$
 $= \$8229.89$

$NPC = 0$

$PV(\text{total}) = (833.33 + 8229.89) - 11,000 = 0$
 $= \$9063.22$

write the formula used
2/10

2)



(A) $FV = ?$

$n = 5 \text{ years}$

$i = 10\%$

$PV_5 = 200,000$

$FV(A) (\text{total payment}) = PV(1+i)^n$

$FV = \$200,000(1+0.10)^5$

$FV = \$322102$

How Did you calculate!

(9.6)

3)

$$A = \left[\frac{i}{(1+i)^{n-1}} \right] \bar{r}$$

$$P_{VR} = -250.000$$

$$P_{NS} = -370.800$$

$$A_R \underline{\underline{E}}_R = -40.000$$

$$A_5 \bar{I}_5 = -50,000$$

$$n_R = 5 \text{ years}$$

$$n_s = 5 \text{ years}$$

$$IR = 9\%$$

$$I_S = 9\%$$

$$FV_R = P_0(1+i)^n$$

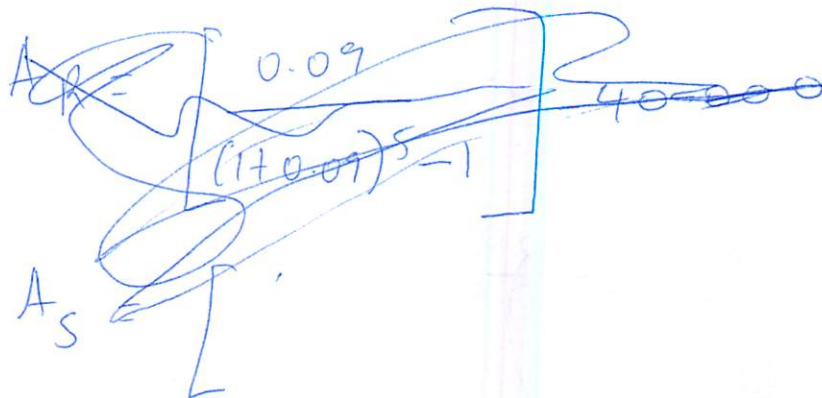
$$= -250,000(1 + 0.09)^5$$

$$= -384,998.46$$

$$FV_5 = -370,500(1 + 0.09)^5$$

8-570570

How Did
You Calculate?

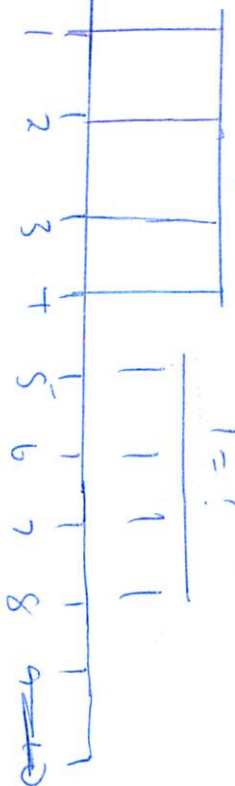


Machine R = is cheaper than Machine J

So therefore ϵ -Machine R is better

4)

$$i = 10\%$$



~~2,000~~

$$i_x = ?$$

$$n = 8 \text{ years}$$

$$P =$$

$$i = 10\% \text{ first 4 years}$$

$$\bar{FV} = P_0 (1+i)^n$$

$$\bar{FV} = 2,000 (1+0.10)^4$$

$$\bar{FV} = 29$$

$$P_u = \frac{\bar{FV}}{(1+i)^n}$$

$$P_{u1} = \frac{2000}{(1.10)^4}$$

$$\frac{1}{2} = \frac{1}{2}$$

$$P_{u1} = 1366.03$$

$$2,000 - 1366.03$$

$$P_{u2} = 633.97$$

$$633.97 = \frac{2000}{(1+i)^4}$$

$$(1+i)^4 = \frac{1}{633.97} \times 2000$$

$$(1+i)^4 = 3.15$$

$$4 + i^4 = 3.15$$

$$i^4 = 3.15 - 4$$

$$i^4 = -0.85$$

$$i = -0.2125$$

How?

Answer

TEST 1-Engineering Economy CHEG 2308: Date September 23, 2021- Section 1-12:30-2:00

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting, otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please use the factor table that was given to you.

- 1) A concept car that will get 100 miles per gallon and carry 4 persons would have a carbon-fiber and aluminum composite frame with a 900 cc three cylinders turbodiesel/electric hybrid power plant. The extra cost of these technologies is estimated to be \$11,000. If gasoline savings over a comparable conventional car would be \$900 in year 1, increasing by 10% each year, what is the present worth of the savings over a 10-year period at an interest rate of 8% per year?
- 2) For the cash flows shown, determine the future worth in year 5 at an interest rate of 10% per year.

Year	1	2	3	4	5
Cash Flow	\$300,000	\$275,000	\$250,000	\$225,000	\$200,000
3)	-25,000	-25,000	-25,000	-25,000	-25,000

The TT Racing and Performance Motor Corporation wishes to evaluate two alternative machines for NASCAR motor tune-ups. Use the best method at 9% per year to select the better alternative.

	Machine R	Machine S
First cost, \$	-250,000	-370,500
Annual operating cost, \$ per year	-40,000	-50,000
Life, years	5	5
Salvage value, \$	20,000	20,000

4. How much interest is payable each year on a loan of \$2,000 if the interest rate is 10% per year when half of the loan principal will be repaid as a lump sum at the end of four years and the other half will be repaid in one lump-sum amount at the end of eight years? How much Interest will be paid over the eight-year period?

5. You invest \$25,000 in a stock-based mutual fund. This fund should earn (on average) 10% per year over a long period of time. How much should your investment be worth in 25 years?

$$(25,000)(0.010)(25)$$

$$= \$6,250$$

MID-TERM TEST

Objectives of Mid-term Test

- 1) To test the students about the AW, FW, PW**
- 2) Analysis of the different project economically using different time periods and using LCM**
- 3) Critical thinking in solving problems and analysis for solving the problems using different methodologies for analysis.**

Above Average

31/40

Mid-Term Test – Engineering Economy Class CHEG 2003-Fall 2019 Section 2-
3:30-5:00 PM

Date October 14, 2021

Student Name Craig Rothschild

No. in Class Roll 14

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible hand writing, otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 10% of the total points for each question. **Please solve the problems using Engineering Notation Formula to ensure the full grades.**

Question 1)

A new office building was constructed five years ago by a consulting engineering firm. At that time the firm obtains a bank loan for \$100,000 with a 12% annual interest rate, compounded semi-annual. The terms of the loan call for equal semi-annual payments to repay the loan in 10 years. The loan also allows for its prepayment at any-time without penalty.

Due to internal changes in the firm, it is now proposed to refinance the loan through an insurance company. The new loan would be for 15 years term with an interest rate of 8% per year, compound semiannual. The new equal semi-annual payment would repayable loan in 20 years period. The insurance company requires the payment of a 5% loan initiation charge (often describes as "five point loan fee") which would be added to the new loan.

A) What is balance due to the original mortgage if 10 payments have been made in the last five years?

B) What is the difference between the equal semi-annual payment on this present bank loan and the proposed insurance company loan?

$$F_w = P_w (1+r)^n - p \left[\frac{(1+r)^n - 1}{r} \right]$$

A) $A = 100k (A/P, 6\%, 40)$
 $A = 100k (0.06646)$
 $\rightarrow 6.646 \times 10^3$

$P = 6.646 \times 10^3 (P/A, 6\%, 30)$
 $6.646 \times 10^3 (13.7648)$
 $= \$91.475544 \times 10^3$

balance due = 91475.544

b) New loan $(1.05 \times 91.475 \times 10^3) = 96049.3212$
Payments semi annual = 60 $\frac{6}{2} = 3\%$
 $96049.3212 (A/P, 3\%, 60) \rightarrow 96049.3212 (0.03613) = 3470.26$
 $6646 - 3470.26 = \$3175.738$

40-10=30
 $\frac{i}{r} \frac{12\%}{2} = 6\%$
since 10 payments

5/10

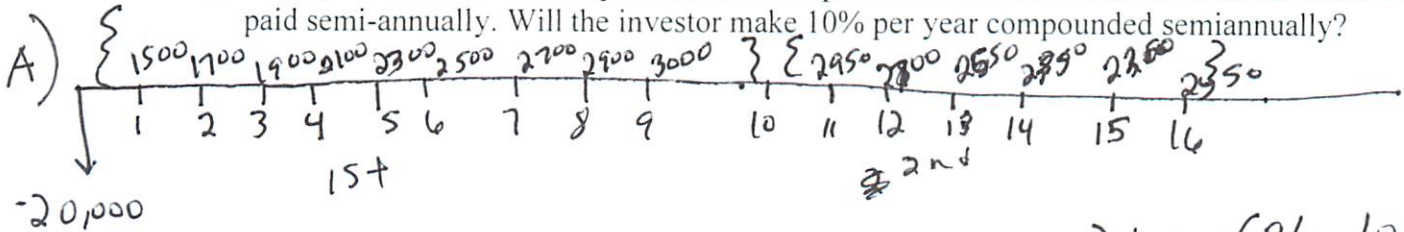
25/12

6/10

Question 2)

A) A machine having first cost of \$20,000 is expected to save \$1500 in the first year of operation and the saving should increase by \$200 until (and including) the 9th year, thereafter, the saving will decrease by \$150 until (and including) the 16th year. Using equivalent uniform annual worth, is this machine economical? Assume a MARR of 10%.

B) A 10-year \$10,000 8% coupon rate bond is purchased at 5% discount. Bond dividend is paid semi-annually. Will the investor make 10% per year compounded semiannually?



$$A w = -20,000(A/P, 10\%, 16) + [1500(P/A, 10\%, 9) + 200(P/G, 10\%, 9)] \rightarrow$$

$$(A/P, 10\%, 16) + [2950(P/G, 10\%, 7) - 150(P/G, 10\%, 7)]$$

$$(P/F, 10\%, 9) (A/P, 10\%, 16)$$

✓ 6/10 = -\$1280.94
The machine is not economical

$$-20,000(0.12782) + [1500(5.7590) + 200(19.4215)](0.12782) + [2950(12.7631) - 150(12.7631)](0.4241)(0.12782)$$

$$= \$1280.94$$

The machine is not economical

B

$$r = 8\% \quad 10,000 \quad n = 10$$

where is the present value

$$10,000 \times 0.05 = 500$$

$$\underline{9,500}$$

The investor will make 10%

10/4

100

7

200

100 10000 10000 10000

100000000 = 200

10000

10000 10000 10000 10000

10000 10000 10000 10000

100000000 =

100000000

100000000 + 100000000 + 100000000

100000000 + 100000000

100000000 (100000000)

10000

100000000 + 100000000 + 100000000

100000000 + 100000000 + 100000000

100000000 + 100000000 + 100000000

10000

Question 3)

UV curable epoxy resins are used in sealing, in gap filling, and as a clear coating. Your boss saw a report submitted by the chief financial officer (CFO) that said the equivalent annual worth of maintaining the equipment used in producing the resins was \$48,436 over the last 5 years. The report showed that the cost in year 1 was \$42,000, and it increased arithmetically by \$4000 each year. Your boss thought \$48,436 was too high, so she asked you to determine what interest rate the CFO used in making the calculations. What was the interest rate?

$$A_w = 48,436 \rightarrow 5 \text{ years}$$

Year	cost
0	
1	42,000
2	→ 4,000
3	→ 4,000
4	→ 4,000
5	48,436

$$i = ?$$

$$48,436 = 42,000$$

$$i = ?$$

$$48,436 + 4000(A/G, i, 5)$$

$$\downarrow -42,000$$

$$6436 = 4000(A/G, i, 5)$$

$$1.609 = (A/G, i, 5)$$

$$i = 22\%$$

In table $n = 5$, $A/G = 1.609$ at 22%.

✓ (10)

Question 4)

Chemical engineers at a Coleman Industries plant in the Midwest have determined that a small amount of a newly available chemical additive will increase the water repellency of Coleman's tent fabric by 20%. The plant superintendent has arranged to purchase the additive through a 5 year contract at \$7000 per year, starting 1 year from now. He expects the annual price to increase by 12% per year thereafter for the next 8 years. Additionally, an initial investment of \$35,000 was made now to prepare a site suitable for the contractor to deliver the additive. Use $i = 15\%$ per year to determine the equivalent total present worth for all these cash flows.

Year	Cost
0	35,000
1	7,000
2	14,100
3	21,000
4	28,000
5	35,000
6	12%
7	12%
8	12%

$$P_W = ? \quad G = 12\% \quad i = 15\%$$

~~$$P_W = 35,000 + A(P/A, 15\%, 4) + A(P/A, 12\%, 4)$$

$$+ (P/F, 15\%, 4) \quad 0.8550 \quad 3.16373$$

$$P_W = 35,000 + 7,000(P/A, 15\%, 5)$$~~

$$P_W = 35,000 + A(P/A, 15\%, 4) + A(1 - (P/F, 15\%, 9)) \cdot (F/P, 12\%, 9) / (15\% - 12\%) \cdot (P/F, 15\%, 4)$$

$$P_W = 35,000 + 7,000 + (2.8550) + [7,000 \cdot (1 - (.2848) \cdot (2.773) / (3\%))] \cdot (.5718)$$

$$35,000 + 19,985 + 28,236 = \$$$

$$\boxed{\$83,221}$$

$$x_2 := 1, x_1 = 0, y = 1/4$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$x_2 := 1, x_1 = 0, y = 1/4$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

$$(x_1, x_2, y) \rightarrow (x_1, x_2, y) + (0, 0, 1/4)$$

Average

Daniel Mwanikwa

26/48

**Mid-Term Test –Engineering Economy Class CHEG 2003-Fall 2019 Section 2-
3:30-5:00 PM**

Date October 14, 2021

Student Name

No. in Class Roll

13

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible hand writing. otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 10% of the total points for each question. **Please solve the problems using Engineering Notation Formula to ensure the full grades.**

Question 1)

A new office building was constructed five years ago by a consulting engineering firm. At that time the firm obtains a bank loan for \$100,000 with a 12% annual interest rate, compounded semi-annual. The terms of the loan call for equal semi-annual payments to repay the loan in 10 years. The loan also allows for its prepayment at any-time without penalty.

Due to internal changes in the firm, it is now proposed to refinance the loan through an insurance company. The new loan would be for 15 years term with an interest rate of 8% per year, compound semiannual. The new equal semi-annual payment would repayable loan in 20 years period. The insurance company requires the payment of a 5% loan initiation charge (often describes as "five point loan fee") which would be added to the new loan.

- A) What is balance due to the original mortgage if 10 payments have been made in the last five years?
B) What is the difference between the equal semi-annual payment on this present bank loan and the proposed insurance company loan?

$$A = \$100,000(A/P, 3\%, 40) \quad r = 12/4 = 3\% \quad t = 40 \text{ month.}$$
$$= \$100,000(0.0433)$$
$$= \$4330$$

new

Since 20 payments are made

$$P = 4330(P/A, 3\%, 20)$$
$$= 4330(14.877)$$
$$= \$64417 \text{ (balance due)}$$

new

$$\text{new } t = 40 - 20 = 20$$

b) Given that the Company requires the payment of 5% loan notation change.

So Service charge will ~~be~~ added in Pot 64417

New loan amount would be.

$$\rightarrow 1.05 \times 64417$$

$$\rightarrow \$ 67638$$

$$\text{Quarter Payment Total} = 80 \text{ months } r = 8/4 = 2$$

$$\begin{aligned} & \text{new loan} \\ & = 67638 (A/P, 2\%, 80) \\ & = 67638 (0.0252) \\ & = \$ 1704 \end{aligned}$$

$$\begin{aligned} & \text{Difference in Quarterly payment} \\ & \Rightarrow \$ 4330 - \$ 1704 \\ & \Rightarrow \$ 2626, \end{aligned}$$

4/11

- First Set
- Second Set
- 1500 1700 1900 2100 2300 2500 2700 2900 3100
- 2950 2800 2650 2500 2350 2200 2050
- 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
- 20000

4/2

16. The machine is not Economical.

B) $= \$10,000 (P/A, 8\%, 10)$
 $= \$10,000 (0.4632)$
 $= \$4632$

$\frac{P}{W}$ $= \$34,080.72$
 $= \$67,100$

5 percent discount
 $(67100 \times 5/100) = \$231.6$
 $\$4632 - \$231.6 = \$4400.4$

$A = 1.000$
 $i = 10\% / 2 = 5\% \text{ Semiannual.}$
 $n = 1$
 $P - (P/A, 5\%, 1) = 0.952$

5 percent discount

$$(67100 \times 5/100) = 8231.6 \rightarrow 3355$$

$$\$4632 - \$231.6 = \$4400.4$$

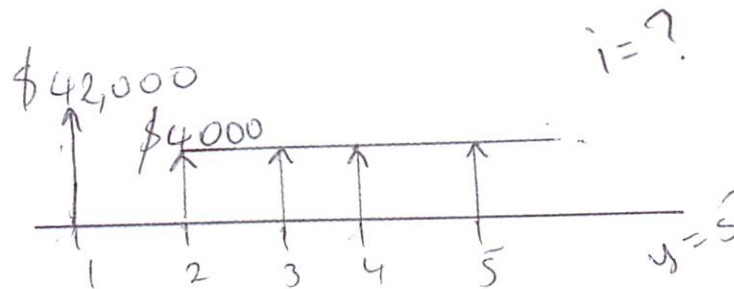
$$A = 1.000$$

$i = 10\% / 2 = 5\%$ Semiannual.

$$P = \binom{n=1}{0/A, 50\%, 1} = 0.952$$

Question 3)

UV curable epoxy resins are used in sealing, in gap filling, and as a clear coating. Your boss saw a report submitted by the chief financial officer (CFO) that said the equivalent annual worth of maintaining the equipment used in producing the resins was \$48,436 over the last 5 years. The report showed that the cost in year 1 was \$42,000, and it increased arithmetically by \$4000 each year. Your boss thought \$48,436 was too high, so she asked you to determine what interest rate the CFO used in making the calculations. What was the interest rate?



$$48,436 = 42,000 + 4000 (A/G, i, 5)$$

$$6436 = 4000 (A/G, i, 5)$$

$$(A/G, i, 5) = 1.6090 \quad \checkmark$$

For $n = 5$ in A/G Column, value of 1.6090 is in 22%
Interest table. 10

Question 4)

Chemical engineers at a Coleman Industries plant in the Midwest have determined that a small amount of a newly available chemical additive will increase the water repellency of Coleman's tent fabric by 20%. The plant superintendent has arranged to purchase the additive through a 5 year contract at \$7000 per year, starting 1 year from now. He expects the annual price to increase by 12% per year thereafter for the next 8 years. Additionally, an initial investment of \$35,000 was made now to prepare a site suitable for the contractor to deliver the additive. Use $i = 15\%$ per year to determine the equivalent total present worth for all these cash flows.

Total Present Worth = Investment + Present Worth.

Calculating Present Worth P_g (Zeroth year)

$$P_g = 7000 \left[\frac{1 - \left[\frac{1 + 0.12}{1 + 0.15} \right]^9}{0.15 - 0.12} \right] + 7000 \times \frac{\left[\frac{1 + 0.12}{1 + 0.15} \right]^9}{0.15 - 0.12} \times 0.57$$

$$P_g = 7000 \times 3.3445 + 7000 \times 7.0572 \times 0.57 =$$

$$23411.5 + 28158.228 = \$ 51569.728$$

$$\text{Total Present Worth} = \$ 35,000 + \$ 51569.728$$

$\downarrow$
initial investment

$$= \$ 86,569.728$$

✓

10

Daniel Nwankwo

26/45

**Mid-Term Test – Engineering Economy Class CHEG 2003-Fall 2019 Section 2-
3:30-5:00 PM**

Date October 14, 2021

Student Name

No. in Class Roll

13

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible hand writing. otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 10% of the total points for each question. **Please solve the problems using Engineering Notation Formula to ensure the full grades.**

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- A) What is balance due to the original mortgage if 10 payments have been made in the last five years?
B) What is the difference between the equal semi-annual payment on this present bank loan and the proposed insurance company loan?

$$A = \$100,000(A/P, 3\%, 40) \quad r = 12\%/4 = 3\% \\ = \$100,000(0.0433) \quad t = 40 \text{ months.} \\ = \$4330$$

Since 20 payments are made

$$P = 4330(P/A, 3\%, 20) \\ = 4330(14.877) \\ = \$64417 \text{ (balance due)}$$

copying

$$\text{new } t = 40 - 20 = 20$$

b) Given that the Company requires the payment of 5% loan interest change.

So Service charge will ~~be~~ added in P of 64417

New loan amount would be.

$$\rightarrow 1.05 \times 64417$$

$$\rightarrow \$ 67638$$

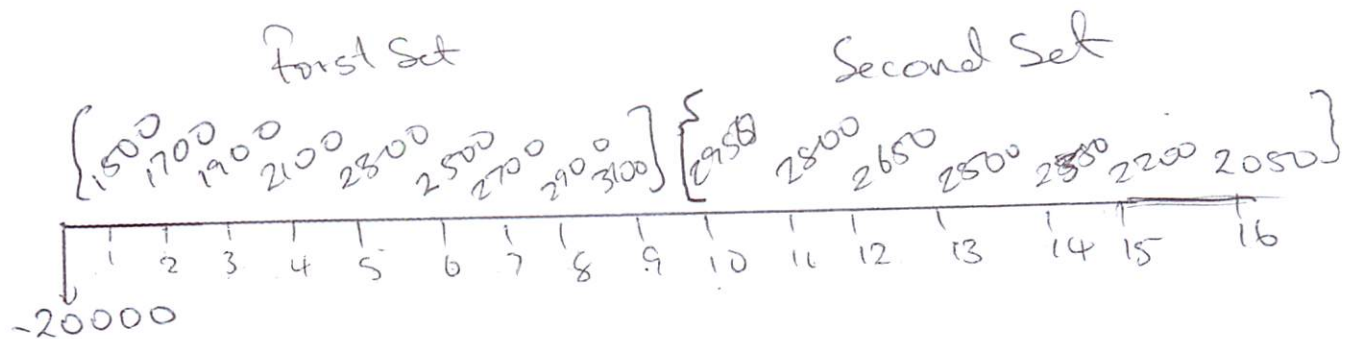
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$$\begin{aligned} & \text{new loan} \\ & = 67638 (A/P, 2\%, 80) \\ & = 67638 (0.0252) \\ & = \$ 1704 \end{aligned}$$

$$\begin{aligned} & \text{Difference in Quarterly payment} \\ & \Rightarrow \$ 4330 - \$ 1704 \\ & \Rightarrow \$ 2626, \end{aligned}$$

Question 2)

- A) A machine having first cost of \$20,000 is expected to save \$1500 in the first year of operation and the saving should increase by \$200 until (and including) the 9th year. thereafter, the saving will decrease by \$150 until (and including) the 16th year. Using equivalent uniform annual worth, is this machine economical? Assume a MARR of 10%.
- B) A 10-year \$10,000 8% coupon rate bond is purchased at 5% discount. Bond dividend is paid semi-annually. Will the investor make 10% per year compounded semiannually?



Equivalent Uniform Annual Value = $-20000 (A/P, 10\%, 16) + [1500(P/A, 10\%, 9) + 200(P/A, 10\%, 9)] (A/P, 10\%, 16) + [2950(P/A, 10\%, 7) - 150(P/A, 10\%, 7)] (P/A, 10\%, 16)$

$= -\$280.74$

∴ The machine is not Economical.

B) $\$10,000 (P/A, 8\%, 10) = \4632

$\$4632 - \$231.6 = \$4400.4$

$A = 1000$

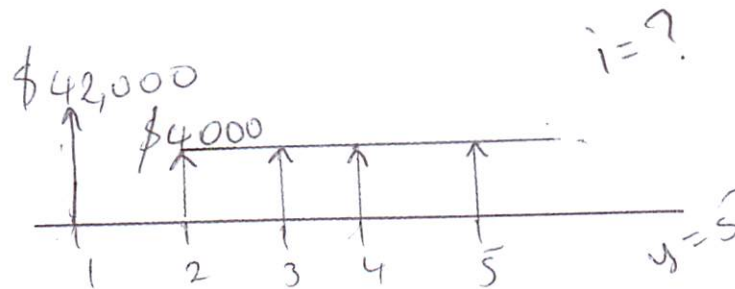
$i = 10\% / 2 = 5\% \text{ Semiannual}$

$n = 1$

$P - (P/A, 5\%, 1) = 0.952$

Question 3)

UV curable epoxy resins are used in sealing, in gap filling, and as a clear coating. Your boss saw a report submitted by the chief financial officer (CFO) that said the equivalent annual worth of maintaining the equipment used in producing the resins was \$48,436 over the last 5 years. The report showed that the cost in year 1 was \$42,000, and it increased arithmetically by \$4000 each year. Your boss thought \$48,436 was too high, so she asked you to determine what interest rate the CFO used in making the calculations. What was the interest rate?



$$48,436 = 42,000 + 4000 (A/G, i, 5)$$

$$6436 = 4000 (A/G, i, 5)$$

$$(A/G, i, 5) = 1.6090 \quad \checkmark$$

For $n = 5$ in A/G Column, value of 1.6090 is in 22%
Interest table. 10

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Chemical engineers at a Coleman Industries plant in the Midwest have determined that a small amount of a newly available chemical additive will increase the water repellency of Coleman's tent fabric by 20%. The plant superintendent has arranged to purchase the additive through a 5 year contract at \$7000 per year, starting 1 year from now. He expects the annual price to increase by 12% per year thereafter for the next 8 years. Additionally, an initial investment of \$35,000 was made now to prepare a site suitable for the contractor to deliver the additive. Use $i = 15\%$ per year to determine the equivalent total present worth for all these cash flows.

Total Present Worth = Investment + Present Worth.

Calculating Present Worth P_g (Zeroth year)

$$P_g = 7000 \left[\frac{1 - \left[\frac{1 + 0.12}{1 + 0.15} \right]^9}{(0.15 - 0.12)} \right] + 7000 \times \frac{\left[\frac{1 + 0.12}{1 + 0.15} \right]^9}{(0.15 - 0.12)} \times 0.57$$

$$P_g = 7000 \times 3.3445 + 7000 \times 7.0572 \times 0.57 =$$

$$23411.5 + 28158.228 = \$ 51569.728$$

$$\text{Total Present Worth} = \$ 35,000 + \$ 51569.728$$

initial investment

$$= \$ 86,569.728$$

✓

(10)

Below Average

**Mid-Term Test –Engineering Economy Class CHEG 2003-Fall 2019 Section 2-
3:30-5:00 PM**

Date October 14, 2021

Student Name Jaylon Brown 5

No. in Class Roll

Direction



Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible hand writing, otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 10% of the total points for each question. **Please solve the problems using Engineering Notation Formula to ensure the full grades.**

Question 1)

A new office building was constructed five years ago by a consulting engineering firm. At that time the firm obtains a bank loan for \$100,000 with a 12% annual interest rate, compounded semi-annual. The terms of the loan call for equal semi-annual payments to repay the loan in 10 years. The loan also allows for its prepayment at any-time without penalty.

Due to internal changes in the firm, it is now proposed to refinance the loan through an insurance company. The new loan would be for 15 years term with an interest rate of 8% per year, compound semiannual. The new equal semi-annual payment would repayable loan in 20 years period. The insurance company requires the payment of a 5% loan initiation charge (often describes as "five point loan fee") which would be added to the new loan.

- A) What is balance due to the original mortgage if 10 payments have been made in the last five years? \$40,000 [P.A. 5, 12%, 100000] past worth
- B) What is the difference between the equal semi-annual payment on this present bank loan and the proposed insurance company loan? [F/A, 8%, 15] future worth

a)

year	1	2	3	4	5
100,000	12%	12%	12%	12%	12%
	6000	6000	6000	6000	6000
	5000	4700			
					<u>60000</u>

2 payments per year

(100000, 12%, 5)

How!

b) insurance company
5% initiation charge

years	1	2	3	...	15
interest	5%	8%	8%		8%

F

Question 2)

- A) A machine having first cost of \$20,000 is expected to save \$1500 in the first year of operation and the saving should increase by \$200 until (and including) the 9th year, thereafter, the saving will decrease by \$150 until (and including) the 16th year. Using equivalent uniform annual worth, is this machine economical? Assume a MARR of 10%.

Not economical

- B) A 10-year \$10,000 8% coupon rate bond is purchased at 5% discount. Bond dividend is paid semi-annually. Will the investor make 10% per year compounded semiannually?

no the investor will not make 10% per year

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A) 20,000	1500	1500	1500	1700	1700	1700	1700	1700	1700	1500	1500	1500	1500	1500	1500	1500
		200	400	600	800	1000	1200	1400	1600	1450	1300	1150	1000	850	700	550

MARR of 10%? [a/w, 200, 9 years]

- B) 10 years 8% of 10,000 = 800 per year
paid 9,500 10% of 10,000 = 1,000 per year

annual worth, 8%

Learn G this
what is the formula
used!

9%

Question 3)

UV curable epoxy resins are used in sealing, in gap filling, and as a clear coating. Your boss saw a report submitted by the chief financial officer (CFO) that said the equivalent annual worth of maintaining the equipment used in producing the resins was \$48,436 over the last 5 years. The report showed that the cost in year 1 was \$42,000, and it increased arithmetically by \$4000 each year. Your boss thought \$48,436 was too high, so she asked you to determine what interest rate the CFO used in making the calculations. What was the interest rate? 2.5 %

5 years \$48,436

year 1 = 42,000

+ 4000 each year

$$48,436 - 42,000 = 6436$$

Calculating for the past

$$4000 \times 4 = 16,000$$

$$\frac{16,000}{6436} = 2.48$$

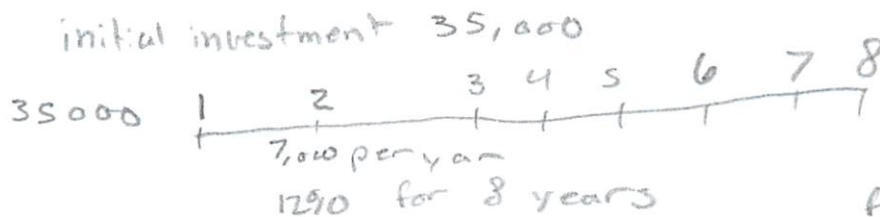
12.1%

~~0.1%~~

Question 4)

Chemical engineers at a Coleman Industries plant in the Midwest have determined that a small amount of a newly available chemical additive will increase the water repellency of Coleman's tent fabric by 20%. The plant superintendent has arranged to purchase the additive through a 5 year contract at \$7000 per year, starting 1 year from now. He expects the annual price to increase by 12% per year thereafter for the next 8 years. Additionally, an initial investment of \$35,000 was made now to prepare a site suitable for the contractor to deliver the additive. Use $i = 15\%$ per year to determine the equivalent total present worth for all these cash flows.

5 years 7,000 per year $i = 15\%$ per year
plus 12% per year



$[PW, 7000, 12\%, 8]$

Present worth

future worth, 7000, 5 years

future worth, 12%, 8 years

1	2	3	4	5	6
	7000	7000	7000	7000	7000



1/1 down

what are the

formula used!

TEST3

Objectives of Test 3

- 1) Compare between alternative with different time-period to select the best economical choice.**
- 2) Calculation of gradients with geometric gradient**
- 3) Using compounded interest rate in different system as compounded semi-annual, compounded quarterly, and compounded annually.**

Above Average

Name: Micheal Sands

Class Roll Number 15

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible hand writing, otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please answer using the Engineering Notation otherwise no grade for it.

Question (1)- (25 points)

You have decided to purchase a new automobile with a hybrid-fueled engine and a six-speed transmission. After the trade-in of your present car, the purchase price of the new automobile is \$30,000. This balance can be financed by an auto dealer at 3%APR with payment over 48 months. Alternatively, you can get a \$2000 discount on the purchase price if you finance the loan balance at an APR of 9% over 48 months. Should you accept the 3 % finance plan or accept the dealer's offer of a \$2000 rebate with 9% Financing ? Both APR are compounded monthly.

Question (2)- (25 point)

The accounting department is involved in a little wager. The accountants believe that an engineer cannot correctly determine which alternative should be chosen using equivalent uniform annual cash flow analysis. As a means of proving this statement, the accountants have provided you with the following data:

Data	Alt. A	Alt.B	Alt.C
Useful Life, Years	7	11	9
First Cost (FC)	\$123,000	\$135,000	\$112,000
Annual Benefit (AB)	67,000	73,000	46,000
M&O Grad. (M&O G)	2,800	3,000	2,000
M&O Cost (M&O)	21,200	29,000	15,000

The accounting department has chosen Alternative B. Use the best method to select the best alternative and use cash flow of each alternative using a MARR of 12%. State whether or not you agree with the accounting department.

Question (3)- (25 points)

A series of quarterly cash flows starts with a cash flow of \$1,000 on April 1, 1982, and is expected to continue through July 1, 1994. Each cash flow has been \$50 greater than the one preceding it. This increase is expected to continue. Use an interest rate of 16% with quarterly compounding, and determine the amount of each cash flow in an equivalent series of equal quarterly cash flows if the first cash flow in the equivalent series is to occur on April 1, 1987, and the last on October 1, 1994.

Question (4)- (25 Points)

A specially built computer system has just been purchased by Progress Greenhouse Products to monitor moisture level and to control drip irrigation in hydroponics beds that grow cluster “tradiro” tomatoes. The system’s first cost was \$97,000 with an AOC of \$10,000 and a salvage value on the international market of \$20,000 after 4 years, when Progress expects to sell the system. Determine the capitalized cost (i.e. forever) at 12% per year and explain its meaning.

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The following costs are associated with three tomato-peeling machines being considered for use in a canning plant. If the canning company uses an interest rate of 12%, which is the best alternative? Use NPW to make your decision. (Note: Consider the least common multiple as the study period.)

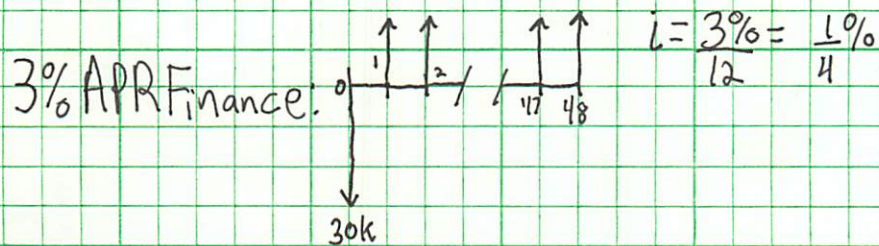
Machine	A	B	C
First cost	\$52,000	\$63,000	\$67,000
O&M costs	15,000	9,000	12,000
Annual benefit	38,000	31,000	37,000
Salvage value	13,000	19,000	22,000
Useful life (yrs)	4	6	12

Question 6 (25 Points)

Three alternatives to incorporate improved techniques to manufacture computer drives to play HD DVD optical disc formats have been developed and costed. Compare the alternatives below using capitalized cost and an interest rate of 12% per year compounded quarterly.

	Alternative E	Alternative F	Alternative G
First cost, \$	−2,000,000	−3,000,000	−10,000,000
Net income, \$ per quarter	300,000	100,000	400,000
Salvage value, \$	50,000	70,000	—
Life, years	4	8	∞

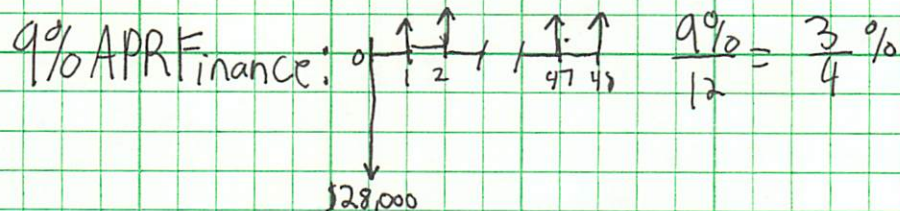
Q1



$$F = 30k(F/P, 1/4\%, 48)$$

$$F = 30k(1.127)$$

$$F = 33.81k$$



$$F = 28k(F/P, 3/4\%, 48)$$

$$F = 28k(1.431)$$

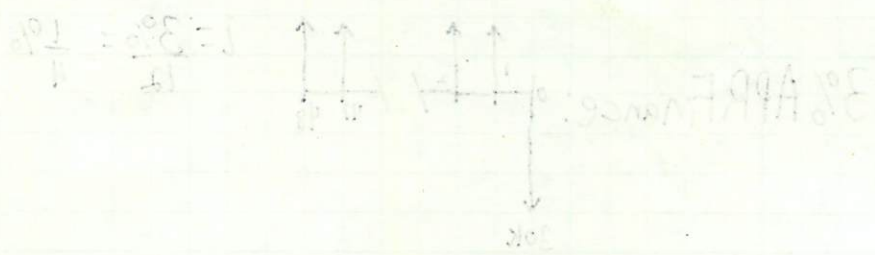
$$F = 40.068k$$

$$33.81k < 40.068k$$

∴ I should pick the 3% finance plan

1000000

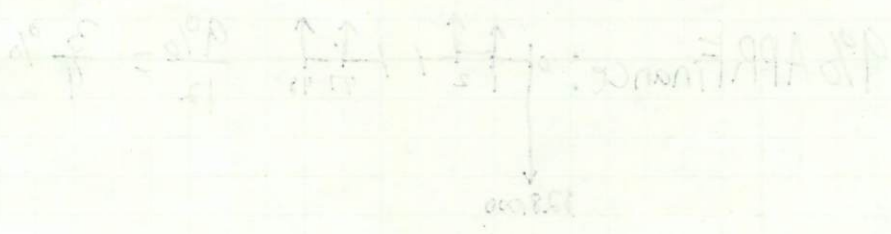
10



$$F = 30K (7.5 \times 10^3)$$

$$F = 30K (1.157)$$

$$F = 33.81K$$



$$F = 38K (7.5 \times 10^3)$$

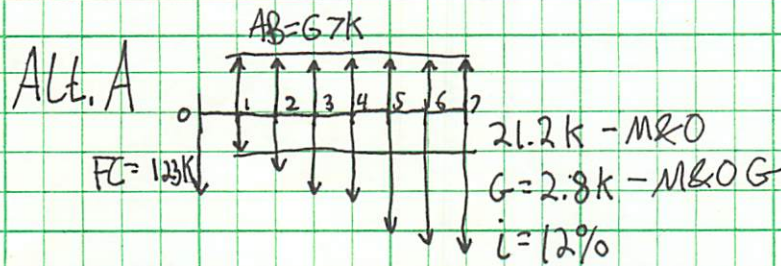
$$F = 38K (1.131)$$

$$F = 40.003K$$

$$33.81K < 40.003K$$

∴ I should pick the 30K force value

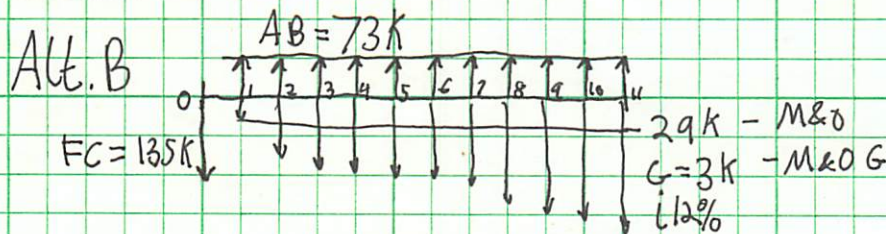
Q₂



$$AW_A = -123K(A/P, 12\%, 7) + 67K - 21.2K - 2.8K(A/G, 12\%, 7)$$

$$AW_A = -123K(.2191) + 67K - 21.2K - 2.8K(2.551)$$

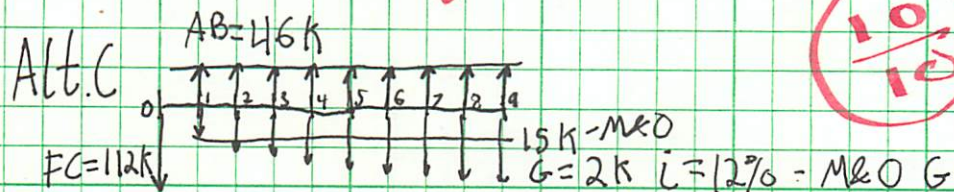
$$AW_A = 11.7079K$$



$$AW_B = -135K(A/P, 12\%, 11) + 73K - 29K - 3K(A/G, 12\%, 11)$$

$$AW_B = -135K(.1684) + 73K - 29K - 3K(3.895)$$

$$AW_B = 9.581K$$



$$AW_C = -112(A/P, 12\%, 9) + 46K - 15K - 2K(A/G, 12\%, 9)$$

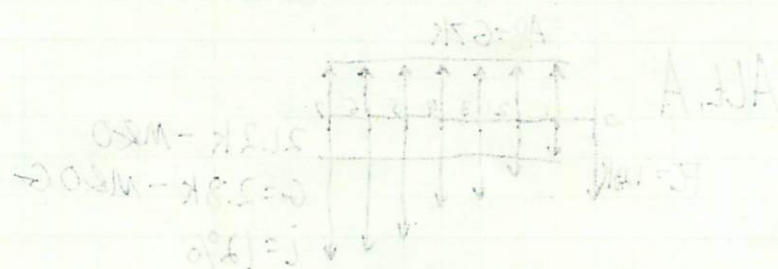
$$AW_C = -112(.1877) + 46K - 15K - 2K(3.257)$$

$$AW_C = 3.4636K$$

$AW_A > AW_B > AW_C$; $\therefore$ Alt. A is the best choice.

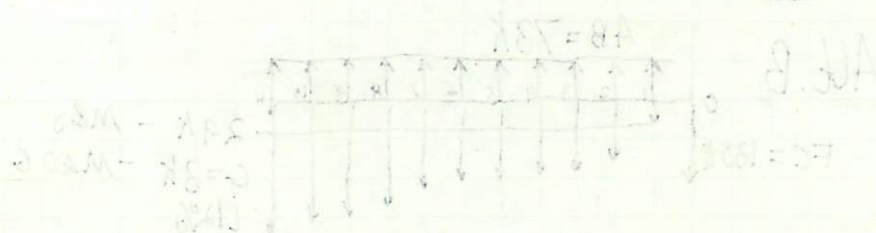
I do not agree with the accounting department.

Michael Smith



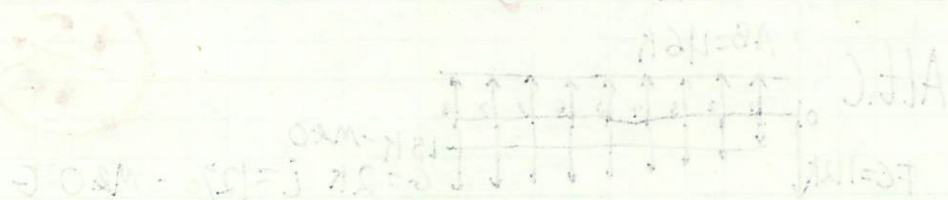
$$A W_A = -13 k(3.141) + 15.705 k - 13 k(2.221) = 11.705 k$$

$$A W_A = -13 k(1.613) + 15.705 k - 13 k(1.130) = 11.705 k$$



$$A W_B = -13 k(1.613) + 9.281 k - 13 k(1.130) = 9.281 k$$

$$A W_B = -13 k(1.613) + 9.281 k - 13 k(1.130) = 9.281 k$$



$$A W_C = -13 k(1.613) + 3.123 k - 13 k(1.130) = 3.123 k$$

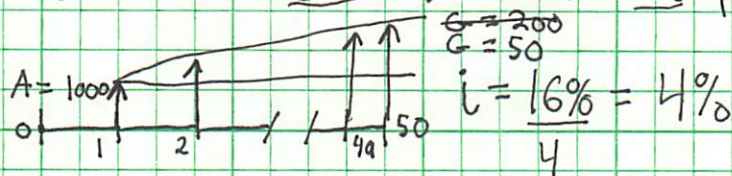
$$A W_C = -13 k(1.613) + 3.123 k - 13 k(1.130) = 3.123 k$$

I do not agree with the assumed distribution.
 $A W_A > A W_B > A W_C$: : A is the best choice.

Q3

From April 1982 to July 1994

there are 50 quarters. $\therefore$ 50 periods



$$PW = 1000(P/A, 4\%, 50) + 50(P/G, 4\%, 50)$$

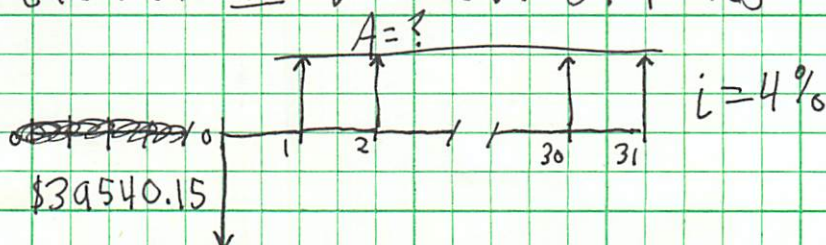
$$PW = 1000(21.482) + 50(361.163)$$

$$PW = 39540.15$$

Are you sure

From April 1987 to October 1994

there are 31 quarters. $\therefore$ 31 periods



$$A = 39540.15(A/P, 4\%, 31)$$

$$A = 39540.15(.0569)$$

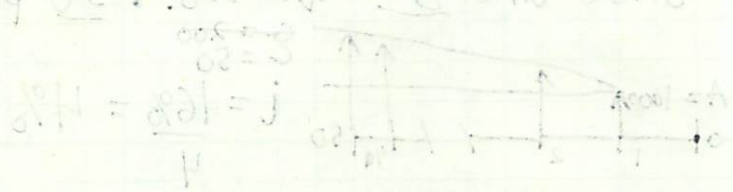
$$A = 2249.83$$

Are you sure

Each cash flow will have an equal amount of \$2249.83 per quarter

Q3

From April 1987 to July 1991
there are 50 quarters: 50 periods

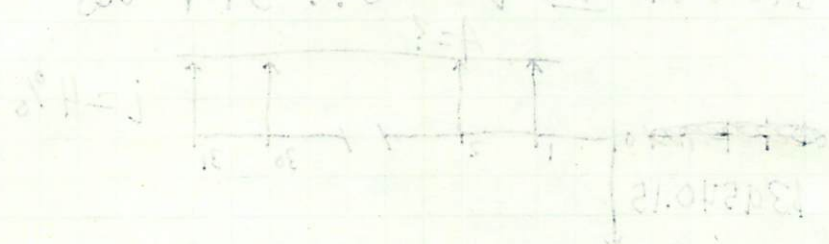


$$PW = 1000(614, 10\%, 50) + 50(614, 10\%, 50)$$

$$PW = 1000(91.487) + 50(391.163)$$

$$PW = 34210.12$$

From April 1987 to October 1991
there are 51 quarters: 51 periods

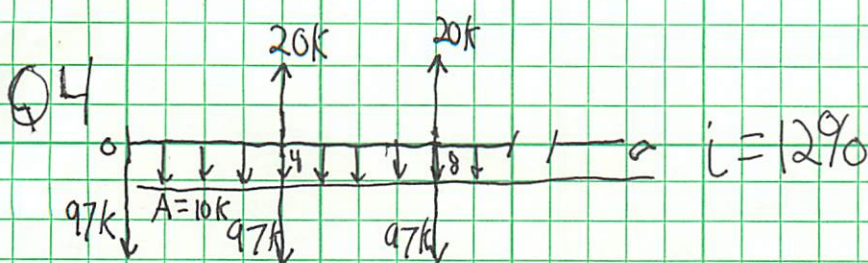


$$A = 34210.12(1.10, 51)$$

$$A = 34210.12(1.056)$$

$$A = 36114.83$$

Each cash flow will have an
equal amount of 36114.83 per quarter



$$CC = (97k(A/P, 12\%, 4))/1.12 + 10k/1.12 - [20k(A/P, 12\%, 4))/1.12] \times (P/F, 12\%, 4)$$

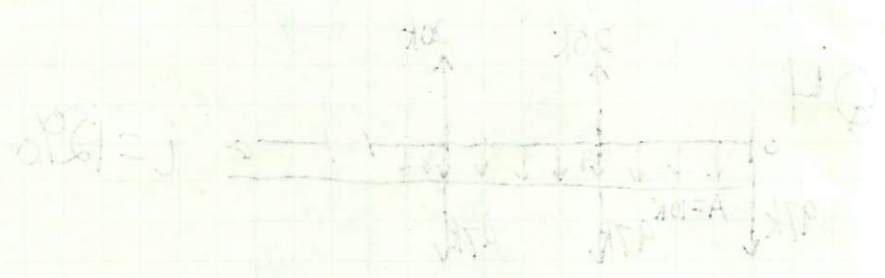
$$CC = (97(.3292))/1.12 + 10k/1.12 - [20k(.3292))/1.12] (.6355)$$

$$CC = 314.5689k$$

The capital cost of the computer system is \$314,568.90. To keep the system, Progress would have to sell & buy system every 4 years. This is the meaning behind it.

✓ 10/10

Investment Costs



$$CC = 10K(A/P + 1/P) + 2K(1/P) \cdot 10$$

$$CC = 10K(0.1 + 0.1) + 2K(0.1) \cdot 10$$

$$CC = 2K(1.2) = 2.4K$$

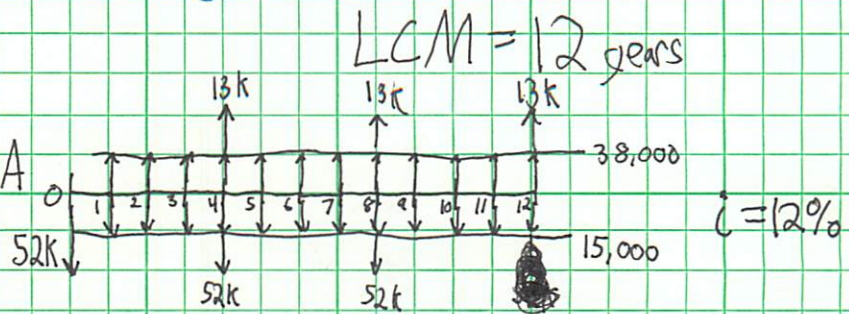
The capital cost of the computer system is \$24,000. To keep the system, you would have to sell & buy system every 1 year. This is one reason for buying it.

10/10

Michael Sands

Q5

Machine A

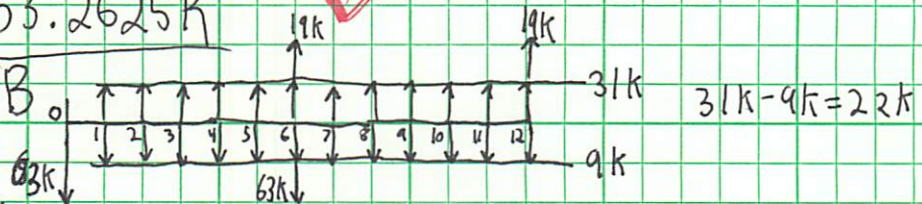


$$PW_A = -52k - 39k(P/F, 12\%, 4) - 39k(P/F, 12\%, 8) - 15k(P/A, 12\%, 12) + 13k(P/F, 12\%, 12) + 38k(P/A, 12\%, 12)$$

$$PW_A = -52k - 39k(.6355) - 39k(.2039) - 15k(6.194) + 13k(.2567) + 38k(6.194)$$

$$PW_A = 53.2625k$$

Machine B

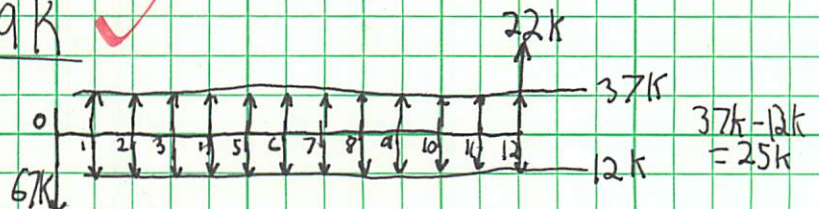


$$PW_B = -63k - 44k(P/F, 12\%, 6) + 19k(P/F, 12\%, 12) + 22k(P/A, 12\%, 12)$$

$$PW_B = -63k - 44k(.5066) + 19k(.2567) + 22k(6.194)$$

$$PW_B = 55.8549k$$

Machine C



$$PW_C = -67k + 22k(P/F, 12\%, 12) + 25k(P/A, 12\%, 12)$$

$$PW_C = -67k + 22k(.2567) + 25k(6.194)$$

$$PW_C = 93.4974$$

Machine C > Machine B > Machine A
 $\therefore$ Machine C is the best alternative

10/10

Machine A

$$LCA = 13 \text{ years}$$

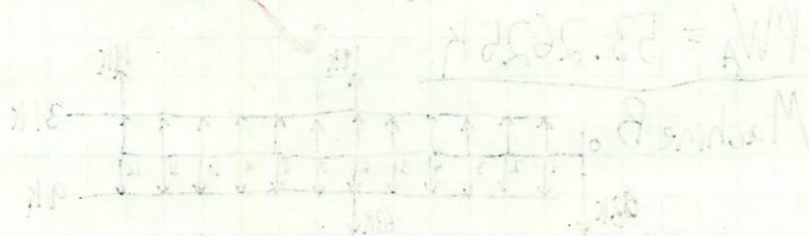


$$PW_A = -25K - 3K(P/A, 13, 12\%) + 12K(P/A, 13, 12\%) + 12K(P/A, 13, 12\%)$$

$$PW_A = -25K - 3K(6.167) + 12K(6.167) + 12K(6.167)$$

$$PW_A = -25K - 18.5K + 74.0K + 74.0K$$

$$PW_A = 20.0K$$



$$PW_B = -25K - 3K(P/A, 13, 12\%) + 12K(P/A, 13, 12\%) + 12K(P/A, 13, 12\%)$$

$$PW_B = -25K - 3K(6.167) + 12K(6.167) + 12K(6.167)$$

$$PW_B = -25K - 18.5K + 74.0K + 74.0K$$

$$PW_B = 20.0K$$



$$PW_C = -25K - 3K(P/A, 13, 12\%) + 12K(P/A, 13, 12\%) + 12K(P/A, 13, 12\%)$$

$$PW_C = -25K - 3K(6.167) + 12K(6.167) + 12K(6.167)$$

$$PW_C = -25K - 18.5K + 74.0K + 74.0K$$

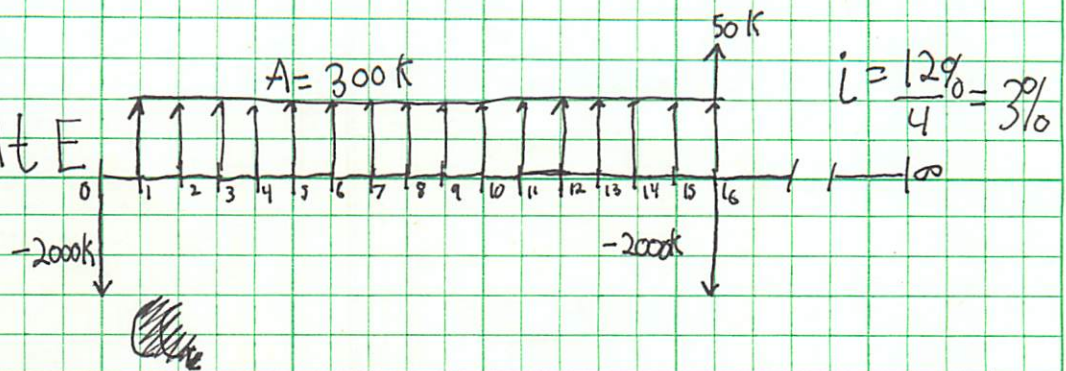
$$PW_C = 20.0K$$

Machine C > Machine B > Machine A
 ∴ Machine C is the best alternative

Michael Sands

Q6

Alt E

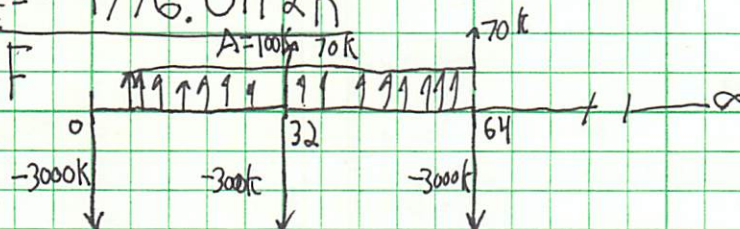


$$CC_E = (2000k(A/P, 3\%, 16)) / .03 - [(50k(A/P, 3\%, 16)) / .03](P/F, 3\%, 16) - 300k / .03$$

$$CC_E = (2000k(.0796)) / .03 - [50k(.0796) / .03](.6232) - 300k / .03$$

$$CC_E = -4776.0112k$$

Alt F

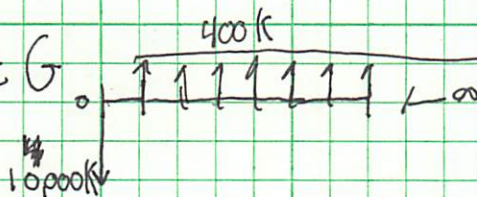


$$CC_F = (3000k(A/P, 3\%, 32)) / .03 - 100k / .03 - [70k(A/P, 3\%, 32) / .03](P/F, 3\%, 32)$$

$$CC_F = (3000k(.0490)) / .03 - (100k / .03) - [70k(.0490) / .03](.3853)$$

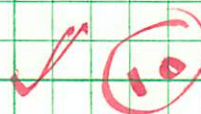
$$CC_F = 1522.271k$$

Alt G



$$CC_G = 10000k - 400 / .03$$

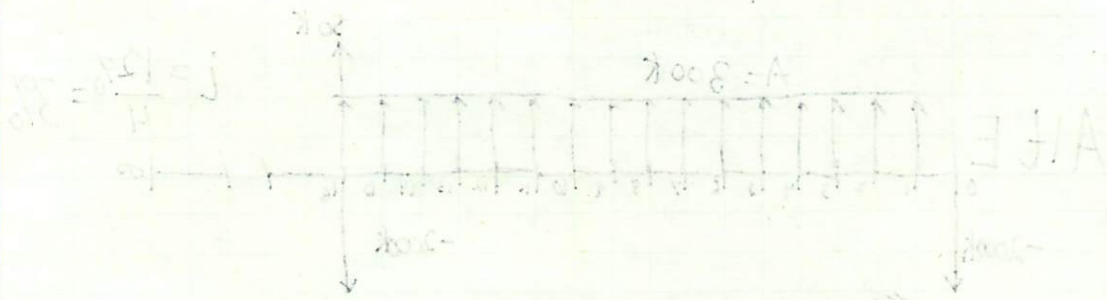
$$CC_G = -3333.333k$$



CC of Alternatives: Alt E < Alt G < Alt F

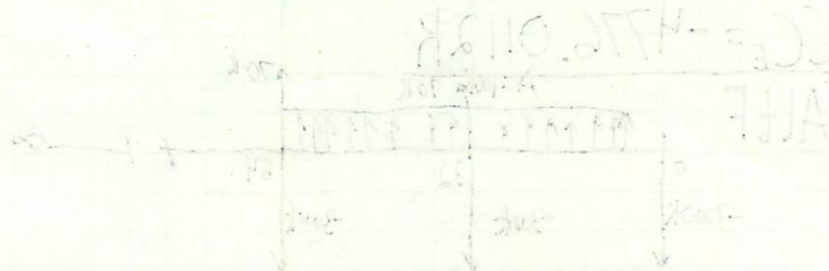
∴ Alt E is the best choice

Wishal parv?



$$C_E = (3000K(1/0.15)(1 - (1/0.15)^{10}) - [(50K(1/0.15)(1 - (1/0.15)^{10}) - 300K/0.15]$$

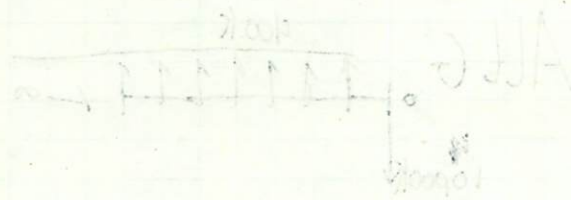
$$C_E = (3000K(4.019) - [50K(4.019) - 300K/0.15]$$



$$C_E = (3000K(1/0.15)(1 - (1/0.15)^{10}) - [100K(4.019) - 300K/0.15]$$

$$C_E = (3000K(4.019) - [100K(4.019) - 300K/0.15]$$

$$C_E = 1222.25K$$



$$C_E = 1000K - 100K/0.15$$

$$C_E = -333.333K$$

∴ Alternative: $AFF < AFF < AFF$
 ∴ AFF E is the best choice

Average

TEST -: Date October 28, 2021- Section-2-CHEG 2308 3:30-5:00 PM
Name: Craig Rothsen, Id Class Roll Number 14

43160

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible hand writing, otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please answer using the Engineering Notation otherwise no grade for it.

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Question (2)-(25 point)

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Alt.B	Alt.C
11	9
\$135,000	\$112,000
73,000	46,000
3,000	2,000
29,000	15,000

Data	Alt. A
Useful Life, Years	7
First Cost (FC)	\$123,000
Annual Benefit (AB)	67,000
M&O Grad. (M&O G)	2,800
M&O Cost (M&O)	21,200

The accounting department has chosen Alternative B. Use the best method to select the best alternative and use cash flow of each alternative using a MARR of 12%. State whether or not you agree with the accounting department.

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A series of quarterly cash flows starts with a cash flow of \$1,000 on April 1, 1982, and is expected to continue through July 1, 1994. Each cash flow has been \$50 greater than the one preceding it. This increase is expected to continue. Use an interest rate of 16% with quarterly compounding, and determine the amount of each cash flow in an equivalent series of equal quarterly cash flows if the first cash flow in the equivalent series is to occur on April 1, 1987, and the last on October 1, 1994.

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A specially built computer system has just been purchased by Progress Greenhouse Products to monitor moisture level and to control drip irrigation in hydroponics beds that grow cluster "tradiro" tomatoes. The system's first cost was \$97,000 with an AOC of \$10,000 and a salvage value on the international market of \$20,000 after 4 years, when Progress expects to sell the system. Determine the capitalized cost (i.e. forever) at 12% per year and explain its meaning.

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The following costs are associated with three tomato-peeling machines being considered for use in a canning plant. If the canning company uses an interest rate of 12%, which is the best alternative? Use NPW to make your decision. (Note: Consider the least common multiple as the study period.)

Machine	A	B	C
First cost	\$52,000	\$63,000	\$67,000
O&M costs	15,000	9,000	12,000
Annual benefit	38,000	31,000	37,000
Salvage value	13,000	19,000	22,000
Useful life (yrs)	4	6	12

Question 6 (25 Points)

Three alternatives to incorporate improved techniques to manufacture computer drives to play HD DVD optical disc formats have been developed and costed. Compare the alternatives below using capitalized cost and an interest rate of 12% per year compounded quarterly.

	Alternative E	Alternative F	Alternative G
First cost, \$	—2,000,000	—3,000,000	—10,000,000
Net income, \$ per quarter	300,000	100,000	400,000
Salvage value, \$	50,000	70,000	—
Life, years	4	8	∞

Craig Rothschild Test 3

1) A_1

$$\frac{0.03}{12} = .0025$$

$$F = P(1+i)^n$$

$$30,000(1+.0025)^{48}$$

$$= \frac{33,819.84}{48} = 704.58\$$$

A_2

$$\frac{0.09}{12} = .0075$$

$$30,000 - 2,000 = 28,000\$$$

$$28,000(1+.0075)^{48}$$

$$= \frac{40,079.34}{48} = 834.95\$$$

10/10

The first choice at 3% APR is the better option.

2) ~~NPV~~ $PV = P \times (12\%, 132)$
 $r = 12\%$

~~$NPV \text{ of } A \text{ or } B = -123,000(A/P, 12\%, 7) - 21,200 + 28,000(P/F, 12\%, 7)$~~

A Annual revenue (A) = $AB - M/OG$
 $\$43,000 \rightarrow = 67,000 - 2800 - 21200$
 $= 43,000\$$

$$AE(12\%) = -123,000(A/P, 12\%, 7) + 43,000$$

$$= -123,000(0.2191) + 43,000$$

$$AE(12\%) = \$11,6050.7$$

is this on G?

B Annual amount = $\$73,000 - \$3,000 - \$29,000$
 $= \$41,000$

$$AE(12\%) = -135,000(A/P, 12\%, 11) + 41,000$$

$$= -135,000(0.11654) + 41,000$$

$$= \$18,260$$

C Annual revenue = $46,000 - 2,000 - 15,000$
 $= \$29,000$

$$AE(12\%) = -112,000(A/P, 12\%, 9) + 29,000$$

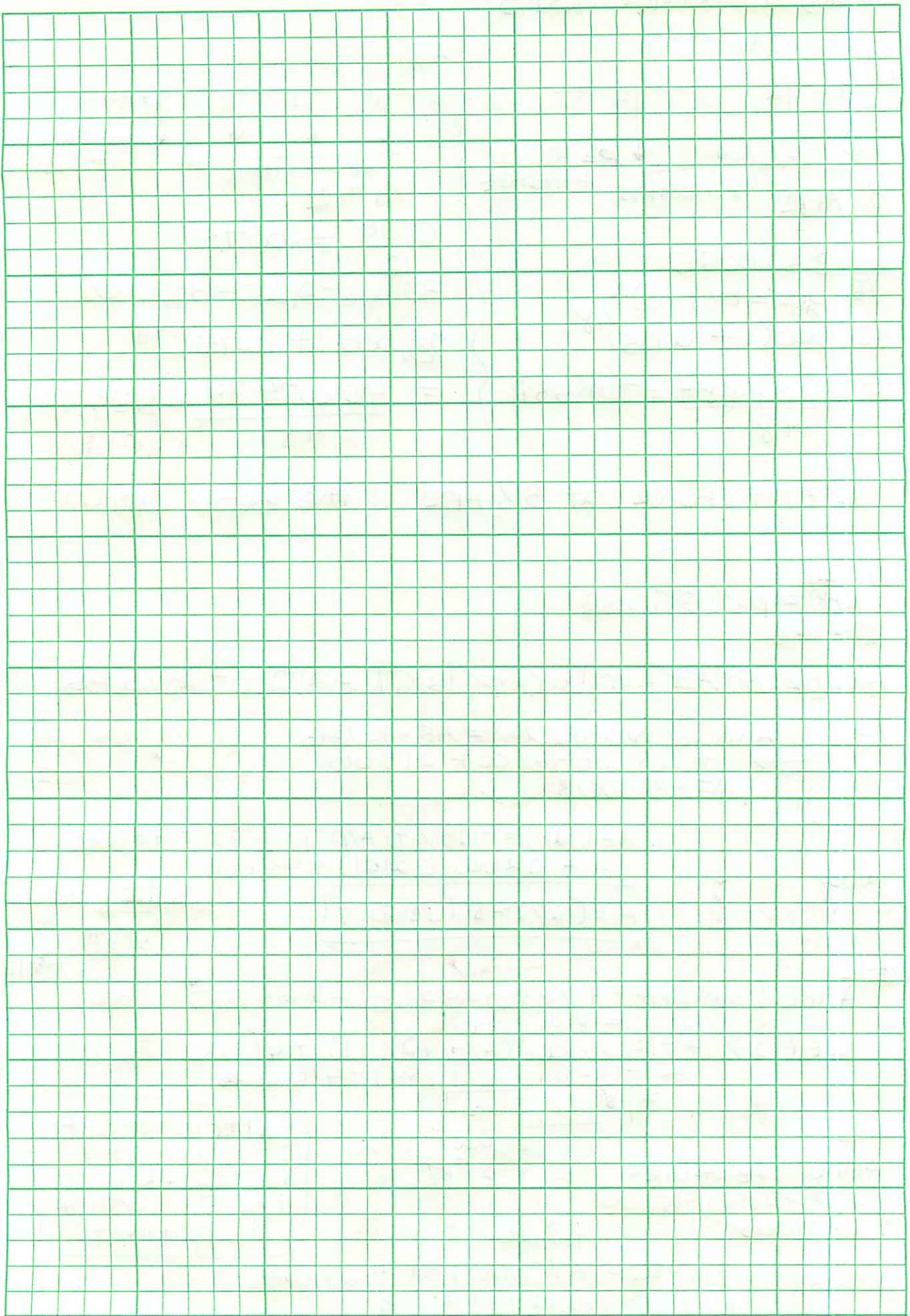
$$= -112,000(0.1877) + 29,000$$

$$= \$7,977.6$$

Alternative B is higher and we agree with the accounting department

5/10

is this on G?



3) Amount of 1st payment = \$1000

of n = 66 Annual i = 16% quarterly = $16/4 = 4\%$

$$\text{Total PV} = \cancel{1000(1.04)^{66}} + 1000 \left[\frac{1 - (1 + r)^{-n}}{r} + \frac{50((1 + r)^n - 1)}{r^2 \times (1 + r)^n} \right]$$

$$= 1000 \times \left[\frac{1 - (1 + 4\%)^{-66}}{4\%} + \frac{50 \times ((1 + 4\%)^{66} - 1)}{(4\% \times (1 + 4\%)^{66})} \right]$$

$$= 45826.04$$

$n_1 = 31$
 $r = 4\%$
 $n_2 = 20$

$$45826.04 = P \left[\frac{1 - (1 + r)^{-n_1}}{r} + \frac{(1 + r)^{-n_1} - (1 + r)^{-n_2}}{r} \right]$$

~~45826.04~~
 $P = 45826.04 \times 2.1911 / 17.588$

~~X~~ $\boxed{= \$5708.974}$

~~X~~ 0/10

4)

$$\text{Annual Worth} = [(-97000) \left[\frac{0.12}{(1 + 0.12)^4} - 1 \right] + [20000 \times (0.12 / (1.12^4 - 1))]]$$

$$= -37851.05 \$$$

$$(-37851.05) \times \frac{1}{0.12} = -314592.10 = \text{Capitalized cost}$$

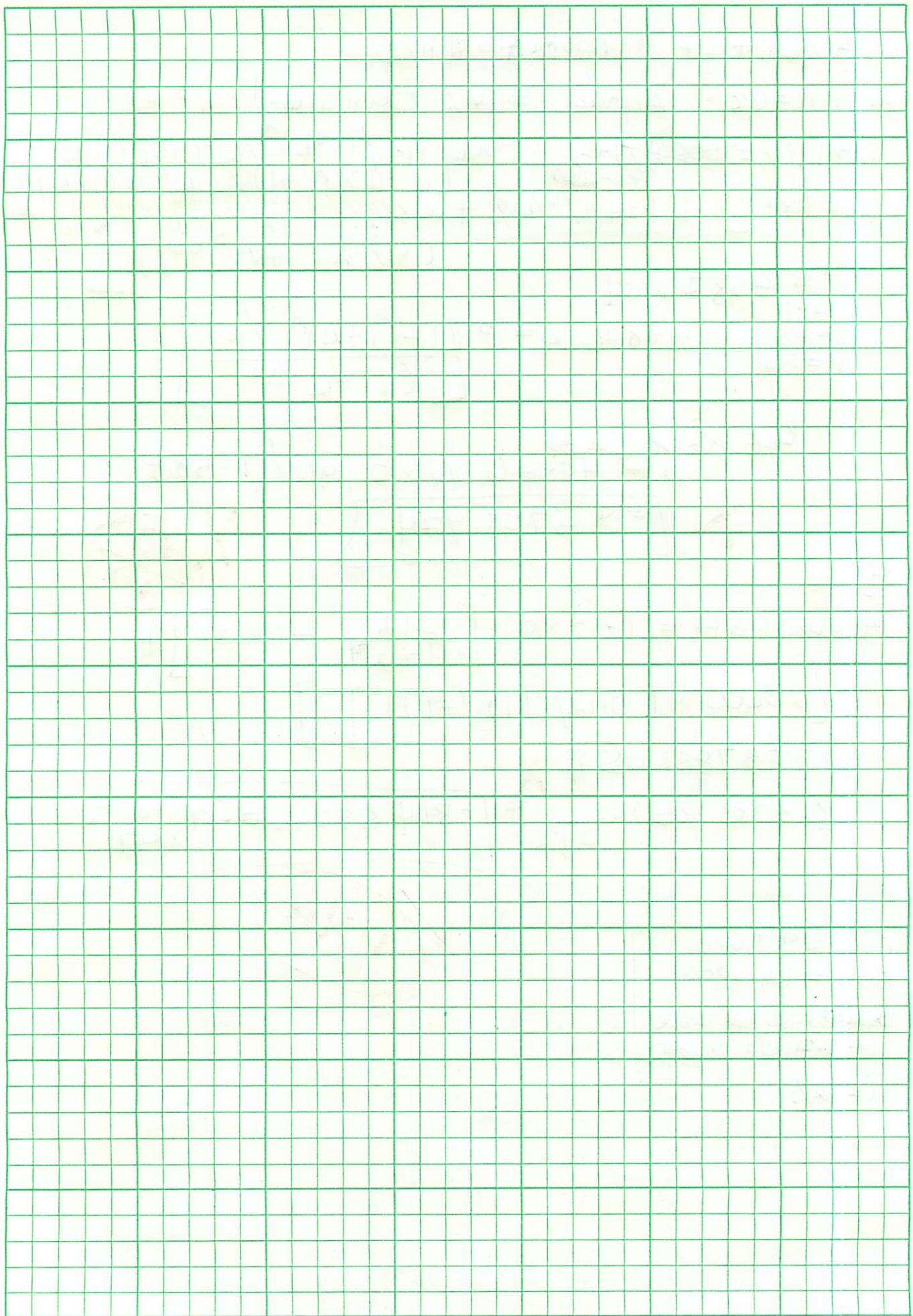
$\checkmark$ 10/10

Cost = 97,000

AUC = 10,000

~~Salvage value~~
= 29,000 4 years

i = 12%



5) LCM of 4, 6 and 12 = 12 years

$$NPV_A = -50,000 + (30,000 - 15,000) (P/A, 12\%, 4) + 13,000 (P/F, 12\%, 4)$$

$$= -50,000 + 69,851 + 8,362$$

$$= \$18,213$$

$$NPV_B = NPV_A (1 + (P/F, 12\%, 4) + (P/F, 12\%, 8))$$

$$= 18,213 [1 + (1.12)^{-4} + (1.12)^{-8}]$$

$$= 37,067$$

$$NPV_C = NPV_A (1 + (P/F, 12\%, 6) + (P/F, 12\%, 12))$$

$$= 37,067 [1 + (1.12)^{-6} + (1.12)^{-12}]$$

$$= \$55,846$$

$$NPV_2 = -67,000 + (37,000 - 12,000) (P/A, 12\%, 12) + 22,000 (P/F, 12\%, 12)$$

$$= -67,000 + 154,180 + 5,447$$

$$= 93,497$$

Machine C is the right choice

(c) interest rate = 12% compound quarterly
 $12/4 = 3\%$

Alternative F = $4 \times 4 = 16$ quarters
 $F = 8 \times 4 = 32$ "
 $G = 12 \times 4 = 48$ "

$$F = (2 \times 10^6) (A/P, 3\%, 16) + 3 \times 10^6 + 5 \times 10^4 (A/F, 3\%, 16)$$

$$0.03 = 47.7 \times 10^4$$

$$F = (3 \times 10^6) (A/P, 3\%, 32) + 10 \times 10^4 + (7 \times 10^4) (A/F, 3\%, 32)$$

$$= -15.2 \times 10^6$$

$$G = 10 \times 10^6 + 4 \times 10^4 = 3.3 \times 10^7$$

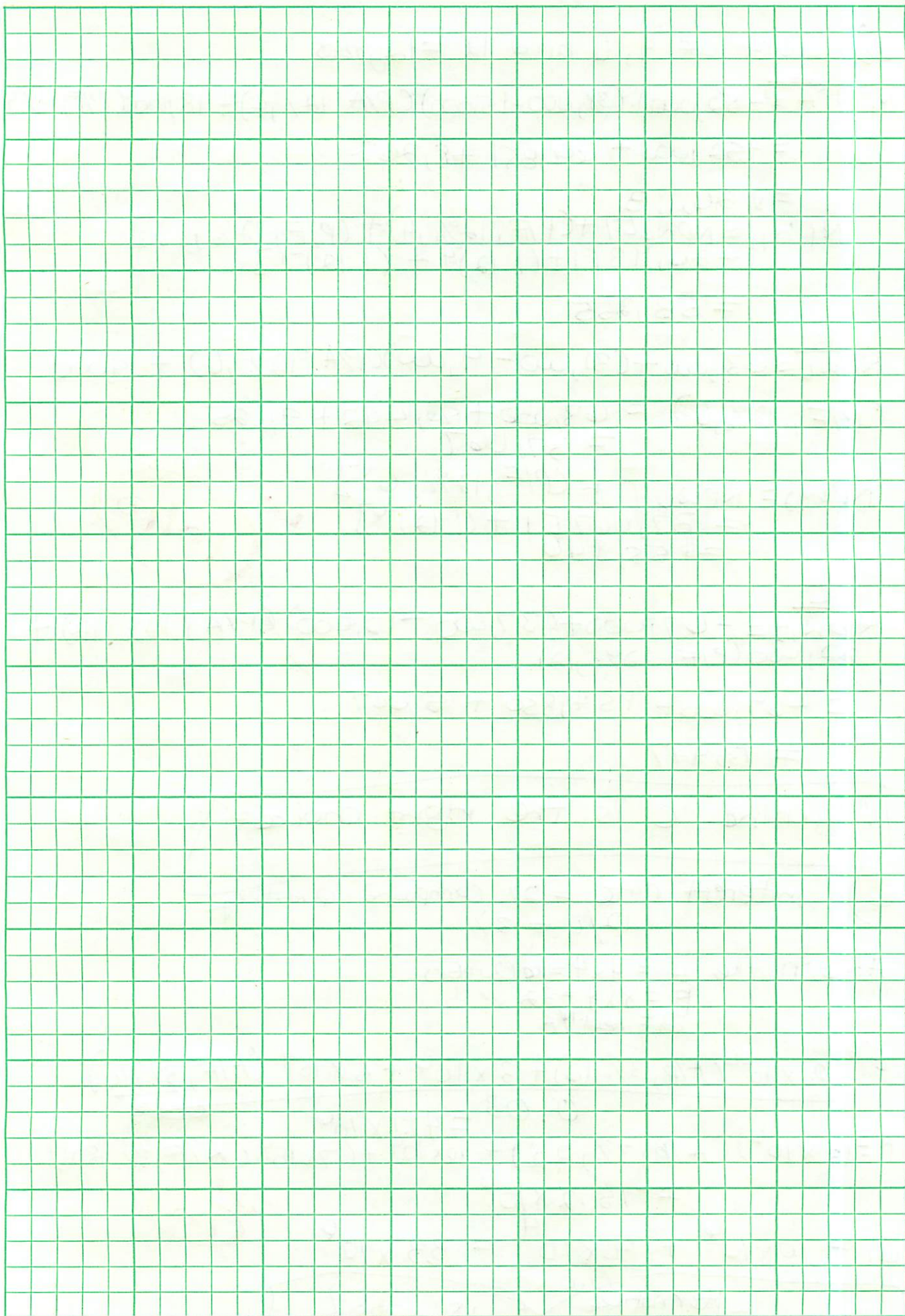
$$0.03$$

So, Alternative F is good

✓ 10

✓ 1000





Below Average

Ermin Alimado

20%
60

1) price new car : 30,000

3% APR

Payment over 48 months

Case #1

purchase price = 30,000

3% / 12 = 0.0025

Monthly installment

(P/F, 0.25%, 48)

$$= 30,000 \cdot 0.0025 / 1 - (1 + 0.0025)^{-48}$$

$$= 31.872$$

1-110

Case #2

purchase price = 30,000 - \$2,000 = 28,000

9% / 12 = 0.0075%

(F/P, 0.75%, 48)

$$(28,000 \cdot 0.0075) / (1 + 0.75)^{48} - (1 + 0.75)^{48}$$

$$= 33.456$$

Case #1 is the best choice

A
c) initial cost = 123,000

$$\text{Sum: } 67,000 - (2800 + 21200) = 43,000$$

$$\text{Net value} = -123,00 + 43,000 \cdot 4.5638$$

\$73,243

B) initial cost = \$135,000

$$\text{Sum: } 46,000 - (2000 + 15000) = 29,000$$

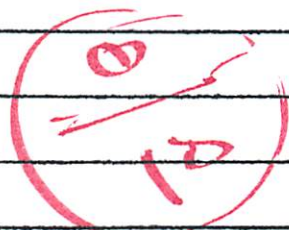
$$\begin{aligned} \text{net value} &= -112,000 + 29,000 \cdot 5.3282 \\ &= 42,518 \end{aligned}$$

option B is the best option
due to more net present value

Did you use
Annual worth

you forget using

LCM for Present worth



Ernie Alameda

4) initial cost 97,000

AOC 10,000

$$(97,000 + 10,000 (P/A, 11\%, 4) - 2,000 (F/P, 12\%, 4)) \\ = 97,000 + 2,037.3 - 11,710.52 \\ = 114,166.3$$

How

10%

5) A) $i = 12\%$

$$38,000 - 15,000 = 23,000$$

10/10

Net present =

$$-52,000 - 52,000 (P/F, 12\%, 4) - 52,000 (P/F, 12\%, 8) \\ + 23,000 (P/A, 12\%, 12) + 13,000 (P/P, 12\%, 4) + \\ 131,000 (P/F, 12\%, 8) + 13,000 (P/F, 12\%, 12)$$

$$= 2000 - 33046 - 21002.8 + 142471.2 + 8261.5 \\ + 5250.7 + 337.1 \\ = 53,272$$

first period

b) $n = 2$

$$31,000 - 9,000 = 22,000$$

$$= -63,000 - 63,000(0.5066) + 22,000(6.1944) \\ + 19,000(0.5066) + 19,000(0.2567)$$

$$= 55,864$$

c) $n = 1$

$$37,000 - 12,000 = 25,000$$

$$= -67,000 + 25,000(P/A, 12\%, 12) + 22,000(P/F, 12\%, 12)$$

$$= -67,000 + 25,000(6.1944) + 22,000(0.2567)$$

$$= 93,507$$

Option C has the most net value

Ermin Aljerado

6) Altern. E

1st cost = -240000

$$\text{PV of net} = 5000 / (1/4) = 5000 / 0.02 \\ = 250000$$

$$\text{PV of upgrade} = -13000 / (1 + 8/400)^{40} \\ - 13000 / (1 + 8/400)^{80} + \dots = \infty$$

$$(-13000 / 1.02^{40}) \cdot 1 / (1 - 1/1.02^{40}) = -10763.39$$

$$\text{Total} = -240000 + 250000 - 10763.39 \\ = -763.39$$

Altern. F

1st cost = -168000

$$\text{PV of net income} = 9000 / 0.02 = 450,000$$

$$\text{Replacement cost} = -168000 + 30000 = -138,000$$

$$\text{PV of replacement cost} = -138 / 1.02^{40} \cdot 1 / (1 - 1/1.02^{40}) \\ = -283981.35$$

$$\text{Total PV} = -168000 + 450000 - 283,981.35 \\ = -1981.35$$

Alternate E is best

Objectives of Final Exam

- 1) The importance and objectives of the Final exam is to test the students' understanding of the materials for the course and understand the activities during the course.**
- 2) To test the students for understanding the scope of Engineering Economy that they will be using in their career of engineering**

Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
The Time of the Final Exam is December 2-2021 at 2:30-4:30 PM

Name

No in the Roll

Direction

Please read the questions carefully.

Part 1

Match each term with its definition by placing the term number beside its correct definition.

Number	Term	Number	Term
1	ROR		minimum Attractive rate of return
2	ROR		Is known by internal rate of return (IRR) or Profitability Index
3	AW		is especially applicable to large capital investment decision when decision when a prime goal is to to maximize the future wealth of a corporation's stockholders.
4	FW		Capitalized cost (CC) is the present worth of an alternative that will last "forever"
5	LCM		Is known by equivalent annual worth (EAW), equivalent annual cost (EAC), annual equivalent (AE), and EUAC (equivalent uniform annual costs)
6	Nominal rates		is the Interest rate is compounded more frequently than once per year
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9	Break Even Point		A decrease in the value of a currency and on the other hand it is a decrease in the value of a currency
10	Inflation		Is the diagram that can show the inflow and outflow estimates. From that diagram, the net of the flow can be determined the net of money
11	Cash Flow		Is the value of a parameter or decision variable that makes two relations equal. In other words, it is the interest rate such that two alternatives' cash flows are equivalent
12	MARR		is the increase in the amount of money necessary to purchase the same amount of a product or services over time
13	Inflation		Is the rate paid on the unpaid balance of borrowed money, or the rate earned on the unrecovered balance of

			an investment, so that the final payment or receipt brings the balance to exactly zero with interest considered.
14	CC		Is named as Least Common Multiple and it is used to equalized the time periods for different projects with different time periods
15	Effective interest rates		Is the Interest rate per time period without regard to compounding frequency

Part 2

Questions From 1-15- True and false Statement

		<u>T</u>	<u>F</u>
<u>1</u>	IRR decision rule is that if $IRR > \text{or} = MARR$, The project is economically not justifiable.		
2	The disadvantage of multiple projects comparison for selecting the best calculation is using annual worth and using the LCM		
3	FW decision rule using ($i = MARR \geq 0$), then the project is economically justified		
4	$(P/A, i\%, N)(F/P, i\%, N) = (F/A, i\%, N)$		
5	The CW of a series of end-of-period uniform payments A, with interest at $i\%$ per period		
6	Breakeven point is the value of a parameter or decision variable that makes two relations equal variable that makes two relations equal		
7	$(P/G, i\%, N)(F/P, i\%, N) = (F/G, i\%, N)$		
8	$(A/G, i\%, N)(P/A, i\%, N) = (P/G, i\%, N)$		
9	Capital Worth is $CW = i / A$.		
10	The CW is of a series of end-of-period uniform payments A, with interest at $i\%$ per period		
11	<i>Economic life</i> : is the period of time (years) that yields the minimum equivalent uniform annual cost (EUAC) of owning and operating as asset		
12	<i>IRR is the interest rate at which the present worth and equivalent uniform annual worth are equal to 0</i>		

13	<i>The Geometric gradient series is the frequent increase happening by constant amount.</i>		
14	<i>The expected life n is the number of years at which the lowest AW of costs occurs. This is called the economic service life or ESL.</i>		
15	<i>Modified B/C is equal to = <u>Benefit-Dis-benefits / initial investment</u></i>		

Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
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Part 2 - Solving Problems

Name

No in the Roll

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting, otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. **Please answer using the Engineering Notation otherwise no grade for it.**

Q1)

- A) An engineer borrowed \$3000 from a bank, payable in six equal end-of-year payments at 8%. The bank agreed to reduce the interest on the loan if interest rate declined in the United States before the loan was fully repaid. At the end of three years, at the time of the third payment, the bank agreed to reduce the interest rate from 8% to 7% on the remaining debt. What was the amount of the equal annual end-of year payments for each of the first three years? What was the amount of the equal annual end-of-year payments for each of the last three years?

A) **Answer**

$$A = P(A/P, 8\%, 6) = 3000(0.2163) = 648.90$$

First 3 payments were 648.90 each

Balance due after 3rd payment = present worth of the originally planned last 3 payment of 648.90

$$P = 648.90(P/A, 8\%, 3) = 648.90(2.577) = 1672.22$$

Last 3 Payments

$$A' - 1672.22(A/P, 7\%, 3) = 1672.22(0.3811) = \$637.28.$$

B) Two Alternatives in the below table

Alternative	A	M
P, \$	23,000	8,000
S, \$	4,000	0
Life, years	10	5
M&O, \$/year	3,500	1,500
Labor rate \$/hr	24	12
People	1	3
Output, tons/hr	8	6

Find the breakeven tones per year to justify the higher initial cost alternative A at i=10%

Answer is

Sec 8.2 - Two Alternative Breakeven - Example 1

Solution approach:

1. Determine VC expression for both A and M using the common variable x = tons per year
2. Set up AW relations for both alternatives
3. Equate AW relations and solve for x
4. Determine when A or M is selected

A: variable cost expression $\frac{\$24}{\text{hour}} \frac{1 \text{ hour}}{8 \text{ tons}} \frac{x \text{ tons}}{\text{year}} = 3x$

M: variable cost expression $\frac{\$12}{\text{hour}} (3 \text{ operators}) \frac{1 \text{ hour}}{6 \text{ tons}} \frac{x \text{ tons}}{\text{year}} = 6x$

cont →

Slide to accompany Blank and Tarquin
Basics of Engineering Economy, 2008

8 - 18

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Q2)

The following costs are associated with three tomato-peeling machines being considered for use in a food canning plant.

	Machine A	Machine B	Machine C
First cost	\$52,000.00	\$63,000.00	\$67,000.00
Maintenance & Operating Costs	15,000.00	9,000.00	12,000.00
Annual benefits	38,000.00	31,000.00	37,000.00
Salvage Value	13,000.00	19,000.00	22,000.00
Useful life in Years	4	6	12

If the canning company uses a MARR of 12% which is the best alternative? USE NPW to make your decision Note: Consider the least common multiple as the study period.

Answer

Use LCM

Machine A

$$\begin{aligned} NPW_4 &= -52,000 + (38,000 - 15,000)(P/A, 12\%, 4) + 13,000(P/F, 12\%, 4) \\ &= -52,000 + 69,851 + 8262 \\ &= 26,113 \end{aligned}$$

$$\begin{aligned} NPW_{12} &= NPW_4[1 + (P/F, 12\%, 4) + (P/F, 12\%, 8)] \\ &= 26,113[1 + (1.12)^{-4} + (1.12)^{-8}] = 53,255 \end{aligned}$$

Machine B

$$\begin{aligned}
 NPW_6 &= -63,000 + (31,000 - 9,000)(P/A, 12\%, 6) + 19,000(P/F, 12\%, 6) \\
 &= -63,000 + 90,442 + 9,625 = 37,067 \\
 NPW_{12} &= NPW_6[1 + (P/F, 12\%, 6)] \\
 &= 37,067[1 + (1 + (1.12)^{-6})] \\
 &= 55,846
 \end{aligned}$$

Machine C

$$\begin{aligned}
 NPW_{12} &= -67,000 + (37,000 - 12,000)(P/A, 12\%, 12) + 22,000(P/F, 12\%, 12) \\
 &= -67,000 + 154,850 + 5,647 \\
 &= 93,497
 \end{aligned}$$

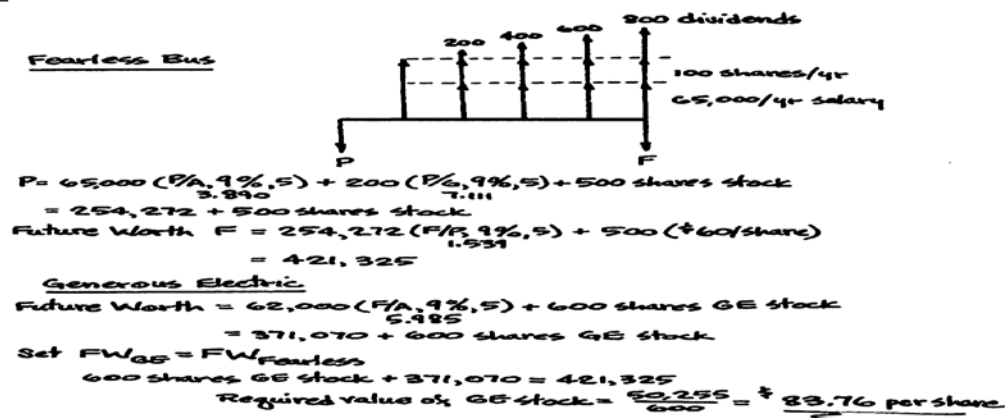
Machine C is the best Machine.

Q3)

A business executive is offered a management job at Generous Electrical Company. They offer to give him a five-year contract, which calls for a salary of \$62,000 per year, plus 600 shares of their stock at the end of the five years. The executive is currently employed by Fearless Bus Company and they, too, offered him a five-year contract. It calls for a salary of \$65,000, plus 100 shares of Fearless Stock each year. The stock is currently worth \$60 per share and pays an annual dividend of \$2 per share. Assume end-of-year payments of salary and stock. Stock dividends begin one year after the stock is received. The executive believes that the value of stock and the dividend will remain constant. If the executive considers 9% a suitable rate of return in this situation, what must the Generous Electric stock be worth per share to make the two offers equally attractive?

Answer

9-4



Q4) Optional

Midwest Power and Light operates 14 coal-fired power plants in several states around the United States. The company recently settled a lawsuit by agreeing to pay \$60 million in mitigation costs related to acid rain. The settlement included \$21 million to reduce emissions from barges and trucks in the Ohio River Valley, \$24 million for projects to conserve energy and produce alternative energy, \$3 million for Chesapeake Bay, \$2 million for Shenandoah National Park, and \$10 million to acquire ecologically sensitive lands in Appalachia. The question of how to distribute the money over time has been posed. Plan A involves spending \$5 million now and the remaining

\$55 million equally over a 10-year period (that is, \$5.5 million in each of years 1 through 10). Plan B requires expenditures of \$7 million now, \$23 million 2 years from now, and \$30 million 7 years from now. Determine which plan is more economical based on a present worth analysis over a 10-year period at an interest rate of 10% per year.

Above Average

Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
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Name Micheal Sands

No in the Roll 15

Direction

Please read the questions carefully.

$$\frac{13}{15} + \frac{13}{15} = \frac{26}{30}$$

Part 1

Match each term with its definition by placing the term number beside its correct definition.

Number	Term	Number	Term
1	ROR	12 ✓	minimum Attractive rate of return
2	ROR	1 ✓	Is known by internal rate of return (IRR) or Profitability Index
3	AW	4 ✓	is especially applicable to large capital investment decision when decision when a prime goal is to to maximize the future wealth of a corporation's stockholders.
4	FW	14 ✓	Capitalized cost (CC) is the present worth of an alternative that will last "forever"
5	LCM	3 ✓	Is known by equivalent annual worth (EAW), equivalent annual cost (EAC), annual equivalent (AE), and EUAC (equivalent uniform annual costs)
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12	MARR	10 X	is the increase in the amount of money necessary to purchase the same amount of a product or services over time
13	Inflation	2 ✓	Is the rate paid on the unpaid balance of borrowed money, or the rate earned on the unrecovered balance of

			an investment, so that the final payment or receipt brings the balance to exactly zero with interest considered.
14	CC	5✓	Is named as Least Common Multiple and it is used to equalized the time periods for different projects with different time periods
15	Effective interest rates	6✓	Is the Interest rate per time period without regard to compounding frequency

Part 2

-2 (13/15)

Questions From 1-15- True and false Statement

		<u>T</u>	<u>F</u>
1	IRR decision rule is that if $IRR \geq MARR$, The project is economically not justifiable.	✓	F
2	The disadvantage of multiple projects comparison for selecting the best calculation is using annual worth and using the LCM	✓	F
3	FW decision rule using ($i = MARR \geq 0$), then the project is economically justified	✓	T
4	$(P/A, i\%, N)(F/P, i\%, N) = (F/A, i\%, N)$	✓	+
5	The CW of a series of end-of-period uniform payments A, with interest at $i\%$ per period	✓	T
6	Breakeven point is the value of a parameter or decision variable that makes two relations equal	✓	T
7	$(P/G, i\%, N)(F/P, i\%, N) = (F/G, i\%, N)$	✓	T
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12	IRR is the interest rate at which the present worth and equivalent uniform annual worth are equal to 0	✓	T

13	<i>The Geometric gradient series is the frequent increase happening by constant amount.</i>	✓	F
14	<i>The expected life n is the number of years at which the lowest AW of costs occurs. This is called the economic service life or ESL.</i>	✓	T
15	<i>Modified B/C is equal to = <u>Benefit-Dis-benefits / initial investment</u></i>	X	T

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Part 2 - Solving Problems

Name Micheal Sands

No in the Roll 15

28
40

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Salvage Value	13,000.00	19,000.00	22,000.00
Useful life in years	4	6	12

Useful life in Years

4

6

12

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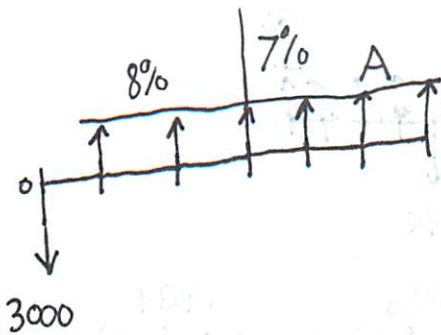
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A business executive is offered a management job at Generous Electrical Company. They offer to give him a five-year contract, which calls for a salary of \$62,000 per year, plus 600 shares of their stock at the end of the five years. The executive is currently employed by Fearless Bus Company and they, too, offered him a five-year contract. It calls for a salary of \$65,000, plus 100 shares of Fearless Stock each year. The stock is currently worth \$60 per share and pays an annual dividend of \$2 per share. Assume end-of-year payments of salary and stock. Stock dividends begin one year after the stock is received. The executive believes that the value of stock and the dividend will remain constant. If the executive considers 9% a suitable rate of return in this situation, what must the Generous Electric stock be worth per share to make the two offers equally attractive?

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Midwest Power and Light operates 14 coal-fired power plants in several states around the United States. The company recently settled a lawsuit by agreeing to pay \$60 million in mitigation costs related to acid rain. The settlement included \$21 million to reduce emissions from barges and trucks in the Ohio River Valley, \$24 million for projects to conserve energy and produce alternative energy, \$3 million for Chesapeake Bay, \$2 million for Shenandoah National Park, and \$10 million to acquire ecologically sensitive lands in Appalachia. The question of how to distribute the money over time has been posed. Plan A involves spending \$5 million now and the remaining \$55 million equally over a 10-year period (that is, \$5.5 million in each of years 1 through 10). Plan B requires expenditures of \$7 million now, \$23 million 2 years from now, and \$30 million 7 years from now. Determine which plan is more economical based on a present worth analysis over a 10-year period at an interest rate of 10% per year.

Q1
A)



~~15/25~~

$$3000 = A(P/A, 8\%, 3)$$

$$F = 3000(P/F)$$

$$A = 3000(P/A, 8\%, 3)$$

$$A = 3000(0.38803) = 3000(0.21632) = 648.96$$

$$F = 648.96(F/A, 8\%, 3)$$

$$F = 648.96(3.2464) = 2106.78$$

$$A = 2106.78(A/P, 7\%, 3)$$

$$A = 2106.78(0.38105) = 802.79$$

~~15/10~~

www!

Payments For the First three years is \$648.96
Payments for the last three years is \$802.79

$$B) \text{ Alt. A: } -23,000(P/A, 10\%, 10) + 4000(A/F, 10\%, 10) - 3500 - 3x$$

$$\frac{244}{12} \times \frac{12}{8} = 3 \text{ Alt. M: } -8000(A/P, 10\%, 5) - 1500 - 6x$$

$$\frac{12}{12} \times \frac{3}{6} \times \frac{12}{6} = 6$$

$$-6492.25 - 3x = -2110.4 - 3610.4 - 6x$$

$$+3x = 3381.85$$

$$x = 1127$$

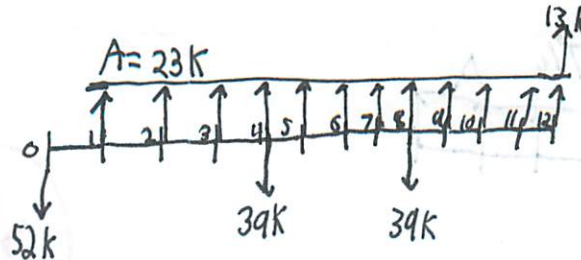
~~10/15~~

To breakeven, tone per year must be about 1127 tones

Q2

LCM = 12

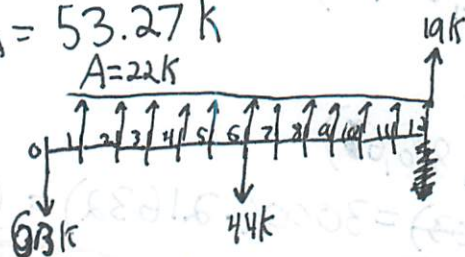
Machine A



$$PW_A = -52k + 23k(P/A, 12\%, 12) - 39k(P/F, 12\%, 4) - 39k(P/F, 12\%, 8) + 13k(P/F, 12\%, 12)$$

$$PW_A = 53.27k$$

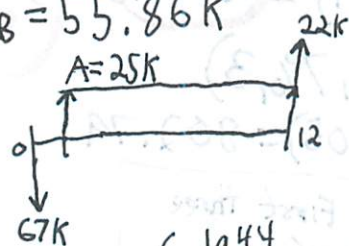
Machine B



$$PW_B = -63k + 22k(P/A, 12\%, 12) - 44k(P/F, 12\%, 6) + 19k(P/F, 12\%, 12)$$

$$PW_B = 55.86k$$

Machine C



$$PW_C = -67k + 25k(P/A, 12\%, 12) + 22k(P/F, 12\%, 12)$$

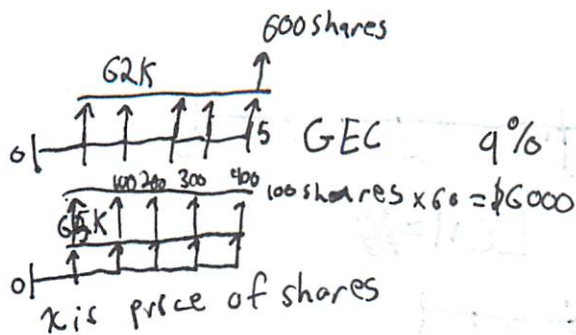
$$PW_C = 93.507$$

10/13

$$PW_C > PW_B > PW_A$$

∴ Machine C is the best alternative

Q3



$$62K + 600x = 65K + 30000 + 2000$$

$$600x = 35000$$

$$x = 58.33$$

GEC's stock must be \$58.33

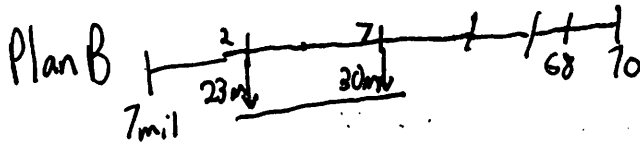
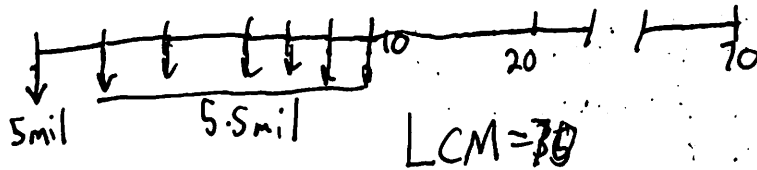
It can be calculated!

How!

$$\frac{2}{15}$$

Q4

Plan A



$$PW_A = -5 \text{ mil} - 5.5 \text{ mil} (P/A, 10\%, 70) - 5.5 \text{ mil} (P/F, 10\%, 10) - 5.5 \text{ mil} (P/F, 10\%, 20) \dots - 5.5 \text{ mil} (P/F, 10\%, 70)$$

$$= -5 \text{ mil} - 5.5 (4.9873) - 5.5 (.3855) - 5.5 ($$

$$- 5 \text{ mil} - 5.5 (4.9873) - 5 (.3855 + .1486 + .0573 + .0221 + .0085 + .0033 + .001)$$

$$PW_A = -63.06 \text{ mil}$$

easier way →

$$PW_B = -7 \text{ mil} - 23 \text{ mil} (.47619) (P/A, 10\%, 70) - 30 \text{ mil} (.10541) (P/A, 10\%, 70)$$

$$PW_B = -147.97 \text{ mil}$$

$$PW_A = -5 \text{ mil} - 5.5 \text{ mil} (4.9873) (P/A, 10\%, 70) - 5 \text{ mil} (.06275) (P/A, 10\%, 70)$$

$$PW_A = -63.06 \text{ mil}$$

$$PWA > PWB$$

∴ PWA is the better alternative

..
..

Average

Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
The Time of the Final Exam is December 2-2021 at 2:30-4:30 PM

Name Craig Rothschild

No in the Roll

14

Direction

Please read the questions carefully.

Part 1

-2

$$\frac{13}{15} + \frac{7}{15} = \frac{20}{30}$$

$$= \frac{20}{30}$$

Match each term with its definition by placing the term number beside its correct definition.

Number	Term	Number	Term
1	ROR	12✓	minimum Attractive rate of return
2	ROR	1✓	Is known by internal rate of return (IRR) or Profitability Index
3	AW	4✓	is especially applicable to large capital investment decision when decision when a prime goal is to to maximize the future wealth of a corporation's stockholders.
4	FW	14✓	Capitalized cost (CC) is the present worth of an alternative that will last "forever"
5	LCM	3✓	Is known by equivalent annual worth (EAW), equivalent annual cost (EAC), annual equivalent (AE), and EUAC (equivalent uniform annual costs)
6	Nominal rates	15✓	is the Interest rate is compounded more frequently than once per year
7	Fixed Costs	7X	Includes costs such as direct labor, subcontractors, materials, indirect costs, marketing, advertisement, legal, and warranty.
8	Variable Costs	8X	Includes costs such as buildings, insurance, fixed overhead, some minimum level of labor, equipment capital recovery, and information systems.
9	Break Even Point	10✓	A decrease in the value of a currency and on the other hand it is a decrease in the value of a currency
10	Inflation	11✓	Is the diagram that can show the inflow and outflow estimates. From that diagram, the net of the flow can be determined the net of money
11	Cash Flow	9 ✓	Is the value of a parameter or decision variable that makes two relations equal. In other words, it is the interest rate such that two alternatives' cash flows are equivalent
12	MARR	13✓	is the increase in the amount of money necessary to purchase the same amount of a product or services over time
13	Inflation	2✓	Is the rate paid on the unpaid balance of borrowed money, or the rate earned on the unrecovered balance of

		14	an investment, so that the final payment or receipt brings the balance to exactly zero with interest considered.
14	CC	5 ✓	Is named as Least Common Multiple and it is used to equalized the time periods for different projects with different time periods
15	Effective interest rates	✓	Is the Interest rate per time period without regard to compounding frequency

Part 2

Questions From 1-15- True and false Statement

			<u>T</u>	<u>F</u>
<u>1</u>	IRR decision rule is that if $IRR > \text{or } = MARR$, The project is economically not justifiable.	X	↑	
2	The disadvantage of multiple projects comparison for selecting the best calculation is using annual worth and using the LCM	X	T	
3	FW decision rule using ($i = MARR \geq 0$), then the project is economically justified	X		F
4	$(P/A, i\%, N)(F/P, i\%, N) = (F/A, i\%, N)$	✓	T	
5	The CW of a series of end-of-period uniform payments A, with interest at $i\%$ per period	✓	T	
6	Breakeven point is the value of a parameter or decision variable that makes two relations equal	✓	↑	
7	$(P/G, i\%, N)(F/P, i\%, N) = (F/G, i\%, N)$	X		F
8	$(A/G, i\%, N)(P/A, i\%, N) = (P/G, i\%, N)$	✓	T	
9	Capital Worth is $CW = i / A$.	X	T	
10	The CW is of a series of end-of-period uniform payments A, with interest at $i\%$ per period	X	⚡	F
11	<i>Economic life</i> : is the period of time (years) that yields the minimum equivalent uniform annual cost (EUAC) of owning and operating as asset	✓	↑	
12	<i>IRR is the interest rate at which the present worth and equivalent uniform annual worth are equal to 0</i>	✓	↑	

13	The Geometric gradient series is the frequent increase happening by constant amount.	X	T	
14	The expected life n is the number of years at which the lowest AW of costs occurs. This is called the economic service life or ESL.	✓	T	
15	Modified B/C is equal to = <u>Benefit-Dis-benefits / initial investment</u>	X	T	

25/40 + 10 extra points

Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
The Time of the Final Exam is December 2-2021 at 2:30-4:30 PM

Part 2 - Solving Problems

Name Craig Rothschild

No in the Roll : 14

10 Points

25/40 = 35

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting, otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please answer using the Engineering Notation otherwise no grade for it.

Q1

- A) An engineer borrowed \$3000 from a bank, payable in six equal end-of-year payments at 8%. The bank agreed to reduce the interest on the loan if interest rate declined in the United States before the loan was fully repaid. At the end of three years, at the time of the third payment, the bank agreed to reduce the interest rate from 8% to 7% on the remaining debt. What was the amount of the equal annual end-of year payments for each of the first three years? What was the amount of the equal annual end-of-year payments for each of the last three years?

B) Two Alternatives in the below table

Alternative	A	M
P, \$	23,000	8,000
S, \$	4,000	0
Life, years	10	5
M&O, \$/year	3,500	1,500
Labor rate \$/hr	24	12
People	1	3
Output, tons/hr	8	6

Find the breakeven tones per year to justify the higher initial cost alternative A at $i=10\%$

Q2)

The following costs are associated with three tomato-peeling machines being considered for use in a food canning plant.

	Machine A	Machine B	Machine C
First cost	\$52,000.00	\$63,000.00	\$67,000.00
Maintenance & Operating Costs	15,000.00	9,000.00	12,000.00
Annual benefits	38,000.00	31,000.00	37,000.00
Salvage Value	13,000.00	19,000.00	22,000.00

Useful life in Years

4

6

12

If the canning company uses a MARR of 12% which is the best alternative? USE NPW to make your decision Note: Consider the least common multiple as the study period.

Q3)

A business executive is offered a management job at Generous Electrical Company. They offer to give him a five-year contract, which calls for a salary of \$62,000 per year, plus 600 shares of their stock at the end of the five years. The executive is currently employed by Fearless Bus Company and they, too, offered him a five-year contract. It calls for a salary of \$65,000, plus 100 shares of Fearless Stock each year. The stock is currently worth \$60 per share and pays an annual dividend of \$2 per share. Assume end-of-year payments of salary and stock. Stock dividends begin one year after the stock is received. The executive believes that the value of stock and the dividend will remain constant. If the executive considers 9% a suitable rate of return in this situation, what must the Generous Electric stock be worth per share to make the two offers equally attractive?

Q4) Optional

Midwest Power and Light operates 14 coal-fired power plants in several states around the United States. The company recently settled a lawsuit by agreeing to pay \$60 million in mitigation costs related to acid rain. The settlement included \$21 million to reduce emissions from barges and trucks in the Ohio River Valley, \$24 million for projects to conserve energy and produce alternative energy, \$3 million for Chesapeake Bay, \$2 million for Shenandoah National Park, and \$10 million to acquire ecologically sensitive lands in Appalachia. The question of how to distribute the money over time has been posed. Plan A involves spending \$5 million now and the remaining \$55 million equally over a 10-year period (that is, \$5.5 million in each of years 1 through 10). Plan B requires expenditures of \$7 million now, \$23 million 2 years from now, and \$30 million 7 years from now. Determine which plan is more economical based on a present worth analysis over a 10-year period at an interest rate of 10% per year.

Q3 ~~1/~~ or share x DIVIDEND per share

Year	
1	(100 x 2) = 200
2	(200 x 2) = 400
3	(300 x 2) = 600
4	(400 x 2) = 800
5	(500 x 2) = 1000
Total	= 3000

1. Dividend received Fearless
= 3000

2. Total Salary (\$65,000 x 5 years)
= -325000

3. Total amount
= -(325000 + 3000)
= -328000

Salary received from
generous co.
(62000 x 5 years)
= 310000

Income from 600 shares
at 9% →

+ 328000 - 310000
= 18000

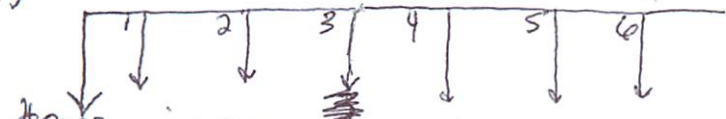
600 share = $\frac{18000}{9} \times 100 = 200000$

Share price per share = $\frac{200000}{600} = 333.33$

Q1 $L_1 = 8\%$ $L_2 = 7\%$ loan = \$3000

A)

year six last payment



$$A = [i * p * (1+i)^n] / [(1+i)^n - 1]$$

~~$A = 3000(A/P, 8\%, 3)$~~
 ~~$A = 3000(A/P, 8\%, 3)$~~
 ~~$= 3000(A/P, 8\%, 3)$~~
 ~~$= 1164.09$~~

$A = (0.08 * 3000 * 1.08^6) / (1.08^6 - 1)$
 $= 648.95$
 OR
 $A = 3000(A/P, 8\%, 6)$
 $= 648.95$

~~10~~

$648.92 * 2 = 1297.92 = P_{new}$

9/13

~~$P = 1297.92(A/P, 7\%, 3)$~~

$$A = [i * p * (1+i)^n] / [(1+i)^n - 1]$$

$A = [0.07 * 1297.92 * (1+0.07)^3] / [(1+0.07)^3 - 1]$
 $= 637.12$

Now! Now!

$A_1 = 648.95 \rightarrow 8\%$
 $A_2 = 637.12 \rightarrow 7\%$

How did you get this value

Q1) B

$i = 10\%$

Alternative A

$$\text{Variable cost} = \frac{\text{Labor rate \$ / hr}}{\text{Output, tons / hr}} \times \text{people}$$
$$\frac{24(1)}{8} = 3$$

$$\begin{aligned} AW_A &= -23,000 (A/P, 10\%, 10) \\ &\quad + 4000 (A/F, 10\%, 10) - 3500 \\ &\quad - 3X \\ &= -37,421 + 250.8 - 3500 - 3X \\ &= -6991.3 - 3X \quad (A_1) \end{aligned}$$

Alternative M

$$\frac{12(3)}{6} = 6$$

$$\begin{aligned} AW_M &= -8000 (A/P, 10\%, 5) - 1500 - 6X \\ &= -3610.4 - 6X \quad (B_1) \end{aligned}$$

at equal

$$-6991.3 - 3X = -3610.4 - 6X$$

↓

$$6991.3 + 3X = 3610.4 + 6X$$

$$3X = 3380.9$$

$$X = 1126.967 \text{ ton per year}$$

↓
1127 ~~per~~ ton/year

The Alt A should be ~~preferred~~ used because it's 3 people smaller

Q2) ILCM $\rightarrow 4, 6, \text{ and } 12 = \underline{12}$

MARR of 12% $\rightarrow i = 12\%$

$$\begin{aligned} NPW_A(4) &= -52,000 + (38,000 - 15,000)(P/A, 12\%, 4) + 13,000(P/F, 12\%, 4) \\ &= -52,000 + 69,851 + 8,262 \\ &= \$2.6 \times 10^4 \end{aligned}$$

$$\begin{aligned} NPW_A(12) &= NPW_A(4) [1 + (P/F, 12\%, 4) + (P/F, 12\%, 8)] \\ &= 2.6 \times 10^4 [1 + (1.12)^{-4} + (1.12)^{-8}] \\ &= 53,125.5 \rightarrow \$5.3 \times 10^4 \end{aligned}$$

$$\begin{aligned} NPW_B(6) &= -63,000 + (31,000 - 9,000)(P/A, 12\%, 6) + 19,000(P/F, 12\%, 6) \\ &= -63,000 + 90,442 + 9,625 \\ &= \$37,067 \rightarrow 3.7 \times 10^4 \end{aligned}$$

$$\begin{aligned} NPW_B(12) &= NPW_B(6) [1 + (P/F, 12\%, 6)] \\ &= 37,067 [1 + (1.12)^{-6}] \\ &= \$55,846 \rightarrow 5.58 \times 10^4 \end{aligned}$$

$$\begin{aligned} NPW_C(12) &= -67,000 + (37,000 - 12,000)(P/A, 12\%, 12) + 22,000(P/F, 12\%, 12) \\ &= -67,000 + 154,800 + 5,647 \\ &= \$93,447 \rightarrow 9.35 \times 10^4 \end{aligned}$$

Machine C is the best alternative

10/10

Q4) Option a)

-60 million

-21

-24

-3 Bay

-2

-10

plan A

10/10

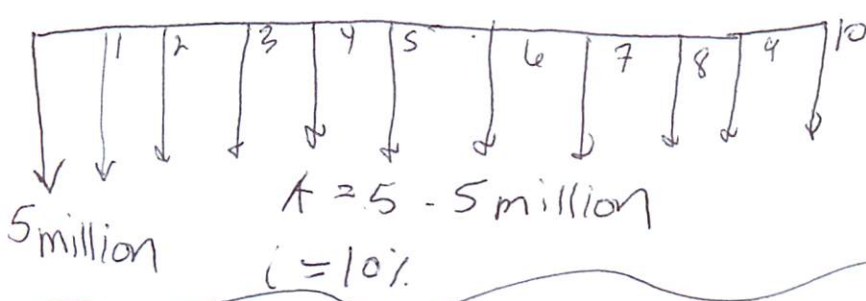
$t_0 = \$5 \text{ million}$

$t_1 \text{ to } t_{10} = \5.5 million

$$PV = \frac{5}{(1+i)^0} + \frac{5.5}{1.1} + \frac{5.5}{(1+i)^2} \dots$$

$$PV = 5 + 33.79$$

$$\frac{5.5}{(1.1)^{10}}$$



plan B

$t = \text{time}$

$t_0 = \$7 \text{ million}$

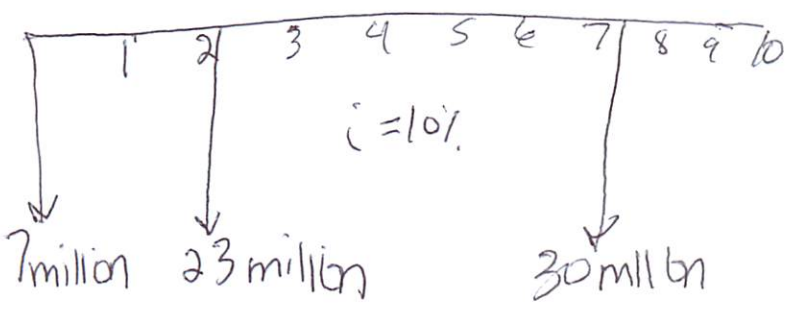
$t_2 = \$25 \text{ million}$

$t_7 = 30 \text{ million}$

$$PV = \frac{7}{(1+i)^0} + \frac{25}{(1.1)^2} + \frac{30}{(1.1)^7}$$

$$= 7 + 20.66 + 15.39$$

$$= \underline{43.05}$$



Since Plan A is less than Plan B

Plan A is the more Economical based ~~choice~~

Below Average

*Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
The Time of the Final Exam is December 2-2021 at 2:30-4:30 PM*

Name Daniel Benitez

No in the Roll #2

Direction

Please read the questions carefully.

$$\frac{4}{11} + \frac{12}{15} = \frac{23}{30}$$

Part 1

Match each term with its definition by placing the term number beside its correct definition.

Number	Term	Number	Term
1	ROR	12 ✓	minimum Attractive rate of return
2	ROR	1 ✓	Is known by internal rate of return (IRR) or Profitability Index
3	AW	15 ✗	is especially applicable to large capital investment decision when decision when a prime goal is to to maximize the future wealth of a corporation's stockholders.
4	- FW	14 ✓	Capitalized cost (CC) is the present worth of an alternative that will last "forever"
5	- LCM	FW ✗	Is known by equivalent annual worth (EAW), equivalent annual cost (EAC), annual equivalent (AE), and EUAC (equivalent uniform annual costs)
6	Nominal rates	3 ✗	is the Interest rate is compounded more frequently than once per year
7	- Fixed Costs -	8 ✓	Includes costs such as direct labor, subcontractors, materials, indirect costs, marketing, advertisement, legal, and warranty.
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9	Break Even Point	10 ✓	A decrease in the value of a currency and on the other hand it is a decrease in the value of a currency
10	- Inflation	11 ✓	Is the diagram that can show the inflow and outflow estimates. From that diagram, the net of the flow can be determined the net of money
11 -	- Cash Flow	19 ✓	Is the value of a parameter or decision variable that makes two relations equal. In other words, it is the interest rate such that two alternatives' cash flows are equivalent
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		4	an investment, so that the final payment or receipt brings the balance to exactly zero with interest considered.
14	CC -	5✓	Is named as Least Common Multiple and it is used to equalized the time periods for different projects with different time periods
15	Effective interest rates -	6✓	Is the Interest rate per time period without regard to compounding frequency

Part 2

-3 (12/15)

Questions From 1-15- True and false Statement

			<u>T</u>	<u>F</u>
<u>1</u>	IRR decision rule is that if $IRR \geq MARR$, The project is economically not justifiable.	X	✓	
2	The disadvantage of multiple projects comparison for selecting the best calculation is using annual worth and using the LCM	X	✓	
3	FW decision rule using ($i = MARR \geq 0$), then the project is economically justified	✓	✓	
4	$(P/A, i\%, N)(F/P, i\%, N) = (F/A, i\%, N)$	✓	✓	
5	The CW of a series of end-of-period uniform payments A, with interest at $i\%$ per period	✓	✓	
6	Breakeven point is the value of a parameter or decision variable that makes two relations equal	✓	✓	
7	$(P/G, i\%, N)(F/P, i\%, N) = (F/G, i\%, N)$	✓	✓	
8	$(A/G, i\%, N)(P/A, i\%, N) = (P/G, i\%, N)$	✓	✓	
9	Capital Worth is $CW = i / A$.	✓		✓
10	The CW is of a series of end-of-period uniform payments A, with interest at $i\%$ per period	✓	✓	
11	<i>Economic life</i> : is the period of time (years) that yields the minimum equivalent uniform annual cost (EUAC) of owning and operating as asset	✓	✓	
12	<i>IRR is the interest rate at which the present worth and equivalent uniform annual worth are equal to 0</i>	X		✓

13	<i>The Geometric gradient series is the frequent increase happening by constant amount.</i>	✓	✓
14	<i>The expected life n is the number of years at which the lowest AW of costs occurs. This is called the economic service life or ESL.</i>	✓	✓
15	<i>Modified B/C is equal to = <u>Benefit-Dis-benefits / initial investment</u></i>	✓	✓

Final Exam: Date December 2-2021- Section 2-3:30-5:00pm
The Time of the Final Exam is December 2-2021 at 2:30-4:30 PM
Part 2 - Solving Problems

Name Daniel
Benitez

No in the Roll # 2



Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting, otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please answer using the Engineering Notation otherwise no grade for it.

Q1)

- A) An engineer borrowed \$3000 from a bank, payable in six equal end-of-year payments at 8%. The bank agreed to reduce the interest on the loan if interest rate declined in the United States before the loan was fully repaid. At the end of three years, at the time of the third payment, the bank agreed to reduce the interest rate from 8% to 7% on the remaining debt. What was the amount of the equal annual end-of year payments for each of the first three years? What was the amount of the equal annual end-of-year payments for each of the last three years?

B) Two Alternatives in the below table

Alternative	A	M
P, \$	23,000	8,000
S, \$	4,000	0
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M&O, \$/year	3,500	1,500
Labor rate \$/hr	24	12
People	1	3
Output, tons/hr	8	6

Find the breakeven tones per year to justify the higher initial cost alternative A at $i=10\%$

Q2)

The following costs are associated with three tomato-peeling machines being considered for use in a food canning plant.

	Machine A	Machine B	Machine C
First cost	\$52,000.00	\$63,000.00	\$67,000.00
Maintenance & Operating Costs	15,000.00	9,000.00	12,000.00
Annual benefits	38,000.00	31,000.00	37,000.00
Salvage Value	13,000.00	19,000.00	22,000.00

Useful life in Years

4

6

12

If the canning company uses a MARR of 12% which is the best alternative? USE NPW to make your decision Note: Consider the least common multiple as the study period.

Q3)

A business executive is offered a management job at Generous Electrical Company. They offer to give him a five-year contract, which calls for a salary of \$62,000 per year, plus 600 shares of their stock at the end of the five years. The executive is currently employed by Fearless Bus Company and they, too, offered him a five-year contract. It calls for a salary of \$65,000, plus 100 shares of Fearless Stock each year. The stock is currently worth \$60 per share and pays an annual dividend of \$2 per share. Assume end-of-year payments of salary and stock. Stock dividends begin one year after the stock is received. The executive believes that the value of stock and the dividend will remain constant. If the executive considers 9% a suitable rate of return in this situation, what must the Generous Electric stock be worth per share to make the two offers equally attractive?

Q4) Optional

Midwest Power and Light operates 14 coal-fired power plants in several states around the United States. The company recently settled a lawsuit by agreeing to pay \$60 million in mitigation costs related to acid rain. The settlement included \$21 million to reduce emissions from barges and trucks in the Ohio River Valley, \$24 million for projects to conserve energy and produce alternative energy, \$3 million for Chesapeake Bay, \$2 million for Shenandoah National Park, and \$10 million to acquire ecologically sensitive lands in Appalachia. The question of how to distribute the money over time has been posed. Plan A involves spending \$5 million now and the remaining \$55 million equally over a 10-year period (that is, \$5.5 million in each of years 1 through 10). Plan B requires expenditures of \$7 million now, \$23 million 2 years from now, and \$30 million 7 years from now. Determine which plan is more economical based on a present worth analysis over a 10-year period at an interest rate of 10% per year.



\$5,000,000

A = ?

$$55M = CA/P (10\% \cdot 10)$$

$$= (0.16275)$$

$$= 8,951,250$$

Plan B



53M

23M

30M

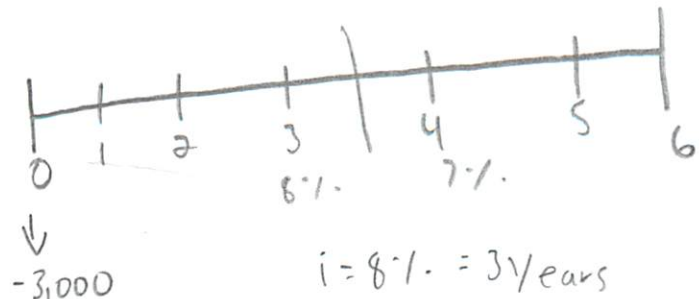
$$53,000,000 (A/P (10\% \cdot 10)) = 8,951,250$$

$$(0.16275)$$

Plan B

Q1:

a)



لاستمر
6 years

$$-3,000 (A/P \ 8\% \ 3) = \underline{1,640.09}$$

$$-3,000 (0.38803) = 1,164.09 \text{ Year } 1,2,3$$

$$\underline{1,164.09 (F/A \ 8\% \ 3)} = 1,164.09 (3.2464) \quad \text{total}$$

$$= 3,774.101 \text{ 1st three years}$$

$$3,774.101 (A/P \ 8\% \ 3)$$

$$3,774.101 (0.38803) = 1,466.404$$

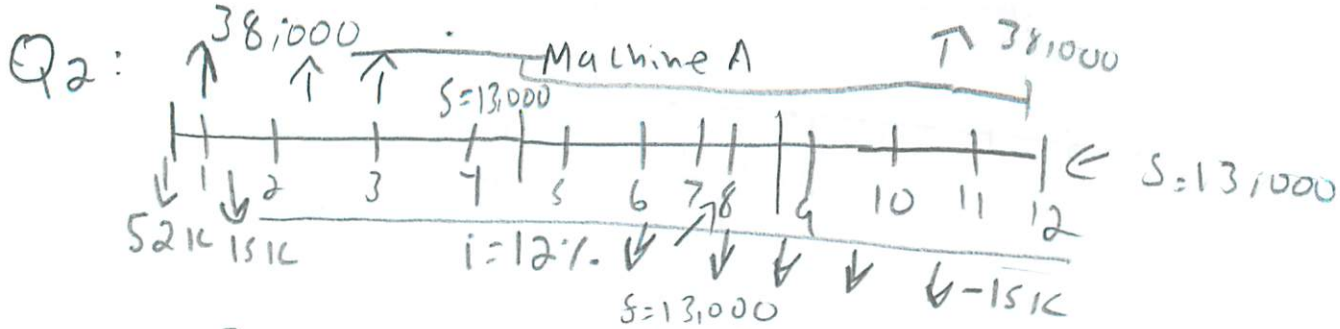
$$1,466.40 (F/A \ 8\% \ 3) = 1,466.40 (3.2464)$$

(Here!)

$$\underline{4,760.53}$$

b)





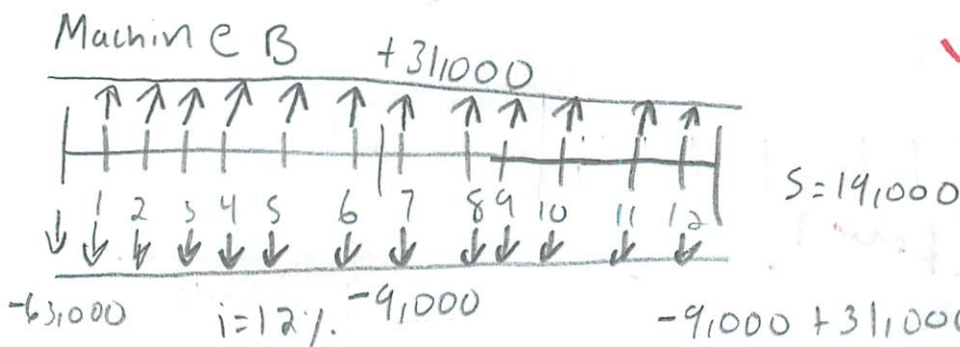
$$\begin{aligned}
 & -52,000 + 23,000 (F/A \ 12\% \cdot 4) + 13,000 (P/F \ 12\% \cdot 4) \\
 & = -52,000 + 23,000 (4.7793) + 13,000 (.6355) \\
 & = 66,185.41
 \end{aligned}$$

$$\begin{aligned}
 & 66,185.41 + 23,000 (F/A \ 12\% \cdot 4) + 13,000 (P/F \ 12\% \cdot 4) \\
 & = 66,185.41 + 23,000 (4.7793) + 13,000 (.6355) \\
 & = 184,370.8
 \end{aligned}$$

$$\begin{aligned}
 & 184,370.8 + 23,000 (F/A \ 12\% \cdot 4) + 13,000 (P/F \ 12\% \cdot 4) \\
 & = 302,556.24
 \end{aligned}$$

Why you
Did the Future
worth!

~~9/10~~



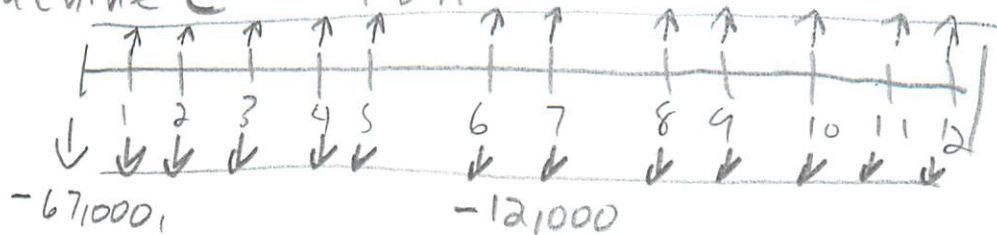
$$\begin{aligned}
 & -63,000 + \underline{22,000 (F/A \ 12\% \cdot 6)} + \underline{19,000 (P/F \ 12\% \cdot 6)} \\
 & = 125,154.8 \qquad \qquad \qquad = -63,000 + 22,000 (8.1152) + 19,000 (.5066)
 \end{aligned}$$

$$\begin{aligned}
 & = 125,154.8 + 22,000 (F/A \ 12\% \cdot 6) + 19,000 (P/F \ 12\% \cdot 6) \\
 & = 125,154.8 + 22,000 (8.1152) + 19,000 (.5066) \\
 & = 313,314.6
 \end{aligned}$$

Is this
NPV!

Is this NPV!

Machine C + 37,000



$$S = 22,000$$

$$i = 12\%$$

$$37,000 - 12,000$$

$$A = 25,000$$

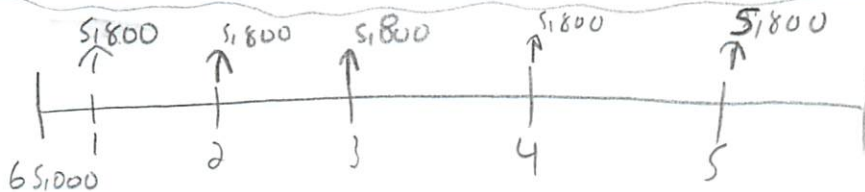
$$-67,000 + 25,000 (F/A \ 12\% \cdot 12) + 22,000 (P/F \ 12\% \cdot 12)$$

$$-67,000 + 25,000 (24,1331) + 22,000 (.2567)$$

$$= 541,474.9$$

The best alternative is machine C

Q3



Fearless
Bus
Company

100 shares per year

$$\$60 - 2\$ = \$58 \times 100 = \$5,800$$

$$65,000 + 5,800 (F/A \ 9\% \cdot 5)$$

$$(5.4847)$$

$$= 99,711.26$$



$$A = 15,539.58 \div 600 \text{ shares}$$

$$62,000 (A/P \ 9\% \cdot 5) = 15,939.58$$

$$(.25709)$$

$$\text{Shares} = 26.58$$

HOMEWORK-1

OBJECTIVES OF HOME WORK 1

- 1) The homework is designed to allow student to practice what they have learnt about interest rate used in different types of problems.**
- 2) Analysis of problems that were discussed in the classroom to train the students of how to manipulate the information and using the concept of cash flow diagram in solving the problems.**
- 3) Using and solving problems in a way how to back track problem in the form of given annual worth, present worth and also with different time period.**

Above Average

Homework-1-: Date September 14-2021- Section 1-CHEG-2308 - Engineering Economy
Student Name: Daniel Benitez

Roster No.

Due Date September 21-2021

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please write legible handwriting, otherwise, there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question.

- 1) Given the cash flow table below, determine the unknown value "A" if the interest rate is 7%.

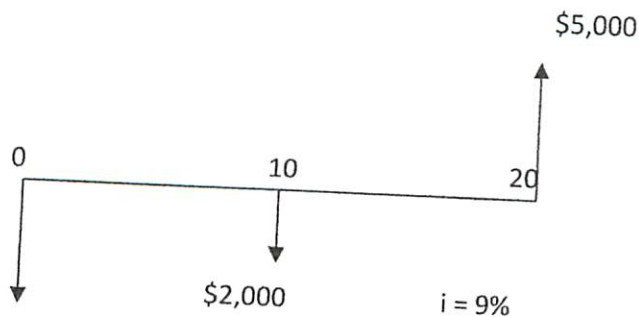
Year	0	1	2	3	4	5	6-10
Cash flow in \$	-10,000	0	0	0	1,000	A	A

2)

Determine the value of "X" from the cash flows given in table below at an interest rate of 8%.

Year	0	1	2	3	4	5
Cash flows	-10,000 + X	600	700	800	900	900

- 3) Given the cash flow diagram below, compute the value of P

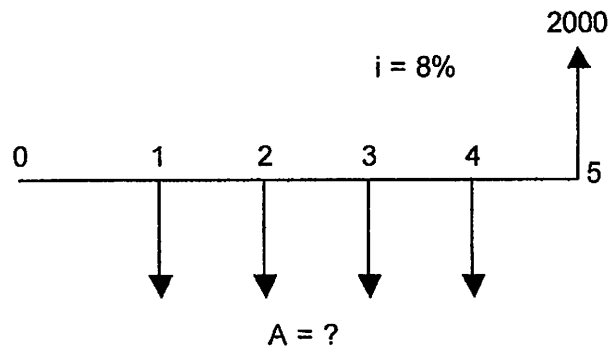


4)

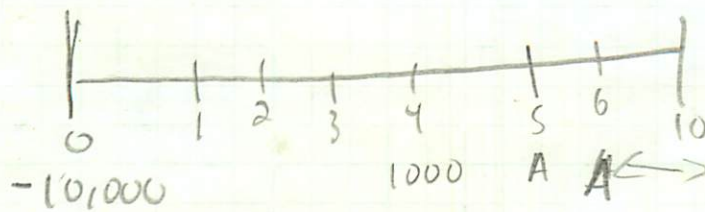
Given the cash flows below, compute the value of the present worth for an interest rate of 5%.

Year	1	2	3	4	5	6-20
Cash flow	4,000	3,000	2,000	1,000	0	4,000

- 5) Given the cash flow diagram below, determine the unknown value using an interest rate of 8%.



1).



$$"A" = \frac{1,000 - 10,000 (P/P \ 7\% \ 4)}{1,000 - 10,000 (1.311)} =$$

$$1,000 - 13,110$$

$$A = 12,110$$

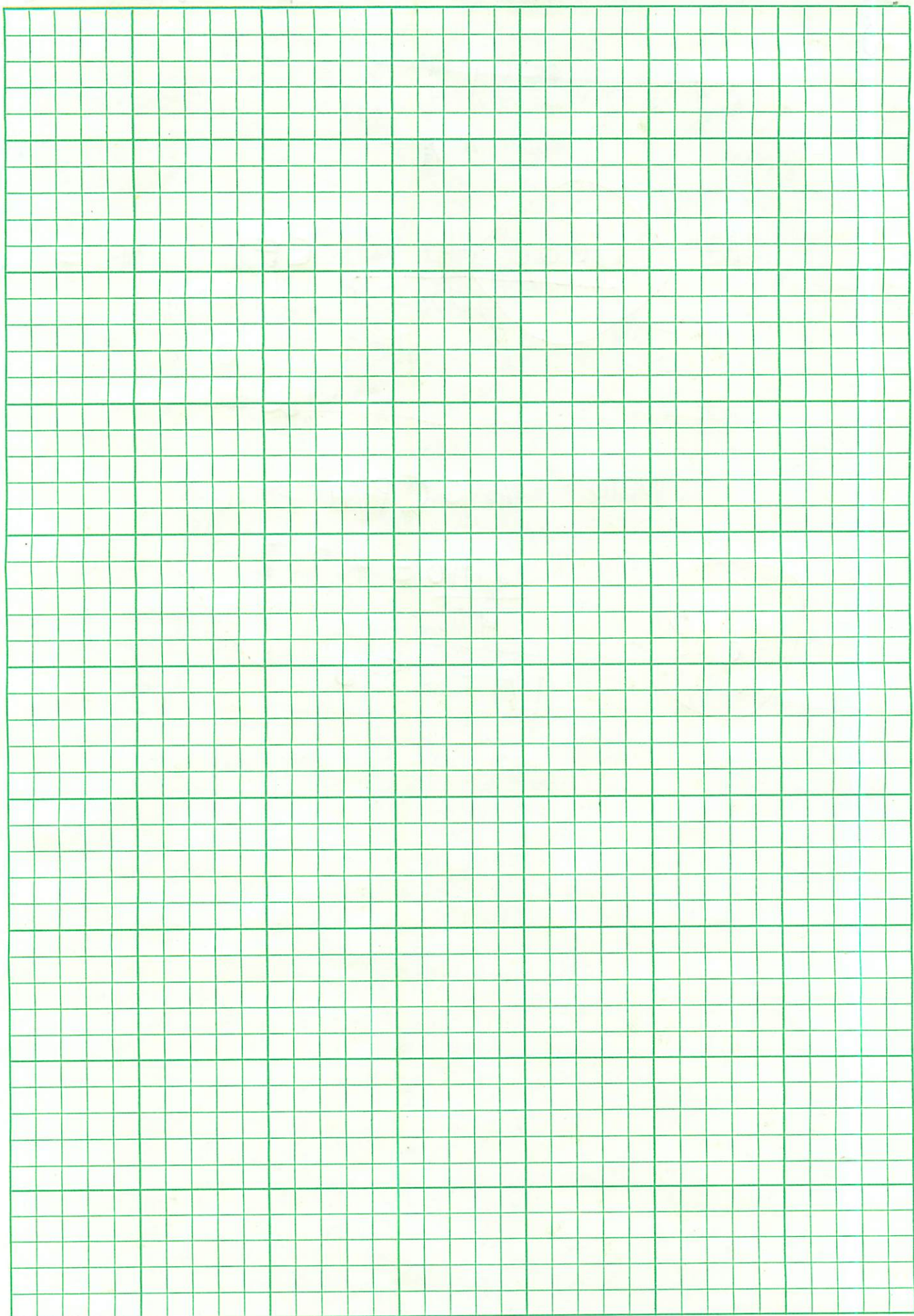
$$12,110 = A (P/A \ 7\% \ 6)$$

$$12,110 = 4.767$$

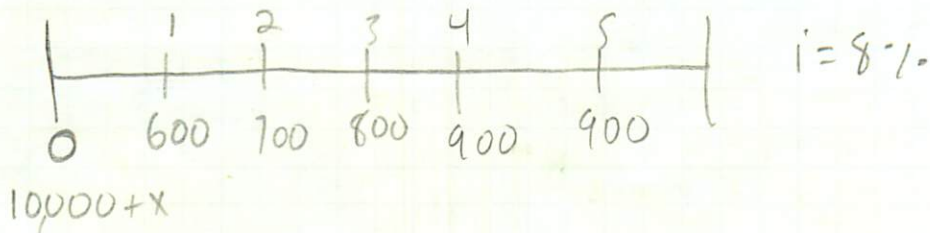
$$A = 2,540$$

None

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2.



$$PW = 600(P/F 8\%, 1) + 700(P/F 8\%, 2) + 800(P/F 8\%, 3) + 900(P/F 8\%, 4) + 900(P/F 8\%, 5)$$

or
X

$$555.54 + 600.11 + 635.04 + 661.5 + 612.54$$

$$X = 3064.73$$

$$-10,000 + X + 3064.73 = 0$$

$$+10,000$$

$$X + 3064.73 = 10,000$$

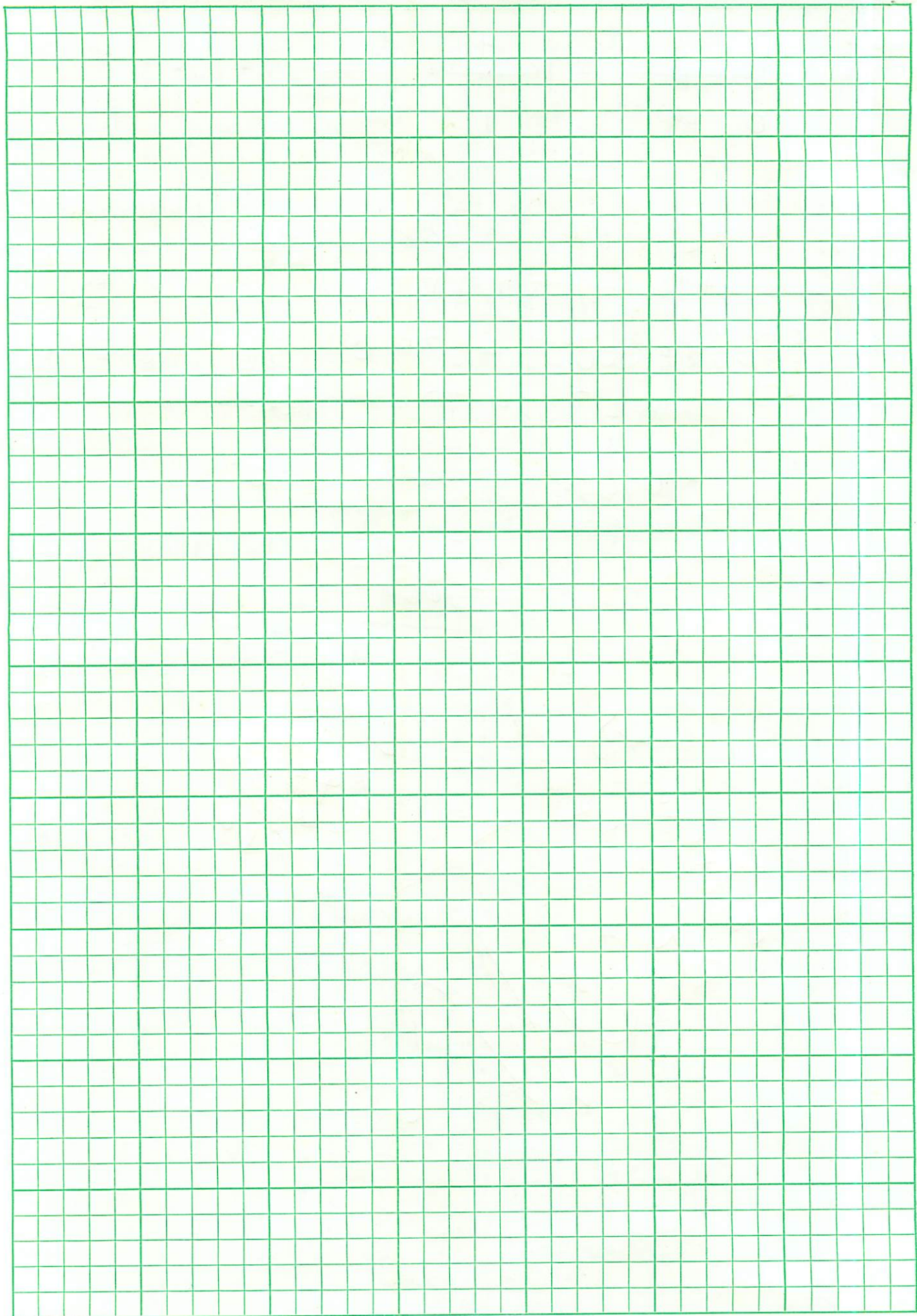
$$-3064.73 \quad -3064.73$$

$$X = 6935.27$$

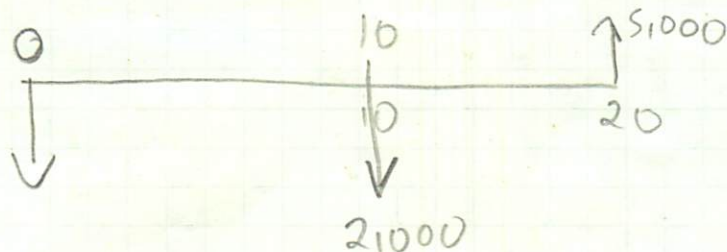
where X is the initial investment

~~6935.27~~

~~6935.27~~



#3

Value of $P = ?$ 

$$i = 9\%$$

$$n = 20 \text{ Years}$$

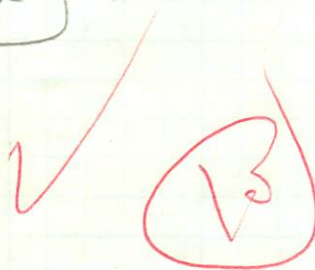
$$P = ?$$

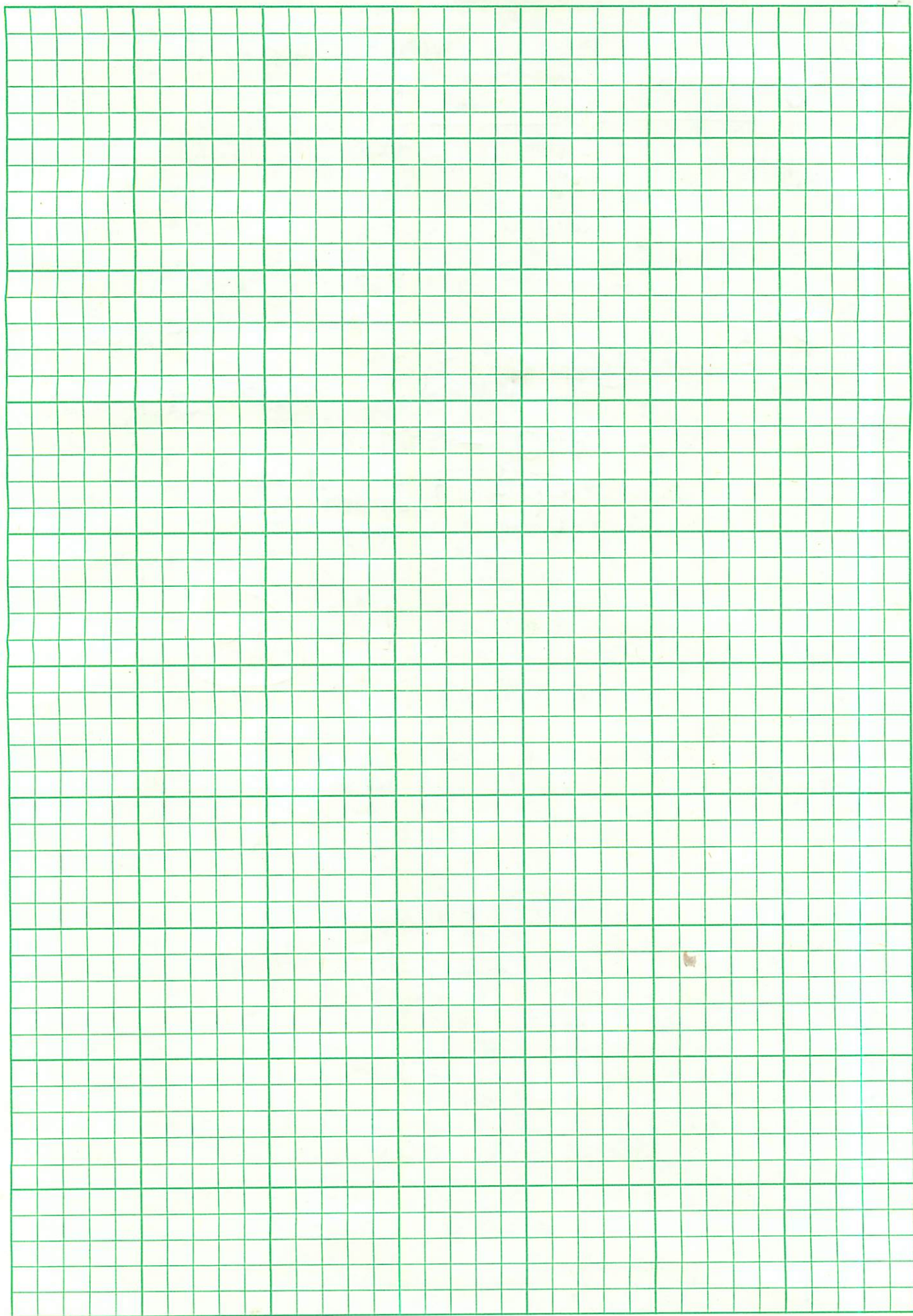
$$F = 5,000$$

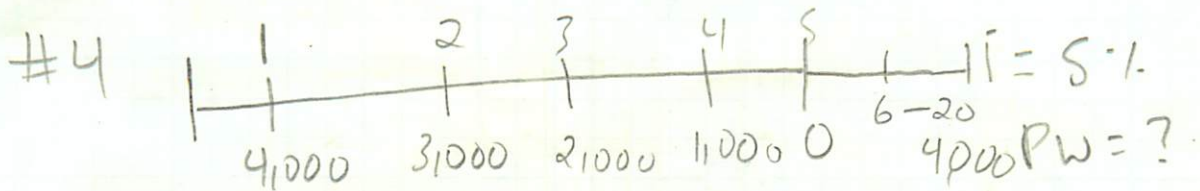
$$P = 5,000 (\text{PIF } 9\% \cdot 20) - 21,000 (\text{PIF } 9\% \cdot 10)$$

$$= 892 - 844.8$$

$$P = 47.2$$







$$PW = 4000(1.05)^{-1} + 3000(1.05)^{-2} + 2000(1.05)^{-3} + 1000(1.05)^{-4} + 4000(P/A\ 5\% \cdot 15)$$

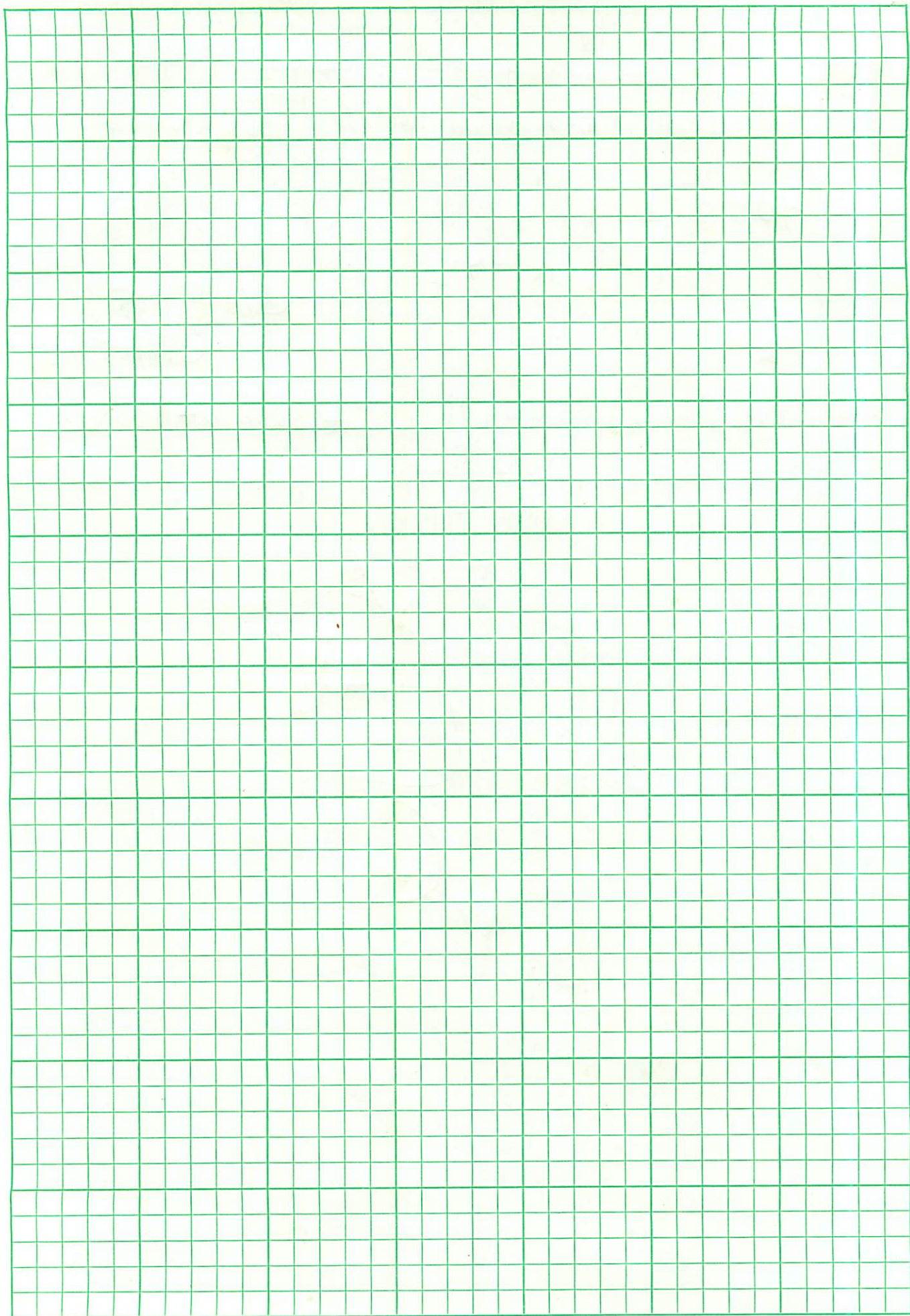
(P/F 5% · 5)

$$PW = 3809.52 + 2721.08 + 1727.67 + 822.70 + 4000(10.380)$$

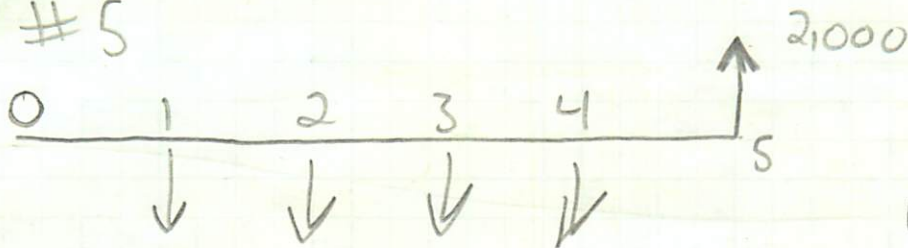
C-7835

$PW = 41,611$

where is 6



#5

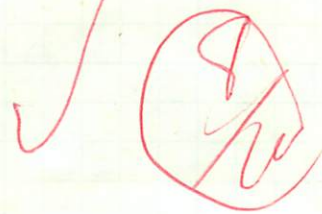
 $i = 8\%$ $A = ?$

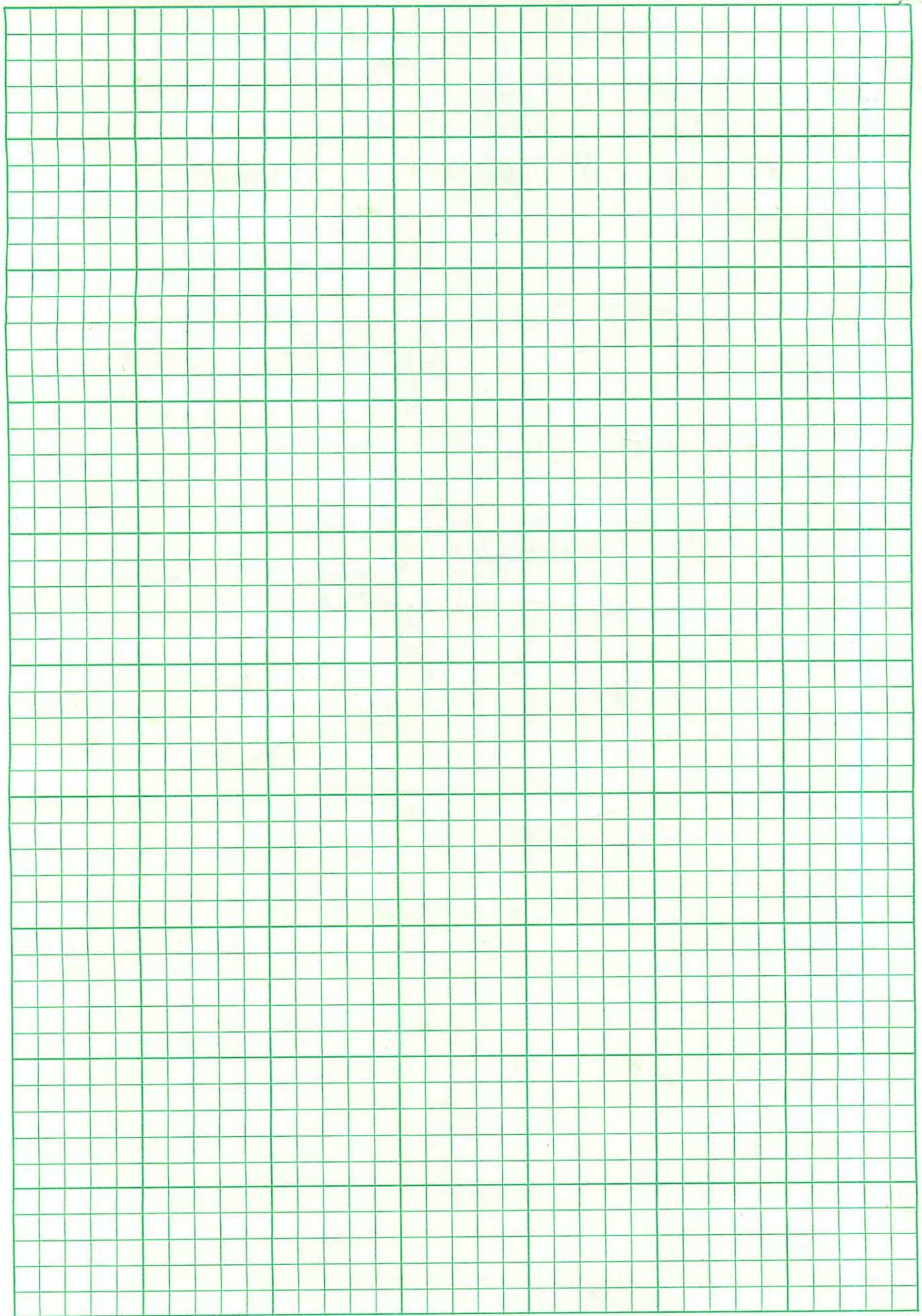
$$\frac{i}{(1+i)^n - 1} = \frac{0.08}{(1+0.08)^5 - 1} = \frac{0.08}{.4693} = .17046$$

$$A = F \left(\frac{i}{(1+i)^n - 1} \right) -$$

$$A = \frac{2,000 \times .17046}{1 - .17046} = 2,000 \times .20548$$

$$A = 410.97$$





Average

Tyreese Washington

Engineering Economy

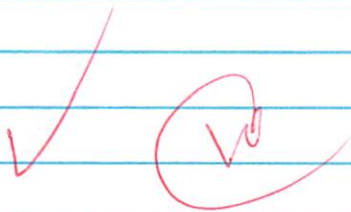
Homework 1

1) $P = F - P(F/P, i, n)$
 $= 1,000 - 10,000(F/P, 7\%, 4)$
 $= 1,000 - 10,000(1.311)$
 $= 1,000 - 13,110$
 $= -\$12,110$

$12,110 = A(P/A, 7\%, 6)$

$12,110 = A(4.767)$

$A = \frac{12,110}{4.767} = \$2,540$



2) $P = F[P/F, i, n]$

$= F\left[\frac{1}{(1+i)^n}\right]$

$= 900\left[\frac{1}{(1.08)^5}\right]$

$P_1 = 612.52$

$P = G\left[\frac{(1+i)^n - 1}{i(1+i)^n} - \frac{n}{(1+i)^n}\right]$

$n=4, i=8\%, G=100$

$P = \frac{100}{0.08} \left[\frac{(1.08)^4 - 1}{0.08(1.08)^4} - \frac{4}{(1.08)^4} \right]$

$P_2 = 465$

$P = P_1 + P_2$

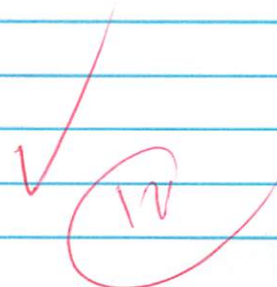
$-10,000 + X = 465 + 612.52$

$X = 11077.52$



3) $P = [5,000(P/F, 9\%, 20)] - [2,000(P/F, 9\%, 10)]$

$= (5,000 \cdot 0.1784) - (2,000 \cdot 0.4224) = \47.20





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Faint text at the bottom of the page, possibly a footer or concluding remarks.

$$4) P = 4000(P/A, 5\%, 5) - 1000(P/G, 5\%, 5) + 4000(P/A, 5\%, 15) \\ (P/F, 5\%, 15) \\ = 4000(4.3295) - 1000(8.2369) + 4000(10.3797)(0.78353) \\ P = \$41,611$$

$$5) A = (2000 + A)(A/F, 8\%, 5)$$

$$A = F \left[\frac{i}{(1+i)^n - 1} \right]$$

$$A/F = \frac{i}{(1+i)^n - 1} = \frac{0.08}{(1+0.08)^5 - 1} = 0.17045$$

$$F = P(1+i)^n$$

$$A = P \left[\frac{i(1+i)^n}{(1+i)^n - 1} \right] \\ = 2000 \left(\frac{0.17045}{(1-0.17045)} \right)$$

$$A = 410.94$$

1. The first part of the paper is a review of the literature.

2. The second part of the paper is a description of the methodology.

3. The third part of the paper is a presentation of the results.

4. The fourth part of the paper is a discussion of the results.

5. The fifth part of the paper is a conclusion.

6. The sixth part of the paper is a list of references.

7. The seventh part of the paper is an appendix.

8. The eighth part of the paper is a glossary.

9. The ninth part of the paper is a bibliography.

10. The tenth part of the paper is a list of figures.

11. The eleventh part of the paper is a list of tables.

12. The twelfth part of the paper is a list of equations.

13. The thirteenth part of the paper is a list of symbols.

14. The fourteenth part of the paper is a list of abbreviations.

15. The fifteenth part of the paper is a list of acronyms.

16. The sixteenth part of the paper is a list of initialisms.

17. The seventeenth part of the paper is a list of contractions.

18. The eighteenth part of the paper is a list of colloquialisms.

Below Average

HW 1

1. $1600/(1.07)^4 + 5.1A/(1.07)^5 = 10,000$
 $762.8952 + 5.1A/(1.07)^5 = 10,000$
 $5.1A/(1.07)^5 = 9237.1048A$
 $A = \$2540$

2.

Year	Cash Flow	Discounted at 5%	Discounted Cash Flow
0	-10,000 + x	1	-10,000 + x
1	600	0.925	555.5556
2	700	0.857	600.1272
3	800	0.793	635.0458
4	900	0.735	661.5269
5	900	0.680	612.5249

NPV = 0

$= -10,000 + x + 3044.81 = 0$

$x = 6935.19$

3. $P = [5,000(P/F, 9\%, 20)] - [2,000(P/F, 9\%, 10)]$
 $= (5,000 \times 0.1784) - (2,000 \times 0.4224) = \4720

4. Let Present worth be x

$r = 5\% = 0.05 \quad (1+r) = 1.05$

$x = 4000/1.05 + 3000/(1.05)^2 + 2000/(1.05)^3 + 1000/(1.05)^4 + 4000 \times ((1/1.05)^5 + (1/1.05)^6 + \dots + (1/1.05)^{10})$

$= \$41611$

5. $2000 \times PVIF(8\%, 5) = A \times PVIF(8\%, 4)$

$2000 \times 0.6806 = A \times 3.3121$

$A = \$410.98$

30/50

5/5

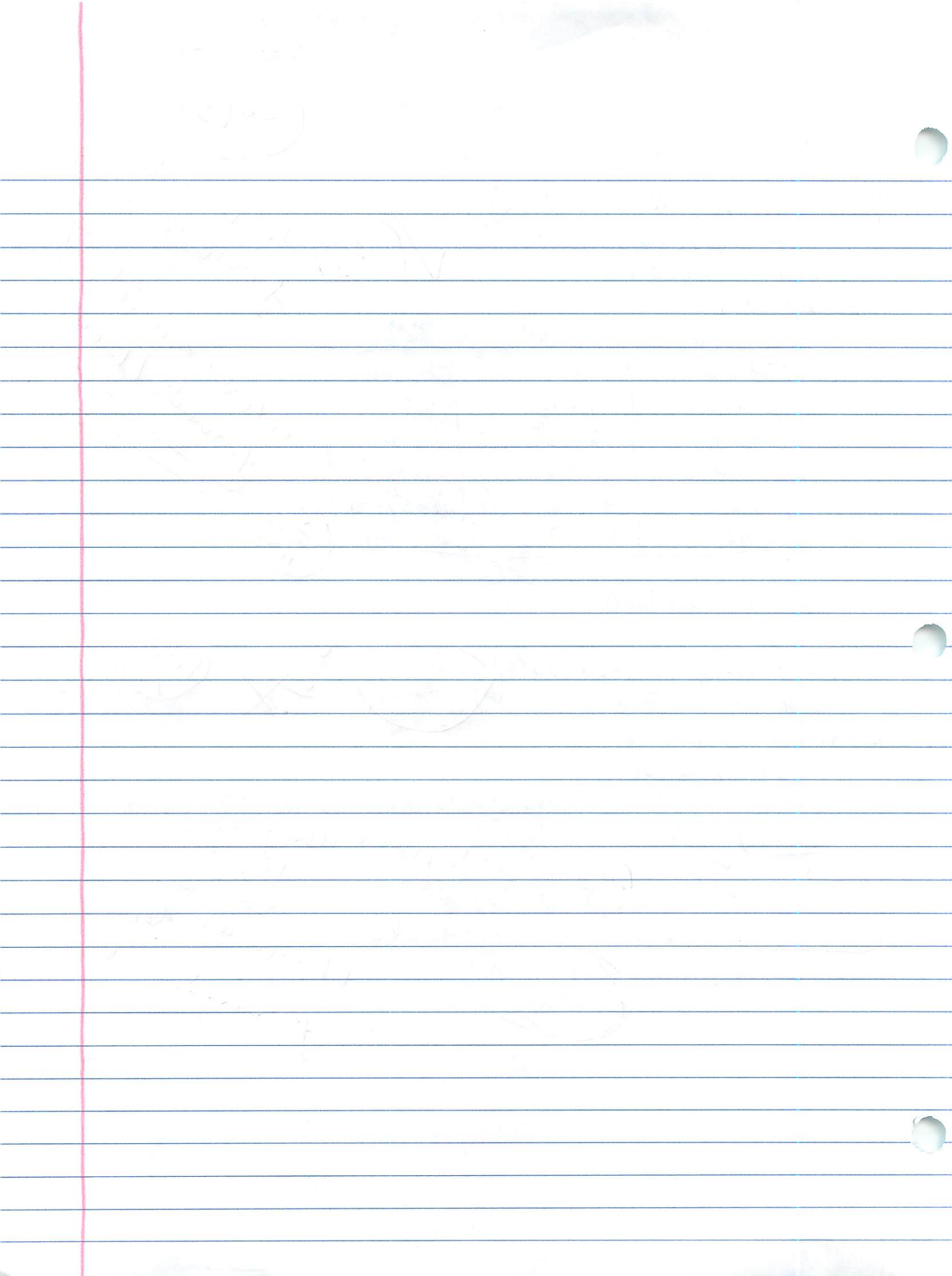
where are the formula used

5/10

10/10

where is the formula used

where are the formula used



Ermin Alvarado

Hw #1

31/50

- 1) Determine unknown value "A" if the interest rate is 7%

Year	0	1	2	3	4	5	6-10
Cash Flow	-10,000	600	0	0	1000	A	A

PV of outflow = PV of inflow

$$10000 = \frac{1000}{(1.07)^4} + \frac{A}{(1.07)^5} + \frac{A}{(1.07)^6} + \dots + \frac{A}{(1.07)^{10}}$$

$$10000 = 762.90 + A [PVAF(7\%, 5-10 \text{ yrs})]$$

$$10000 = 762.90 + A \times 3.6364$$

$$= 762.90 + 3.6364(A)$$

$$A = \frac{10000 - 762.90}{3.6364}$$

$$= 2540.18$$

~~How do you
calculate?
What are the formulas
used~~

Ermin Alvarade Hw #1

Determine the value of x

2)

Year	0	1	2	3	4	5
Cash Flow	$-10,000 + x$	600	700	800	900	900

PV Factor at 8%

Discounted Cash flow

0.9259

555.56

0.8573

600.14

0.7938

635.07

0.7350

661.53

0.6806

612.52

Present worth $\$1 = 3,064.81$

$$-10,000 + x + 3,064.81 = 0$$

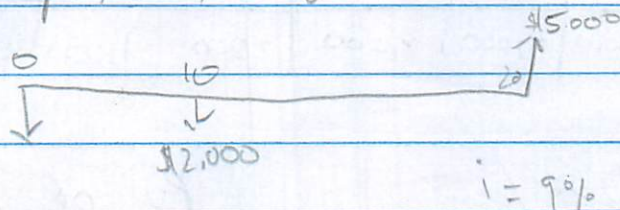
$$x + 3,064.81 = 10,000$$

$$x = \$6,935.19$$

where are the formula use

Ermin
Alvarado Hw #1

3) Compute the value of P



$$P = \frac{CF_0}{(1+r)^0} + \dots + \frac{CF_n}{(1+r)^n}$$

$$P = \frac{-2000}{(1+0.09)^0} + \frac{5000}{(1+0.09)^{20}}$$

$$P = -844.844 + 892.156$$
$$= \$47.312$$

Value of P is \$47.312

✓ (10)

4)

Year	1	2	3	4	5	6-20
cash flow	4,000	3,000	2,000	1,000	0	4,000

PVF @ 8%

0.9524

0.9070

0.8638

0.8227

0.7835

8.1227

PV of cash flows

\$ 3,809.6

\$ 2,721

\$ 1,727.6

\$ 822.70

\$ 0

\$ 32,530.8

Value of present worth is \$41,611.7

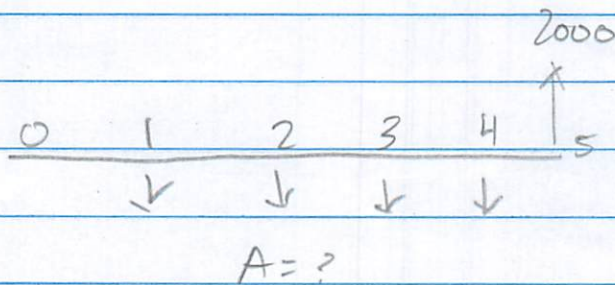
Where are the formula used?

5/11/21

Ermin Alvarado

Hw #1

5)



PV of \$2000 today = PV of annuity stream

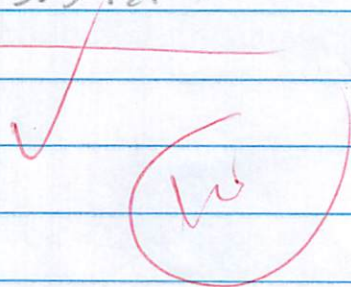
$$\$2000 \cdot PVIF(8\%, 5) = A \cdot PVIFA(8\%, 4)$$

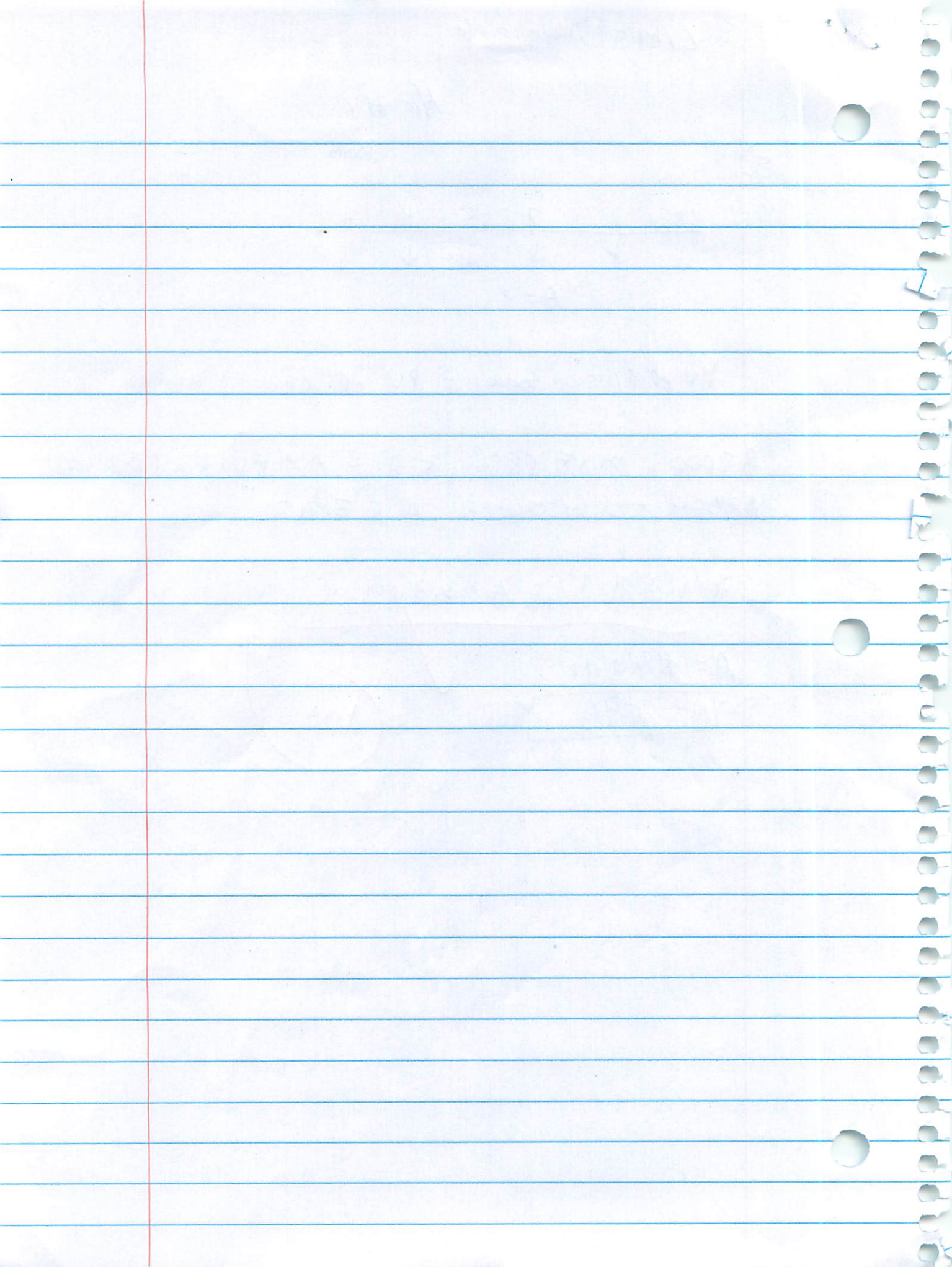
$$\$2000 \cdot 0.6806 = A \cdot 3.3121$$

$$\$1,361.1 = A \cdot 3.3121$$

$$A = \$410.98$$

$$A \approx \$411$$





Homework-2

OBJECTIVES OF HOME WORK 2

- 1) To expose the students on how to solve the problem of arithmetic gradient included in an example of shifted series and regular series and either to calculate the present worth or future worth and then calculate the annual worth.**
- 2) To expose the students on how to solve the problem of geometric gradient included in an example of shifted series and regular series and either to calculate the present worth or future worth and then calculate the annual worth.**
- 3) To expose students to tough problems to solve**

Above Average

40/45

Homework2 is Due on October 12-2021

Name: Micheal Sands

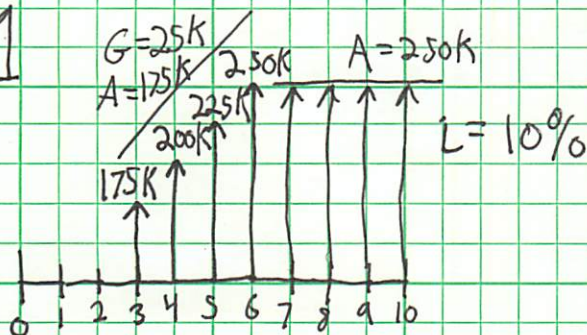
Roll Number: 15

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please use engineering notation in solving the problems. It is mandatory to use the engineering notation and math formulas. Please write legible hand writing, otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please Answer the questions each question in a separate page.

Q1- A West Virginia coal mining operation has installed an in-shaft monitoring system for oxygen tank and gear readiness for emergencies. Based on maintenance patterns for previous systems, costs are minimal for the first few years, increase for a time period, and then level off. Maintenance costs are expected to be \$175,000 in year 3, \$200,000 in year 4, and amounts increasing by \$25,000 per year through year 6 and remain constant thereafter for the expected 10-year life of this system. If similar systems will replace the current one, determine the perpetual equivalent annual maintenance cost at $i=10\%$ per year.

Q1



$$P_2 = 175K(P/A, 10\%, 4) + 25K(P/G, 10\%, 4)$$

$$175K(3.170) + 25K(4.378) = 664.2K$$

$$P_0 = 664.2K(P/F, 10\%, 2)$$

$$\textcircled{1} P_0 = 664.2K(.8264) = 548.895K$$

$$P_6 = 250K(P/A, 10\%, 1)$$

$$P_6 = 250K(3.170) = 792.5K$$

$$P_0 = 792.5(P/F, 10\%, 6)$$

$$\textcircled{2} P_0 = 792.5(.5645) = 447.366K$$

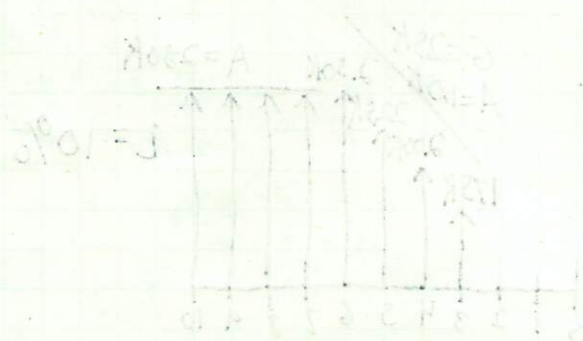
$$PW = 548.895K + 447.366K = 996.261K$$

$$AW = 996.261K(A/P, 10\%, 10)$$

$$AW = 996.261K(.1627) = 162.092K$$

$$AW = \$162,092$$

10/10



Q1

$$P_2 = 125K(3.150) + 25K(1.328) = 404.3K$$

$$P_2 = 125K(3.150) + 25K(1.328) = 404.3K$$

$$P = 264.9K(1.102) = 292.8K$$

$$P = 264.9K(1.102) = 292.8K$$

$$P = 250K(1.102) = 275.5K$$

$$P = 250K(1.102) = 275.5K$$

$$P = 250K(1.102) = 275.5K$$

$$P = 250K(1.102) = 275.5K$$

$$P = 250K(1.102) = 275.5K$$

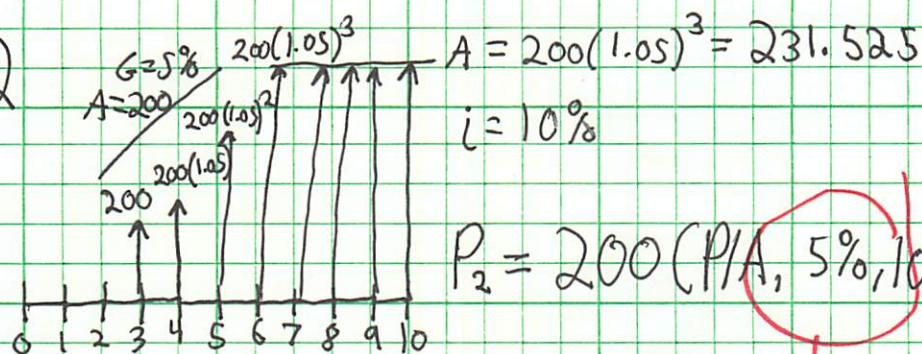
$$P = 250K(1.102) = 275.5K$$

$$P = 250K(1.102) = 275.5K$$

$$P = 250K(1.102) = 275.5K$$

- Q2) A West Virginia coal mining operation has installed an in-shaft monitoring system for oxygen tank and gear readiness for emergencies. Based on maintenance patterns for previous systems, costs are minimal for the first few years, increase for a time-period, and then level off. Maintenance costs are expected to be \$200 in year 3, and increase by 5% per year through year 6 and remain constant thereafter for the expected 10-year life of this system. If similar systems will replace the current one, determine the perpetual equivalent annual maintenance cost at $i=10\%$ per year.

Q2



$$P_2 = 200(P/A, 5\%, 10\%, 4)$$

$$P_2 = 200 \left(\frac{1 - (1+g)^n (1+i)^{-n}}{i - g} \right)$$

$$P_2 = 200 \left(\frac{1 - (1+.05)^4 (1+.1)^{-4}}{.1 - .05} \right) = 679.2$$

$$P_0 = 679.2(P/F, 10\%, 2)$$

$$P_0 = 679.2(.8264) = 561.3$$

$$200(1.05)^3$$

$$P_0 = 231.525(P/A, 10\%, 4)$$

$$P_0 = 231.525(3.17) = 733.9$$

$$P_0 = 733.9(P/F, 10\%, 6)$$

$$P_0 = 733.9(.5645) = 414.3$$

$$PW = 561.3 + 414.3 = 975.6$$

$$AW = 975.6(A/P, 10\%, 10) = 975.6(.1627)$$

$$AW = \$158.73$$

$$P_2 = 200(1.02)^4 = 231.232$$

$$P_2 = 200(1.02)^4 = 231.232$$

$$P_2 = 200 \left(\frac{1 - (1 + j)^{-n}}{j} \right)$$

$$P_2 = 200 \left(\frac{1 - (1 + 0.02)^{-4}}{0.02} \right) = 231.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

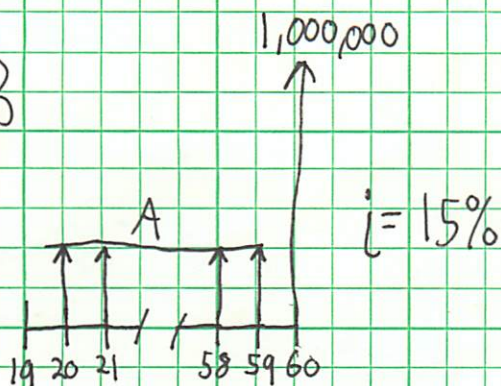
$$P_2 = 231.232(1.02)^3 = 244.232$$

$$P_2 = 231.232(1.02)^3 = 244.232$$

Q3)

A young engineer wishes to become a millionaire by the time he is sixty years old. He believes that by careful investment he can obtain a 15% rate of return. He plans to add a uniform sum of money to his investment program each year, beginning on his 20th birthday and continuing through his 59th birthday. How much money must the engineer set aside in this project each year?

Q3



$$P_{59} = 1,000,000(P/F, 15\%, 1) = 1,000,000(.8696)$$

$$P_{59} = 869,600$$

$$A = 869,600(A/F, 15\%, 40)$$

$$A = 869,600(.00056) = 486.98$$

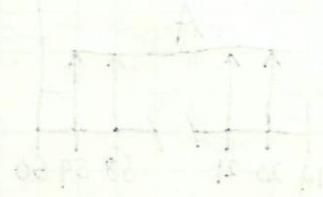
$$A = \$486.98$$

10

000,000.1

80

000.1



$$(000.1) 000,000.1 = (1, 000, 000.1) 000,000.1 = 000$$

$$000.1 000 = 000$$

$$(000.1 000) 000,000.1 = A$$

$$80.284 = (000.1) 000,000.1 = A$$

80.284

4)

An engineer has received two bids for an elevator to be installed in a new building. The bids, plus his evaluation of the elevators, are as follows:

<i>Alternatives</i>	<i>Bids</i>	<i>Engineer's estimates</i>		
	<i>Installed cost</i>	<i>Service life, in years</i>	<i>Annual operating cost, including repairs</i>	<i>Salvage value at end of service life</i>
Westinghome	\$45,000	10	\$2700/yr	\$3000
Itis	54,000	15	2850/yr	4500

The engineer will make a present worth analysis using a 10% interest rate. Prepare the analysis and determine which bid should be accepted.

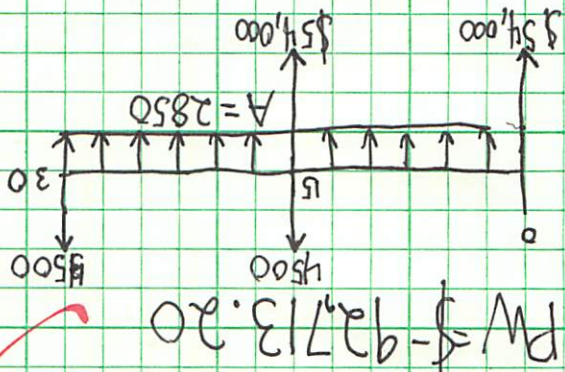
$PW_{IS} > PW_{West} \therefore It is the better choice$

$PW = -92,459.40$

$PW = -54,000 - 49,500(0.2394) - 2,850(9.427) + 45,000(0.0573)$

$PW = -54,000 - 49,500(P/F, 10\%, 15) - 2,850(P/A, 10\%, 30) + 45,000(P/F, 10\%, 30)$

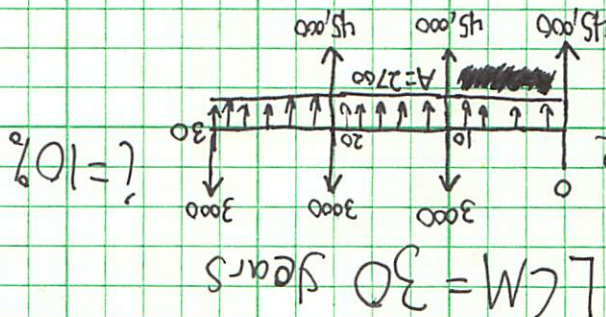
$\frac{15}{10}$



It is

$PW = -45,000 - 42,000(0.3855) - 42,000(0.1486) - 2,700(9.427) + 30,000(0.0573)$

$PW = -45,000 - 42,000(P/F, 10\%, 10) - 42,000(P/F, 10\%, 20) - 2,700(P/A, 10\%, 30) + 30,000(P/F, 10\%, 30)$



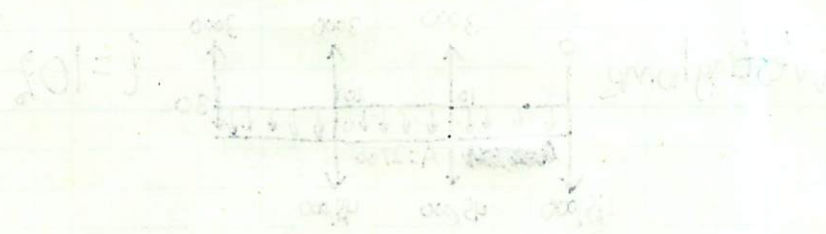
Westinghouse

$LCM = 30 \text{ years}$

Q4

24

$$[CM = 30 \text{ years}]$$

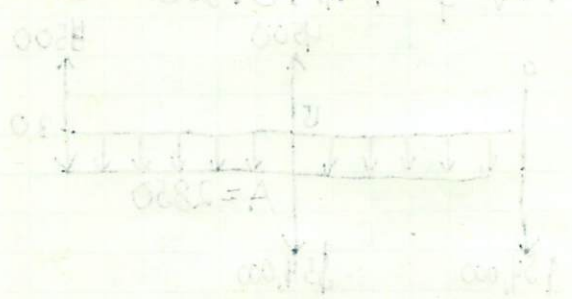


$$PW = -12,000 - 12,000(P/A, 10\%, 30) + 100(P/F, 10\%, 30)$$

$$PW = -12,000 - 12,000(.382) + 100(.0523)$$

$$PW = -17,373.20$$

10%



Case 2

$$PW = -24,000 - 24,000(P/A, 10\%, 30) + 100(P/F, 10\%, 30)$$

$$PW = -24,000 - 24,000(.382) + 100(.0523)$$

$$PW = -31,424.20$$

$PW_{case 1} > PW_{case 2}$: Case 1 is the better choice

Average

30/40

Homework2 is Due on October 12-2021

Name: Craig Rothschild

Roll Number: 14

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. Please use engineering notation in solving the problems. It is mandatory to use the engineering notation and math formulas. Please write legible hand writing, otherwise there is a deduction from your grade 10 points. Missing Cash Flow Diagram is deductible points equal to 20% of the total points for each question. Please Answer the questions each question in a separate page.

Q1- A West Virginia coal mining operation has installed an in-shaft monitoring system for oxygen tank and gear readiness for emergencies. Based on maintenance patterns for previous systems, costs are minimal for the first few years, increase for a time period, and then level off. Maintenance costs are expected to be \$175,000 in year 3, \$200,000 in year 4, and amounts increasing by \$25,000 per year through year 6 and remain constant thereafter for the expected 10-year life of this system. If similar systems will replace the current one, determine the perpetual equivalent annual maintenance cost at $i=10\%$ per year.

Year	Cost
0	P_W
1	
2	
3	175,000
4	200,000
5	225,000
6	250,000
7	
8	
9	
10	

$G = 25,000$

$i = 10\%$

$A'_3 = A_3 - G = 150k$

$A'_6 = A_6 - G = 225k$

$P_W = A'_3(P/A, 10\%, 4) + G(P/G, 10\%, 4) + A'_6(P/A, 10\%, 4) + (P/F, 10\%, 6)$

$\rightarrow 150(3.1699) + 25(4.3781) + 225(3.1699) + (0.5645)$

$P_W = 886.55$

$A_W = P_W(A/P, 10\%, 10)$

$= 886.55(0.16275)$

$= 886(0.16275)$

$A_W \rightarrow \$144.196k$

Answer is on next page.

Q1

year	cost
0	PW
1	
2	
3	175,000
4	200,000
5	225,000
6	250,000
7	
8	
9	
10	

$$PW = ? \quad P_1 = [A_3(P/A, 10\%, 4) + G(P/G, 10\%, 4)](P/F, 10\%, 3)$$

$$= [175(3.1699) + 25(4.3781)](0.8264)$$

$$= \$553.1 \text{ K}$$

$$P_2 = [A_4(P/A, 10\%, 4)](P/F, 10\%, 6)$$

$$= [250(3.1699)](0.5645)$$

$$= \$447.35 \text{ K}$$

$$G = 25,000$$

$$i = 10\%$$

$$PW = P_1 + P_2 \rightarrow 553.1 + 447.35$$

$$= 1000.44$$

$$AW = PW(A/P, 10\%, 10)$$

$$1000.44(0.6275)$$

$$AW = \$628.2 \text{ K}$$

✓ 10/10

Q2) A West Virginia coal mining operation has installed an in-shaft monitoring system for oxygen tank and gear readiness for emergencies. Based on maintenance patterns for previous systems, costs are minimal for the first few years, increase for a time-period, and then level off. Maintenance costs are expected to be \$200 in year 3, and increase by 5% per year through year 6 and remain constant thereafter for the expected 10-year life of this system. If similar systems will replace the current one, determine the perpetual equivalent annual maintenance cost at $i=10\%$ per year.

Year	Cost
0	P_W
1	
2	P_1
3	A_1 \$200 $\downarrow (200)(0.05) + 200$ year 4
4	\$210 $\rightarrow (210)(0.05) + 210$ year 5
5	\$220.5 $\rightarrow (220.5)(0.05) + 220.5$ year 6
6	P_2 \$231.525
1	
10	

$i = 10\%$

$$A_W = P_W(A/P, 10\%, 10) ?$$

$$P_W = A_1(P/A, 10\%, 2)$$

$$P_1 = A_1 \left[1 - \left(\frac{1+g}{1+i} \right)^N \right]$$

$$= 200 \left[1 - \frac{(1+0.05)^4}{1+0.1} \right]$$

$$= 679.17 + A(P/A, 10\%, 4)$$

$$P_1 = 679.17 + 200(3.1699) = 1055.18$$

$$P_W = P_1(P/F, 10\%, 2) + P_2(P/F, 10\%, 6)$$

$$1055.18(0.8264) + 733.91(0.5645)$$

$$\downarrow 679.17 \downarrow$$

$$1055.18(0.8264) + 733.91$$

$$P_W = 1085.18 + 414.29$$

$$= 1499.47$$

$$A_W = 1499.47(0.16275) = 244.04$$

$$A_W \Rightarrow 158.77K$$



Q3)

A young engineer wishes to become a millionaire by the time he is sixty years old. He believes that by careful investment he can obtain a 15% rate of return. He plans to add a uniform sum of money to his investment program each year, beginning on his 20th birthday and continuing through

his 59th birthday. How much money must the engineer set aside in this project each year?

Year	Cost
20th	P_w
59th	P
60th	$1,000,000$

~~15% rate of return~~

$$i = 15\% \quad P_1 = F(P/F, 15\%, 1)$$

$$P_1 + A \text{ each } (n) \quad = 1 \times 10^6 (0.8696)$$

$$F_{59th} = \$869,600$$

$$A = F_{59th} (A/F, 15\%, 40)$$

$$= \$869,600 (0.00056)$$

$$= \boxed{\$486.976}$$

✓
10/2

4)

An engineer has received two bids for an elevator to be installed in a new building. The bids, plus his evaluation of the elevators, are as follows:

Alternatives	Bids	Engineer's estimates		
	Installed cost	Service life, in years	Annual operating cost, including repairs	Salvage value at end of service life
Westinghome	\$45,000	10	\$2700/yr	\$3000
Itis	54,000	15	2850/yr	4500

The engineer will make a present worth analysis using a 10% interest rate. Prepare the analysis and determine which bid should be accepted.

Westinghome $i = 10\%$

~~Itis~~

$$\begin{aligned}
 P_0 &= \$45,000 + 2700(P/A, 10\%, 10) - 3000(P/F, 10\%, 10) \\
 &= 45,000 + 11,590.42 - 1156.5 \\
 &= 61,590.42 - 1156.5 \\
 &= \$60,433.92
 \end{aligned}$$

Itis

$$\begin{aligned}
 P_0 &= \$54,000 + 2850(P/A, 10\%, 15) - 4500(P/F, 10\%, 15) \\
 &= 54,000 + 21,677.39 - 1,077.3 \\
 &= 74,600.085
 \end{aligned}$$

The westinghome is bid that should be accepted.

Handwritten text at the top of the page, possibly a title or header.

Handwritten header text			Handwritten header text	
Handwritten text	Handwritten text	Handwritten text	Handwritten text	Handwritten text
Handwritten text	Handwritten text	Handwritten text	Handwritten text	Handwritten text
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Handwritten text	Handwritten text	Handwritten text	Handwritten text	Handwritten text

Handwritten text below the table, possibly a subtitle or section header.

Handwritten mathematical derivations and notes. Includes a circled diagram on the left and several lines of algebraic expressions involving variables and functions.

$$(f(x) + g(x))' = f'(x) + g'(x)$$

$$(f(x) - g(x))' = f'(x) - g'(x)$$

$$(f(x) \cdot g(x))' = f'(x)g(x) + f(x)g'(x)$$

$$\left(\frac{f(x)}{g(x)} \right)' = \frac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$$

Other handwritten notes include:

- Handwritten text on the left side of the page.
- Handwritten text on the right side of the page.
- Handwritten text at the bottom of the page.

Below Average

Jaylen Lewis CHEG Hwk 2

5
40

4)

$$PW_1 = -45,000 - 2700(P/A, 10\%, 30) - 3000(P/F, 10\%, 4) - 3000(P/F, 10\%, 20) - 3000(P/F, 10\%, 30)$$

$$= -72,226.8$$

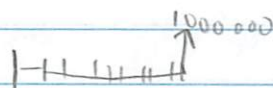
How

$$PW_2 = -54,000 - 2850(P/A, 10\%, 30) - 4500(P/F, 10\%, 15) - 4500(P/F, 10\%, 30)$$

$$= -84,522.5$$

2nd PW is better alternative

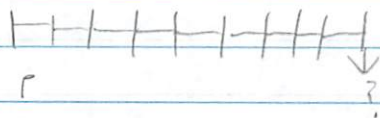
3)



$$A = F(A/F, 15\%, 40) \\ 1,000,000(A/F, 15\%, 40) \\ = \$560$$

How!

2)



$$P = 200(P/F, 10\%, 3) + 216(P/F, 10\%, 4) + 220.5(P/F, 10\%, 5) + 271.53(P/F, 10\%, 6) + 231.53(P/A, 10\%, 4)$$

$$= \$975.52$$

How

1)

$$P = 175(P/F, 10\%, 3) + 200(P/F, 10\%, 4) + 225(P/F, 10\%, 5) + 250(P/F, 10\%, 6)$$

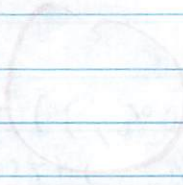
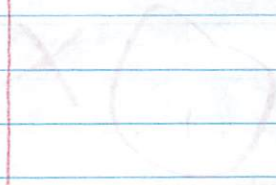
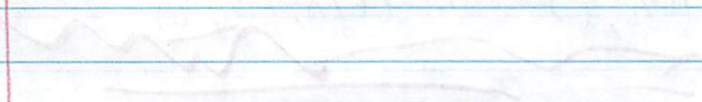
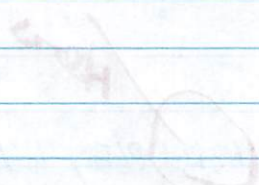
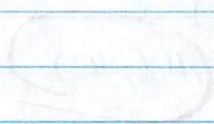
$$= \$548.90$$

X



1/4 cup

1/2 cup



PRACTICE TEST AS HOMEWORK 3

OBJECTIVES OF HOMEWORK 3

- 1) Test the students to draw cash flow-diagram.**
- 2) Compare between alternatives with different time-periods.**
- 3) Present worth and Annual worth problems**
- 4) Calculate interest at different time-periods to use effective interest rate and the calculations of compounded interest rate issues such as compounded daily, compounded monthly, compounded quarterly, compounded semi-annually and annually.**
- 5) Using future worth in the analysis.**
- 6) Annual benefits and annual costs.**
- 7) What is salvage values. How to apply in a problem solving.**
- 8) Using LCM to be used in different time-periods projects and the analysis.**

Above Average

Homework - 3: Date October 19-2018 – Section 2 -3:30-5:00 pm

Due Date October 26-2021

Name: Micheal Sands

40/40 Roll Number 15

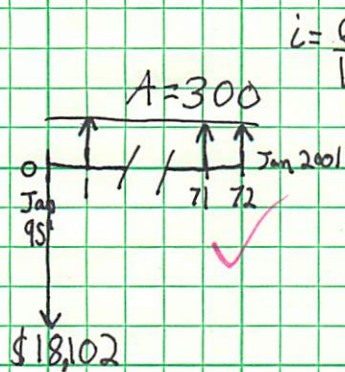
Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. The steps to solve the problems are: a) identify the input and the required output in the answer, b) formulate the solving problem C) solve the problem in the question and write the answer, as I explained in the classroom.

- 1) The purchase of the car that Joe dreams about can be accomplished by making payments of \$300 a month for six years, if the first payment is made on February 1, 1995, and the last payment is made on January 1, 2001. The financing company charges 6% nominal interest rate compounded monthly. Joe wants to be able purchase the car for cash on January 1, 1995, just after he graduates from college. Joe has a job and started making depositing of \$275 each month into an account that pays 9% compounded monthly beginning with the first deposit on February 1, 1990. The last deposit is to be made on January 1, 1995. Will Joe have saved up enough money to purchase the car? If not, how much should Joe be saving each month if all other conditions remain the same?



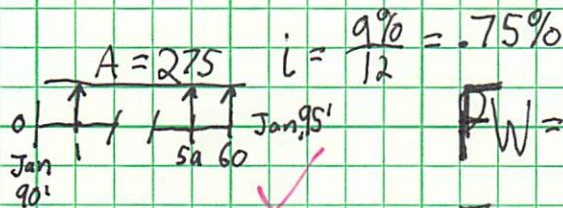
1)



$$PW = 300(P/A, .5\%, 72)$$

$$PW = 300(60.340)$$

$$PW = 18102 \quad \checkmark$$



$$FW = 275(F/A, .75\%, 60)$$

$$FW = 275(75.425)$$

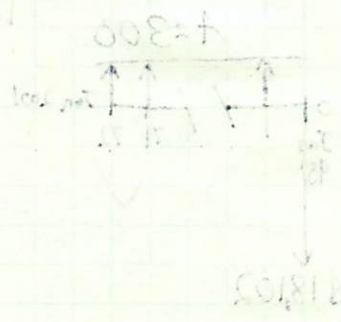
$$FW = 20,741.88 \quad \checkmark$$

$$\$20,741.88 > \$18102$$

$\therefore$ Joe will have saved up enough money.

10/10

1)

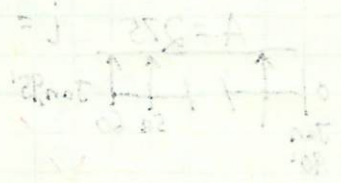


$$i = \frac{30}{12} = 2.5$$

$$PM = 300(6.4 \cdot 2.5^2)$$

$$PM = 300(60.340)$$

$$PM = 1810.5$$



$$i = \frac{30}{12} = 2.5$$

$$FM = 352(6.4 \cdot 2.5^2)$$

$$FM = 1188$$

$$FM = 1188$$

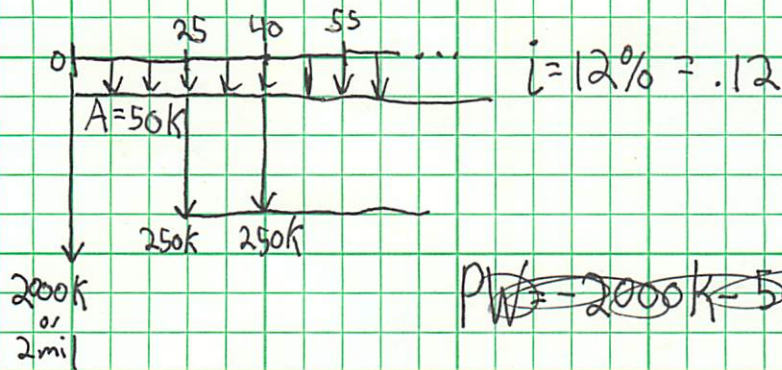
$$1188 < 1810.5$$

∴ JCB will have saved up enough money

$$1188 < 1810.5$$

- 2) The Lubbock Board of City Development has decided to ask the City Council to construct a tunnel under the snowcapped mountain range east of downtown Lubbock so that out of town visitors can reach historic prairie dog town without becoming lost and ending up at the ski lift. This project is expected to have a first cost of \$2,000,000 and an annual maintenance cost of \$50,000. In addition major repairs costing \$250,000 will be required after 25 years and each 15 years thereafter. Use an interest rate of 12% and determine the capitalized cost of the project.

2)



$$\cancel{PW = -2000k - 50k/.12 - (250k + 250k(A/F, 12\%, 15))}$$

$$PW = -2000k - 50k/.12 - \left[\frac{250k + 250k(A/F, 12\%, 15)}{.12} \right] (P/F, 12\%, 25)$$

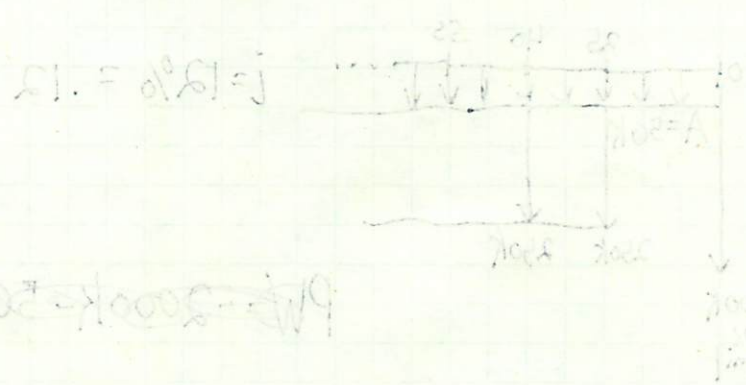
$$= -2000k - 50k/.12 - \left[\frac{250k + 250k(.0268)}{.12} \right] (.0588)$$

$$= -2434.64967k$$

Capital cost of Project
is \$2,434,649.67



3)



$$i = 1.2\% = .012$$

$$PMT = 5000K - 20K(12) - (300K)$$

200K (4/12)

$$PMT = 5000K - 20K(12) - (300K + 20K(4/12)(.012))$$

$$= 5000K - 20K(12) - (300K + 20K(.012)(.012))$$

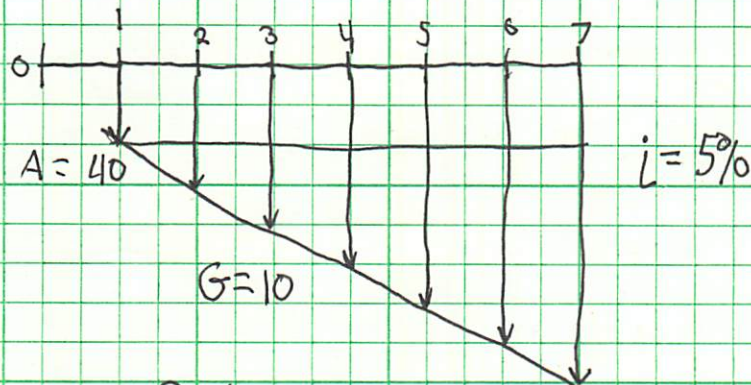
$$= 5134.64K$$

Capital cost of project is \$5,134,640.00

4/12

- 3) On a new car, it is estimated that the maintenance cost will be \$40 the first year. Each subsequent year, it is expected to be \$ 10 more than the previous one. How much would you need to set aside when you bought a new car to pay all future maintenance costs if you planned to keep it seven years? Assume interest is 5% per annum.

3)



$$P = -(40(P/A, 5\%, 7) + 10(P/G, 5\%, 7))$$

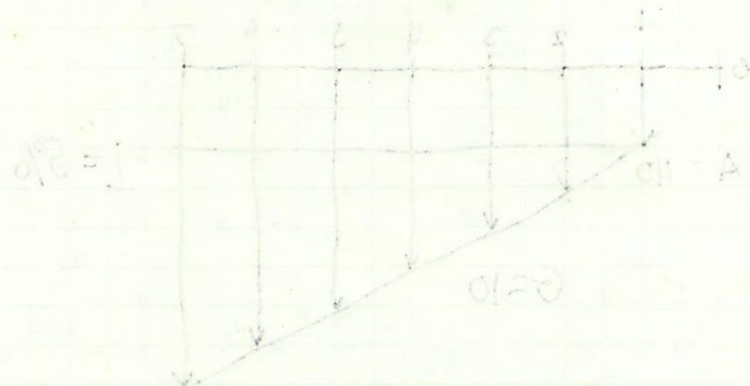
$$P = -(40(5.786) + 10(16.232))$$

$$P = -393.76$$

✓ 10/10

\$393.76 must be saved

(3)



$$P = 10(0.111) + 10(0.111) = 2.22$$

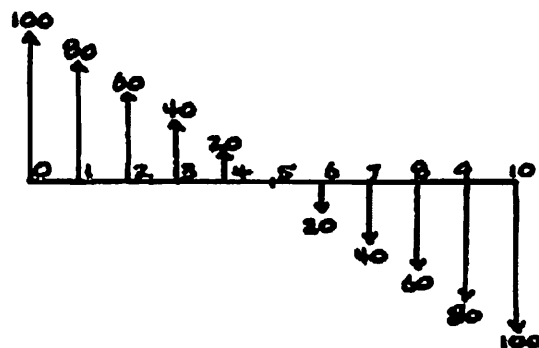
$$P = 10(0.222) + 10(0.222) = 4.44$$

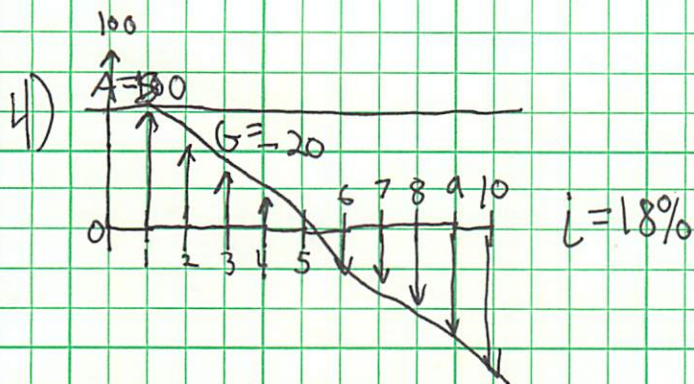
$$P = 10(0.333) + 10(0.333) = 6.66$$

$$P = 10(0.444) + 10(0.444) = 8.88$$

4)

Find the Present Equivalent of the following cash flow diagram if $i = 18\%$.





$$PW = 100 + 80(P/A, 18\%, 10) - 20(P/G, 18\%, 10)$$

$$PW = 100 + 80(4.4941) - 20(14.3525)$$

$$PW = 172.48$$

10/10

Average

Name: Craig Rothschild

Roll Number 14

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems. The steps to solve the problems are: a) identify the input and the required output in the answer, b) formulate the solving problem C) solve the problem in the question and write the answer, as I explained in the classroom.

- 1) The purchase of the car that Joe dreams about can be accomplished by making payments of \$300 a month for six years, if the first payment is made on February 1, 1995, and the last payment is made on January 1, 2001. The financing company charges 6% nominal interest rate compounded monthly. Joe wants to be able purchase the car for cash on January 1, 1995, just after he graduates from college. Joe has a job and started making depositing of \$275 each month into an account that pays 9% compounded monthly beginning with the first deposit on February 1, 1990. The last deposit is to be made on January 1, 1995. Will Joe have saved up enough money to purchase the car? If not, how much should Joe be saving each month if all other conditions remain the same?

$$0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$

$$\$300 \quad \quad \quad \quad \quad \quad \rightarrow$$

6% nominal compounded monthly

$n = 6 \cdot 12 = 72$ ✓ $PW = ?$

$i = \frac{6\%}{12} = 0.5\%$ ✓

$$PW = A(P/A, 0.5\%, 72)$$

$$\rightarrow 300(60.3395)$$

$$\rightarrow 18,101.85 \$$$

How much the car is worth

$$0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$

$$\$275 \quad \quad \quad \quad \quad \rightarrow$$

$i = 9\%$ monthly

$9/12 = .75 = i$

$n = 5 \cdot 12 = 60$

$$F = A(F/A, 0.75\%, 60)$$

$$\rightarrow 275(75.4241)$$

$$= 20,741.627$$

Yes, Joe will have saved up enough to buy a car.

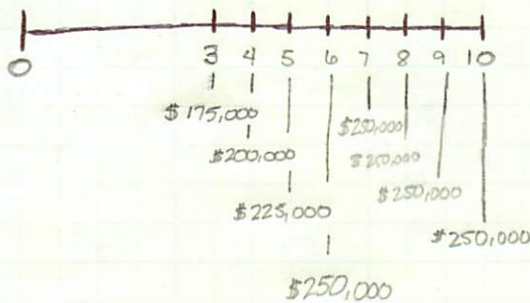
$$10$$

$$\frac{10}{10}$$

Question 1

\$175,000 in year 3

\$200,000 in year 4

amount increase by \$25,000 through year 6
remained constant thereafter for the expected 10 year life span

$$AW = \{ [-175,000 (P/A, 10\%, 4) - 20,000 (P/G, 10\%, 4)]$$

$$[(P/F, 10\%, 2) - 225,000 (P/A, 10\%, 4) (P/F, 10\%, 6)] \}$$

$$(A/P, 10\%, 10)$$

$$= \{ [-175,000 (3.1699) - 20,000 (4.3781)] [(0.8264) - 225,000$$

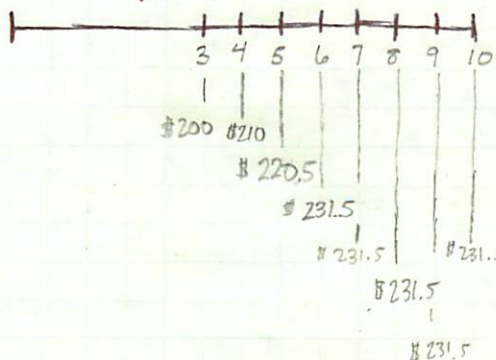
$$(3.1699)] \} (0.16275)$$

$$AW = -596.318$$

Question 2

Maintenance

\$200 in year 3

increase by 5% per year through year 6
remain constant thereafter for expected 10-year $i = 10\%$ per yearUniform Series
Year 3 to 6

$$PW = \frac{200 [1 - (P/F, 10\%, 4) (F/P, 5\%, 4)]}{(0.1 - 0.05)} = \$923.768$$

$$\text{Maintenance Cost Yr. 6} = 200 (F/P, 5\%, 3) = 200 (1.158) = 231.60$$

$$PW \text{ for Yr. 7 to Yr. 10} = 231.60 (P/A, 10\%, 4) = 231.60 (3.170) = 734.17$$

$$\text{Tot. Present Worth} = 923.768 (P/F, 10\%, 2) + 734.17 (P/F, 10\%, 6)$$

$$= 923.768 (0.8264) + 734.17 (0.5645)$$

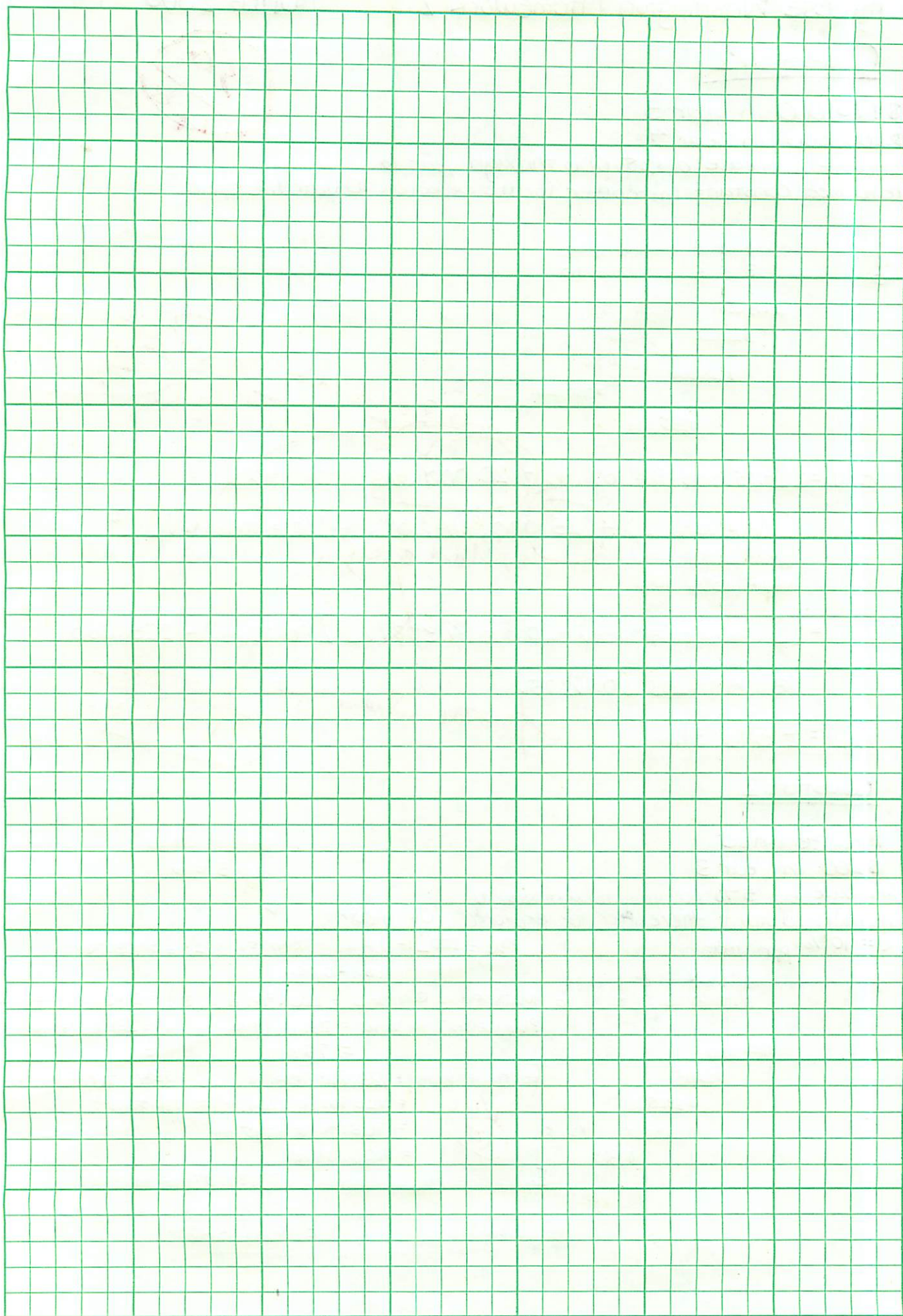
$$= 763.4018 + 415.44$$

$$= 1177.8418$$

$$\text{Equivalent Annual Worth} = 1177.8418 (A/P, 10\%, 10)$$

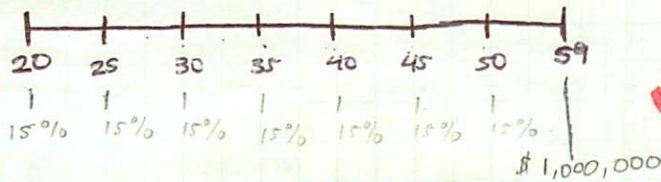
$$= 1177.8418 (0.1627)$$

$$\text{Equivalent Annual Worth} = 191.6348$$



Question 3

Millionaire by 60 yrs. old
15% Rate of Return
From 20th Birthday to 59th Birthday



Maturity period = 60 - 20 = 40

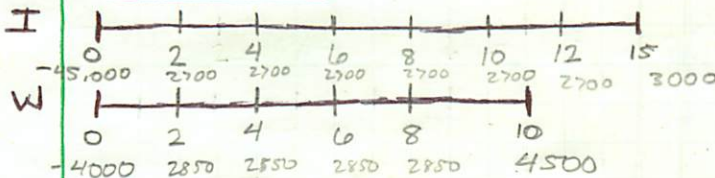
$$F = \$1,000,000 (P/F, 15\%, 40) = \$1,000,000 (0.8696) = \$869,600$$

$$A = 869,600 (A/F, 15\%, 40) = 869,600 (0.00056) = \$488.78$$

$$A = \$488.78$$

is this the cash flow diagram

Question 4



a. 10 yrs, b. 15 yrs = 30 yrs

$$I: [-54,000 + 4500 (P/F, 10\%, 15) - 2850 (P/A, 10\%, 15)]$$

$$= -54,000 + 4500 (0.2394) - 2850 (7.606)$$

$$= -74599.8$$

$$30 \text{ yrs.}$$

$$= [-74599.8 - 74599.8 (P/F, 10\%, 15)]$$

$$= -74599.8 - 17859.19$$

$$I = -92458.99$$

$$W: [-45,000 + 3000 (P/F, 10\%, 10) - 2700 (P/A, 10\%, 10)]$$

$$= [-45,000 + 3000 (0.385) - 2700 (6.145)]$$

$$= -60437$$

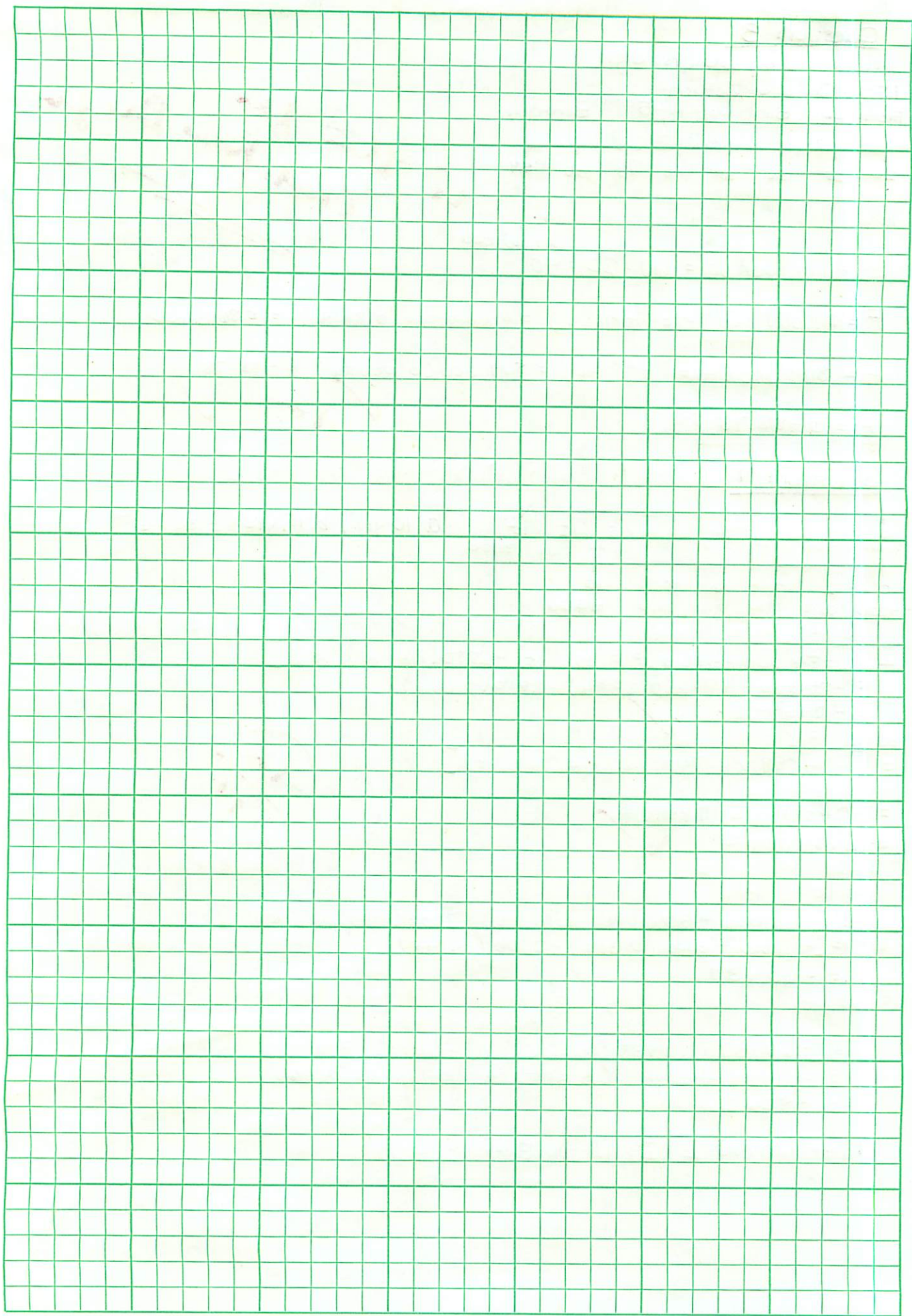
30 yrs.

$$= [-60437 - 60437 (P/F, 10\%, 10) - 60437 (P/F, 10\%, 20)]$$

$$= -60437 - 60437 (0.385) - 60437 (0.1486)$$

$$= -92626$$

Alternative 2 (I) is the Better option.



14



Clintworth 1910

...the ... of ...
...the ... of ...
...the ... of ...

...the ... of ...
...the ... of ...
...the ... of ...

Yes, 205
Will have
given up
every to day
of car.

0	1	2	3	4	5	6	7	8	9	10
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

12.00 monthly
19.12 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2

10.10
10.10

0	1	2	3	4	5	6	7	8	9	10
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

12.00 monthly
19.12 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2
11.25 = 2

10.10
10.10

10.10
10.10

- 2) The Lubbock Board of City Development has decided to ask the City Council to construct a tunnel under the snowcapped mountain range east of downtown Lubbock so that out of town visitors can reach historic prairie dog town without becoming lost and ending up at the ski lift. This project is expected to have a first cost of \$2,000,000 and an annual maintenance cost of \$50,000. In addition major repairs costing \$250,000 will be required after 25 years and each 15 years thereafter. Use an interest rate of 12% and determine the capitalized cost of the project.

$$P_1 = \text{1st cost} = 2,000,000$$

$$\text{and } = 50,000 \text{ annual maintenance}$$

$$P_2 = \frac{50,000}{0.12\%} = 416,666.66\$$$

$$\text{3rd} =$$

$$250,000(P/F, 12\%, 25) + 250,000(P/F, 12\%, 40)$$

$$+ 250,000(P/F, 12\%, 55) \dots$$

$$\rightarrow 250,000(P/F, 12\%, 25) + 250,000(A/F, 12\%, 15) / 0.05$$

$$\rightarrow 250,000(P/F, 12\%, 25) + 55883.832$$

$$= 305883.832(P/F, 12\%, 25)$$

$$P_3 = 17,993.698$$

$$P_1 + P_2 + P_3 = P_H (\text{total})$$

$$\rightarrow 2,434,659.765 \$$$

$(P/F, i, n) = \frac{1}{(1+i)^n}$
 $\rightarrow P = F(1+i)^{-n}$
 $(A/F, i, n) = \frac{1}{i} \left[1 - \frac{1}{(1+i)^n} \right]$
 $\rightarrow F = A \cdot \frac{i}{1 - (1+i)^{-n}}$

✓ 10/12

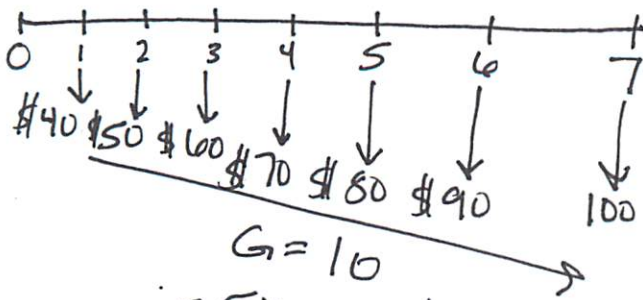
The first cost is \$1,000,000. The annual maintenance cost is \$20,000. The annual revenue is \$40,000. The annual operating cost is \$10,000. The annual depreciation cost is \$10,000. The annual interest cost is \$10,000. The annual tax cost is \$10,000. The annual insurance cost is \$10,000. The annual fire cost is \$10,000. The annual theft cost is \$10,000. The annual vandalism cost is \$10,000. The annual other cost is \$10,000.

$$\begin{aligned}
 &P_1 = 1,000,000 \\
 &P_2 = 20,000 \\
 &P_3 = 40,000 \\
 &P_4 = 10,000 \\
 &P_5 = 10,000 \\
 &P_6 = 10,000 \\
 &P_7 = 10,000 \\
 &P_8 = 10,000 \\
 &P_9 = 10,000 \\
 &P_{10} = 10,000
 \end{aligned}$$

$$P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8 + P_9 + P_{10} = P_{total}$$

$$P_{total} = 1,140,000$$

- 3) On a new car, it is estimated that the maintenance cost will be \$40 the first year. Each subsequent year, it is expected to be \$10 more than the previous one. How much would you need to set aside when you bought a new car to pay all future maintenance costs if you planned to keep it seven years? Assume interest is 5% per annum.



$G = 10$
 $i = 5\% \text{ annual}$

\$10 more each year

$$F_c = ?$$

$$F = A(F/A, 5\%, 7) + 10(A/G, 5\%, 16)$$

$$\rightarrow 40(8.1420) + 10(2.3579)$$

$$= 349.25 \$$$

why
 how

~~scribbled out text~~

4/10

$$F = 5$$

$$F = 4(1/10, 2/10) + 10(1/10, 2/10) = 4$$

$$F = 4(1/10, 2/10) + 10(1/10, 2/10) = 4$$

$$F = 4(1/10, 2/10) + 10(1/10, 2/10) = 4$$

1/10
2/10
1/10
2/10

$$F = 4(1/10, 2/10) + 10(1/10, 2/10) = 4$$

$$F = 4(1/10, 2/10) + 10(1/10, 2/10) = 4$$

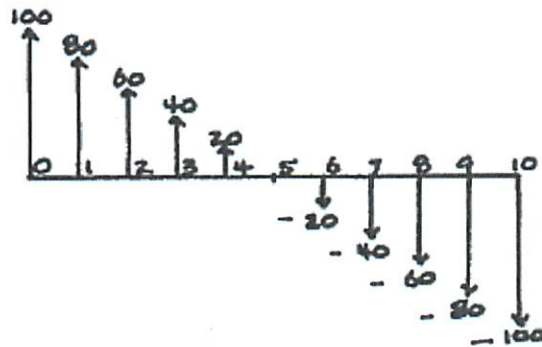
$$F = 4(1/10, 2/10) + 10(1/10, 2/10) = 4$$



some examples

4)

Find the Present Equivalent of the following cash flow diagram if $i = 18\%$.



$$P_v = \frac{F_v}{(1+i)^n}$$

Year 0 → 100	6 → -7.41
1 → 67.79	7 → -12.56
2 → 43.09	8 → -15.96
3 → 24.34	9 → -18.04
4 → 10.31	10 → -19.106
5 → 0	
= 245.53	= -73.074

$$\text{Total } P_v = 245.53 - 73.076 = \boxed{172.454}$$

How!
 where are the
 formula used here!
 you have to
 use the formula notation!

$$\frac{5}{10}$$



$10.5 \leftarrow 10$
 $9.5 \leftarrow 9$
 $8.5 \leftarrow 8$
 $7.5 \leftarrow 7$
 $6.5 \leftarrow 6$
 $5.5 \leftarrow 5$
 $4.5 \leftarrow 4$
 $3.5 \leftarrow 3$
 $2.5 \leftarrow 2$
 $1.5 \leftarrow 1$
 $0.5 \leftarrow 0$

10.5
 9.5
 8.5
 7.5
 6.5
 5.5
 4.5
 3.5
 2.5
 1.5
 0.5

$$[10.5 - 0.5] = 10.0 = 10.0$$

10.0
 9.5
 8.5
 7.5
 6.5
 5.5
 4.5
 3.5
 2.5
 1.5
 0.5

10.0
 9.5
 8.5
 7.5
 6.5
 5.5
 4.5
 3.5
 2.5
 1.5
 0.5



Below Average

- 1) 72 monthly installments of \$300, starting Feb. 1, 1995.
6% nominal interest rate compounded monthly $\rightarrow 0.06/12 = 0.005 = 0.05\%$

$$\begin{aligned}\text{Jan 1, 1995} &= 300(P/A, 0.5, 72) \\ &= 300(60.3395) \\ &= \$18,101.9\end{aligned}$$

✓

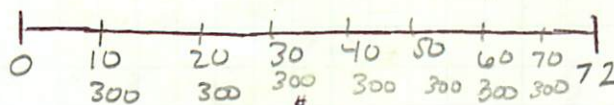
4/40

Joe 60 deposits of \$275 each ending Jan. 1, 1995.
9% compounded monthly $\rightarrow 0.09/12 \rightarrow 0.0075 \rightarrow 0.75\%$

$$\begin{aligned}\text{Jan 1, 1995} &= 275(F/A, 0.75, 60) \\ &= 275(75.4241) \\ &= \$20,741.6\end{aligned}$$

10/15

Joe will have enough money to purchase the car.



- 2) project first cost = 2,000,000
Annual maintenance cost = \$50,000
major repair cost = \$250,000
interest rate = 12%
 $(P/F, i, n) \rightarrow P = F(i+i)^n - n \rightarrow F = \frac{A[(1+i)^n - n - 1]}{i} \rightarrow (A/F, i, n)$

$$\text{Construction Cost} \Rightarrow P_1 = \$2,000,000$$

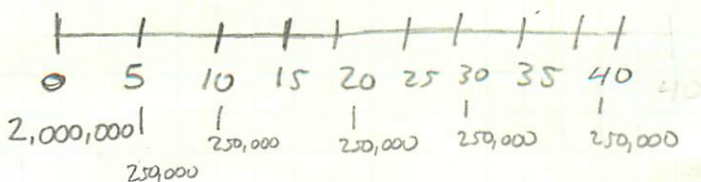
$$\text{Maintenance Cost} \Rightarrow P_2 = \frac{\$50,000}{0.12} = \$16,666.67$$

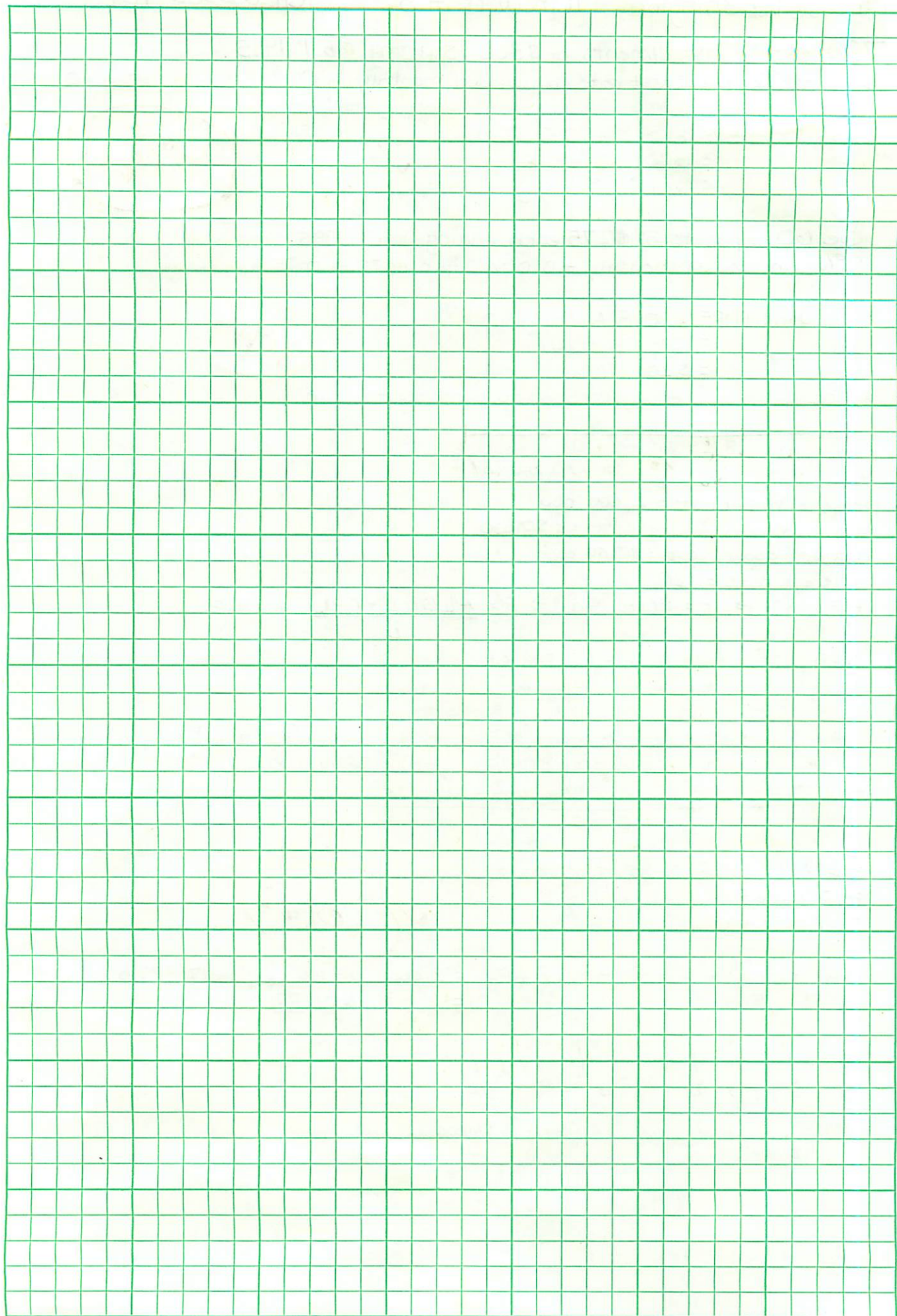
$$\begin{aligned}\text{Renovation Cost} \Rightarrow P_3 &= 250,000(P/F, 12, 25) + 250,000(P/F, 12, 40) + \\ &\quad 250,000(P/F, 12, 55) + 250,000(P/F, 12, 70) + \dots \\ &\rightarrow \frac{250,000(P/F, 12, 25) + 250,000(A/F, 12, 15)}{0.05}\end{aligned}$$

$$\begin{aligned}&= 250,000(P/F, 12, 25) + 55883.8326 \\ &= 305883(P/F, 12, 25) \\ &= 17,993.698\end{aligned}$$

✓ 10/17

$$\begin{aligned}\text{Total Present Worth} \Rightarrow P_1 + P_2 + P_3 &= 2,000,000 + 16,666.67 + 17,993.698 \\ &= \boxed{2,434,659.77}\end{aligned}$$





- 3) Maintenance cost $\rightarrow$ 40 the first year
Each subsequent year \$10 more than previous one
interest 5%

0/10

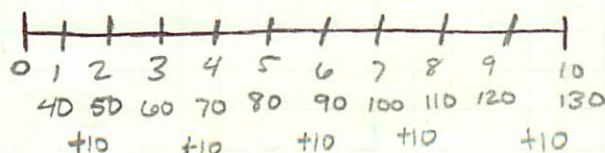
$$= 40(P/F, 5\%, 1) + 50(P/F, 5\%, 2) + 60(P/F, 5\%, 3) + 70(P/F, 5\%, 4) + 80(P/F, 5\%, 5) \\ + 90(P/F, 5\%, 6) + 100(P/F, 5\%, 7) + 110(P/F, 5\%, 8) + 120(P/F, 5\%, 9) + 130(P/F, 5\%, 10)$$

$$= 40(0.9524) + 50(.9070) + 60(.8638) + 70(.8227) + 80(.7835) + 90(.7462) \\ + 100(.7107) + 110(.6768) + 120(.6446) + 130(.6139)$$

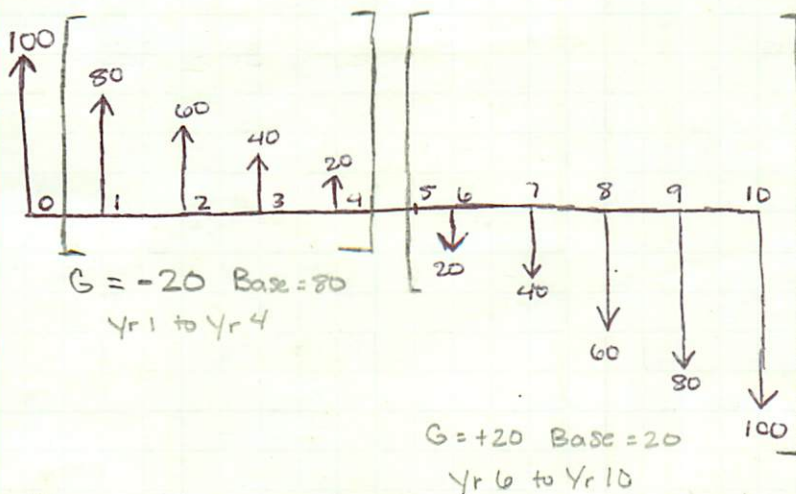
$$= 38.096 + 45.35 + 51.828 + 57.589 + 62.68 + 67.158 + 71.07 + 74.448 \\ + 77.352 + 79.807$$

$$= 692.698$$

How

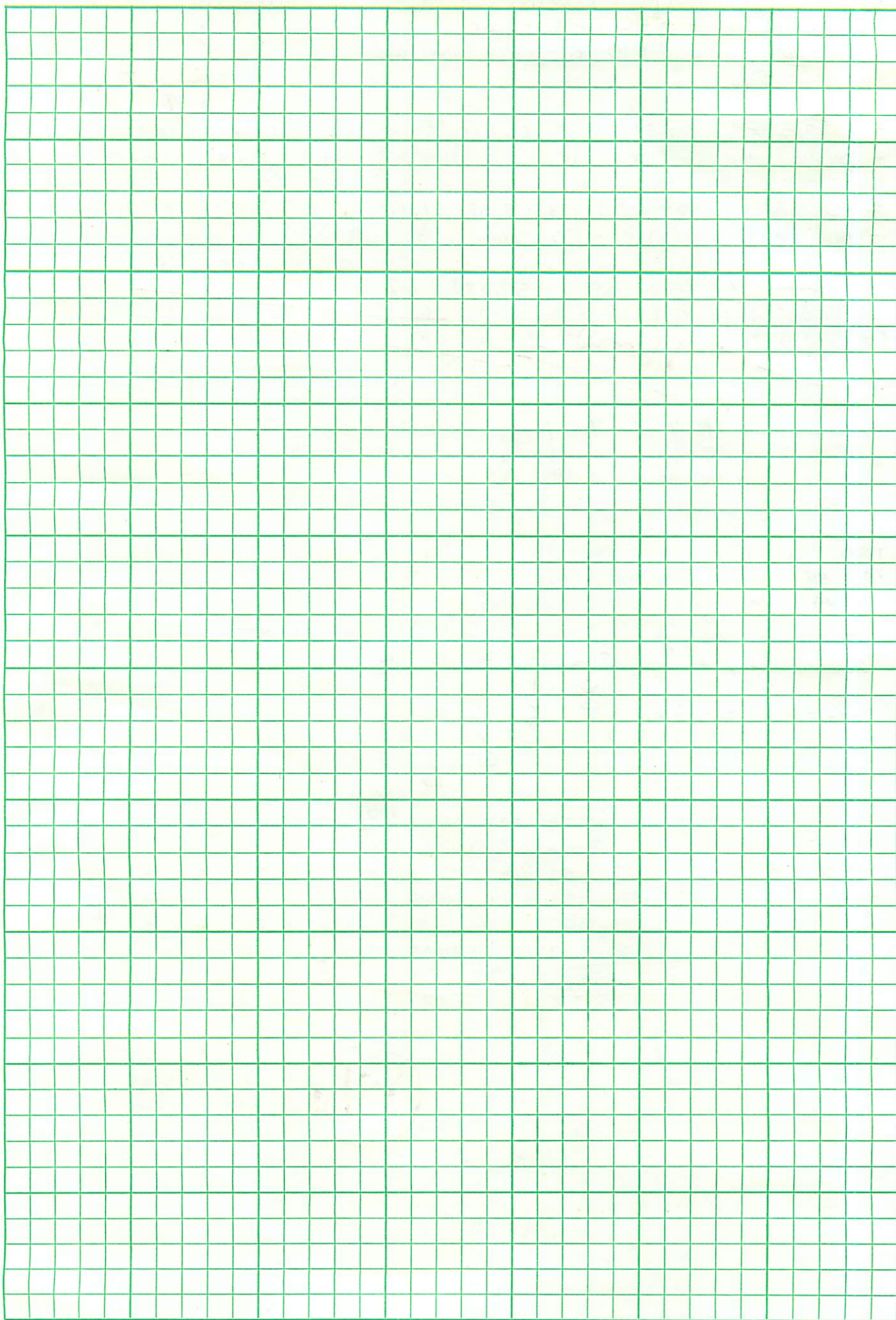


4)

 $i = 18\%$

$$\text{Present Equivalent} = 100 + 80(P/A, 18\%, 4) - 20(P/G, 18\%, 4) \\ - (P/F, 18\%, 5) \times [20(P/A, 18\%, 5) + 20(P/G, 18\%, 5)] \\ = 100 + 80(2.69006) - 20(3.48281) - (0.43711) \times \\ [20(3.127171) + 20(5.23125)] \\ = 172.55$$

10/10

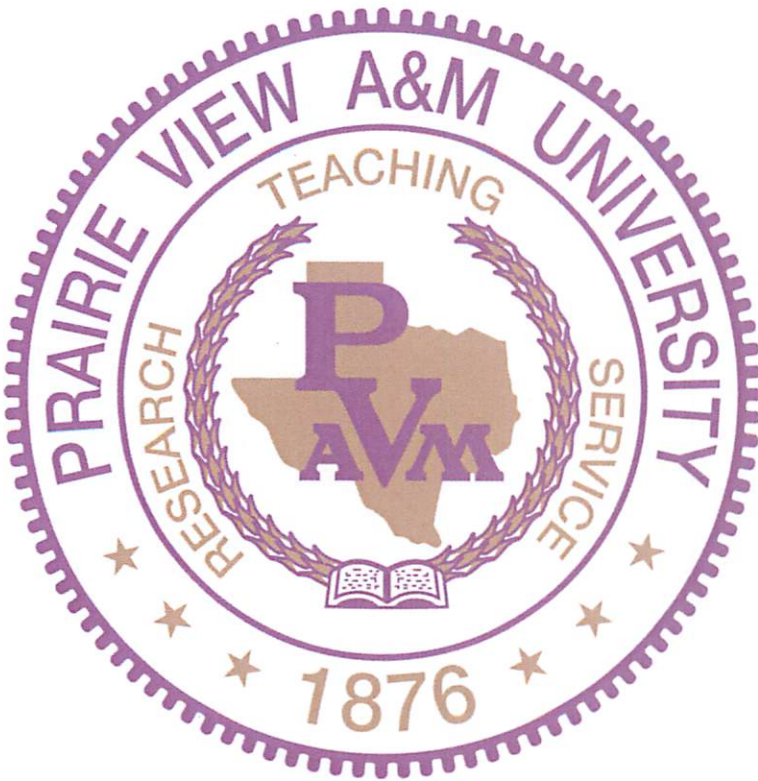


Homework Project

The Purpose of the homework Project

1. The project will enhance the students' social and behavioral well-being and enhance collaboration in the real-world environment.
2. Strengthen their ability for understanding the global economy, locally and nation's issues that are facing every nation on the Earth.

Project



ECONOMY INTEREST RATE ANALYSIS

Assigned by: Dr. Shakir

ABSTRACT

This project will cover the issue of compounding interest rate, its impact on an individual as well as the national economy, and give an example of an economic analysis of a project while also discussing the social impacts of such a project.

Micheal Sands

Mechanical Engineering Student

Number: 15

CHEG 2308-P02

Due Date: 11/23/21

2/10

Interest rate is an important topic to discuss, as its influence can be found in practically all walks of life. In the following analysis, I will cover the issue associated with compounding interest rate, its impacts on individual and national economies, an example of a detailed project that has been analyzed in terms of differing interest rates, and the social impacts of such a project.

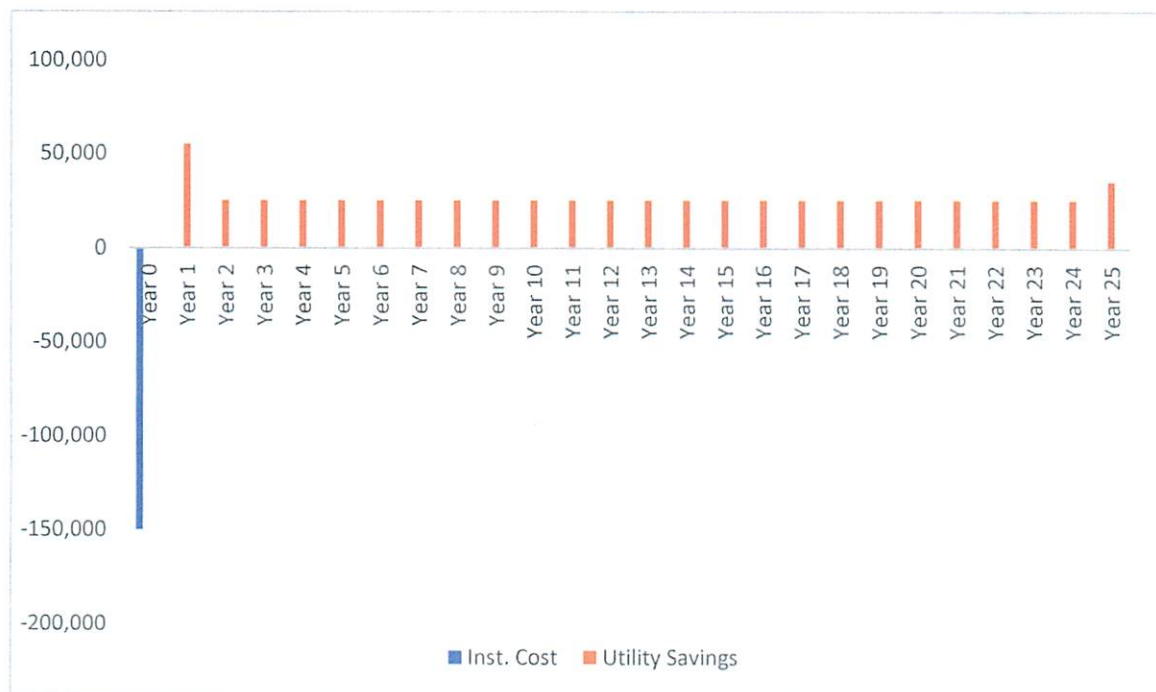
The major issue associated with interest rate is its seemingly benign compounding effect. The very nature of interest rate is one that is meant to be the manifestation of the value of money, whether from an individual or an organization point-of-view. The issue is that the increase is when it is compounded over long periods of time. In this respect, the amount incurred are minimal at best in the early life of compounding interest rate, but it exponentially grows from its base amount. For example, let's say that I get a loan for \$100 at 12% interest rate compounded monthly. If I forget to pay them, the money I would owe to the lender in one year $100(F/P, .5\%, 12) = \$106.17$, in 5 years $100(F/P, .5\%, 60) = \$134.9$, in 10 years $100(F/P, .5\%, 120) = \$181.94$, and in 30 years $100(F/P, .5\%, 360) = \$602.26$. From this analysis, you can see that the money increases at an unthreatening amount for most of its life, but at 30 years the loan would have exploded to more than 6 times the original amount. Even with a small amount of money, you should be able to start to see where issues regarding compounding interest rate lay. At first it is negligible at most, but it can quickly swell to unmanageable amounts.

The impact of compounding interest on individuals is that it influences their financial directions, as it can be beneficial or detrimental. It all depends on the reference from the perspective of the individual. I already gave an example of a negative aspect can have on an individual, but there are correct ways to utilize interest rates. For example, let's say I chose to take \$600 dollars out of my salary every year for the next 30 years, and I put it into a bank account that pays 5% interest. How much would I have at the end of 30 years? If we use the compound amount factor, $(F/A, 5\%, 30)$, then we can see that I would end up with \$39,863.40. This is more than double the \$18,000 I would have had if I did not invest it. Understanding the way interest rates work leads individuals to invest in the economy or keep their money to themselves. Individuals are less likely to finance for a home if the housing interest rates are high rather than when it is low. Individuals are less likely to put their money in an account with low interest rates when another bank is willing to pay higher interest rates. The impact of interest applies for individual citizens to hedge funds. Interest rates can be the driving force of commerce between individuals.

Just like with individuals, a national economy is impacted by the ebb and flow of interest rates within its borders. While not the only factor, the impact of interest rate can affect a nation's currency and debt. Higher the interest rates the lower the value of its currency. This bulging of the interest rate is a leading indicator of high inflation rates. We can see countries with rampant interest rates that has currency that is worth less than the paper it was printed on. Understanding how interest rates impact national economies is paramount to staunch the collapse of its economy.

For my example project, I have been tasked with fitting a university building with solar energy. Being an engineer, I decide to use my knowledge from my Economy Analytic course to guide my choices. I am given several key properties that will define how much the project will cost. I am notified that the building's size is 25000 ft^2 , and it requires a minimum of \$50,000 to power the building throughout the year. Solar panels are estimated to cut that number in half. The money that is left over will be put into an account with a ROR of 10%. I look around for vendors, and I find SunCo who gives me an estimate cost of construction will be \$150,000. They have a finance plan at 10% interest rate. They insure me that the panels will last 25 years. After that, I should be able to salvage the parts for \$10,000. In addition, the state of Texas also gives a tax credit for installing the panels to encourage green energy. They will cut the university a \$30,000 tax credit at the end of the first year. That money saved will also go into the same account as the money saved from the reduced energy cost.

Here we can see a cash flow diagram for the project:



To ensure that this is a worthy investment for the university, I will have to find the PW, FW, AW, and capitol recovery.

First, we will need to find the present worth. We can find this by using the following equation:

$$PW = -150,000 + 30,000 \left(\frac{P}{F}, 10\%, 1 \right) + 25,000 \left(\frac{P}{A}, 10\%, 25 \right) + 10,000 \left(\frac{P}{F}, 10\%, 25 \right)$$

$$PW = -150,000 + 30,000(.9091) + 25,000(9.077) + 10,000(.0923)$$

$$PW = \$105121$$

The final worth can be found through the following equation:

$$FW = -150,000\left(\frac{F}{P}, 10\%, 25\right) + 30,000\left(\frac{F}{P}, 10\%, 24\right) + 25,000\left(\frac{F}{A}, 10\%, 25\right) + 10,000$$

$$FW = -150,000(10.835) + 30,000(9.85) + 25,000(98.347) + 10,000$$

$$FW = \$1,138,925$$

We can find the annual worth by using the following equation:

$$AW = -150,000\left(\frac{A}{P}, 10\%, 25\right) + 30,000\left(\frac{A}{P}, 10\%, 24\right) + 25,000 + 10,000\left(\frac{A}{F}, 10\%, 25\right)$$

$$AW = -150,000(.1102) + 30,000(.1113) + 25,000 + 10,000(.0102)$$

$$AW = \$11,911$$

By using the RATE function on Excel, I was able to calculate the ROR to be 13%.

$$\text{RATE}(25, 11911, -150000, 1138925) = 13\%$$

The capitol recovery then will be the following:

$$CR = 150,000\left(\frac{A}{P}, 10\%, 25\right) - 30,000\left(\frac{A}{P}, 10\%, 24\right) - 10,000\left(\frac{A}{F}, 10\%, 25\right)$$

$$CR = 150,000(.1102) - 30,000(.1113) - 10,000(.0102)$$

$$CR = \$13,089$$

Since the \$25,000 > \$13,089, this would be a good investment for the university.

However, the university insists that I give them more information before they consider my proposal. First, they want me to check what the payback period is. We can find this through the following way.

$$0 = -150,000 + 30,000\left(\frac{P}{F}, 10\%, 1\right) + 25,000\left(\frac{P}{A}, 10\%, x\right)$$

$$122,727 = 25,000\left(\frac{P}{A}, 10\%, x\right)$$

$$4.909 = \left(\frac{P}{A}, 10\%, x\right)$$

$$x \approx 7.3 \text{ years}$$

I determined that the payback period will be a minimum of 8 years, as there will still be some left of the first cost at the end of year 7.

Lastly, they want me to check to see what the differences are when apply different interest rates to gauge if they should be looking for a higher interest rate or lower. These were found using the same techniques as above:

Interest Rate	PW	AW	FW	ROR	Payback period
5%	\$233,875	\$36,310	\$856,473	3.75%	7 years
10%	\$105,121	\$11,911	\$1,138,925	13%	8 years
15%	\$37688	\$6,504	\$1,250,725	17%	9 years

In conclusion, if the University values shorter payback periods, then I would suggest we go for a lower interest rate. However, if their goal is to maximize the profits from the whole project, then I would suggest we go for a higher interest rate.

Now that we have a clear understanding of the financial properties of the project, I will cover the social impact this project will have. The environment is in free fall due to our dependency on fossil fuels. While only covering a single building, I believe it is a great first step to lessen the university's impact on the environment. If the university sets this presence of green energy, then the students and community will follow. ✓

With this project, I have highlighted the issues of interest rates as well as its impacts on individuals and national economies. I have also shown an example of an engineering project that utilizes an understanding of interest rates while also delving into the social impacts of such a project. The project is not likely to be as straight-forward when applied to real life, as real life has many more constraints than in examples. However, I believe it shows the value of knowing how to calculate a project's efficiency. ✓

*What are the References!
used!*

Economic Analysis Project

Craig Rothschild

Professor Shakir

CHEG 2308

11/23/2021

Economic Analysis Project

Introduction

Interest rates determine how much money lenders and investors are willing to save and invest. Increased demand for loanable funds increases interest rates, while an increase in supply of loanable funds decreases interest rates. Interest rates are one of the most important aspects of an economic system. The issues of interest rates are with how high or low they are. On one issue you can earn a return on your investment. For example, suppose a high-school student decides he wants to plan for retirement at a youthful age of 18 years old. He then put his money into an IRA also known as an individual retirement account and after a certain number of years until he reaches 45 years old that money earns interest. Which in the end he gets a return on his investment. This is the good issue with Interest rate. On the other hand, let us say someone wanted to attend college but they do not have the funds to so they take out a loan and that loan must be paid back but the loaner not only wants his/her original money but also the loaner wants to gain a return. So, an interest rate is applied, for the time duration it takes the future college student to pay off the loan and if you are a borrower this could be considered a bad issue because you are paying more money which could lead to date.

The impact of interest rates on personal loans, national economy, and global economy are mentioned here starting with the impact of a personal.. The way interest rates impact a personal loan by increasing the amount of money of the thing you are purchasing at the time. See personal loan interest rates are expressed as a percentage of the amount of money you borrow, and many personal loans are unsecured, they cannot be backed up, which puts the borrower at a disadvantage. How the interest rates impact the national economy is for one, when interest rates are rising, both business and consumers will lower their spending, reducing the amount of cashflow in the economy. This will cause stock prices to fall and earnings to drop. On a more positive note, when interest rates fall drastically business and consumers will increase their spending causing the stock market to rise and earnings to increase. On a global scale interest rates impacts are enormous. Because the United States has one of the largest economies it will be impacted the most by global scale interest rates but continuing the impact of interest rates rising can benefit foreign trade. The stronger the US dollar will accompany the interest rate increase which should boost US demand for products around the world, increasing corporate profits for domestic and foreign companies alike.

Examples

NEW EXAMPLE *

The cost below is from 3 different electric chargers be considered to power up chevy automobiles. If chevy must choose between them which is the best alternative? While choosing the alternative Use the best method to select the best alternative so they can make their final decision. The following interest rates are A-5% B-7% C-11%

Electric charger	A	B	C
Interest rate %	7	10	12
First cost \$	80,000	80,000	84,000
Useful life years	5	7	11
ANNUAL BENEFIT	60,000	65,000	67,000
SALAVGE VAULE	15,000	20,000	30,000
M&O Grad(M&O G)	2000	3000	2400
M&O Cost (M&O)	12,000	10,000	13,000

Annual revenue (A) = AB –M&O G

A

$$60,000 - 2000(P/G, 7\%, 5) - 12,000 = 32,706$$

$$AE(7\%) = -80,000(A/P, 7\%, 5) + 32,706 = 13,194$$

B

$$65,000 - 3000(P/G, 10\%, 5) - 10,000 = 34,414$$

$$AE(10\%) = -80,000(A/P, 10\%, 5) + 34,414$$

$$=13,310$$

C

$$67,000 - 2000(P/G, 12\%, 5) - 12,000$$

$$=42,206$$

$$AE(12\%) = -84,000(A/P, 12\%, 5) + 42,206$$

$$= 18,903$$

Chevy car manufacturers have lost money in sales due to people not buying their cars. The reason for this is that Tesla has created cars that run on electricity and not gas which can be recharged at any time. This change has saved car drivers lots of money and the use of gas has decreased. Since the demand for gas has decreased significantly, the price of oil has gone up to make up for it. After looking at this change, soon cars will no longer use gas and only electricity for many reasons and Chevy is behind on this evolution. So, Chevy is deciding to buy electric chargers to install them into their cars for \$5000 each car, Chevy wants to have at least 100 cars on the road. The total cost will be 500,000 which must be paid off in 10 years and the annual Maintenance cost is 5000\$ with an annual income of 10,000. There is another alternative to the electric charger the annual maintenance is 6000\$ and annual income 8,000 total cost \$400,000. The loan must be paid off in 10 years. Chevy expects a MARR of 15%. What investment would be the best choice for Chevy and the annual worth?

	A	B
Purchase price	\$500,000-P	\$500,000-P
Annual Maintenance	\$5000-A	\$6000-A
Annual income	\$10,000-A	\$8,000-A
Life, years	10-n	10-n

$$CR(A) = -\$500,000(A/P, 10\%, 10) + \$10,000(A/F, 10\%, 10) = -\$80,747.5$$

$$CR(B) = -\$500,000(A/P, 10\%, 10) + \$8,000(A/F, 10\%, 10) = -\$80,873$$

In other words, Chevy must make \$80,747.5 per year to make MARR or to recover their capital at 10% for choice A and for B \$80,873

$$A = \$10,000 - \$5000 = \$5000$$

$$B = \$8,000 - \$6000 = \$2000$$

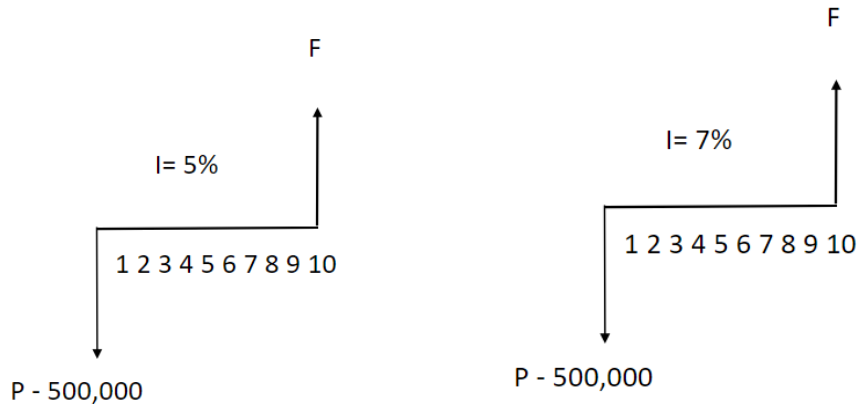
$$AW(A) = CR + A = \$85,747.5$$

$$AW(B) = CR + A = \$82,873$$

The best choice will be A the amount needed to make is less.

Part 2

If Chevy were to choose A from the previous example and the cost would remain the same at \$500,000, what bank loan should they choose for the lowest cost. The bank chase has rate of return is 5% yearly which for chevy that is a 5% interest rate, and the bank Wells Fargo rate of return is 7% yearly which for chevy that is a 7% interest rate. What loan would be a better choice for chevy? Both loans are for 10 years.



$P = 500,000$

I for chase = 5%

I for Wells Fargo = 7%

$F = ?$

Chase

$$F = 500,000(F/P, 5\%, 10) = 638,150$$

Wells Fargo

$$F = 500,000(F/P, 7\%, 10) = 701,300$$

The chase loan will be better for chevy because of low interest rates leading to a lower cost on the total loan payment.

Conclusion (FOR EXAMPLES)

After choosing the right electric charger to use for the business chevy still faced a problem and that was interest rate. The Interest rate impacted the business cost of the loan which either they will be paying way more for the actual loan or a decent amount so the bank could get a return on their investment. The interest rate was applied to the principal, which is the amount of \$500,000 of the

loan. In a way the business is in debt because the interest rate is the cost of debt for the borrower and the rate of return for the lender. The money to be repaid is usually more than the borrowed amount since lenders require compensation for the loss of use of the money during the loan period. The lender could have invested the funds during that period instead of providing a loan, which would have generated income from the asset. The difference between the total repayment sum and the original loan is the interest charged. As seen from my personal examples the interest rate on a loan impact on a business is that it puts the business in debt and if the business is not successful it is a possibility of bankruptcy. So, it is best for the borrower to choose a lower rate to avoid this and make sure their business accumulates a lot of money to recover from the interest.

Final Conclusion

Interest rates have a major impact on the economy from personal to global. That impact is either positive or negative. On the positive side of interest rates the lenders mostly, banks can choose the best interest rate to earn profit and a business can pick which interest rates work for their business. The negative impact of interest rates is that the world economy can crash if the interest rates are too high or too low and businesses can go into debt, by taking on high interest rates thinking they will make enough profit to cover the entire loan but really, they will not be able to cover those costs. Interest rates impact is so strong it can change the whole world's economy especially the United States that is why it is important to understand that interest rates too high or too low can cause a major impact on the world, personal and normal businesses.

References

INTEREST RATE

In-text: (Interest Rate, 2021)

Your Bibliography: Investopedia. 2021. *Interest Rate*. [online] Available at:

<<https://www.investopedia.com/terms/i/interestrate.asp>> [Accessed 1 December 2021].

(Interest Rates and How They Work, 2021)

HANDOUT MATERIALS

September 16-2021

Practice Problems

- 1) The ABC Company deposited \$100 000 in a bank account on June 15 and withdrew a total of \$115 000 exactly one year later. Compute: (a) the interest which the ABC Company received from the \$100 000 investment, and (b) the annual interest rate which the ABC Company was paid.
- 2) What is the annual rate of simple interest if \$265 is earned in four months on an investment of \$15 000?
- 3) Determine the principal that would have to be invested to provide \$200 of simple interest income at the end of two years if the annual interest rate is 9%.
- 4) Compare the interest earned from an investment of \$1000 for 15 years at 10% per annum simple interest, with the amount of interest that could be earned if these funds were invested for 15 years at 10% per year, compounded annually.
- 5) At what annual interest rate is \$500 one year ago equivalent to \$600 today?
- 6) Suppose that the interest rate is 10% per year, compounded annually. What is the minimum amount of money that would have to be invested for a two-year period in order to earn \$300 in interest?
- 7) How long would it take for an investor to double his money at 10% interest per year, compounded annually?

Practice Problems

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems.

- 1) How much will accumulate in an individual retirement account (IRA) in 15 years if \$5000 is deposited in an account at the end of each quarter during that time? The account earns 8% interest, compounded quarterly. What is the effective interest rate?
- 2) Suppose you wanted to buy an \$180,000 house. You have \$20,000 cash to use as down payment. The bank offers to lend you the remainder at 6% nominal interest. The term of the loan is 20 years. Compute your monthly loan payment
- 3) Ray Witmore, an engineering professor at UTM, is preparing to retire to his farm and care for his cats and dogs. During his many years at UTM he invested well and has a balance of \$1,098,000 in his retirement fund. How long will he be able to withdraw \$100,000 per year, beginning today, if his account earns interest at rate 4% per year?
- 4) Abby W. Deposits \$75 per month into an account pay 9% interest for 2 years to be used to purchase a car. The car she selected costs more than the amount in the account. She agrees to pay \$125 per month for two years at 12% interest rate, and also uses a gift from her uncle of \$375 as part of the down payment what is the cost of the car to the nearest dollars.
- 5) The following data are assigned with three grape-crushing machine under consideration by Rabbit Ridge Wineries LLC

Items	Smart Crush	Super Crush	Savage crush
First Cost	\$52,000	\$63,000	\$105,000
O&M	\$15,000	\$9,000	\$12,000
Annual Benefits	\$38,000	\$31,000	\$37,000
Savage Values	\$13,000	\$19,000	\$22,000
Useful Life	4 Years	6 Years	12 Years

If Rabbit Ridge uses MARR of 12% which alternative if any should be chosen?

Practice Problems

Direction

Please read the questions carefully. Please draw the cash flow diagrams and explain the steps that you are going to approach to solve the problems then solve the problem. Show the details in solving the problems.

- 1) How much will accumulate in an individual retirement account (IRA) in 15 years if \$5000 is deposited in an account at the end of each quarter during that time? The account earns 8% interest, compounded quarterly. What is the effective interest rate?

Answer

$$I=8/4 = 2\% \quad n=4 \times 15=60$$

$$F=5000 \text{ (F/A, 2\%, 60)}$$

$$\$570,255$$

$$\text{Effective interest rate is } (1+0.02)^4 - 1 \\ = 8.24\%$$

- 2) Suppose you wanted to buy a \$240,000 house. You have \$20,000 cash to use as down payment. The bank offers to lend you the remainder at 6% nominal interest. The term of the loan is 20 years. Compute your monthly loan payment.

Answer

$$\text{Amount of the loan} = 240,000 - 20,000 \\ = \$220,000$$

$$\% \text{ rate per month is } 6/12 = 0.5\% \text{ per month}$$

$$N = 12 \times 20 = 240$$

$$A = 220,000(A/P, 0.5\%, 240)$$

$$A = 220,000 \times 0.00716$$

$$A = \$1575.2$$

- 3) Ray Witmore, an engineering professor at UTM, is preparing to retire to his farm and care for his cats and dogs. During his many years at UTM he invested well and has a balance of \$2,098,000 in his retirement fund. How long will he be able to withdraw \$250,000 per year, beginning today, if his account earns interest at rate 4% per year?

Answer

$$A = \$250,000 \quad P = 2,098,000 - 250,000 = \$1,848,000$$

$$250,000 = 1,848,000 (A/P, 4\%, N)$$

$$250,000 / 1,848,000 = (A/P, 4\%, N)$$

$$= 0.1353$$

Looking at the table 4% for A/P factor and to find that it is between 9 years and 10 years.

- 4) Abby W. Deposits \$175 per month into an account pay 9% interest for 2 years to be used to purchase a car. The car she selected costs more than the amount in the account. She agrees to pay \$125 per month for two years at 12% interest rate, and also uses a gift from her uncle of \$575 as part of the down payment what is the cost of the car to the nearest dollars.

Answer

Interest is equal $= 9/12 = 0.75\%$ per month

Number of months $= 2 \times 12 = 24$ months

$F = 175(F/A, 0.75\%, 24)$

$F = 75 \times 26.189$

$= 4583.075$ in the account

$I = 12/12 = 1\%$ $n = 12 \times 2 = 24$

$P = 125(P/A, 1\%, 24)$

$= 125(21.243)$

$= 2655.38$

Total of the car price is $= 4583.07 + 2655.38 + 575$

7813.455 is the cost of automobile.

- 5) The following data are assigned with three grape-crushing machine under consideration by Rabbit Ridge Wineries LLC

Items	Smart Crush	Super Crush	Savage crush
First Cost	\$152,000	\$163,000	\$205,000
O&M	\$25,000	\$19,000	\$22,000
Annual Benefits	\$48,000	\$41,000	\$47,000
Savage Values	\$13,000	\$19,000	\$22,000
Useful Life	4 Years	6 Years	12 Years

If Rabbit Ridge uses MARR of 12% which alternative if any should be chosen?

The Answer

Solution 1 is

Using LCM as = 12 years

Smart Crush (3 CYCLES OF 4 YEARS)

$NPW 4 \text{ years} = -152,000 + (48,000 - 25,000)(P/A, 12\%, 4) + 13,000(P/F, 12\%, 4)$

$= -152,000 + 23,000(P/A, 12\%, 4) + 13,000(P/F, 12\%, 4)$

$= -152,000 + 23,000 \times (6.19) + 13,000 (0.6355)$

$= -152,000 + 142,370 + 8261.5$

$= -1368.5$

$NPW 12 \text{ years} = -1368.5 - 1368.5(P/F, 12\%, 4) - 1368.5(P/F, 12\%, 8)$

$= -1368.5 - 1368.5 \times 0.6355 - 1368.5 \times 0.4039$

$= -1368.5 - 869.68 - 552.73$

$= -2790.91$

Super Crush (2 CYCLES OF 6 YEARS)

$NPW 6 = -163,000 + (41,000 - 19,000)(P/A, 12\%, 6) + 19,000(P/F, 12\%, 6)$

$$\begin{aligned}
 &= -163,000 + 22,000 \times 4.11 + 19,000 \times 0.5066 \\
 &= -163,000 + 90,420 + 9,625.4 \\
 &= -62,954.6
 \end{aligned}$$

$$\begin{aligned}
 NPW_{12} &= -62,954.6 - 62,954.6 (P/F, 12\%, 6) \\
 &= -62,954.6 - 31,892.8 \\
 &= -94,847.4
 \end{aligned}$$

Savage Crush (one Cycle of 12 years)

$$\begin{aligned}
 NPW_{12} &= -205,000 + 25,000(P/A, 12\%, 12) + 22,000(P/F, 12\%, 12) \\
 &= -205,000 + 25,000 \times 6.194 + 22,000 \times 0.2567 \\
 &= -205,000 + 154,850.0 + 5,647.4 \\
 &= -89,502.6
 \end{aligned}$$

Other solution is

Using Annual worth

For Smart Crush is four years and calculate annual worth as follow

$$\begin{aligned}
 AW \text{ for 4 years} &= -152,000 (A/P, 12\%, 4) + 23,000 + 13,000(A/F, 12\%, 4) \\
 AW &= -152,000 \times 0.3292 + 23,000 + 13,000 \times 0.1574
 \end{aligned}$$

Using Annual worth for 6 years is

$$AW = -163,000(A/P, 12\%, 6) + 22,000 + 19,000(A/F, 12\%, 6)$$

Using Annual worth for Savage crush is

$$\begin{aligned}
 AW &= -205,000(A/P, 12\%, 12) + 25,000 + 22,000(A/F, 12\%, 12) \\
 AW &= 205,000 \times 0.1614 + 25,000 + 22,000 \times 0.0414
 \end{aligned}$$

Review Questions and Answers

Engineering Economy

Fall 2021

Example -1

- If Farah Manufacturing wants its investments to double in value in 4 years, what rate of return would it have to make on the basis of (a) simple interest and (b) compound interest

Answer Example -1

$$(a) F = P + P(n)(i)$$

$$2P = P + P(4)(i)$$

$$i = 25\%$$

$$(b) F = P(1 + i) (1 + i) (1 + i) (1 + i)$$

$$2P = P(1 + i)^4$$

$$2 = (1 + i)^4$$

$$\log 2 = \log(1 + i)^4$$

$$0.301 = 4 \log(1 + i)$$

$$\log(1 + i) = 0.0753$$

$$(1 + i) = 10^{0.0753}$$

$$i = 18.93\%$$

Example -2

- Two years ago, ASARCO, Inc. invested \$580,000 in a certificate of deposit that paid *simple* interest of 9% per year. Now the company plans to invest the total amount accrued in another certificate that pays 9% per year *compound* interest. How much will the new certificate be worth 2 years from now?

Answer Example-2

- Amt original certificate = $580,000 + 80,000(2)(0.09) = \$684,400$
- Total amt after two more years = $684,400(1.09)(1.09)$
- = $\$813,136$

Example - 3

- Valley Rendering, Inc. is considering purchasing a new flotation system for recovering more grease. The company can finance a \$150,000 system at 5% per year compound interest or 5.5% per year simple interest. If the total amount owed is due in a single payment at the end of 3 years, (a) which interest rate should the company select, and (b) how much is the difference in interest between the two schemes?

Answer Example 3

- (a) Amt owed, comp'd interest =
 $150,000(1.05)(1.05)(1.05)$
- = \$173,644
- Amt owed, simple interest = $P + Pni$
- = $150,000 + 150,000(3)(0.055)$
- = $150,000 + 24,750$
- = \$174,750
-

Example 4

- Hughes Cable Systems plans to offer its employees a salary enhancement package that has revenue sharing as its main component. Specifically, the company will set aside 1% of total sales for yearend bonuses for all its employees. The sales are expected to be \$5 million the first year, \$5.5 million the second year, and amounts increasing by 10% each year for the next 5 years. At an interest rate of 8% per year, what is the equivalent annual worth in years 1 through 5 of the bonus package?

Answer Example - 4

Solve for P_g in geometric gradient equation and then convert to A :

$$A_1 = 5,000,000(0.01) = 50,000$$

$$P_g = 50,000[1 - (1.10/1.08)^5]/(0.08 - 0.10) \\ = \$240,215$$

$$A = 240,215(A/P, 8\%, 5) \\ = 240,215(0.25046) \\ = \$60,164$$

Example -5

- Burling Water Cooperative currently contracts the removal of small amounts of hydrogen sulfide from its well water using manganese dioxide filtration prior to the addition of chlorine and fluoride. Contract renewal for 5 years will cost \$75,000 annually for the next 3 years and \$100,000 in years 4 and 5. Assume payment is made at the end of each contract year. Burling Coop can install the filtration equipment for \$150,000 and perform the process for \$60,000 per year. At a discount rate of 6% per year, does the contract service still save money?

Answer Example 5

- $PWC = -75,000(P/A, 6\%, 3) - 100,000(P/A, 6\%, 2)(P/F, 6\%, 3)$
- $= -75,000(2.6730) - 100,000(1.8334)(0.8396)$
- $= \$-354,407$
- $PWB = -150,000 - 60,000(P/A, 6\%, 5)$
- $= \$-402,744$
- The contract service is a better deal with a smaller PW of costs.

Example-6

- Atari needs \$4.5 million in new investment capital
- to develop and market downloadable games software for its new GPS2-ZX system. The plan is to sell \$10,000 face-value corporate bonds at a discount of \$9000 now. A bond pays a dividend each 6 months based on a bond interest rate of 5% per year with the \$10,000 face value returned after 20 years. Will a purchase make at least 6% per year compounded semiannually?

Answer Example- 6

- Semiannual bond dividend is $10,000(0.05)/2 = \$250$ per 6 months. Semiannual
- interest rate expected is $6\%/2 = 3\%$.
- $PW = -9000 + 250(P/A, 3\%, 40) + 10,000(P/F, 3\%, 40)$
- $= -9000 + 250(23.1148) + 10,000(0.3066)$
- $= \$-155$
- No, the bond investment does not make the target rate since $PW < 0$.

Example-7

- Anderson-McKee Construction expects to invest \$835,000 for heavy equipment replacement 2 years from now and another \$1.1 million 4 years from now. How much must the company deposit into a sinking fund each month to provide for the purchases, if the fund earns a rate of return of 12% per year compounded monthly.

Answer - 7

- Solve for F at the end of year 4 and then convert to A:
- $F = 835,000(F/P, 1\%, 24) + 1,100,000$
- $= 835,000(1.2697) + 1,100,000$
- $= \$2,160,200$
- $A = 2,160,200(A/F, 1\%, 48)$
- $= 2,160,200(0.01633)$
- $= \$35,276$

Example 8

- Copper Refiner Phelps Dodge purchased a model MTVS peristaltic pump for injecting antiscalant at its nanofiltration water conditioning plant. The cost of the pump was \$950. If the chemical cost is \$10 per day, determine the equivalent cost per month at an interest rate of 12% per year compounded monthly. Assume 30 days per month and a 3-year pump life

Answer 8

Move chemical cost to end of interest period and amortize pump:

- Chemical cost/mo = $10(30) = \$300$
- $A = 950(A/P, 1\%, 36) + 300$
- $= 950(0.03321) + 300$
- $= \$331.55$

Example 9

- For the alternatives shown, determine the sum of the incremental cash flows for Alternative B - Alternative A.

	<u>Alternative A</u>	<u>Alternative B</u>
• First cost,	\$ 50,000	85,000
• Annual operating cost, \$ per year	\$8,600	\$2000
• Annual revenue, \$ per year	22,000	45,000
• Salvage value, \$	3,000	8,000
• Life, years	3	6

Answer 9

	<u>Year</u>	<u>Alternative B</u>	<u>Alternative A</u>	<u>B - A</u>
•	0	-85,000	-50,000	-35,000
•	1	43,000	13400	29,600
•	2	43,000	13400	29,600
•	3	43,000	13400-50,000+3000	76,600
•	4	43,000	13400	29,600
•	5	43,000	13400	29,600
•	6	43,000+8000	13400+3000	<u>34,600</u>
				Sum = \$194,600

Example 10

2) A firm is considering three mutually exclusive alternatives as part of the production improvement program. The alternatives are:

	A	B	C
Installed costs	\$10,000	\$15,000	\$20,000
Uniform Annual Benefit	\$1,625	\$1,625	\$1,800
Useful life in Years	10	20	20

For each alternative, the salvage value at the end of useful life is zero. At the end of 10 years, Alt A could be replaced by another A with identical cost and benefits. The MARR is 6%. If the analysis period is twenty years, which alternative should be selected?

Example 11

A battery manufacturing plant has been ordered to cease discharging acidic waste liquids containing mercury into the city sewer system. As a result, the firm must now adjust the pH and remove the mercury from its waste liquids. Three firms have provided quotations on the necessary equipment. An analysis of the quotations provided the following table of costs.

Bidder	Installed cost	Annual operating cost	Annual income from mercury recovery	Salvage value
Foxhill Instrument	\$35,000	\$8000	\$2000	\$20,000
Quichsilver	\$40,000	\$7000	\$2200	\$ 0
Almaden	\$100,000	\$2000	\$3500	\$ 0

If the installation can be expected to last twenty years and money is worth 7%, which equipment should be purchased?

Answer 11

Foxhill

$$\begin{aligned}\text{PW of Cost} &= 35,000 + (8000 - 2000)(P/A, 7\%, 20) - 20,000(P/F, 7\%, 20) \\ &= 35,000 + 6000(10.594) - 20,000(0.2584) \\ &= \$93,396.\end{aligned}$$

Quicksilver

$$\begin{aligned}\text{PW of Cost} &= 40,000 + (7000 - 2200)(P/A, 7\%, 20) \\ &= 40,000 + 4800(10.594) = \$90,851.\end{aligned}$$

Almaden

$$\begin{aligned}\text{PW of Cost} &= 100,000 + (2000 - 3500)(P/A, 7\%, 20) \\ &= 100,000 - 1500(10.594) = \$84,109.\end{aligned}$$

Select the Almaden bid

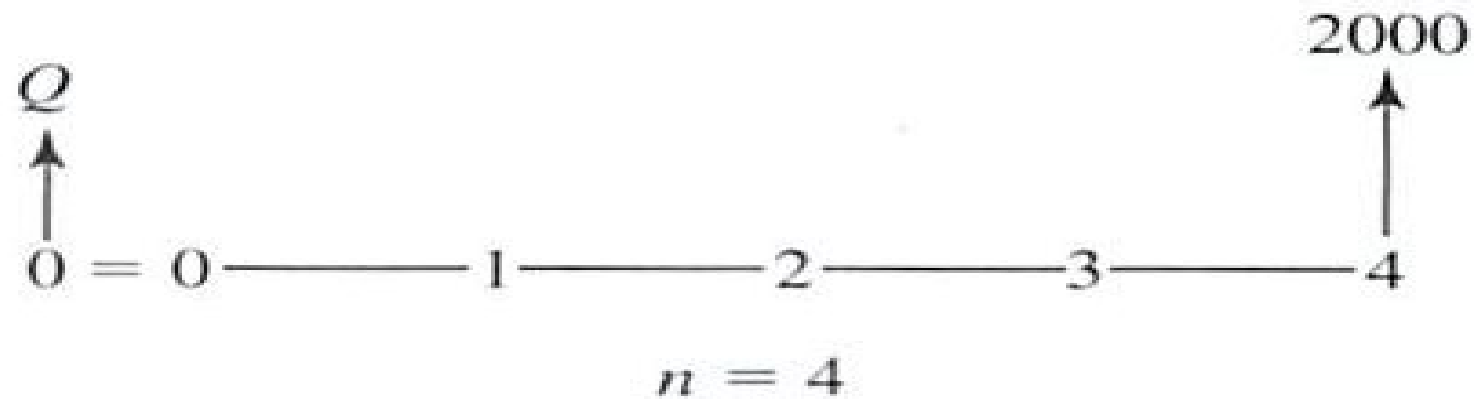
Problem Solving

Problem-1

A firm has borrowed \$5,000,000 for 5 years at 10% per year compound interest. The firm will make no payments until the loan is due, when it will pay off the interest and principal in one lump sum. What is the total payment?

Problem 2

Solve the diagram for the unknown Q assuming an 8% interest rate.



Problem3

A student has inherited \$50,000. If it is placed in a savings account that earns 3% interest, how much is in the account in 30 years?

Problem 4

We know that a certain piece of equipment will cost \$150,000 in 5 years. How much must be deposited today using 6% interest to pay for it?

Problem 5

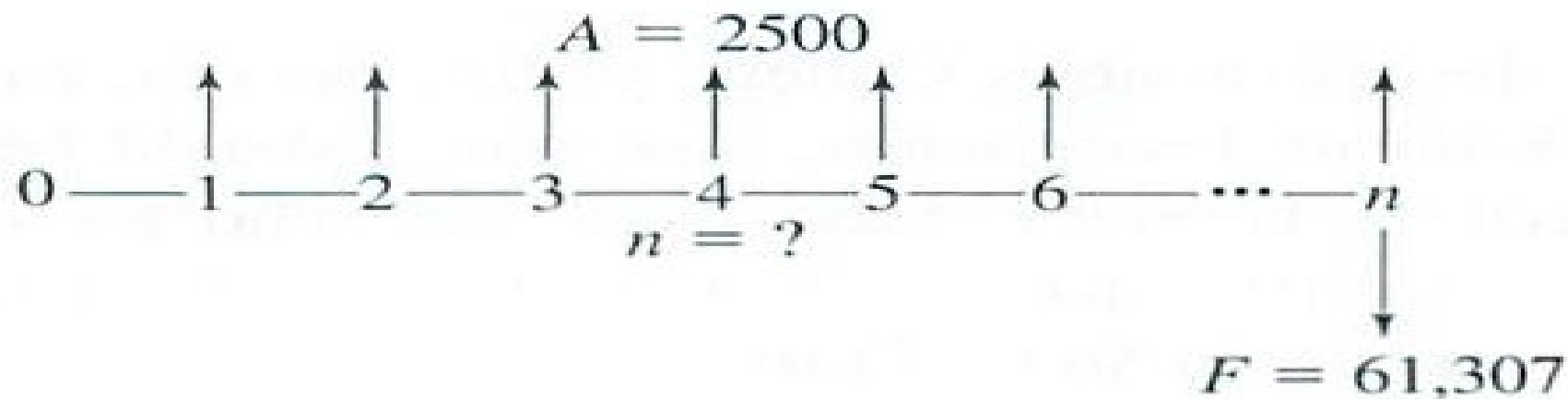
How much must you invest now at 4.2% interest to accumulate \$175,000 in 46 years?

Problem 6

Alvin's Uncle Arnold gave him \$16,000 from selling the old family farm. Alvin wants to start college and have \$12,000 available to buy a used car when he graduates in 4 years. Alvin earns 2% in his savings account. How much can he spend on a motorcycle now and still have enough to grow to the \$12,000 he needs when he graduates?

Problem7

The cash flows have a present value of 0. Compute the value of n , assuming a 10% interest rate.



Problem 8

How many months will it take to pay off a \$525 debt, with monthly payments of \$15 at the end of each month, if the interest rate is 18%, compounded monthly?

Replacement Costs Analysis

Question-1

- A recent college grad is trying to decide whether he should keep his presently owned car or purchase a new one. A new car will cost \$26,000 and have annual operation and maintenance costs of \$1200 per year with an \$8000 salvage value in 5 years, which is its economic service life. The presently owned car has a resale value *now* of \$5000; 1 year from now it will be \$3000, 2 years from now \$2500, and 3 years from now \$2200. Its operating cost is expected to be \$1900 this year, with costs increasing by \$200 per year. The presently owned car will definitely not be kept longer than 3 more years. Assuming used cars like the one presently owned *will always* be available, should the presently owned car be sold now, 1 year from now, 2 years from now, or 3 years from now? Use annual worth calculations at *i*10% per year.

Answer question -1

- $AW_C = -26,000(A/P, 10\%, 5) - 1200 + 8000(A/F, 10\%, 5)$
- $= \$-6748.35$
- $AW_1 = -5000(A/P, 10\%, 1) - 1900 + 3000(A/F, 10\%, 1)$
- $= \$-4400$
- $AW_2 = -5000(A/P, 10\%, 2) - [1900 + 200(A/G, 10\%, 2)] + 2500(A/F, 10\%, 2)$
- $= \$-3685.71$
- $AW_3 = -5000(A/P, 10\%, 3) - [1900 + 200(A/G, 10\%, 3)] + 2200(A/F, 10\%, 3)$
- $= \$-3343.23$
- Lowest AW is at three years (defender). Therefore, keep the defender three years and then replace it with a used vehicle just like the one that is currently owned.

Question 2

- A biotech company planning a plant expansion is trying to determine whether it should upgrade the existing controlled-environment rooms or purchase new ones. The presently owned rooms were purchased 4 years ago for \$250,000. They have a current “quick sale” value of \$30,000. However, for an investment of \$100,000 now, they can be adequate for another 4 years, after which they would be sold for \$40,000. Alternatively, new controlled-environment rooms cost \$300,000. They are expected to have a 10-year economic life with a \$50,000 salvage value at that time. Determine whether the company should upgrade the existing controlled- environment rooms or purchase new ones. Use an MARR of 12% per year and assume that used controlled-environment rooms will always be available.

Answer to Question 2

- $AW_D = -130,000(A/P, 12\%, 4) + 40,000(A/F, 12\%, 4)$
- $= \$-34,431$
- $AW_C = -300,000(A/P, 12\%, 10) + 50,000(A/F, 12\%, 10)$
- $= \$-50,246$
- Upgrade the existing controlled-environment rooms

Question 3

- A critical machine in the Phelps-Dodge copper refining operation was purchased 7 years ago for \$160,000. Last year a replacement study was performed with the decision to retain for 3 more years. The situation has changed. The equipment is estimated to have a value of \$8000 if “scavenged” for parts now or anytime in the future. If kept in service, it can be minimally upgraded at a cost of \$43,000 to make it usable for up to 2 more years. Its operating cost is estimated at \$22,000 the first year and \$25,000 the second year. Alternatively, the company can purchase a new system that will have an equivalent annual worth of \$47,063 per year over its ESL. The company uses a MARR of 10% per year. Use annual worth analysis to determine when the company should replace the machine.

Answer to Question 3

- $AW_{D1} = -(8000 + 43,000)(A/P, 10\%, 1) - 22,000 + 8000(A/F, 10\%, 1)$
- $= \$-70,100$
- $AW_{D2} = -(8000 + 43,000)(A/P, 10\%, 2) - 22,000(P/F, 10\%, 1)(A/P, 10\%, 2)$
- $+ (8000 - 25,000)(A/F, 10\%, 2)$
- $= \$-49,005$
- $AW_C = \$-47,063$
- The company should replace the existing machine *now*.

Question 4

A 2000-pound, counterbalanced, propane forklift can be purchased for \$30,000. Due to the intended service use, the forklift's market value drops 20% of its prior year's value in Years 1 and 2 and then declines by 15% until Year 10 when it will have a scrap/market value of \$1000. Maintenance of the forklift is \$400 per year during Years 1 and 2 while the warranty is in place. In Year 3 it jumps to \$750 and increases \$200 per year thereafter. What is the optimal life of the forklift using $i = 10\%$?

Please Answer This question

Review Questions and Answers

Engineering Economy

Fall 2021

Example -1

- If Farah Manufacturing wants its investments to double in value in 4 years, what rate of return would it have to make on the basis of (a) simple interest and (b) compound interest

Answer Example -1

$$(a) F = P + P(n)(i)$$

$$2P = P + P(4)(i)$$

$$i = 25\%$$

$$(b) F = P(1 + i) (1 + i) (1 + i) (1 + i)$$

$$2P = P(1 + i)^4$$

$$2 = (1 + i)^4$$

$$\log 2 = \log(1 + i)^4$$

$$0.301 = 4 \log(1 + i)$$

$$\log(1 + i) = 0.0753$$

$$(1 + i) = 10^{0.0753}$$

$$i = 18.93\%$$

Example -2

- Two years ago, ASARCO, Inc. invested \$580,000 in a certificate of deposit that paid *simple* interest of 9% per year. Now the company plans to invest the total amount accrued in another certificate that pays 9% per year *compound* interest. How much will the new certificate be worth 2 years from now?

Answer Example-2

- Amt original certificate = $580,000 + 80,000(2)(0.09) = \$684,400$
- Total amt after two more years = $684,400(1.09)(1.09)$
- = $\$813,136$

Example - 3

- Valley Rendering, Inc. is considering purchasing a new flotation system for recovering more grease. The company can finance a \$150,000 system at 5% per year compound interest or 5.5% per year simple interest. If the total amount owed is due in a single payment at the end of 3 years, (a) which interest rate should the company select, and (b) how much is the difference in interest between the two schemes?

Answer Example 3

- (a) Amt owed, comp'd interest =
 $150,000(1.05)(1.05)(1.05)$
- = \$173,644
- Amt owed, simple interest = $P + Pni$
- = $150,000 + 150,000(3)(0.055)$
- = $150,000 + 24,750$
- = \$174,750
-

Example 4

- Hughes Cable Systems plans to offer its employees a salary enhancement package that has revenue sharing as its main component. Specifically, the company will set aside 1% of total sales for yearend bonuses for all its employees. The sales are expected to be \$5 million the first year, \$5.5 million the second year, and amounts increasing by 10% each year for the next 5 years. At an interest rate of 8% per year, what is the equivalent annual worth in years 1 through 5 of the bonus package?

Answer Example - 4

Solve for P_g in geometric gradient equation and then convert to A :

$$A_1 = 5,000,000(0.01) = 50,000$$

$$P_g = 50,000[1 - (1.10/1.08)^5]/(0.08 - 0.10) \\ = \$240,215$$

$$A = 240,215(A/P, 8\%, 5) \\ = 240,215(0.25046) \\ = \$60,164$$

Example -5

- Burling Water Cooperative currently contracts the removal of small amounts of hydrogen sulfide from its well water using manganese dioxide filtration prior to the addition of chlorine and fluoride. Contract renewal for 5 years will cost \$75,000 annually for the next 3 years and \$100,000 in years 4 and 5. Assume payment is made at the end of each contract year. Burling Coop can install the filtration equipment for \$150,000 and perform the process for \$60,000 per year. At a discount rate of 6% per year, does the contract service still save money?

Answer Example 5

- $PWC = -75,000(P/A, 6\%, 3) - 100,000(P/A, 6\%, 2)(P/F, 6\%, 3)$
- $= -75,000(2.6730) - 100,000(1.8334)(0.8396)$
- $= \$-354,407$
- $PWB = -150,000 - 60,000(P/A, 6\%, 5)$
- $= \$-402,744$
- The contract service is a better deal with a smaller PW of costs.

Example-6

- Atari needs \$4.5 million in new investment capital
- to develop and market downloadable games software for its new GPS2-ZX system. The plan is to sell \$10,000 face-value corporate bonds at a discount of \$9000 now. A bond pays a dividend each 6 months based on a bond interest rate of 5% per year with the \$10,000 face value returned after 20 years. Will a purchase make at least 6% per year compounded semiannually?

Answer Example- 6

- Semiannual bond dividend is $10,000(0.05)/2 = \$250$ per 6 months. Semiannual
- interest rate expected is $6\%/2 = 3\%$.
- $PW = -9000 + 250(P/A, 3\%, 40) + 10,000(P/F, 3\%, 40)$
- $= -9000 + 250(23.1148) + 10,000(0.3066)$
- $= \$-155$
- No, the bond investment does not make the target rate since $PW < 0$.

Example-7

- Anderson-McKee Construction expects to invest \$835,000 for heavy equipment replacement 2 years from now and another \$1.1 million 4 years from now. How much must the company deposit into a sinking fund each month to provide for the purchases, if the fund earns a rate of return of 12% per year compounded monthly.

Answer - 7

- Solve for F at the end of year 4 and then convert to A:
- $F = 835,000(F/P, 1\%, 24) + 1,100,000$
- $= 835,000(1.2697) + 1,100,000$
- $= \$2,160,200$
- $A = 2,160,200(A/F, 1\%, 48)$
- $= 2,160,200(0.01633)$
- $= \$35,276$

Example 8

- Copper Refiner Phelps Dodge purchased a model MTVS peristaltic pump for injecting antiscalant at its nanofiltration water conditioning plant. The cost of the pump was \$950. If the chemical cost is \$10 per day, determine the equivalent cost per month at an interest rate of 12% per year compounded monthly. Assume 30 days per month and a 3-year pump life

Answer 8

Move chemical cost to end of interest period and amortize pump:

- Chemical cost/mo = $10(30) = \$300$
- $A = 950(A/P, 1\%, 36) + 300$
- $= 950(0.03321) + 300$
- $= \$331.55$

Example 9

- For the alternatives shown, determine the sum of the incremental cash flows for Alternative B - Alternative A.

	<u>Alternative A</u>	<u>Alternative B</u>
• First cost,	\$ 50,000	85,000
• Annual operating cost, \$ per year	\$8,600	\$2000
• Annual revenue, \$ per year	22,000	45,000
• Salvage value, \$	3,000	8,000
• Life, years	3	6

Answer 9

	<u>Year</u>	<u>Alternative B</u>	<u>Alternative A</u>	<u>B - A</u>
•	0	-85,000	-50,000	-35,000
•	1	43,000	13400	29,600
•	2	43,000	13400	29,600
•	3	43,000	13400-50,000+3000	76,600
•	4	43,000	13400	29,600
•	5	43,000	13400	29,600
•	6	43,000+8000	13400+3000	<u>34,600</u>
				Sum = \$194,600

Example 10

2) A firm is considering three mutually exclusive alternatives as part of the production improvement program. The alternatives are:

	A	B	C
Installed costs	\$10,000	\$15,000	\$20,000
Uniform Annual Benefit	\$1,625	\$1,625	\$1,800
Useful life in Years	10	20	20

For each alternative, the salvage value at the end of useful life is zero. At the end of 10 years, Alt A could be replaced by another A with identical cost and benefits. The MARR is 6%. If the analysis period is twenty years, which alternative should be selected?

Example 11

A battery manufacturing plant has been ordered to cease discharging acidic waste liquids containing mercury into the city sewer system. As a result, the firm must now adjust the pH and remove the mercury from its waste liquids. Three firms have provided quotations on the necessary equipment. An analysis of the quotations provided the following table of costs.

Bidder	Installed cost	Annual operating cost	Annual income from mercury recovery	Salvage value
Foxhill Instrument	\$35,000	\$8000	\$2000	\$20,000
Quicksilver	\$40,000	\$7000	\$2200	\$ 0
Almaden	\$100,000	\$2000	\$3500	\$ 0

If the installation can be expected to last twenty years and money is worth 7%, which equipment should be purchased?

Answer 11

Foxhill

$$\begin{aligned}\text{PW of Cost} &= 35,000 + (8000 - 2000)(P/A, 7\%, 20) - 20,000(P/F, 7\%, 20) \\ &= 35,000 + 6000(10.594) - 20,000(0.2584) \\ &= \$93,396.\end{aligned}$$

Quicksilver

$$\begin{aligned}\text{PW of Cost} &= 40,000 + (7000 - 2200)(P/A, 7\%, 20) \\ &= 40,000 + 4800(10.594) = \$90,851.\end{aligned}$$

Almaden

$$\begin{aligned}\text{PW of Cost} &= 100,000 + (2000 - 3500)(P/A, 7\%, 20) \\ &= 100,000 - 1500(10.594) = \$84,109.\end{aligned}$$

Select the Almaden bid

Chapter 2 Assignment and Examples

Arithmetic Series

Question - 1

- By filling carbon nanotubes with miniscule wires made of iron and iron carbide, incredibly thin nano wires could be extruded by blasting the carbon nanotubes with an electron beam. If Gentech Technologies spends \$2.7 million *now* in developing the process, how much would the company have to receive in licensing fees 3 years from now to recover its investment at 20% per year interest?

Answer question -1

- $F = 2,700,000(F/P, 20\%, 3)$
- $= 2,700,000(1.7280)$
- $= \$4,665,600$

Question 2

- French car maker Renault signed a \$95 million contract with ABB of Zurich, Switzerland, for automated underbody assembly lines, body assembly workshops, and line control systems. If ABB will be paid in 3 years (when the systems are ready), what is the present worth of the contract at 12% per year interest?

Answer to question 2

- $P = 95,000,000(P/F, 12\%, 3)$
- $= 95,000,000(0.7118)$
- $= \$67,621,000$

Question 3

- A mechanical consulting company is examining its cash flow requirements for the next 7 years. The company expects to replace office machines and computer equipment at various times over the 7-year planning period. Specifically, the company expects to spend \$7000 two years from now, \$9000 three years from now, and \$5000 five years from now. What is the present worth of the planned expenditures at an interest rate of 10% per year?

Answer to Question 3

- $P = 7000(P/F, 10\%, 2) + 9000(P/F, 10\%, 3) + 5000(P/F, 10\%, 5)$
- $= 7000(0.8264) + 9000(0.7513) + 5000(0.6209)$
- $= \$15,651$

Question 4

- A proximity sensor attached to the tip of an endoscope could reduce risks during eye surgery by alerting surgeons to the location of critical retinal tissue. If a certain eye surgeon expects that by using this technology, he will avoid lawsuits of \$0.6 and \$1.35 million 2 and 5 years from now, respectively, how much could he afford to spend now if his out-of-pocket costs for the lawsuits would be only 10% of the total amount of each suit? Use an interest rate of 10% per year.

Answer to Question 4

- $P = 600,000(0.10)(P/F, 10\%, 2) + 1,350,000(0.10)(P/F, 10\%, 5)$
- $= 60,000(0.8264) + 135,000(0.6209)$
- $= \$133,406$

Question 5

- Allen Bradley claims that its XM1Z1A and XM442 electronic overspeed detection relay modules provide customers a cost-effective monitoring and control system for turbo machinery. If the equipment provides more efficient turbine performance to the extent of \$20,000 in year 1, \$22,000 in year 2, and amounts increasing by \$2000 per year, how much could Mountain Power and Light afford to spend now at 10% per year interest if it wanted to recover its investment in 5 years?

Answer to question 5

$$P = 20,000(P/A, 10\%, 5) + 2000(P/G, 10\%, 5)$$

- $= 20,000(3.7908) + 2000(6.8618)$

- $= \$89,539.60$

Question 6

- Fomguard LLC of South Korea developed a hightech fiber-optic fencing mesh (FOM) that contains embedded sensors that can differentiate between human and animal contact. In an effort to curtail illegal entry into the United States, a FOM fence has been proposed for certain portions of the U.S. border with Canada. The cost for erecting the fence in year 1 is expected to be \$7 million, decreasing by \$500,000 each year through year 5. At an interest rate of 10% per year, what is the equivalent uniform annual cost of the fence in years 1 to 5?

Answer to Question 6

- $A = 7,000,000 - 500,000(A/G, 10\%, 5)$
- $= 7,000,000 - 500,000(1.8101)$
- $= \$6,094,950$

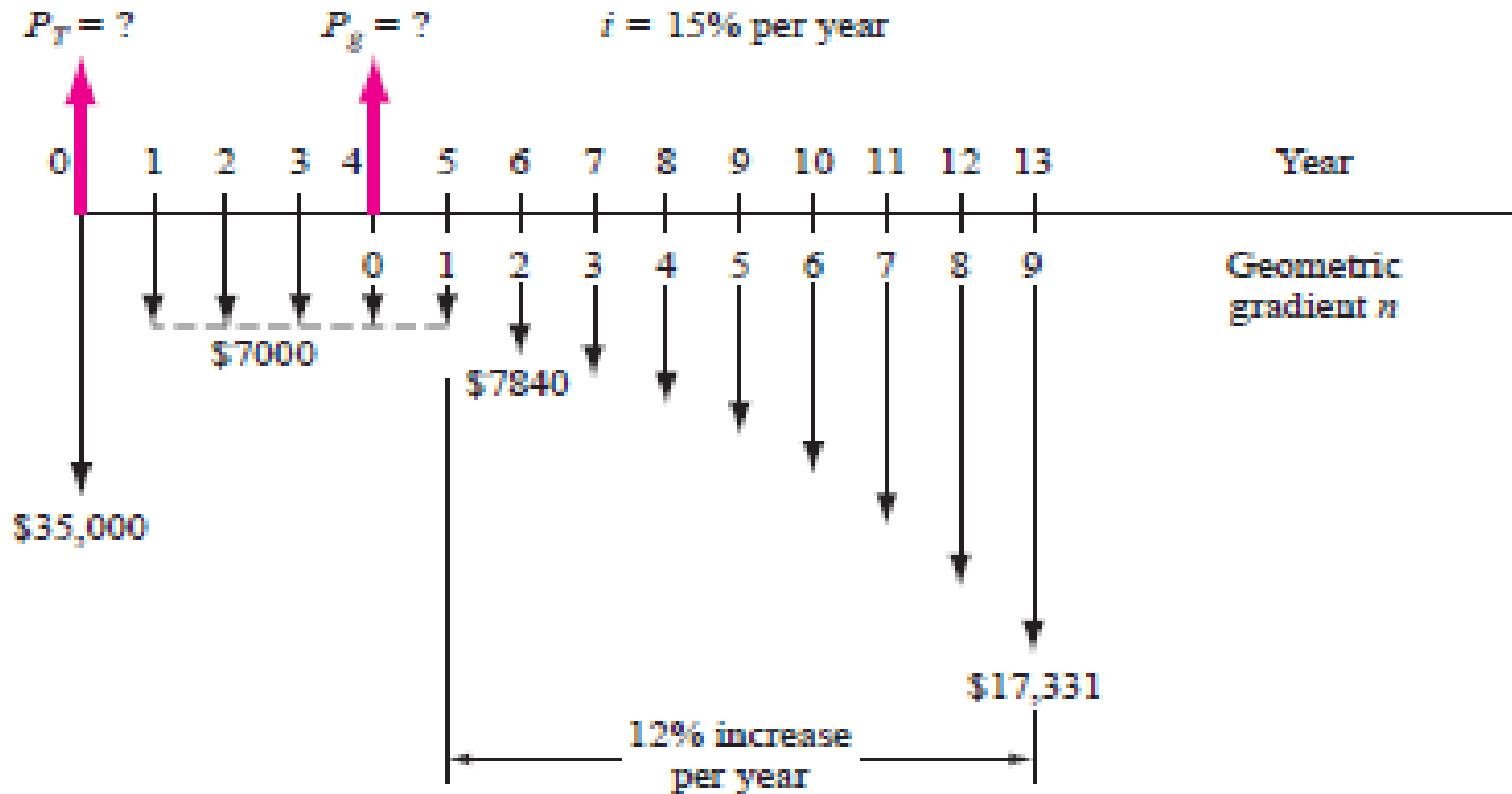
Mid-term Exam Preparation

March 2, 2021

Question -1

- Chemical engineers at a Coleman Industries plant in the Midwest have determined that a small amount of a newly available chemical additive will increase the water repellency of Coleman's tent fabric by 20%. The plant superintendent has arranged to purchase the additive through a 5-year contract at \$7000 per year, starting 1 year from now. He expects the annual price to increase by 12% per year starting in the sixth year and thereafter through year 13. Additionally, an initial investment of \$35,000 was made now to prepare a site suitable for the contractor to deliver the additive. Use $i=15\%$ per year to determine the equivalent total present worth for all these cash flows.

Answer question-1



Answer

$g = 0.12$ and $i = 0.15$.

P_g is used to determine the present worth

P_g for the entire geometric series at actual year 4, which is moved to year 0 using $(P/F, 15\%, 4)$.

$$\begin{aligned} P_T &= 35,000 + A(P/A, 15\%, 4) + A_1(P/A, 12\%, 15\%, 9)(P/F, 15\%, 4) \\ &= 35,000 + 7000(2.8550) + \left[7000 \frac{1 - (1.12/1.15)^9}{0.15 - 0.12} \right] (0.5718) \\ &= 35,000 + 19,985 + 28,247 \\ &= \$83,232 \end{aligned}$$

Question - 2

An engineer planning for retirement decides that she wants to have income of \$100,000 per year for 20 years with the first withdrawal beginning 30 years from now. If her retirement account earns interest at 8% per year, the annual amount she would have to deposit for 29 years beginning 1 year from now is closest to

Answer to Question- 2

- $P_{29} = 100,000(P/A, 8\%, 20)$
- $= 100,000(9.8181)$
- $= \$981,810$
-
- $F_{29} = P_{29}$
- $A = F_{29}(A/F, 8\%, 29)$
- $= \$981,810(A/F, 8\%, 29)$
- $= \$981,810(0.00962)$
- $= \$9445$
-

Question - 3

Atlas Long-Haul Transportation is considering installing Valutemp temperature loggers in all of its refrigerated trucks for monitoring temperatures during transit. If the systems will reduce insurance claims by \$40,000 per year for 5 years, how much should the company be willing to spend now if it uses an interest rate of 12% per year compounded quarterly?

Answer - 3

- 3.28 $i/\text{yr} = (1 + 0.03)^4 - 1 = 12.55\%$
- $P = 40,000(P/A, 12.55\%, 5)$
- $= 40,000(3.5562)$
- $= \$142,248$

Question 4

The Bureau of Indian Affairs provides various services to American Indians and Alaskan Natives. The Director of Indian Health Services is working with chief physicians at some of the 230 clinics nationwide to select the better of two medical X-ray system alternatives to be located at secondary-level clinics. At 5% per year, select the more economical system.

	Del Medical	Siemens
First cost, \$	−250,000	−224,000
Annual operating cost, \$ per year	−231,000	−235,000
Overhaul in year 3, \$	—	−26,000
Overhaul in year 4, \$	−140,000	—
Salvage value, \$	50,000	10,000
Expected life, years	6	6

Answer to Question 4

- Monetary units are in \$1000. Calculate PW values to select Siemens.

-

- $$\begin{aligned} PW_{Del} &= -250 - 231(P/A, 5\%, 6) - 140(P/F, 5\%, 4) + 50(P/F, 5\%, 6) \\ &= -250 - 231(5.0757) - 140(0.8227) + 50(0.7462) \\ &= \$-1500.355 \quad (\$-1,500,355) \end{aligned}$$

-

- $$\begin{aligned} PW_{Sie} &= -224 - 235(P/A, 5\%, 6) - 26(P/F, 5\%, 3) + 10(P/F, 5\%, 6) \\ &= -224 - 235(5.0757) - 26(0.8638) + 10(0.7462) \\ &= \$-1431.786 \quad (\$-1,431,786) \end{aligned}$$

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Question - 5

The president of GE Healthcare is considering an external long-term contract offer that will significantly improve the energy efficiency of their imaging systems. The payment schedule has two large payments in the first years with continuing payments thereafter. The proposed schedule is \$200,000 now, \$300,000 four years from now, \$50,000 every 5 years, and an annual amount of \$8000 beginning 15 years from now. Determine the capitalized cost at 6% per year.

Answer - 5

-
- Monetary terms are in \$1000 units.
-
- $$CC = -200 - 300(P/F, 6\%, 4) - 50(A/F, 6\%, 5)/0.06 - (8/0.06)(P/F, 6\%, 14)$$
- $$= -200 - 300(0.7921) - 50(0.1774)/0.06 - (8/0.06)(0.4423)$$
- $$= \$-644.437 \quad (\$-644,437)$$

Question 6

A major repair on the suspension system of Jane's 3-year old car cost her \$2,000 because the warranty expired after 2 years of ownership. Based on this experience, she will plan on additional \$2000 expenses every 3 years henceforth. Also, she spends \$800 every 2 years for maintenance now that the warranty is over. This is for years 2, 4, 6, 8, and 10 when she plans to donate the car to charity. Use these costs to determine Jane's equivalent perpetual annual cost (for years 1 through infinity) at $i = 5\%$ per year, if cars she owns in the future have the same cost pattern.

Answer to Question 6

- $AW_{800} = \{-800[(P/F, 5\%, 2) + (P/F, 5\%, 4) + (P/F, 5\%, 6) + (P/F, 5\%, 8)$
- $\quad \quad \quad + (P/F, 5\%, 10)]\}(A/P, 5\%, 10)$
- $\quad \quad \quad = \{-$
- $800[(0.9070) + (0.8227) + (0.7462) + (0.6768) + (0.6139)]\}(0.12950)$
- $\quad \quad \quad = \$-390$
-
- $AW_{2000} = \{-2000[(P/F, 5\%, 3) + (P/F, 5\%, 6) + (P/F, 5\%, 9)]\}(A/P, 5\%, 10)$
- $\quad \quad \quad = \{-2000[(0.8638) + (0.7462) + (0.6446)]\}(0.12950)$
- $\quad \quad \quad = \$-584$
-
- $\quad \quad \quad \text{Total AW} = -390 - 584$
- $\quad \quad \quad = \mathbf{\$ -974 \text{ per year}}$