

**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 7: ETHICS & CONTRACTS

TOPICS COVERED IN TEST 7:

- 1. FUNDAMENTALS OF ETHICS IN ENGINEERING**
- 2. FUNDAMENTALS OF LEGAL ASPECTS OF
CONTRACTUAL CLAUSES**

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
ETHICS AND CONTRACTS TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
March 8, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

Name: _____

1. In a self-regulated profession,
 - a. the professional engineer controls training and evaluation criteria
 - b. professional boards and societies control training and evaluation criteria
 - c. the supervisor controls training and evaluation criteria
 - d. country's president controls training and evaluation criteria

2. A code of ethics is a set of
 - a. guidelines
 - b. regulations
 - c. policies
 - d. affidavits

3. If a contract does not include the boilerplate cause, "Time is of the essence," which of the following is true?
 - a. It is difficult to recover losses for extra hours billed
 - b. Standard industry time guidelines apply
 - c. Damages for delay cannot be claimed
 - d. Workers need not be paid for downtime in the project

4. Registered engineers' first obligation/consideration to society is
 - a. public safety
 - b. public welfare
 - c. steal cement and sale on Ebay
 - d. to meet the needs of a particular enterprise

5. "Full prior disclosure" is a phrase used to hedge against

- a. misunderstandings
- b. misinterpretations
- c. both A & C
- d. None of the above

6. Winning contracts through bribery is a form of

- a. fair competition
- b. unfair competition
- c. acceptable in the USA
- d. None of the above

7. In which of the following fee structures is a specific sum paid to the engineer *for each day* spent on the project?

- a. Salary plus
- b. Per-diem fee
- c. Lump-sum fee
- d. Cost plus fixed rate

8. Groundwater resource in a community is polluted and many have been diagnosed with cancer. Would it be ethical to call in some of the affected individuals to the court to testify during a trial against a battery manufacturing company that is *suspected* of polluting the ground with disposal of highly toxic chemicals on the land?

- a. YES
- b. NO
- c. Not without consent of the individuals

9. Engineers are to uphold the health, safety, and public _____.

- a. welfare
- b. support
- c. trust
- d. confidence

10. An engineer working for a large consulting firm has decided to establish his own business. Although the new business is several months from start-up, the engineer should

- a. discuss his plans with his current supervisor
- b. resign immediately
- c. tell his colleagues of his plans
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11. An American Society of Civil Engineers (ASCE) member and geotechnical engineer is contacted by a local structural engineer with a proposal concerning a large subdivision project on which the structural engineer has been retained to perform work. The structural engineer informs the member that the owner is seeking to retain a geotechnical engineer to perform work on the subdivision project and that he, the structural engineer, is prepared to recommend the ASCE member to the owner. However, in exchange, the structural engineer would expect the member to pay him a flat fee of \$500 for each lot the member is engaged to perform work on as a “referral fee.” The structural engineer claims that the owner of the subdivision plot is aware of and has agreed to this proposed financial arrangement between the structural engineer and the member. Concerned with the ethical implications of this transaction, the member contacts the ASCE ethics hotline, which in turn forwards the question to the Committee on Professional Conduct for its views on the matter.

Which of the following statements are *applicable*?

The members of the Committee on Professional Conduct felt that, if the subdivision owner were unaware of the proposed financial transaction between the geotechnical engineer and the structural engineer, the payment of a referral fee to the structural engineer would raise clear ethical concerns under Canon 4 of the ASCE code of ethics, which reads as follows: “Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.”

While the committee members were skeptical that an owner would voluntarily accept this type of financial transaction, they also felt that the owner’s agreement did not remove the ethical taint from the payment. Canon 5 of the ASCE Code of Ethics reads as follows: “Engineers shall build their professional reputations on the merit of their services and shall not compete unfairly with others.”

The committee members felt that the payment of a fee in exchange for the structural engineer’s recommendation was inconsistent with the strictures on gratuities for securing work.

The American Bar Association code does permit “reciprocal referral agreements” among attorneys whereby attorneys agree to refer prospective clients to one another as long as these arrangements are not exclusive and the client is made aware of the existence and nature of them.

- a. All 4 statements
- b. Only statement #4
- c. Statements 1, 2 and 3
- d. Only Statements 2 and 3

12. A registered engineer is being interviewed for television on a matter relating to his expertise that affects the public safety. The interviewer asks a question about the chances for a cure for AIDS. The engineer should
- a. express his opinion honestly and completely
 - b. decline to comment
 - c. recount what he read in a magazine article on the subject
 - d. suggest everyone get an AIDS test
13. A registered engineer has applied for a promotion at a firm she has been working at for several years. During an interview for the new position, she is asked to contrast her qualifications with other registered engineers at the firm who have applied for the same position. She should
- a. withdraw her application for the position
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 - c. demand to speak to the interviewer's supervisor
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 - c. inform the opposing party of the findings.
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15. A tort is
- a. a civil wrong committed against another person
 - b. a section of a legal contract
 - c. a legal procedure in which complaints are heard in front of an arbitrator rather than a judge or jury
 - d. the breach of a contract

ABOVE AVERAGE

(x1)

13
15 P

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
ETHICS AND CONTRACTS TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
March 8, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

Name: Paige Hines

1. In a self-regulated profession,

- ☒ a. the professional engineer controls training and evaluation criteria
- ☐ b. professional boards and societies control training and evaluation criteria
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3. If a contract does not include the boilerplate cause, "Time is of the essence," which of the following is true?

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AVERAGE

**Student sample work could
not be collected on request**

BELOW AVERAGE

(1)
08/15

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
ETHICS AND CONTRACTS TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
March 8, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

Name: Autumn Carter

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**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 8: STRUCTURAL ANALYSIS

TOPICS COVERED IN TEST 8:

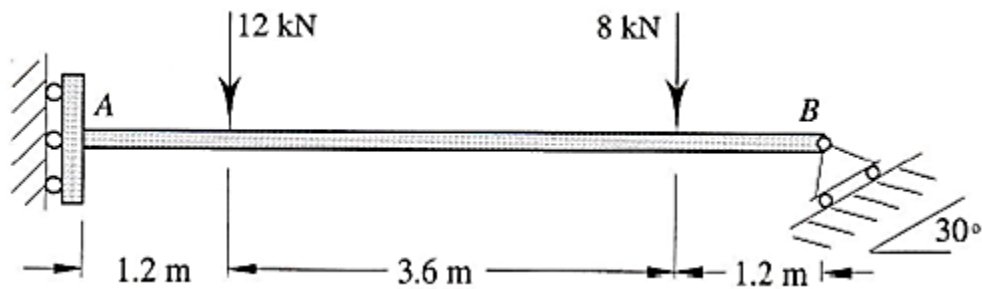
**1. FUNDAMENTALS OF DETERMINATE AND
INDETERMINAL STRUCTURES ANALYSIS**

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
STRUCTURES TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
March 22, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

Name: _____

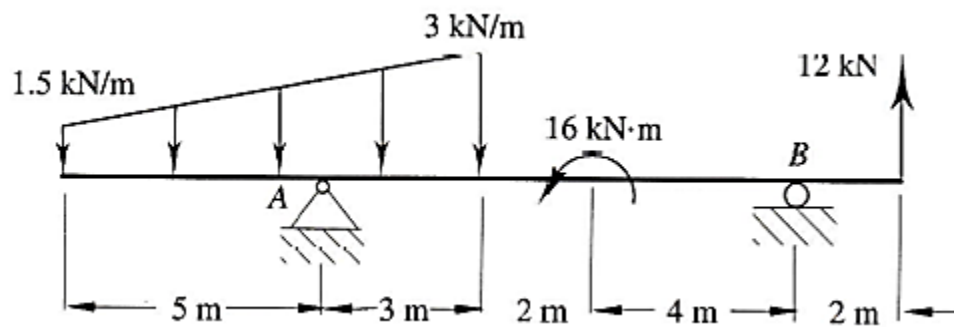
10 Problems Only

1. Find the moment at A. The support at A transmits axial force and bending moment but does not transmit shear.



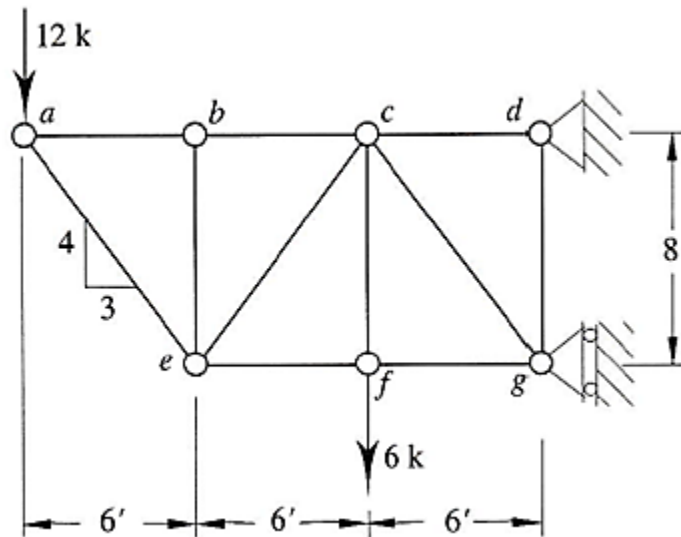
- a. 67 kN.m
- b. 87 kN.m
- c. 117 kN.m
- d. None of the above

2. Find the reaction at B.



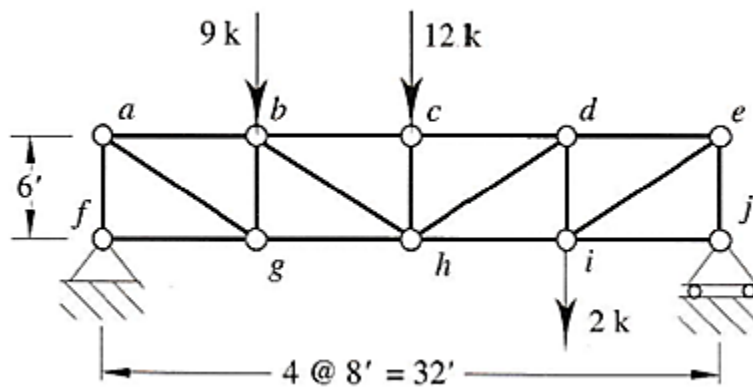
- a. 19.5 kN
- b. 17.5 kN
- c. 14.5 kN
- d. None of the above

3. Find the member force in be .



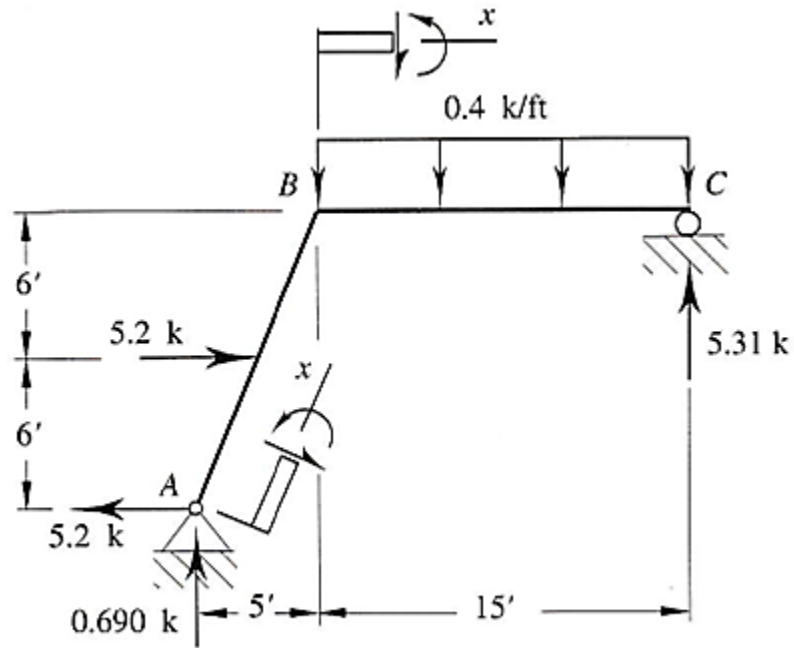
- a. 5 kip
- b. 1 kip
- c. 0 kip
- d. None of the above

4. Find, most nearly, the member tension force in dh .



- a. 13 kip
- b. 19 kip
- c. 0 kip
- d. None of the above

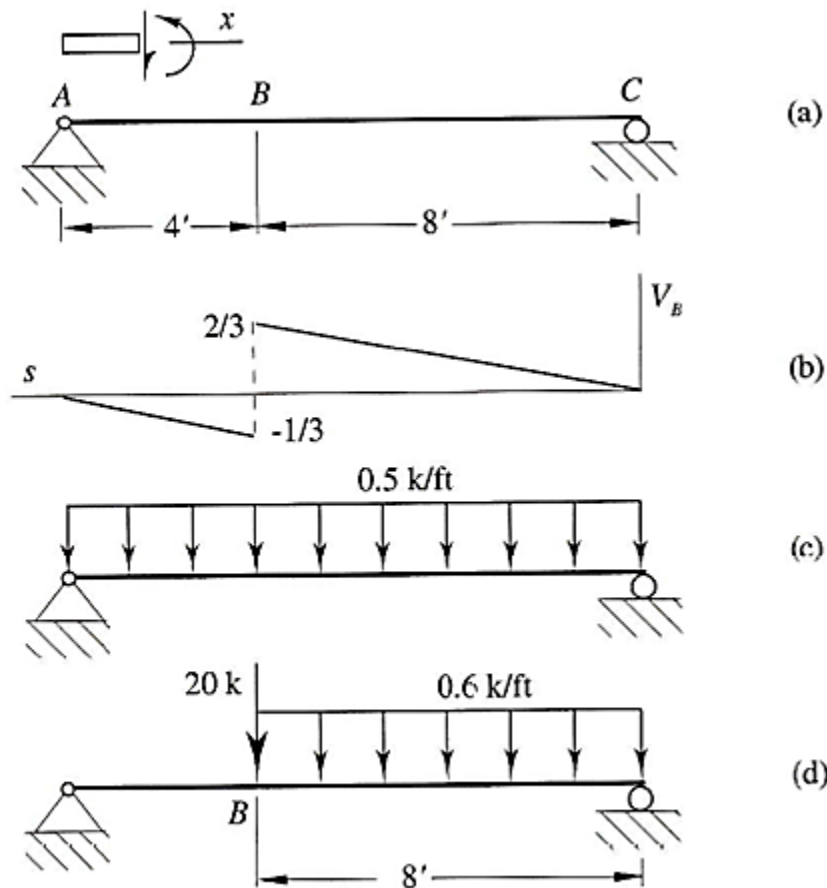
5. Find, most nearly, the maximum shear force in link AB of the frame ABC.



- a. 12 kip
- b. 19 kip
- c. 5 kip
- d. 10 kip

6. The Influence Line for the Shear Force at B of the simply supported beam is given in (b). Dead load is 0.5 kip/ft uniformly placed on the entire beam as shown in (c). Live load consists of a 20 kip concentrated load at B and 0.6 kip/ft uniformly distributed load from B to C, as shown in (d).

The shear force at B due to the Dead Load only is most nearly:

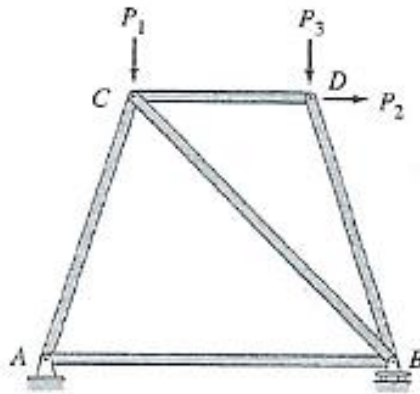


- a. 0.5 kip
- b. 1 kip
- c. 1.5 kip
- d. None of the above

7. The *Maximum* (positive) Live shear force at B of Problem #6 is most nearly:

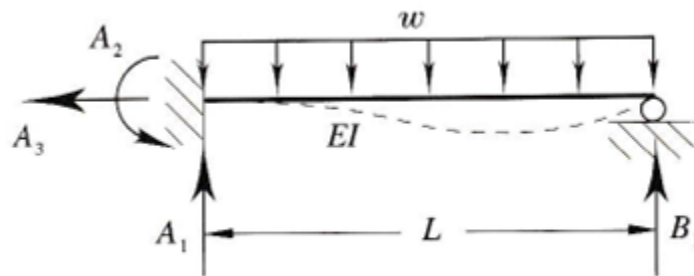
- a. 15 kip
- b. 3 kip
- c. 20 kip
- d. None of the above

8. The truss in the figure, with P_1 , P_2 and P_3 known forces, is:



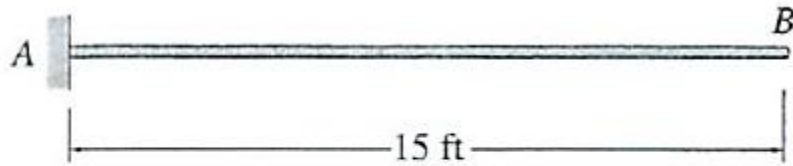
- a. Statically stable
- b. Statically unstable

9. Determine the reaction at B of the propped cantilever beam. Suggest using the Force Method.



- a. $3wL/32$
- b. $3wL/16$
- c. $3wL/8$
- d. None of the above

10. The Influence Line value at point B of the cantilever beam is most nearly:



$$\begin{aligned}EI &= \text{constant} \\ E &= 29,000 \text{ ksi} \\ I &= 500 \text{ in.}^4\end{aligned}$$

- a. -0.0221 ft/k
- b. -0.0555 ft/k
- c. -0.0112 ft/k
- d. -0.0421 ft/k

ABOVE AVERAGE

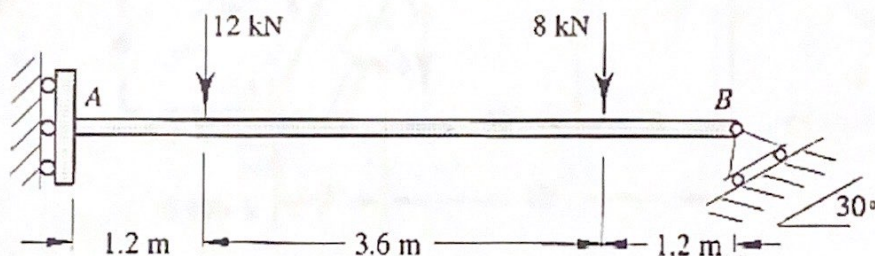
Department of Civil & Environmental Engineering
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STRUCTURES TEST
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March 22, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

10/10 P

Name: Jerral T. Walker

10 Problems Only

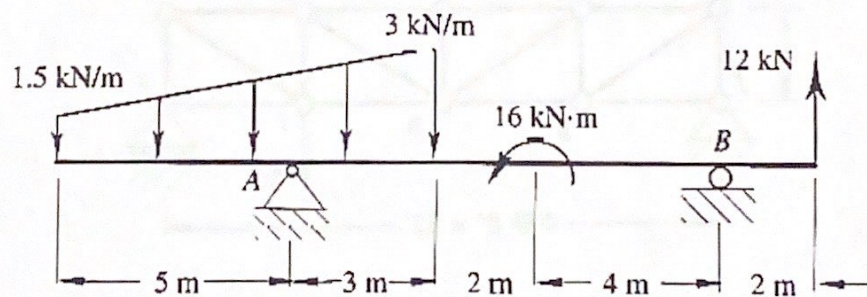
1. Find the moment at A. The support at A transmits axial force and bending moment but does not transmit shear.



$-67.2 \text{ N}\cdot\text{m} \rightarrow 67.2 = M_A$

- a. 67 kN.m
- b. 87 kN.m
- c. 117 kN.m
- d. None of the above

2. Find the reaction at B.



$17.5 \text{ kN} = R_B = 17.5 \text{ kN}$

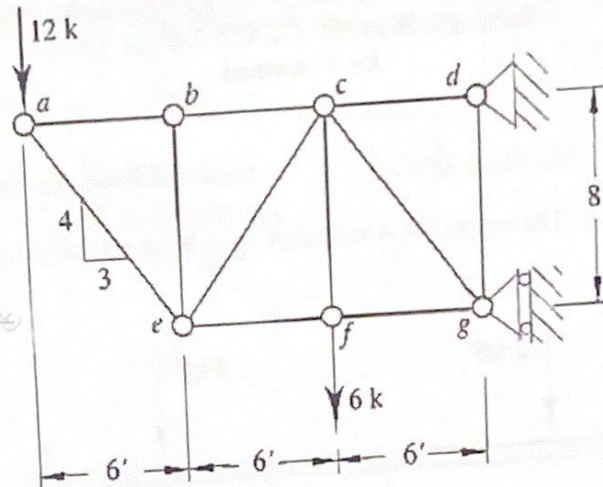
- a. 19.5 kN
- b. 17.5 kN
- c. 14.5 kN
- d. None of the above

$$\begin{aligned}
 \sum M_A &= 19(16) - 4.5(8)(8+6) - \frac{1}{2}(3-1.5)(8)(8) \\
 &\quad - (6 + \frac{1}{2} \times 8) - 12(2) = 0 \\
 R_A &= \frac{221}{9} = 23.55 \text{ kN} \\
 R_A + R_B - 10.5(8) - \frac{1}{2}(3-1.5)(8) - 12 &= 0 \\
 R_B &= -17.55 \text{ kN}
 \end{aligned}$$

3. Find the member force in be .

length of $ae = \sqrt{6^2 + 8^2} = 10'$

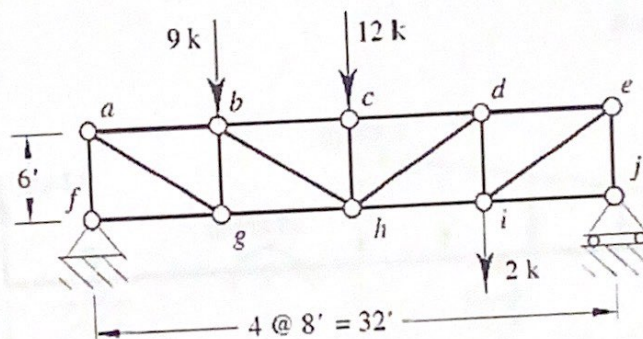
$\sum F_y = 0$
 $12k + F_{ae} \sin \theta = 0$
 $F_{ae} \sin \theta = -12$
 $F_{ae} = \frac{-12}{\frac{8}{10}} = -15k$
 $\sum F_x = 0; F_{ay} + F_{ae} \cos \theta = 0$
 $F_{ay} = 9k$
 At joint e
 $\sum F_y = 0; F_{be} = 0$



Take joint e
 $\sin \theta = \frac{8}{10} = \frac{4}{5}$
 $\cos \theta = \frac{6}{10} = \frac{3}{5}$
 $12k$
 $F_{ae} \sin \theta$
 $F_{ae} \cos \theta$

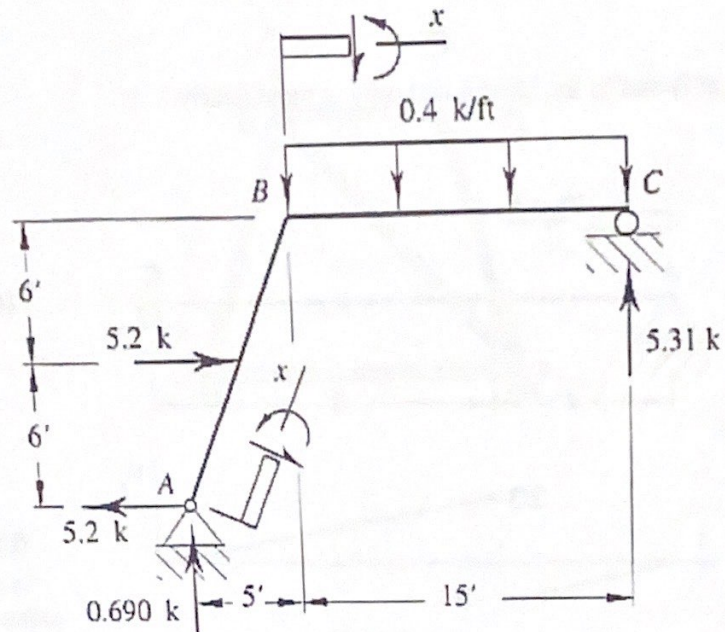
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$$\sum L_y = 0$$

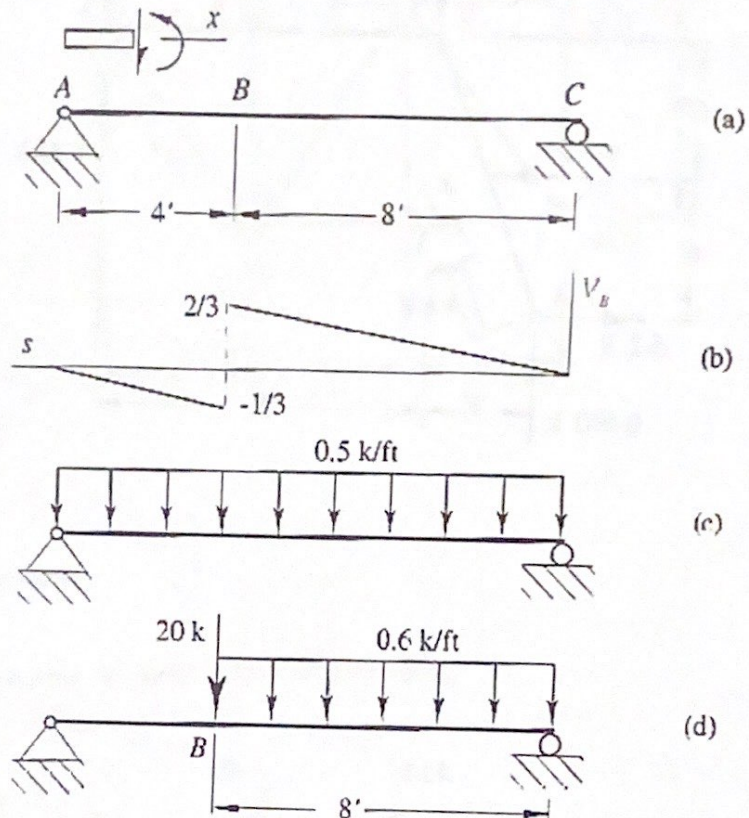
$$4.8 + V_1 = 0.215 \cdot 3$$

$$V_1 = -4.584 \uparrow$$

$$-4.584 \approx 5$$

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- d. None of the above

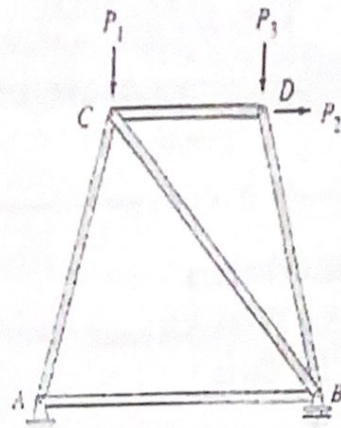
$$= -\frac{1}{2} \times 4 \times 0.5 \times \frac{1}{3} + \frac{1}{2} \times \frac{2}{3} \times 8' \times 0.5$$

$$SF_B = 1 \text{ kip}$$

7. The Maximum (positive) Live shear force at B of Problem #6 is most nearly:

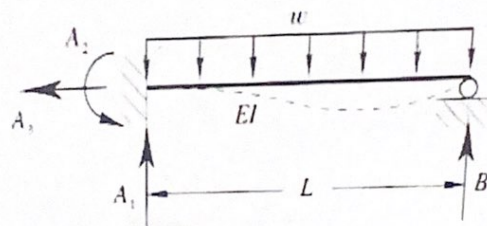
- ☒ a. 15 kip
- b. 3 kip
- c. 20 kip
- d. None of the above

8. The truss in the figure, with P_1 , P_2 and P_3 known forces, is:



- a. Statically stable
- b. Statically unstable

9. Determine the reaction at B of the propped cantilever beam. Suggest using the Force Method.

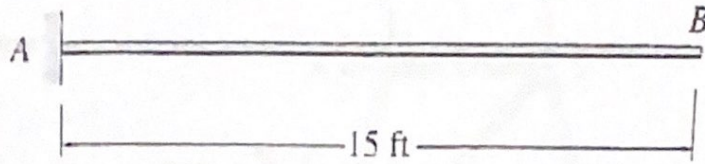


- a. $3wL/32$
- b. $3wL/16$
- c. $3wL/8$
- d. None of the above

$$\frac{wL^4}{8EI} - \frac{B_1 L^3}{3EI} = 0$$

$$B_1 = \frac{3wL}{8}$$

10. The Influence Line value at point B of the cantilever beam is most nearly:



$$EI = \text{constant}$$
$$E = 29,000 \text{ ksi}$$
$$I = 500 \text{ in.}^4$$

- a. -0.0221 ft/k
- b. -0.0555 ft/k
- c. -0.0112 ft/k
- d. -0.0421 ft/k

AVERAGE

**Student sample work could
not be collected on request**

BELOW AVERAGE

**Student sample work could
not be collected on request**

**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 9: WATER RESOURCES ENGINEERING

TOPICS COVERED IN TEST 9:

**1. WATER RESOURCES ENGINEERING TOPICS:
HYDROLOGY AND HYDRAULICS**

Prairie View A&M University
College of Engineering
CVEG 3051: Professional Engineering

WRE: Hydrology & Hydraulics Test (Take Home/Keep Confidential)
(A Handout is Included for SCS Method of Peak Discharge Estimation)

Assigned: March 14, 2022 (Via CANVAS/Assignments)

Due (Hard Copy): March 29, 2022 (5 PM, In class, In Person)

Start Early!!

Name: _____

Please circle a single answer for each problem. There are 15 multiple-choice questions.
(Use scratch papers; do not turn those in)

1. A three-pipe loop system is shown with steady-state inflow of 100 cfs at junction A and two flow demand junctions at B and C. **It is known that the summation of friction head losses around a loop is equal to zero.** Using this concept, and the information given below, solve for the velocity of flow in pipe 3. Use Darcy-Weisbach formula for friction head loss and no other!

Given:

$Q_1 = 40$ cfs $Q_2 = 60$ cfs $f = 0.03$ (for all pipes)

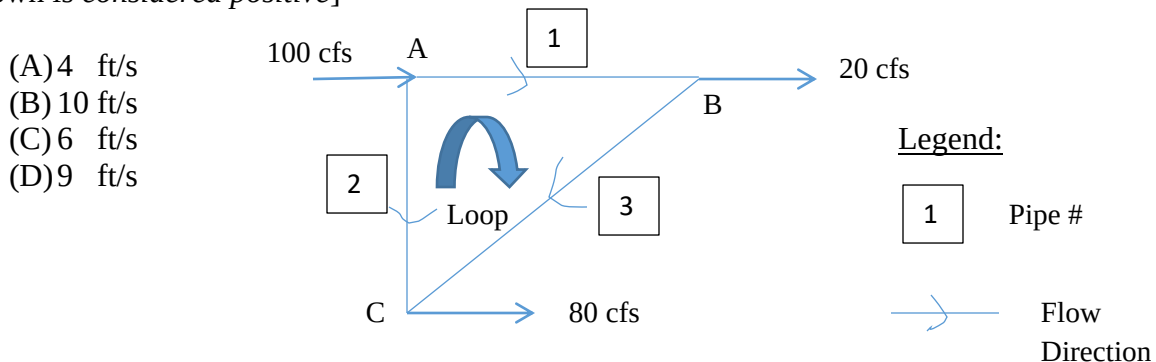
$D_3 = 1.5$ ft $g = 32.2$ ft/s²

Friction head loss through pipe 1 = 1.7 ft

$L_3 = 60$ ft

Friction head loss through pipe 2 = 2.0 ft

[Hint: friction head loss in pipes with flow in the direction of the loop's direction (clockwise) shown is considered positive]



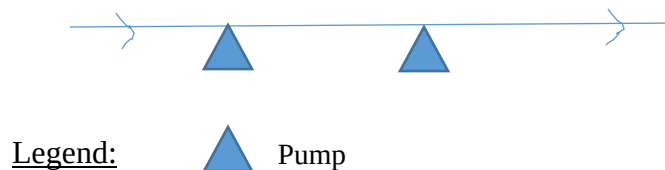
2. Two pumps are connected in *series* in a single pipeline. Find the *combined efficiency* of the pumps at $Q = 2000$ gpm (gallons per minute), given the following data. See figure.

At $Q = 1000$ gpm: H_1 = head provided by pump 1 = 85 ft
 H_2 = head provided by pump 2 = 140 ft
 η_1 = efficiency of pump 1 = 40%
 η_2 = efficiency of pump 2 = 52%

At $Q = 2000$ gpm: H_1 = head provided by pump 1 = 75 ft
 H_2 = head provided by pump 2 = 125 ft
 η_1 = efficiency of pump 1 = 60%
 η_2 = efficiency of pump 2 = 70%

Answer choices for Problem #2:

- (A) 76%
- (B) 56%
- (C) 66%
- (D) 36%

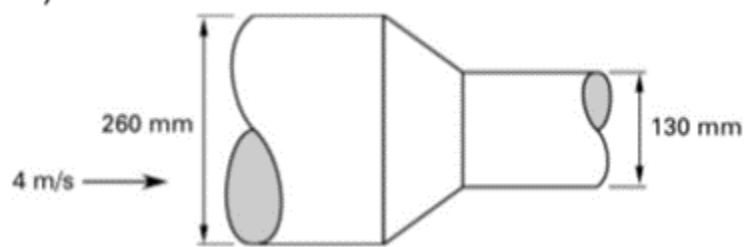


3. A $200 \text{ m}^3/\text{s}$ flow in a trapezoidal channel ($n = 0.015$) is steady and *uniform*. Bottom width and side slopes are 10 m and 2:1 (z:1), respectively. If the flow depth for that condition is 4m, channel slope **and** average shear stress fluid exerts on the channel bed are nearly, respectively:

- (A) $5.0\text{e-}4$ m/m; 12.0 N/m^2
- (B) $7.0\text{e-}4$ m/m; 14.0 N/m^2
- (C) $9.0\text{e-}4$ m/m; 16.0 N/m^2
- (D) None of the above

4. The speed of an incompressible fluid is 4 m/s entering the 260 mm pipe. The speed in the 130 mm pipe is most nearly:

- (A) 40 m/s
- (B) 9 m/s
- (C) 16 m/s
- (D) 12 m/s



5. A hydraulic jump occurs in a wide rectangular channel. The upstream depth and velocity are 0.4m, and 13 m/s, respectively. The downstream flow depth **and** the head loss across the jump are nearly, respectively:

[Specific weight of water = 9810 N/m^3 ; $g = 9.81 \text{ m/s}^2$]

- (A) 4.5 m; 6.7 m
- (B) 5.8 m; 6.7 m
- (C) 6.0 m; 5.0 m
- (D) 3.5 m; 5.5 m

Problems 6-7: Use the SCS (soil conservation service) curve number (CN) handout

Given a 7 mi² fully *pervious* watershed of Group-2 soil characteristics,

6. Use the SCS Curve Number method to find, nearly, the surface runoff depth in *inches*. Gross rainfall depth from a 24-hour storm is 12 inches. The curve number, CN, is 61.

- (A) 8.46 inches
- (B) 7.63 inches
- (C) 6.72 inches
- (D) None of the above

7. Find, nearly, the “time of concentration” in *minutes* using the Federal Aviation Administration (FAA) equation. Runoff coefficient, $C = 0.37$, land slope, $S = 0.091$, overland flow length, $L = 20,000$ feet.

- (A) 400 min
- (B) 500 min
- (C) 900 min
- (D) 200 min

8. A two-day storm's rainfall depths are given in the table. Φ -index is 1.1 mm/hr. A 12-hour UH hydrograph is said to be available for the watershed. The direct runoff depth for the first 12 hours of the second day is nearly:

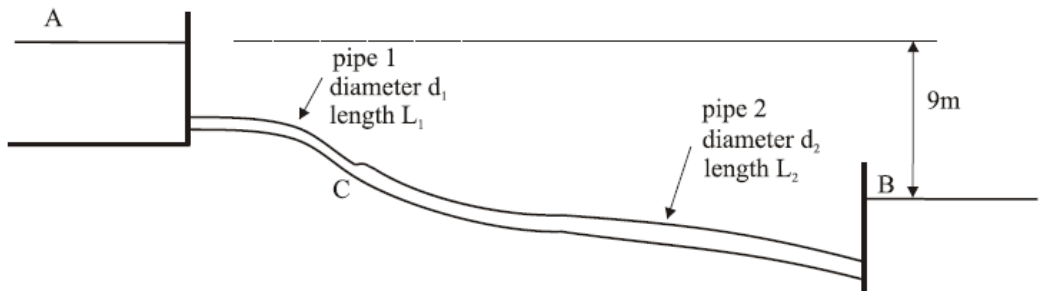
Time period (hour)	Rainfall depth (cm)
0-12	2.4
12-24	5.5
24-36	1.0
36-48	4.8

- (A) 0 cm
- (B) 1.0 cm
- (C) 4.0 cm
- (D) None of the above

9. The direct runoff depth for the last 12 hours of the second day of Problem #8 is nearly:

- (A) 3.5 cm
- (B) 4.5 cm
- (C) 4.8 cm
- (D) None of the above

10. A full direct runoff hydrograph (DRH) contributes 3.53 cm of runoff depth. If the DRH discharge at $t = 0.5$ days (or 12 hours) *after* runoff begins (at $t = 0$) is $235 \text{ m}^3/\text{s}$, the corresponding unit hydrograph's (UH) discharge value at that *same time* $t = 0.5$ days is nearly:
- (A) 85 cms
(B) 92 cms
(C) 72 cms
(D) 46 cms
11. For a return period (or recurrence interval) of 100 years, the probability of a discharge of 15,000 cfs at a location in a river equaling or exceeding once in the next 20 years is nearly:
- (A) 0.100
(B) 0.143
(C) 0.259
(D) 0.182
12. Consider the two reservoirs shown in the figure, connected by a single pipe that *changes diameter* over its length. The surfaces of the two reservoirs have a difference in level of 9m. The pipe has a diameter of 200 mm for the first 15m (from Reservoir A to C) then a diameter of 250 mm for the remaining 45m (from C to Reservoir B). For the entrance loss use $k_L = 0.5$, and for exit loss use $k_L = 1.0$. The expansion at C is *sudden*. For both pipes, $f = 0.01$. **Find the steady-state flow rate, Q , through the pipes.** **HINT:** Consider series pipe head loss concept with Darcy-Weisbach friction loss formula.



Answer choices for Problem #12:

- (A) 0.500 cms
- (B) 0.623 cms
- (C) 0.261 cms
- (D) 1.560 cms

13. At 15°C water temperature, vapor pressure of water is 1.70 kN/m². The saturation vapor pressure at that temperature of water is nearly:
[Given: specific weight of Mercury = 845.52 lb/ft³)

- (A) 0.504 inches of Hg
- (B) 1.450 inches of Hg
- (C) 0.755 inches of Hg
- (D) None of the above

14. At 25°C *air* temperature, the saturation vapor pressure at some temperature of water (not specified here) is 0.940 inches of Hg. If the relative humidity is 30%, the actual vapor pressure of the overlying air is nearly:

- (A) 0.421 inches of Hg
- (B) 0.342 inches of Hg
- (C) 0.282 inches of Hg
- (D) None of the above

15. If rainfall rate (in/hr) exceeds the infiltration capacity (in/hr) of a particular type of soil, then the actual infiltration rate is:

- (A) Equal to the rainfall rate
- (B) Greater than the rainfall rate
- (C) Equal to the infiltration capacity
- (D) None of the above

ABOVE AVERAGE

13
15

P

Prairie View A&M University
College of Engineering
CVEG 3051: Professional Engineering

WRE: Hydrology & Hydraulics Test (Take Home/Keep Confidential)
(A Handout is Included for SCS Method of Peak Discharge Estimation)

Assigned: March 14, 2022 (Via CANVAS/Assignments)

Due (Hard Copy): March 29, 2022 (5 PM, In class, In Person)

Start Early!!

Name: Perla Zaldivar

Please circle a single answer for each problem. There are 15 multiple-choice questions.
(Use scratch papers; do not turn those in)

1. A three-pipe loop system is shown with steady-state inflow of 100 cfs at junction *A* and two flow demand junctions at *B* and *C*. **It is known that the summation of friction head losses around a loop is equal to zero.** Using this concept, and the information given below, solve for the velocity of flow in pipe 3. Use Darcy-Weisbach formula for friction head loss and no other!

Given:

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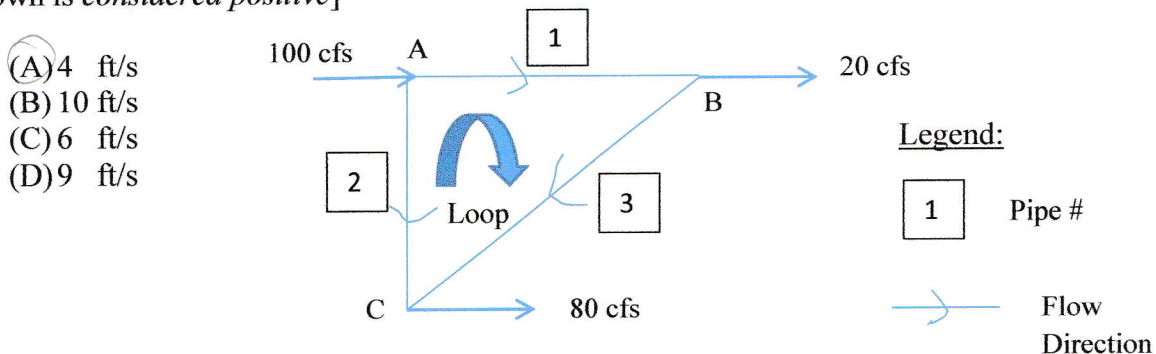
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[Hint: friction head loss in pipes with flow in the direction of the loop's direction (clockwise) shown is considered positive]



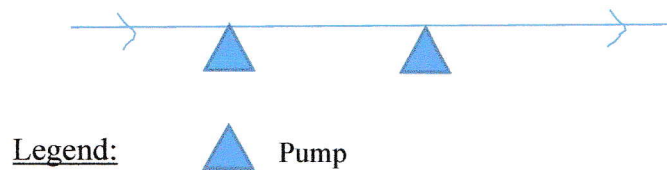
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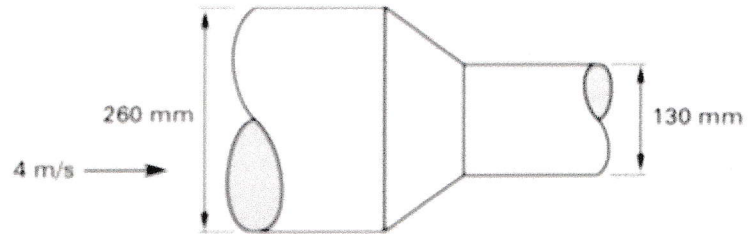


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- ☒ (C) $9.0\text{e-}4$ m/m; 16.0 N/m^2
- ~~(D) None of the above~~

4. The speed of an incompressible fluid is 4 m/s entering the 260 mm pipe. The speed in the 130 mm pipe is most nearly:

- (A) 40 m/s
- (B) 9 m/s
- (C) 16 m/s
- (D) 12 m/s



$$4(260) = 13(V)$$

5. A hydraulic jump occurs in a wide rectangular channel. The upstream depth and velocity are 0.4m, and 13 m/s, respectively. The downstream flow depth **and** the head loss across the jump are nearly, respectively:
 [Specific weight of water = 9810 N/m³; g = 9.81 m/s²]

- (A) 4.5 m; 6.7 m
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Time period (hour)	Rainfall depth (cm) mm
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12-24 1 day	5.5 55
24-36	1.0 10
36-48 2 days	4.8 48

- (A) 0 cm
(B) 1.0 cm
(C) 4.0 cm
(D) None of the above

9. The direct runoff depth for the last 12 hours of the second day of Problem #8 is nearly:

- (A) 3.5 cm
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10. A full direct runoff hydrograph (DRH) contributes 3.53 cm of runoff depth. If the DRH discharge at $t = 0.5$ days (or 12 hours) *after* runoff begins (at $t = 0$) is $235 \text{ m}^3/\text{s}$, the corresponding unit hydrograph's (UH) discharge value at that *same time* $t = 0.5$ days is nearly:

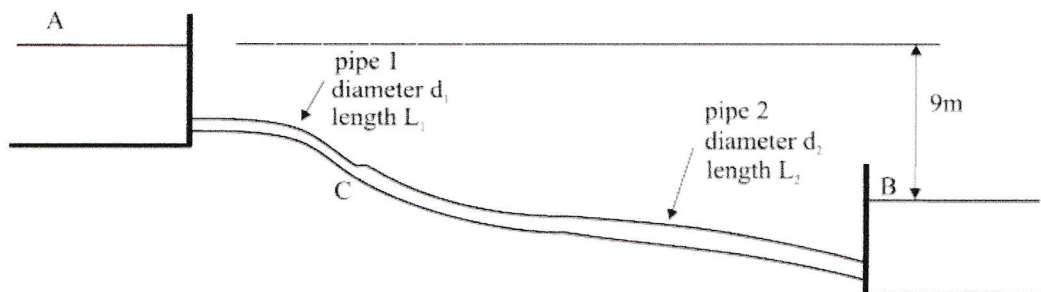
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+1

11. For a return period (or recurrence interval) of 100 years, the probability of a discharge of 15,000 cfs at a location in a river equaling or exceeding once in the next 20 years is nearly:

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[Given: specific weight of Mercury = 845.52 lb/ft³)

- ☒ (A) 0.504 inches of Hg
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T_{water} = 15°C
1.70 kN/m²

14. At 25°C *air* temperature, the saturation vapor pressure at some temperature of water (not specified here) is 0.940 inches of Hg. If the relative humidity is 30%, the actual vapor pressure of the overlying air is nearly: *e_a*

- (A) 0.421 inches of Hg
- (B) 0.342 inches of Hg
- ☒ (C) 0.282 inches of Hg
- (D) None of the above

T = 25°C
0.940 in Hg = e_w
e_a = (rel hum.) e_w
= 0.30 (0.940 in Hg)
=

15. If rainfall rate (in/hr) exceeds the infiltration capacity (in/hr) of a particular type of soil, then the actual infiltration rate is:

- (A) Equal to the rainfall rate
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AVERAGE

Prairie View A&M University
College of Engineering
CVEG 3051: Professional Engineering

12/15 P

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(A Handout is Included for SCS Method of Peak Discharge Estimation)

Assigned: March 14, 2022 (Via CANVAS/Assignments)

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Name: Nathaniel Smith

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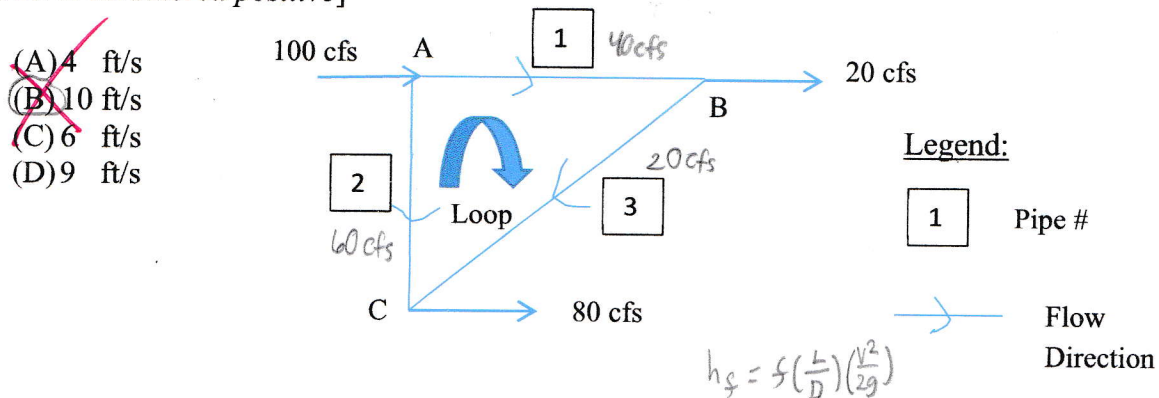
$$D_3 = 1.5 \text{ ft} \quad g = 32.2 \text{ ft/s}^2$$

$$\text{Friction head loss through pipe 1} = 1.7 \text{ ft}$$

$$L_3 = 60 \text{ ft}$$

$$\text{Friction head loss through pipe 2} = 2.0 \text{ ft}$$

[Hint: friction head loss in pipes with flow in the direction of the loop's direction (clockwise) shown is considered positive]



$$1.7 + 2 + 0.03 \left(\frac{60}{1.5} \right) \left(\frac{V_3^2}{2(32.2)} \right) = 0$$
$$3.7 = -0.019 V_3^2$$

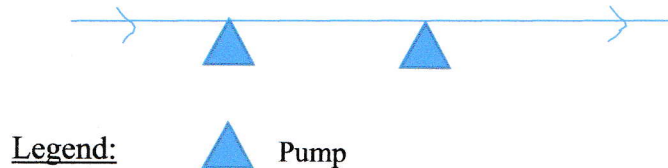
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 (C) $9.0 \times 10^{-4} \text{ m/m}$; 16.0 N/m^2
 (D) None of the above

$$Q = \frac{1}{n} \frac{A^{5/3}}{P^{2/3}} \sqrt{S}$$

$$S = \left(\frac{Q n P^{2/3}}{A^{5/3}} \right)^2$$

$$= \left(\frac{200(0.015)(27.89)^{2/3}}{(72)^{5/3}} \right)^2$$

$$=$$

$$A = by + zy^2$$

$$A = 10(4) + 2(4)^2$$

$$A = 72 \text{ m}^2$$

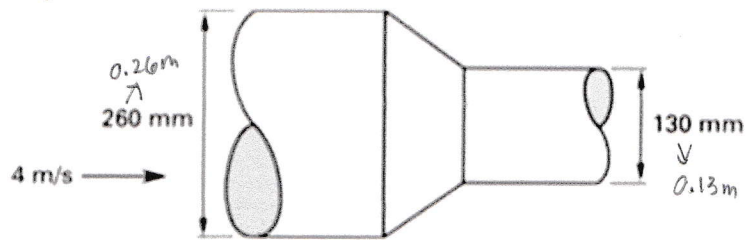
$$P = b + 2y\sqrt{1+z^2}$$

$$P = 10 + 2(4)\sqrt{1+2^2}$$

$$P = 27.89 \text{ m}$$

4. The speed of an incompressible fluid is 4 m/s entering the 260 mm pipe. The speed in the 130 mm pipe is most nearly:

- (A) 40 m/s
(B) 9 m/s
(C) 16 m/s
(D) 12 m/s



$$4 \left(\frac{\pi (0.26)^2}{4} \right) = V_2 \left(\frac{\pi (0.13)^2}{4} \right)$$

$$V_2 = 16 \text{ m/s}$$

5. A hydraulic jump occurs in a wide rectangular channel. The upstream depth and velocity are 0.4m, and 13 m/s, respectively. The downstream flow depth and the head loss across the jump are nearly, respectively:

[Specific weight of water = 9810 N/m³; g = 9.81 m/s²]

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- ☒ (A) 400 min
- (B) 500 min
- (C) 900 min
- (D) 200 min

$$t_c = 1.8(1.1 - .37)(20,000)^{.50} / (.91)^{.333}$$
$$= 412 \approx 400$$

8. A two-day storm's rainfall depths are given in the table. Φ -index is 1.1 mm/hr. A 12-hour UH hydrograph is said to be available for the watershed. The direct runoff depth for the first 12 hours of the second day is nearly:

	Time period (hour)	Rainfall depth (cm)
Day 1	0-12	2.4
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- (A) 3.5 cm
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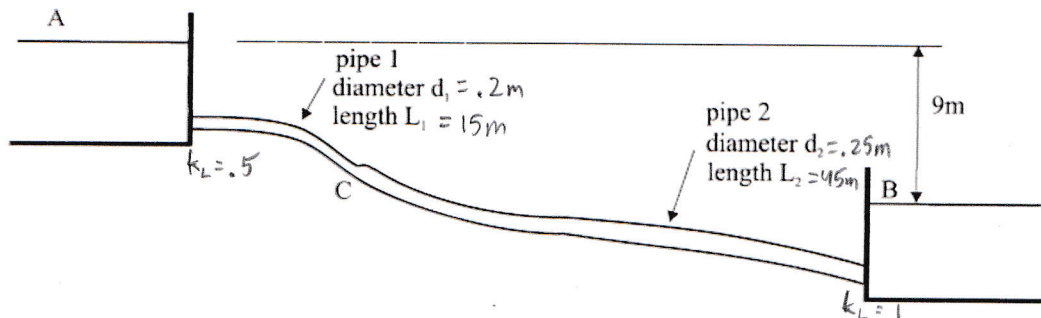
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(C) 72 cms
(D) 46 cms

11. For a return period (or recurrence interval) of 100 years, the probability of a discharge of 15,000 cfs at a location in a river equaling or exceeding once in the next 20 years is nearly:

(A) 0.100
(B) 0.143
(C) 0.259
(D) 0.182

12. Consider the two reservoirs shown in the figure, connected by a single pipe that *changes diameter* over its length. The surfaces of the two reservoirs have a difference in level of 9m. The pipe has a diameter of 200 mm for the first 15m (from Reservoir A to C) then a diameter of 250 mm for the remaining 45m (from C to Reservoir B). For the entrance loss use $k_L = 0.5$, and for exit loss use $k_L = 1.0$. The expansion at C is *sudden*. For both pipes, $f = 0.01$. **Find the steady-state flow rate, Q , through the pipes. HINT: Consider series pipe head loss concept with Darcy-Weisbach friction loss formula.**



Answer choices for Problem #12:

- (A) 0.500 cms
- (B) 0.623 cms
- (C) 0.261 cms
- ☒ (D) 1.560 cms

13. At 15°C water temperature, vapor pressure of water is 1.70 kN/m². The saturation vapor pressure at that temperature of water is nearly:

[Given: specific weight of Mercury = 845.52 lb/ft³)

$$1.70 \frac{\text{kN}}{\text{m}^2} \times \frac{2.24.81 \text{ lb}}{1 \text{ kN}} \times \frac{(\text{in})^2}{(3.28 \text{ ft})^2} = 35.5 \text{ lb/ft}^2$$

- ☒ (A) 0.504 inches of Hg
- (B) 1.450 inches of Hg
- (C) 0.755 inches of Hg
- (D) None of the above

14. At 25°C *air* temperature, the saturation vapor pressure at some temperature of water (not specified here) is 0.940 inches of Hg. If the relative humidity is 30%, the actual vapor pressure of the overlying air is nearly:

- (A) 0.421 inches of Hg
- (B) 0.342 inches of Hg
- ☒ (C) 0.282 inches of Hg
- (D) None of the above

15. If rainfall rate (in/hr) exceeds the infiltration capacity (in/hr) of a particular type of soil, then the actual infiltration rate is:

- (A) Equal to the rainfall rate
- (B) Greater than the rainfall rate
- ☒ (C) Equal to the infiltration capacity
- (D) None of the above

BELOW AVERAGE: N/A For This Test

**PROFESSIONAL ENGINEERING I
SPRING 2022**

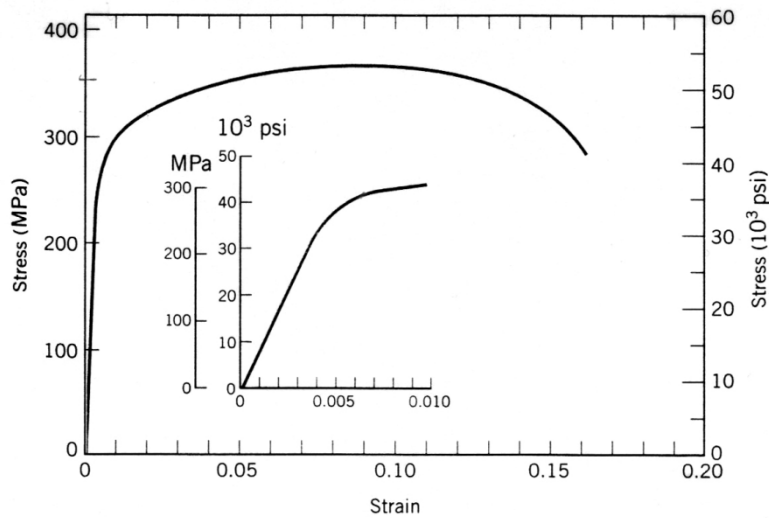
TEST 10: CIVIL ENGINEERING MATERIALS

TOPICS COVERED IN TEST 10:

**1. FUNDAMENTALS OF CE MATERIALS
PROPERTIES AND BEHAVIORS UNDER LOAD
TESTS**

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
CE MATERIALS TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
March 29, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

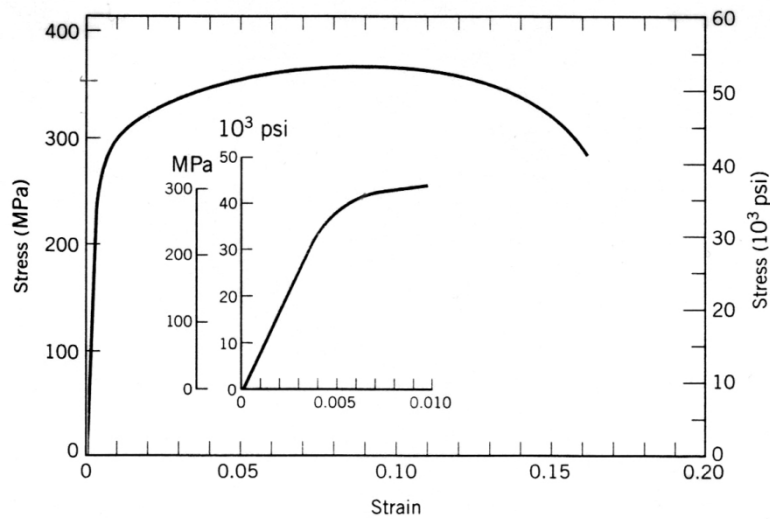
1. Given the engineering stress-engineering strain diagram for an aluminum alloy initially 11 mm in diameter and 50 mm in length, the percent (%) elongation at *ultimate stress* of 360 MPa is nearly:



Tensile stress-strain behavior for an aluminum alloy.

- a. 16.2 %
- b. 5.2 %
- c. 9.0 %
- d. None of the Above

2. True stress (using the Figure for Problem #1) at an engineering strain of 0.04 is nearly:



Tensile stress-strain behavior for an aluminum alloy.

- a. 390 MPa
- b. 360 MPa
- c. 290 MPa
- d. 480 MPa

3. Low resiliency of a material is correlated with:

- a. Low E , high σ_Y and low ductility
- b. Low E , high σ_Y and high ductility
- c. Low E , low σ_Y and low ductility
- d. High E , low σ_Y and high ductility

4. A concrete column of height 5 meters and a cross sectional area of 3 m^2 supports a *mass* of 3,000 kg. Acceleration due to gravity (g) = 10 m/s^2 . Young's modulus of concrete = $20 \times 10^9 \text{ N/m}^2$. The change in the columns height, δ , under the load is nearly:

- a. 0.0035 mm
- b. 0.0025 mm
- c. 0.0058 mm
- d. 0.0035 mm

5. *Plastic deformation*, under tensile test, occurs in a material when:
(*strength = stress*)

- a. Normal stress is greater than yield stress
- b. Normal stress is greater than tensile strength
- c. Normal stress is lower than yield stress
- d. Normal stress is lower than tensile strength

6. *Necking*, under tensile test, occurs in a material when:

- a. Normal stress is greater than yield stress
- b. Normal stress is greater than tensile strength
- c. Normal stress is lower than yield stress
- d. Normal stress is lower than tensile strength

7. In the USA, material hardness tests (Brinell, Rockwell, Indentation etc.) are done per:

- a. ASCE (Am. Soc. of Civil Engrs.) guidelines
- b. ASTM (Am. Standard Testing Method) guidelines
- c. FHWA (Fed. Hwy. Admin.) guidelines
- d. FAA (Fed. Aviation Admin.) guidelines

8. If σ is normal stress, E the modulus of elasticity and ϵ the strain, Hook's law states:

- a. $\sigma = E/\epsilon$
- b. $\sigma = E \epsilon$
- c. $\epsilon = E/\epsilon$
- d. $E = \sigma\epsilon$

9. The property of steel that allows it to undergo large *inelastic* deformations before fracture occurs, is:

- a. Yield
- b. Elasticity
- c. Ductility
- d. Toughness

10. Which statement about Poisson's Ratio, ν , is true?

- a. It is a ratio of two possible strains
- b. It is a ratio of two possible stresses
- c. It is a ratio of two possible modulus of elasticities
- d. None of the above

11. Brinell *hardness* is calculated by measuring:

- a. The diameter of the impression created by the indenter on a surface of a material
- b. The depth of the penetration of the indenter
- c. The side slope of the penetration hole
- d. None of the above

12. The *coefficient of uniformity*, C_u , of a well-graded soil sample is:

- a. Less than 4
- b. Greater than 4
- c. 1
- d. None of the above

13. D_{50} represents a *particle size* such that 50% of the aggregate particles are

- a. Finer than *this size*
- b. Larger than *this size*
- c. Equal to *this size*
- d. None of the Above

14. A poorly graded soil is that in which:

- a. Most particles in the mixture are of different size
- b. Most particles in the mixture are of same size
- c. The smallest particle size or silt is missing in its mixture
- d. None of the above

+1 Point for ALL

ABOVE AVERAGE

**DATA COULD NOT BE
COLLECTED FROM STUDENTS**

AVERAGE

**DATA COULD NOT BE
COLLECTED FROM STUDENTS**

BELOW AVERAGE

**DATA COULD NOT BE
COLLECTED FROM STUDENTS**

**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 11: MATHEMATICS

TOPICS COVERED IN TEST 11:

- 1. CALCULUS I & II, ALGEBRA & TRIGONOMETRY,
MATRICES, SERIESSES, PROBABILITY & STATISTICS**

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
Dr. I. Ahmed
MATHEMATICS TEST (TAKE HOME)
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
Assigned: April 5, 2022 (Take Home Test)

Due: **Tuesday, April 12 (Hard Copy between 3-5 PM, to Dr. Ahmed, Directly)**

1. What is the distance between the points P (1, -3, 5) and Q (-3, 4, -2)?

- a. $\sqrt{10}$
- b. $\sqrt{14}$
- c. 8
- d. $\sqrt{114}$

2. What is the determinant of the following matrix? **(If you do not find the correct answer, make a note)**

$$\begin{vmatrix} 3 & 2 & 7 \\ 3 & 7 & 1 \\ 1 & 5 & 2 \end{vmatrix}$$

- a. -113
- b. -7
- c. 12
- d. 73

3. The partial derivative $\frac{\partial y}{\partial x}$ of $y = x^2 z + 3z^2 x + 6(x + z)$ is:

- a. 5
- b. 7
- c. 8
- d. 9

4. Find the critical points of the function $f(x) = 3x^{5/3} - 15x^{2/3}$ where maxima or minima may be found.

- a. $x = 0$ and $x = 2$
- b. $x = 2$
- c. $x = 0$
- d. None of the above

5. Determine the (x,y) coordinates of the center of the circle defined by the following equation:

$$x^2 - 8x + y^2 - 10y + 25 = 0$$

- a. (3,2)
- b. (3,4)
- c. (4,5)
- d. (5,4)

6. The relative extrema of $f(x) = x^3 - 3x^2 + 3x - 1$ is:

- a. 1
- b. 3
- c. No extrema exists
- d. None of the above

7. $\int \cos 5x \, dx$ is:

- a. $(1/5) \sin 5x + C$
- b. $5 \sin 5x + C$
- c. $(1/5) \sinh 5x + C$
- d. None of the above

8. The scores of a final exam are distributed according to the table shown. What are the approximate mode and arithmetic mean of the scores?

Score	Frequency
38	5
45	2
69	7
76	10
82	12
90	8
91	19
95	15

- a. mode 79; mean 73
- b. mode 82; mean 79
- c. mode 85; mean 85
- d. mode 91; mean 82

9. Solve the system of equations:

$$x - y + z = -3$$

$$2x + y = 1$$

$$y - 3z = 7$$

- a. $x=0, y=1, z=-2$
- b. $x=0, y=2, z=-2$
- c. $x=0, y=-11, z=2$
- d. $x=0, y=1, z=-6$

10. When a helicopter is 1.2 km above one end of an island, the angle of depression to the other end of the island is 22.7° . Find the approximate length of the island (rounded off to the nearest whole number).

- a. 10 km
- b. 3 km
- c. 5 km
- d. 2 km

11. $\log_b b^x$ equals to

- a. x
- b. b
- c. $b-x$
- d. None of the above

12. Two students are working independently on a problem. Their respective probabilities of solving the problem are $\frac{1}{3}$ and $\frac{3}{4}$. What is the probability that at least one of them will solve the problem?

- a. $\frac{1}{2}$
- b. $\frac{5}{8}$
- c. $\frac{2}{3}$
- d. $\frac{5}{6}$

13. If a fair coin is flipped 20 times, what is the probability of the coin landing on heads exactly 10 times? What probability distribution function (pdf) is this problem based on?

- a. 0.176; Binomial
- b. 0.176; Normal
- c. 0.176; Poisson
- d. 0.176; Uniform

14. With a single die, what is the *chance* of rolling a 1 six times in a row? What is the *probability* of *not* rolling a 1 during the course of six rolls of the die?

- a. 0.0321%; 0.885
- b. 0.0021%; 0.335
- c. 0.0061%; 0.666
- d. None of the above

15. Evaluate dy/dx for the following function $y = f(x)$:

$$y = e^{-x} \sin(2x)$$

- a. $e^{-x} [2\cos(2x) - \sin(2x)]$
- b. $-e^{-x} [2\sin(2x) - \cos(2x)]$
- c. $e^{-x} [2\sin(2x) - \cos(2x)]$
- d. $-e^{-x} [2\cos(2x) - \cos(2x)]$

ABOVE AVERAGE

Abram Auguste

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
Dr. I. Ahmed

MATHEMATICS TEST (TAKE HOME)

(CLOSED Books/Notes; OPEN NCEES Formula Sheets)

Assigned: April 5, 2022 (IN-CLASS 2-Hour Test)

Due: Tuesday, April 12 (Hard Copy between 3-5 PM, to Dr. Ahmed, Directly)

15/15 P

1. What is the distance between the points P (1, -3, 5) and Q (-3, 4, -2)?

a. $\sqrt{10}$

b. $\sqrt{14}$

c. 8

d. $\sqrt{114}$

$$d = \sqrt{(-3-1)^2 + (4-(-3))^2 + (-2-5)^2} = \sqrt{(-4)^2 + (7)^2 + (-7)^2} = \sqrt{114} \\ = 10.67708$$

2. What is the determinant of the following matrix? (If you do not find the correct answer, make a note)

$$\begin{vmatrix} 3 & 2 & 7 \\ 3 & 7 & 1 \\ 1 & 5 & 2 \end{vmatrix}$$

a. -113

b. -7

c. 12

d. 73

3. The partial derivative $\frac{\partial y}{\partial x}$ of $y = x^2 z + 3z^2 x + 6(x+z)$ is:

Apply the sum / Difference Rule: $(f \pm g)' = f' \pm g'$

a. 5

b. 7

c. 8

d. 9

$$= 2zx + 3z^2 + 6$$

4. Find the critical points of the function $f(x) = 3x^{5/3} - 15x^{2/3}$ where maxima or minima may be found.

a. $x = 0$ and $x = 2$

b. $x = 2$

c. $x = 0$

d. None of the above

5. Determine the (x,y) coordinates of the center of the circle defined by the following equation:

$$x^2 - 8x + y^2 - 10y + 25 = 0$$

- a. (3,2)
- b. (3,4)
- ☒ c. (4,5)
- d. (5,4)

$$(x-4)^2 + (y-5)^2 = 4^2$$

6. The relative extrema of $f(x) = x^3 - 3x^2 + 3x - 1$ is:

- a. 1
- b. 3
- ☒ c. No extrema exists
- d. None of the above

7. $\int \cos 5x \, dx$ is:

- ☒ a. $(1/5) \sin 5x + C$
- b. $5 \sin 5x + C$
- c. $(1/5) \sinh 5x + C$
- d. None of the above

$$u = 5x \rightarrow \frac{du}{dx} = 5 \quad \text{and} \quad dx = \frac{1}{5} du$$

$$= \frac{1}{5} \int \cos(u) \, du = \sin u \rightarrow \frac{1}{5} \cos(u) \, du = \frac{\sin(u)}{5}$$

$$= \frac{\sin(5x)}{5} + C$$

8. The scores of a final exam are distributed according to the table shown. What are the approximate mode and arithmetic mean of the scores?

Score	Frequency
38	5
45	2
69	7
76	10
82	12
90	8
91	19
95	15

$$\text{mean} = \frac{\text{sum of (score} \times \text{frequency)}}{\text{Total frequency}}$$

$$= \frac{38 \times 5 + 45 \times 2 + 69 \times 7 + 76 \times 10 + 82 \times 12 + 90 \times 8 + 91 \times 19 + 95 \times 15}{5 + 2 + 7 + 10 + 12 + 8 + 19 + 15}$$

$$= \frac{6381}{78} \Rightarrow \text{mean} = 81.8076 \approx 82$$

- a. mode 79; mean 73
- b. mode 82; mean 79
- c. mode 85; mean 85
- ☒ d. mode 91; mean 82

9. Solve the system of equations:

$$x - y + z = -3$$

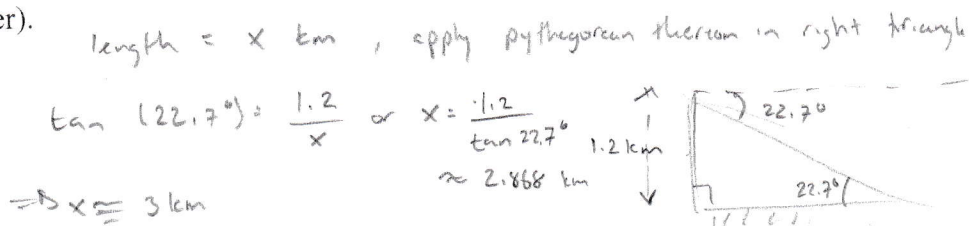
$$2x + y = 1$$

$$y - 3z = 7$$

- a. $x=0, y=1, z=-2$
- b. $x=0, y=2, z=-2$
- c. $x=0, y=-11, z=2$
- d. $x=0, y=1, z=-6$

10. When a helicopter is 1.2 km above one end of an island, the angle of depression to the other end of the island is 22.7° . Find the approximate length of the island (rounded off to the nearest whole number).

- a. 10 km
- b. 3 km
- c. 5 km
- d. 2 km



11. $\log_b b^x$ equals to

log rule: $\log_a (a^b) = \underline{b}$

- a. x
- b. b
- c. $b-x$
- d. None of the above

12. Two students are working independently on a problem. Their respective probabilities of solving the problem are $1/3$ and $3/4$. What is the probability that at least one of them will solve the problem?

- a. $1/2$
- b. $5/8$
- c. $2/3$
- d. $5/6$

A will solve = $1/3 = 0.33$
 B will solve = $3/4 = 0.75$

Both will solve = $0.33 \times 0.75 = 0.25$

$\Rightarrow P(A \text{ or } B) = P(A) + P(B) - P(A \text{ intersect } B) = 0.33 + 0.75 - 0.25 = 0.83$

13. If a fair coin is flipped 20 times, what is the probability of the coin landing on heads exactly 10 times? What probability distribution function (pdf) is this problem based on?

- a. 0.176; Binomial
- b. 0.176; Normal
- c. 0.176; Poisson
- d. 0.176; Uniform

Binomial Distribution: $P(x) = n \times C_x p^x q^{n-x}$

$P(\text{getting exactly 10 heads}) = 20 C_{10} \times 0.5^{10} \times 0.5^{10} = 0.1762$

14. With a single die, what is the *chance* of rolling a 1 six times in a row? What is the *probability* of *not* rolling a 1 during the course of six rolls of the die?

- a. 0.0321%; 0.885
- ☒ b. 0.0021%; 0.335
- c. 0.0061%; 0.666
- d. None of the above

not rolling 1 happens w/ probability $\frac{5}{6}$. Doing this 6 times gives
 $\left(\frac{5}{6}\right)^6 \approx 0.334897$

15. Evaluate dy/dx for the following function $y = f(x)$:

$$y = e^{-x} \sin(2x)$$

Product Rule $(f \cdot g)' = f' \cdot g + f \cdot g'$

- ☒ a. $e^{-x} [2\cos(2x) - \sin(2x)]$
- b. $-e^{-x} [2\sin(2x) - \cos(2x)]$
- c. $e^{-x} [2\sin(2x) - \cos(2x)]$
- d. $-e^{-x} [2\cos(2x) - \cos(2x)]$

$$= (-e^{-x}) \sin(2x) + \cos(2x) + 2e^{-x}$$

AVERAGE

Michael
LeBlanc

14/15 P

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
Dr. I. Ahmed

MATHEMATICS TEST (TAKE HOME)

(CLOSED Books/Notes; OPEN NCEES Formula Sheets)

Assigned: April 5, 2022 (Take Home Test)

Due: **Tuesday, April 12 (Hard Copy between 3-5 PM, to Dr. Ahmed, Directly)**

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- a. $\sqrt{10}$
- b. $\sqrt{14}$
- c. 8
- d. $\sqrt{114}$

2. What is the determinant of the following matrix? (If you do not find the correct answer, make a note)

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- c. 12
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3. The partial derivative $\frac{\partial y}{\partial x}$ of $y = x^2 z + 3z^2 x + 6(x + z)$ is:

- a. 5
- b. 7
- c. 8
- d. 9

4. Find the critical points of the function $f(x) = 3x^{5/3} - 15x^{2/3}$ where maxima or minima may be found.

- a. $x = 0$ and $x = 2$
- b. $x = 2$
- c. $x = 0$
- d. None of the above

5. Determine the (x,y) coordinates of the center of the circle defined by the following equation:

$$x^2 - 8x + y^2 - 10y + 25 = 0$$

- a. (3,2)
- b. (3,4)
- ☒ c. (4,5)
- d. (5,4)

6. The relative extrema of $f(x) = x^3 - 3x^2 + 3x - 1$ is:

- ☒ a. 1
- ☒ b. 3
- c. No extrema exists
- d. None of the above

7. $\int \cos 5x \, dx$ is:

- ☒ a. $(1/5) \sin 5x + C$
- b. $5 \sin 5x + C$
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- a. mode 79; mean 73
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9. Solve the system of equations:

$$x - y + z = -3$$

$$2x + y = 1$$

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- ☒ a. $x=0, y=1, z=-2$
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BELOW AVERAGE

Name!

11/15 P

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
Dr. I. Ahmed

MATHEMATICS TEST (TAKE HOME)

(CLOSED Books/Notes; OPEN NCEES Formula Sheets)

Assigned: April 5, 2022 (IN-CLASS 2-Hour Test)

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☒ b. $x = 2$
c. $x = 0$
d. None of the above

9. Solve the system of equations:

$$x - y + z = -3$$

$$2x + y = 1$$

$$y - 3z = 7$$

- ☒ a. $x=0, y=1, z=-2$
- b. $x=0, y=2, z=-2$
- c. $x=0, y=-11, z=2$
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- d. None of the above

7. $\int \cos 5x \, dx$ is:

- ☒ a. $(1/5) \sin 5x + C$
- b. $5 \sin 5x + C$
- c. $(1/5) \sinh 5x + C$
- d. None of the above

8. The scores of a final exam are distributed according to the table shown. What are the approximate mode and arithmetic mean of the scores?

Score	Frequency
38	5
45	2
69	7
76	10
82	12
90	8
91	19
95	15

- a. mode 79; mean 73
- b. mode 82; mean 79
- c. mode 85; mean 85
- ☒ d. mode 91; mean 82

14. With a single die, what is the *chance* of rolling a 1 six times in a row? What is the *probability* of *not* rolling a 1 during the course of six rolls of the die?

- a. 0.0321%; 0.885
- ☒ b. 0.0021%; 0.335
- c. 0.0061%; 0.666
- d. None of the above

15. Evaluate dy/dx for the following function $y = f(x)$:

$$y = e^{-x} \sin(2x)$$

- ☒ a. $e^{-x} [2\cos(2x) - \sin(2x)]$
- b. $-e^{-x} [2\sin(2x) - \cos(2x)]$
- c. $e^{-x} [2\sin(2x) - \cos(2x)]$
- d. $-e^{-x} [2\cos(2x) - \cos(2x)]$

**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 12: ENVIRONMENTAL ENGINEERING ANALYSIS & DESIGN

TOPICS COVERED IN TEST 12:

- 1. ENVIRONMENTAL ENGINEERING ANALYSIS**
- 2. ENVIRONMENTAL ENGINEERING DESIGN**

AVERAGE

**PASS/FAIL OPTION OFFERED ON
THIS TAKE HOME TEST
REQUIRING FULLY WORKED OUT
SOLUTIONS;**

**STUDENTS HAD A SET OF
PROBLEMS TO CHOOSE FEW
SELECTED ONES;**

EVERYONE PASSED.

P

Prairie View A&M University
College of Engineering
CVEG 3051: Professional Engineering

ENVIRONMENTAL ENGINEERING: ANALYSIS & DESIGN TEST (Take Home)

Assigned: Tuesday, April 5, 2022

Due: Tuesday, April 19, 2021 (5:00 PM to Dr. Ahmed; Hard Copy, In Class)

Name: Porla Zaldivar

PART I-Analyses: Solve Only 3 out of 5 problems
(Cross out any portion you do not wish to be graded)

SHOW ALL (100%) WORK

Problem 1

Water has a carbonate hardness of 92 mg/L as CaCO_3 . Most nearly, what dose of lime (CaO ; oxidation number 2) as substance should be added to the water to reduce the hardness to 30 mg/L as CaCO_3 ?



$$\frac{56}{100g} (92 - 30) = \boxed{34.72 \text{ mg/L}}$$

Problem 2

BOD tests were conducted on composited samples of a raw wastewater and a treated wastewater after chlorination.

The BOD tests for the raw wastewater were set up by pipetting 5.0 ml into each 300-ml bottle. For one pair of bottles, the test results were:

The initial dissolved oxygen (DO) was 8.4 mg/l, and after 5 days of incubation at 20°C, the final DO was 3.7 mg/l. **Calculate the BOD and estimate the 20-day BOD** value assuming a k of 0.10 day⁻¹.

Problem 3

Two rectangular clarifiers each 90 ft long, 16 ft wide, and 12 ft deep are used to settle 0.50 mil gal of water in an 8-hr operational period. Calculate:

(a) Detention Time:

$$V = 90 \text{ ft} (16) (12) = 17,280 \text{ ft}^3$$

$$Q = \frac{0.5 \times 10^6 \text{ gal}}{8 \text{ hr}} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}} = 8355 \text{ ft}^3/\text{hr}$$

$$\frac{17,280 \text{ ft}^3}{8355 \text{ ft}^3/\text{hr}} = \boxed{2.07 \text{ hr}}$$

(b) Horizontal Velocity:

$$V = \frac{8355 \text{ ft}^3/\text{hr}}{12 \text{ ft} \times 16 \text{ ft}} = \boxed{0.012 \text{ ft/s}}$$

(c) Overflow rate:

$$V = \frac{8355 \text{ ft}^3/\text{hr}}{90 \text{ ft} \times 16 \text{ ft}} \left(\frac{7.48 \text{ gal}}{\text{ft}^3} \right) \left(\frac{24 \text{ hr}}{1 \text{ day}} \right)$$

$$V = \boxed{1041.7 \text{ gal/ft}^2}$$

(d) Weir loading:

$$\frac{8355 \text{ ft}^3/\text{hr}}{90 \text{ ft}} \times \frac{7.48 \text{ gal}}{1 \text{ ft}^3} \times \frac{24 \text{ hr}}{1 \text{ day}}$$

$$\boxed{16,667 \text{ gal/d}}$$

Problem 4

A 25-mgd water treatment plant has a flocculation tank 64 ft long and 100 ft wide with a water depth of 16 ft. The four horizontal shafts of paddle flocculators are in compartments separated by baffles. All the paddle units have four arms with three blades each with radius of 3.0, 4.5, and 6.0 ft measuring from the shaft to the center of the 0.80 ft-wide boards. The total length of the paddle boards across the tank is 50 ft. Assume a ratio of water velocity to paddle velocity of 0.3, rotational speed of 0.050 rev/sec, $C_d = 1.8$, and water temperature of 50°F.

Calculate the velocity gradient.

Given: $\rho = 1.936 \text{ lb. sec/ft}^4$ and $\mu = 2.735 \times 10^{-5} \text{ lb. sec/ft}^2$

Problem 5

Dosage of alum with the alum-lime coagulation of a water is 50 mg/l. It is desired to react only 10 mg/l (as CaCO_3) of the natural alkalinity with the alum. What dosage of lime is required, in addition to the 10 mg/l of natural alkalinity, to react with the alum dosage?

$$50 \text{ mg/L of alum} - 10 \text{ mg/L} = 40 \text{ mg/L of alum}$$

$$40 \text{ mg/L of alum} = \frac{56\text{g}}{100\text{g}} = \boxed{22.4 \text{ mg/L of CaO}}$$

PART II-Design: SOLVE Only 2 out of 3 problems
(Cross out any portion you do not wish to be graded)

SHOW 100% (ALL) WORK

Problem 6

[Flocculation Tank Design] Bench studies have determined that aluminum sulfate (alum) promotes acceptable floc formation at a dose of 23 mg/L when applied to a surface water source. Design standards for chemical flocculation require flash mixing at a minimum velocity gradient (G) of 900/s for 120 seconds. Electrical power costs \$0.05/kWh. The water demand is 19,000 m³/d. The water temperature is 20°C.

- (a) What is the total tank volume required for flash mixing?

$$19,000 \text{ m}^3/\text{d} (120 \text{ s}) \left(\frac{1 \text{ min}}{60 \text{ s}} \right) \left(\frac{1 \text{ hr}}{60 \text{ min}} \right) \left(\frac{1 \text{ d}}{24 \text{ hr}} \right)$$

$$26.4 \text{ m}^3$$

- (b) If four tanks are desired, what are the dimensions of each tank?

$$\frac{26.4 \text{ m}^3}{4} = 6.60 \text{ m}^3 \text{ per tank}$$

$$L = 2.4 \text{ m}$$

$$W = 1.3 \text{ m}$$

$$D = 2 \text{ m}$$

- (c) What is the total Power required for flash mixing if the motor efficiency is 85%?

$$P = 900^2 (26.4 \text{ m}^3) (1.002 \times 10^{-6}) = 21.43 \text{ kW}$$

$$\frac{21.43 \text{ kW}}{0.85} = 25.2 \text{ kW}$$

Problem 7

[Sedimentation Tank Design] A treatment plant upgrade calls for design of sedimentation basins to handle a flow rate of 8 MGD. The basins are of Type I suspension with an overflow rate (q_o) of 650 gpd/ft², a length to width ratio of 4:1, a weir overflow rate (q_w) of 20,000 gpd/ft. The minimum settling zone depth is 10 ft and 1.5 ft is allowed for freeboard.

(a) If 3 tanks are chosen, what are the surface dimensions of each tank?

(b) What is the required weir length for each tank?

Problem 8

[Secondary Settling Tank Design] A secondary clarifier accepts effluent from a bioreactor at a flow rate of $8300 \text{ m}^3/\text{d}$ and total suspended solids of 1600 mg/L . The solids loading rate is $2.6 \text{ kg/m}^2\cdot\text{h}$, and the particle settling velocity is 1.29 m/h .

(a) What is the solids loading rate?

$$2.6 \text{ kg/m}^2\cdot\text{h} \left(\frac{24 \text{ h}}{1 \text{ d}} \right) = \boxed{62.4 \text{ kg/m}^2\cdot\text{d}}$$

(b) What is the required surface area based on solids loading rate?

$$1600 \text{ mg/L} \times 8300 \text{ m}^3/\text{d} \times \frac{1}{1000} = 13,280 \text{ kg/d}$$

$$A = \frac{13280 \text{ kg/d}}{62.4 \text{ kg/m}^2\cdot\text{d}} = \boxed{212.82 \text{ m}^2}$$

(c) What is the required surface area based on particle settling velocity?

$$1.29 \text{ m/h} \left(\frac{24 \text{ h}}{1 \text{ d}} \right) = 30.96 \text{ m/d}$$

$$A = \frac{8300 \text{ m}^3/\text{d}}{30.96 \text{ m/d}} = \boxed{268.09 \text{ m}^2}$$

(d) What is the design surface area?

$$\boxed{268.09 \text{ m}^2}$$

**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 13: REINFORCED CONCRETE & STEEL DESIGN

TOPICS COVERED IN TEST 13:

- 1. REINFORCED CONCRETE DESIGN OF BEAMS
AND COLUMNS**
- 2. STEEL DESIGN USING LRFD CODES**

AVERAGE

PASS/FAIL OPTION WAS OFFERED;

**FULLY WORKED OUT SOLUTIONS
WERE REQUIRED;**

**STUDENTS WERE ASKED TO
SOLVE ALL PROBLEMS ON THE
TEST;**

EVERYONE PASSED

Prairie View A&M University
CVEG 3051: Professional Engineering
STEEL & CONCRETE DESIGN TEST

Assigned: Tuesday, April 5, 2022

Due: Tuesday, April 19, 2021 (5:00 PM to Dr. Ahmed; Hard Copy, In Class)

Name: Shadana Lynch

100% Worked Out Solution Requested For Any 5 out of 7 Problems

Problem 1 [Design of Column]

W18X71 is used as a compression member with one end fixed and the other end fixed against rotation but free to translate. The length is 12 ft. If A992 steel is used determine the available design strength of the column (Use LRFD).

$$E = 29000 \text{ ksi}$$

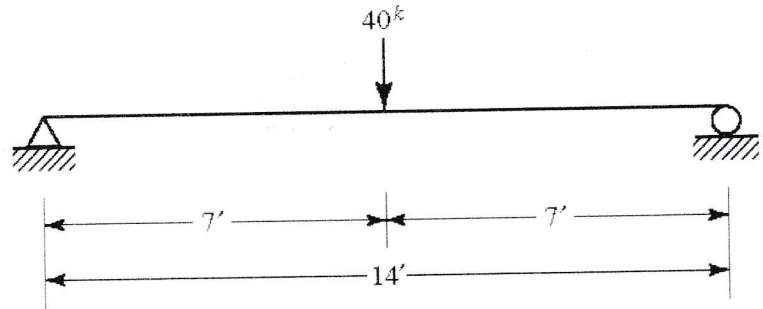
$$I_x = 1170 \text{ in}^4$$

$$I_y = 603 \text{ in}^4$$

$$P_u = \frac{\pi \cdot 29000 \times 603 \text{ in}^4}{(12 \times 12 \times 12)^2} = \boxed{578 \text{ kips}}$$

Problem 2 [Steel Beam Design Strength]

The beam shown in the figure below is laterally braced only at the ends. The 40 kip load is a service live load. Use $F_y = 50$ ksi and determine the available design strength of the beam W12X50. (Use LRFD)



$$Z_x = 64.7 \text{ in}^3$$

$$w_u = 1.4(0.05) = 0.07 \frac{\text{kips}}{\text{ft}}$$

$$P_u = 1.2(0) + 1.6(40) = 64 \text{ kips}$$

$$M_u = \frac{w_u L^2}{8} + \frac{P_u L}{4} = \frac{0.07 \times 14^2}{8} + \frac{64 \text{ kips} \times 14}{4} = 225.72 \text{ kips} \cdot \text{ft}$$

$$M_n = M_p$$

$$= 64.7 \times 50$$

$$= 3235 \text{ kips} \cdot \text{in}$$

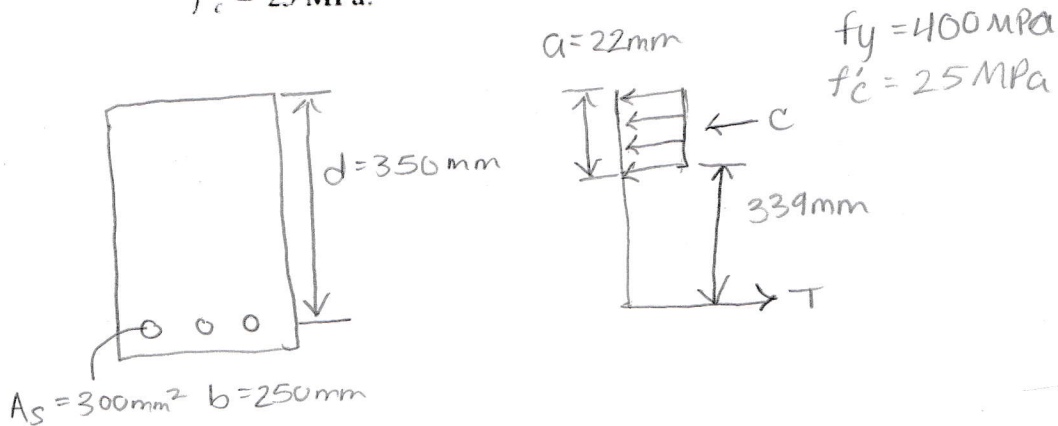
$$= 269.58 \text{ kips} \cdot \text{ft}$$

$$\phi M_n = 0.9 \times 269.58 \text{ kips} \cdot \text{ft} = 242.62$$

$$\Rightarrow \boxed{242.62 > M_u}$$

Problem 3 [RC Beam]

Determine the ultimate moment capacity of a beam of dimensions $b = 250 \text{ mm}$ and $d = 350 \text{ mm}$ and that has 300 mm^2 of reinforcing steel. Assume that $F_y = 400 \text{ MPa}$ and $f'_c = 25 \text{ MPa}$.



$$M_n = A_s f_y (d - \frac{a}{2})$$

$$M_n = (300 \text{ mm}^2)(400 \text{ MPa})(350 \text{ mm} - \frac{22 \text{ mm}}{2})$$

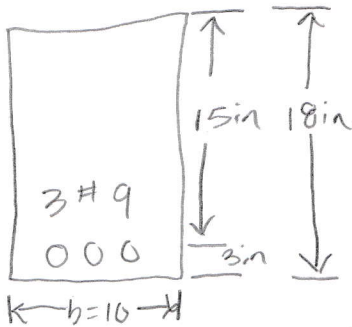
$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{(300 \text{ mm}^2)(400 \text{ MPa})}{0.85(25 \text{ MPa})(250 \text{ mm})} = \frac{120,000}{5312.5} = 22 \text{ mm}$$

$$M_n = 40,680,000 \text{ MPa} \rightarrow 40,680 \text{ N}\cdot\text{m}$$

$$\phi M_n = \boxed{36612 \text{ N}\cdot\text{m}}$$

Problem 4 [RC Beam]

Determine the ultimate moment capacity of a concrete beam with dimensions $b = 10$ in. and $d_{\text{effective}} = 15$ in. and that has 3 #9 bars (3.0 in^2) of tension-reinforcing steel. Assume that $h = 18$ in., $F_y = 40$ ksi, and $f'_c = 5$ ksi. (No need to check for over-reinforcement).



$$a = \frac{A_s f_y}{.85 f'_c b} = \frac{3 \text{ in}^2 (40 \text{ ksi})}{.85 (5 \text{ ksi}) (10 \text{ in})} = 2.82 \text{ in}$$

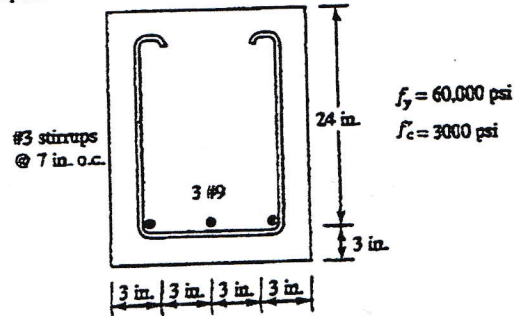
$$M_u = A_s f_y \left(d - \frac{a}{2} \right) = 3 \text{ in}^2 (40 \text{ ksi}) \left(15 - \frac{2.82}{2} \right) \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$M_u = 135.9 \text{ k} \cdot \text{ft}$$

Problem 5 [RC Beam]

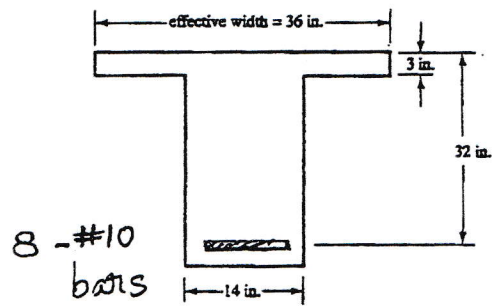
Determine the developmental length required for the tension bar shown. Use calculated K values. Normal weight concrete and uncoated bars are used.

$$A_s \text{ required} = 2.76 \text{ in.}^2$$



Problem 6 [RC T-Beam]

Find the design moment strength of the T-beam shown. Concrete strength is 4000 psi and reinforcing steel grade is 60.



$$a = \frac{A_s f_y}{0.85 f_c' b} = \frac{10.16 \text{ in}^2 (60 \text{ ksi})}{0.85 (4 \text{ ksi}) (36 \text{ in})}$$

$$a = 4.98 \text{ in} > 3 \text{ in}$$

$$A_c = \frac{10.16 \text{ in}^2 (60 \text{ ksi})}{0.85 (4 \text{ ksi})} = 179.3 \text{ in}^2$$

$$\text{Flange area} = 36 \text{ in} \times 3 \text{ in} = 108 \text{ in}^2, A_{c \text{ in web}} = (179.3 - 108) \text{ in}^2 = 71.3 \text{ in}^2$$

$$d_{\text{web}} = \frac{71.3 \text{ in}^2}{14 \text{ in}} = 5.1 \text{ in} \rightarrow a = 3 \text{ in} + 5.1 \text{ in} = 8.1 \text{ in}$$

$$\bar{y} = \frac{(36 \text{ in} \times 3 \text{ in}) \left(\frac{3 \text{ in}}{2}\right) + (14 \text{ in} \times 5.1 \text{ in}) \left(3 \text{ in} + \frac{5.1 \text{ in}}{2}\right)}{(36 \text{ in} \times 3 \text{ in}) + (14 \text{ in} \times 5.1 \text{ in})} = 3.11 \text{ in}$$

$$c = \frac{8.1 \text{ in}}{0.85} = 9.5 \text{ in}$$

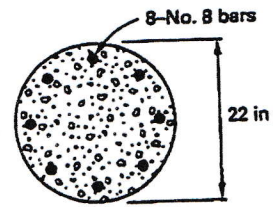
$$\epsilon_t = \frac{0.003 (32 \text{ in} - 9.5 \text{ in})}{9.5} = 0.0071 > 0.005 \rightarrow \phi = 0.9$$

$$\phi M_n = 0.9 (10.16 \text{ in}^2) (60 \text{ ksi}) (32 \text{ in} - 3.11 \text{ in}) \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$\boxed{\phi M_n = 1320.85 \text{ k}\cdot\text{ft}}$$

Problem 7 [RC Column Design]

The short spiral column shown uses eight no. 8 bars. Assume the total loading has a low eccentricity. $f'_c = 3500 \text{ lbf/in}^2$, and $f_y = 40,000 \text{ lbf/in}^2$. Determine the design strength.



**PROFESSIONAL ENGINEERING I
SPRING 2022**

**5-HOUR MOCK FE TEST ON ALL FE-CIVIL TOPICS
WITH 100 MULTIPLE CHOICE QUESTIONS**

**TEST WAS CONDUCTED ONLINE;
THUS, NO STUDENT SAMPLE WORK EXISTS;**

**TEST STATISTICS IS PROVIDED HEREIN
FOLLOWING THE TEST SHEETS.**

1. What is the distance between the points P (1, -3, 5) and Q (-3, 4, -2)?

- a. $\sqrt{10}$
- b. $\sqrt{14}$
- c. 8
- d. $\sqrt{114}$

2. What is the determinant of the following matrix?

$$\begin{vmatrix} 2 & -3 & 9 \\ 2 & 0 & -1 \\ 1 & 4 & 5 \end{vmatrix}$$

- a. -113
- b. -7
- c. 49
- d. 73

3. The partial derivative $\frac{\partial f}{\partial x}$ of x^2y^3 is:

- a. $2xy$
- b. $3y^2x^2$
- c. $2xy^3$
- d. None of the above

4. Find the critical points of the function $f(x) = 3x^{5/3} - 15x^{2/3}$ where maxima or minima may be found.

- a. $x = 0$ and $x = 2$
- b. $x = 2$
- c. $x = 0$
- d. None of the above

5. Determine the (x,y) coordinates of the center of the circle defined by the following equation:

$$x^2 - 8x + y^2 - 10y + 25 = 0$$

- a. (3,2)
- b. (3,4)
- c. (4,5)
- d. (5,4)

6. The relative extrema of $f(x) = x^3 - 3x^2 + 3x - 1$ is:

- a. 1
- b. 3
- c. No extrema exists
- d. None of the above

7. $\int \cos 5x \, dx$ is:

- a. $(1/5) \sin 5x + C$
- b. $5 \sin 5x + C$
- c. $(1/5) \sinh 5x + C$
- d. None of the above

8. The scores of a final exam are distributed according to the table shown. What are the approximate mode and arithmetic mean of the scores?

Score	Frequency
38	5
45	2
69	7
76	10
82	12
90	8
91	19
95	15

- a. mode 79; mean 73
- b. mode 82; mean 79
- c. mode 85; mean 85
- d. mode 91; mean 82

9. Solve the system of equations:

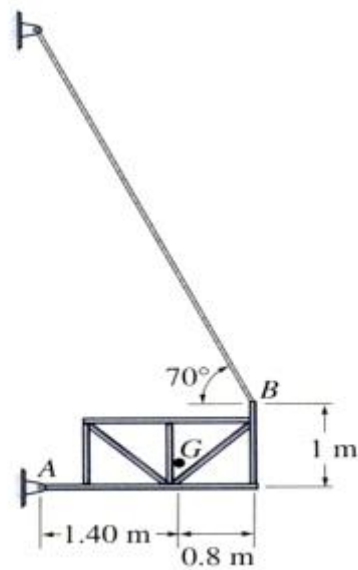
$$\begin{aligned}x - y + z &= -3 \\2x + y &= 1 \\y - 3z &= 7\end{aligned}$$

- a. $x=0, y=1, z=-2$
- b. $x=0, y=2, z=-2$
- c. $x=0, y=-11, z=2$
- d. $x=0, y=1, z=-6$

10. When a helicopter is 1.2 km above one end of an island, the angle of depression to the other end of the island is 22.7° . Find the approximate length of the island (rounded off to the nearest whole number).

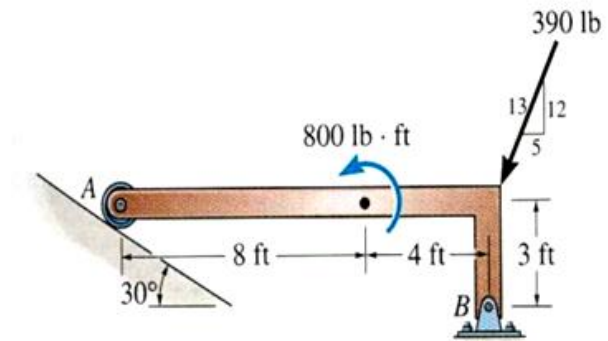
- a. 10 km
- b. 3 km
- c. 5 km
- d. 2 km

11. The structure (Weight = 1962 N) shown with its mass center at G is held in place by the pin at A and the cable at B . Determine the tension in the cable.



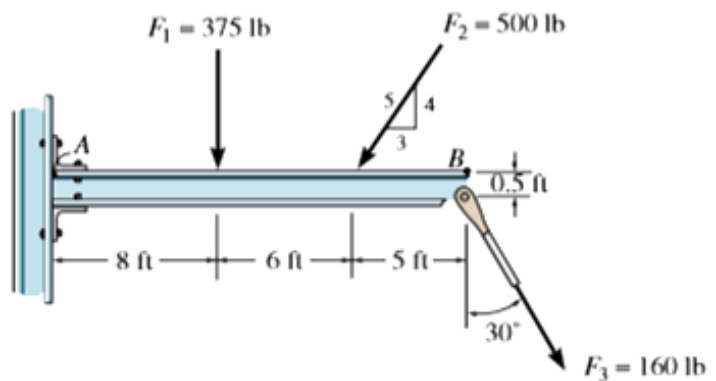
- a. 1035 N
- b. 900 N
- c. 1140 N
- d. 1300 N

12. Find the support reaction at A.



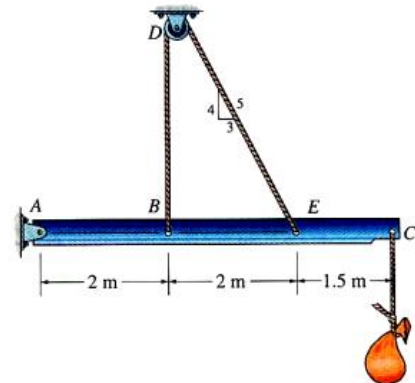
- a. 150 lb
- b. 200 lb
- c. 110 lb
- d. 105 lb

13. Find, nearly, the *resultant moment* about point A. Show



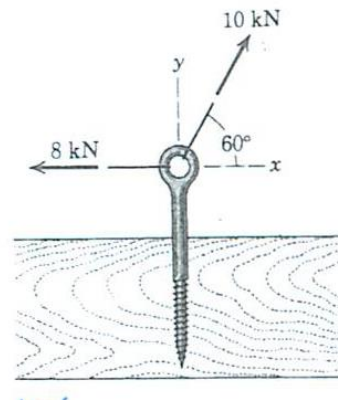
- a. 15,000 lb
- b. 20,140 lb
- c. 11,190 lb
- d. 11270 lb

14. The beam and the cable (with a *frictionless pulley* at *D*) support an 80-kg load at *C*. The cable extends half way into the beam's thickness. Determine the tension in the cable. [$g = 9.81 \text{ m/s}^2$]



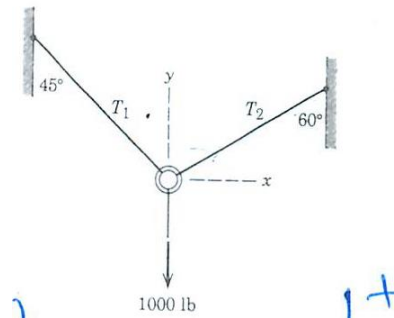
- a. 830 N
- b. 950 N
- c. 1,200 N
- d. 560 N

15. Determine, nearly, the magnitude of the resultant force vector for the situation shown.



- a. 9 N
- b. 5 N
- c. 112 N
- d. 60 N

16. The ring supports the 1000-lb load and is held in position by the two cables attached to vertical walls. Tension T_1 is nearly:

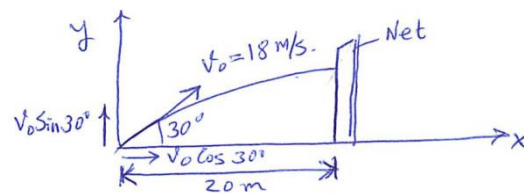


- a. 90 lb
- b. 515 lb
- c. 895 lb
- d. 400 lb

17. A boy throws a ball straight up from the top of a 12-m high tower. If the ball falls past him 0.75 seconds later, determine the velocity at which it was thrown.

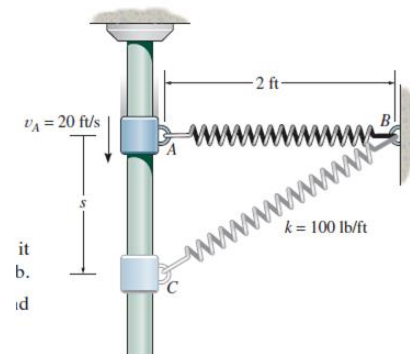
- a. 3.7 m/s
- b. 4.5 m/s
- c. 6.7 m/s
- d. None of the above

18. A daredevil is shot out of a canon at 18 m/s at an angle (with horizontal) of 30° . A vertical net is placed 20m away (horizontal distance) from the daredevil's starting point and safely catches him. How long is the daredevil in the air?



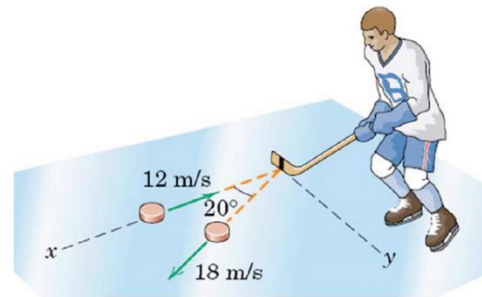
- a. 3.4 seconds
- b. 0.5 seconds
- c. 2.7 seconds
- d. 1.3 seconds

19. The 2-lb block is given an initial velocity of 20 ft/s when it is at A. If the spring has an unstretched length of 2 ft and a stiffness of $k = 100$ lb/ft, determine, nearly, the *velocity of the block at C* when the vertical distance $s = 1$ ft.



- a. 10 ft/s
- b. 23 ft/s
- c. 12 ft/s
- d. 19 ft/s

20. An ice-hockey puck with mass of 0.20 kg has a velocity of 12 m/s before being struck by the stick. After a 0.04 second contact with the stick, the puck moves in the new direction shown with a velocity of 18 m/s. Determine the magnitude of average force F_{avg} exerted by the stick on the puck *during contact*.



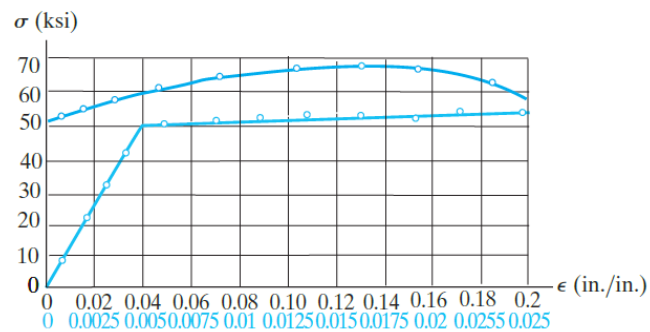
- a. 170 N
- b. 230 N
- c. 148 N
- d. 190 N

21. A jet fighter with a mass of 6450 kg requires 10 *seconds* from rest to reach its takeoff speed of 250 km/h under a constant thrust of $T = 48$ kN. Determine the time average R of the combined air and ground resistance during takeoff. (**Assume:** the jet is a particle in the sky, flying high!)



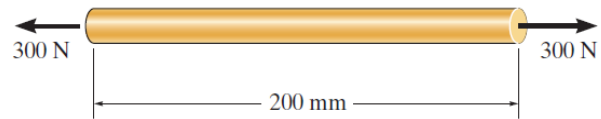
- a. 17 kN
- b. 3.21 kN
- c. 5.0 kN
- d. 1.9 kN

22. The stress–strain diagram for an aluminum alloy specimen having an original diameter of 0.5 in. and a gage length of 2 in. is given in the figure. Determine approximately, the modulus of elasticity for the material.



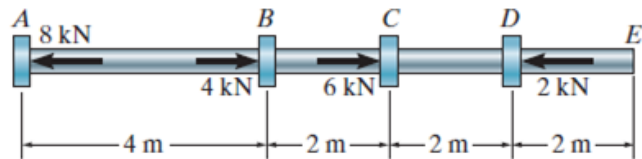
- a. 10×10^3 ksi
- b. 12×10^4 ksi
- c. 15×10^3 ksi
- d. None of the above

23. The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, determine the *change in its length*. $E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.



- a. 0.500 mm
- b. 0.430 mm
- c. 0.126 mm
- d. None of the above

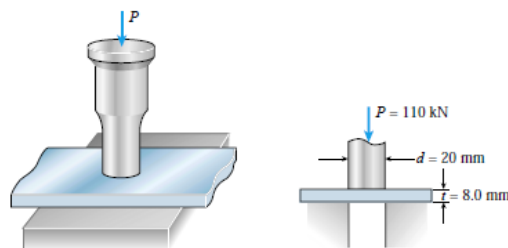
24. The 2014-T6 aluminum rod ($E = 72.4 \text{ GPa}$) has a uniform diameter of 30 mm and supports the load shown. Determine, nearly, the displacement of end A with respect to end E. Neglect the size of the couplings.



- a. 0.50 mm
- b. 0.70 mm
- c. 0.90 mm
- d. None of the above

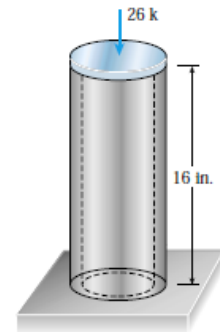
25. A punch for making holes in steel plates is shown in the figure. Assume that a punch having diameter $d = 20 \text{ mm}$ is used to punch a hole in an 8-mm thick plate, as shown in the cross-sectional view. If a force $P = 110 \text{ kN}$ is required to create the hole, **what is the average shear stress in the plate (nearly)?**

The shear surface area in the plate = πdt (or, circumference times the thickness of the plate)



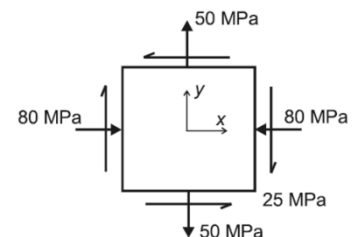
- a. 500 mm
- b. 220 mm
- c. 200 mm
- d. 319 mm

26. A short post constructed from a ***hollow circular tube*** of aluminum supports a *compressive* load of 26 kips. The inner and outer diameters of the tube are $d_1 = 4.0$ in. and $d_2 = 4.5$ in., respectively, and its length is 16 in. The *shortening* of the post due to the load is measured as 0.012 in. **Determine the compressive stress in the post.** (Disregard the weight of the post itself, and assume that the post does not buckle under the load.)



- a. 4500 psi
- b. 8080 psi
- c. 7790 psi
- d. 6500 psi

27. The principal normal stresses, respectively, are:

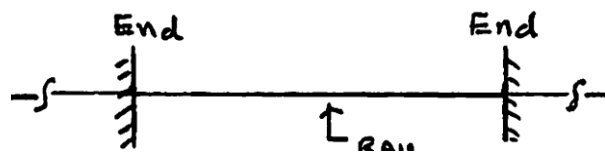


- a. 54.6 MPa; -84.6 MPa
- b. 65.9 MPa; -46.0 MPa
- c. -70.0 MPa; - 54.5 MPa
- d. 65.6 MPa; 46.4 MPa

28. The wall thickness of a 4-ft-diameter *spherical* thin vessel is 5/16 inch. The allowable internal pressure if the stress is limited to 8000 psi is nearly:

- a. 195 psi
- b. 440 psi
- c. 350 psi
- d. 208 psi

29. A 10-m section of steel [$E = 200 \text{ GPa}$ and $\alpha = 11.9(10^{-6})/^{\circ}\text{C}$] rail has a cross sectional area of 7500 mm^2 . Both ends of the rail are tight against adjacent rails that can be assumed rigid for this problem. The rail is supported *against* lateral movement (in other words, no change in diameter allowed). For an increase in temperature of 50°C , determine the normal stress in the rail.

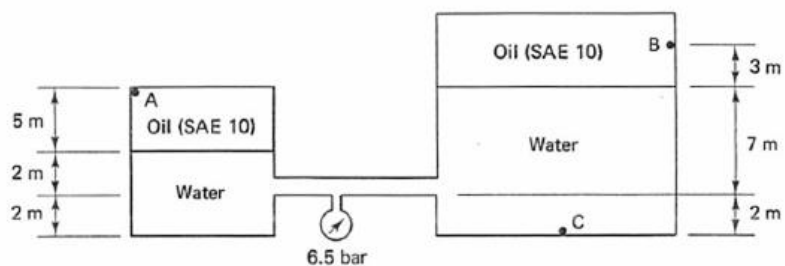


- a. 119 MPa
- b. 96 MPa
- c. 127 MPa
- d. None of the above

30. A well designed ship displaces 130 m^3 of seawater. What is the *weight* of the ship? Density of seawater is 1023 kg/m^3 . [$g = 9.81 \text{ m/s}^2$]

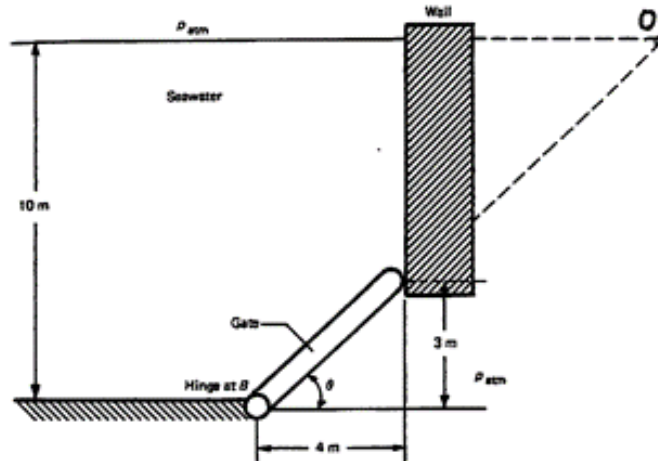
- a. 2.4 Mega N
- b. 9.6 Mega N
- c. 12.7 Mega N
- d. 1.3 Mega N

31. If the pressure gauge shown in the figure indicates a pressure of $6.5 \times 10^5 \text{ N/m}^2$ (6.5 bar) estimate the pressure at point B. The unit weights of the oil and water are 9016 N/m^3 and 9790 N/m^3 , respectively.



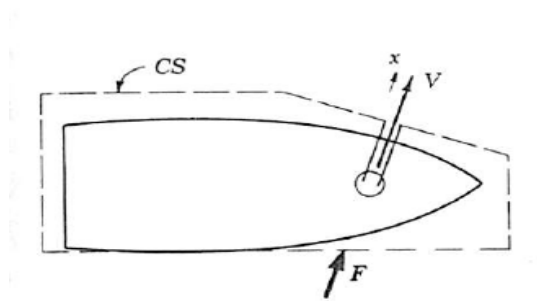
- a. $3.4 \times 10^5 \text{ N/m}^2$
- b. $4.6 \times 10^5 \text{ N/m}^2$
- c. $5.5 \times 10^5 \text{ N/m}^2$
- d. $6.5 \times 10^5 \text{ N/m}^2$

32. A rectangular gate, 2 m wide (into the paper), is hinged at point B and rests against a smooth wall at point A . Estimate the pressure force on the gate due to the seawater of density 1000 kg/m^3 (neglect any effect of atmospheric pressure).



- a. $8.3 \times 10^5 \text{ N}$
- b. $10.3 \times 10^5 \text{ N}$
- c. $4.5 \times 10^5 \text{ N}$
- d. $6.3 \times 10^5 \text{ N}$

33. A jet of water 80 mm in diameter with a velocity of 40 m/s is discharged in a **horizontal x direction (as shown)** from a nozzle mounted on a boat. What force, F , is required to hold the boat stationary? Density of water is 1000 kg/m^3 .



- a. 8090 N
- b. 8040 N
- c. 9600 N
- d. 5600 N

34. Assume that the *drag*, D , acting on a spherical particle that falls very slowly through a viscous fluid is a function of the particle diameter, d , the particle velocity, V , and the fluid viscosity, μ . **How many π terms can be formed?**

- a. 2
- b. 3
- c. 1
- d. None

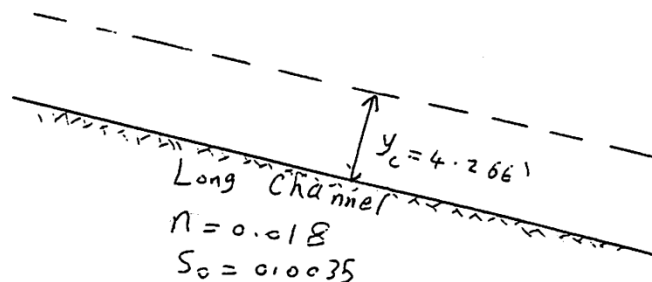
35. Water issues from a *large* tank through a circular 5-in-diameter orifice under a static head of 45 ft. If 534 ft^3 of water volume is discharged in 2 **minutes**, what is the *coefficient of discharge*? The *vena contracta* diameter is measured to be 3.93 inches.

- a. 0.560
- b. 0.406
- c. 0.500
- d. 0.606

36. Oil, with density $\rho = 900 \text{ kg/m}^3$ and $\nu = 0.00001 \text{ m}^2/\text{s}$, flows steadily at $0.2 \text{ m}^3/\text{s}$ through 500m length of a 200-mm diameter cast-iron pipe ($e = 0.26 \text{ mm}$). *Determine, nearly, the head loss due to friction.*

- a. 115 m
- b. 90 m
- c. 230 m
- d. 45 m

37. The depth at some section of the given wide channel was reported to be 4.1 feet. The discharge per unit width is 50 cfs/ft; $y_c = 4.266 \text{ ft}$. The normal flow depth is nearly:



- a. 6 ft
- b. 5 ft
- c. 4 ft
- d. 2 ft

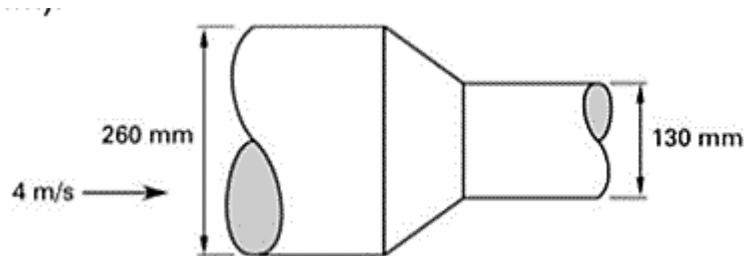
38. A trapezoidal channel has concrete side slopes at 1:1, and a gravel bottom. The average Manning's roughness coefficient for the entire channel cross section is 0.018. The channel bed slope is 0.0005 and the normal flow depth is 1 m. Because of the gravel bottom, the maximum flow velocity in the channel is limited to 0.75 m/s. The bottom width of the channel is nearly:

- a. 0.6 m
- b. 0.5 m
- c. 0.4 m
- d. 0.3 m

39. A 6-cm pipe carries water at 20°C ($\nu = 1.007 \times 10^{-6} \text{ m}^2/\text{s}$) at the rate of 12 liters/s. The Reynolds number for this condition is nearly:

- a. 6.3×10^5
- b. 4.0×10^5
- c. 3.0×10^5
- d. 2.5×10^5

40. The speed of an incompressible fluid is 4 m/s entering the 260 mm pipe. The speed in the 130 mm pipe is most nearly:



- a. 40 m/s
- b. 9 m/s
- c. 12 m/s
- d. 16 m/s

41. A hydraulic jump occurs in a *wide rectangular* channel. The upstream depth and velocity are 0.4m, and 13 m/s, respectively. The downstream flow depth is nearly:
[Specific weight of water = 9810 N/m^3 ; $g = 9.81 \text{ m/s}^2$]

- a. 3.5 m
- b. 4.8 m
- c. 2.9 m
- d. 6 m

42. A manufacturing facility is willing to accept only 1% risk of flooding during its 50-year design life. What is the annual *probability* that flooding *will* occur during the design life?

- a. 0.0002
- b. 0.007
- c. 0.01
- d. 0.05

43. The rank of a river discharge in an annual discharge series data is 11. The sample size is 53. The *return period* is best estimated to be:

- a. 3.86 years
- b. 54 years
- c. 2 years
- d. 4.91 years

44. A flood discharge has a return period of 100 years. The *probability* of it occurring *twice* during the next 10 years is:

- a. 0.00055
- b. 0.096
- c. 0.67
- d. 0.0092

45. Consider a return period of 100 years. The *probability* of it *not occurring* during the next 20 years is:

- a. 0.818
- b. 0.675
- c. 0.717
- d. 0.432

46. Which of the following terms is best defined as a formula or set of steps for solving a particular problem?

- a. program
- b. software

- c. firmware
- d. algorithm

47. The computer language that is executed within a computer's central processing unit is:

- a. DOS
- b. high-level language
- c. assembly language
- d. machine language

48. How many times will the second line be executed?

M = 42

LOOPSTART M = M - 1

P = INTEGER PART OF (M/2)

IF P > 15, THEN GO TO

LOOPSTART, OTHERWISE

GO TO END

END PRINT "DONE"

- a. 8
- b. 11
- c. 9
- d. 12

49. M = 5, P = M * 2 + 6, THEN $n = p^{0.5} =$

- a. 4
- b. 16
- c. 32
- d. 0

50. A computer structured programming program contains the following program segment. What is the value of X after the segment is executed?

X = 0

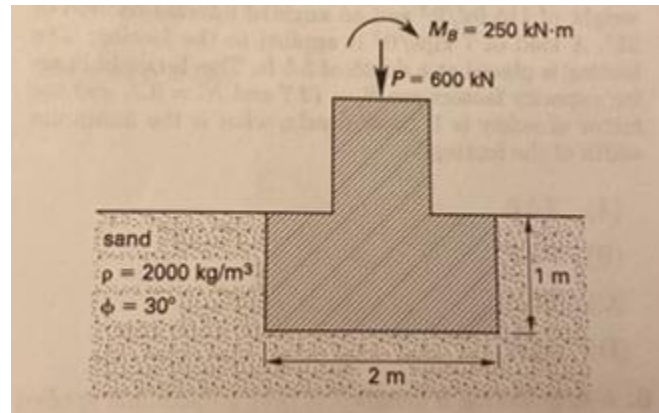
FOR T = -1 TO 2

X = X + T

NEXT T

- a. 6
- b. 4
- c. 3
- d. 2

51. A 2-m wide continuous wall footing is designed to support an axial column load of 600 kN (per meter wall length) and a moment of 250 kN.m (per meter wall length). The footing is placed 1 m into a sandy soil with a density of 2000 kg/m^3 , cohesion of 0.5 Pa, and an angle of internal friction of 30° . Most nearly, the ultimate bearing capacity per meter of footing length is:



- a. 84 kPa
- b. 210 kPa
- c. 430 kPa
- d. 830 kPa

52. A soil has an angle of internal friction of 25° . The Rankine *active* earth pressure coefficient is nearly:

- a. 0.34
- b. 0.41
- c. 0.52
- d. 0.58

53. A soil has a void ratio of 0.41. The unit weight of the solids is 33 kN/m^3 . The saturated unit weight of the soil is most nearly:

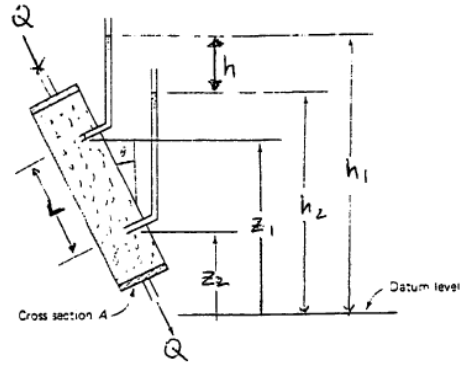
- a. 26 kN/m^3
- b. 29 kN/m^3
- c. 33 kN/m^3
- d. 37 kN/m^3

54. Soil directly below a footing experiences a total compressive stress of 52 kPa. The surface of the water (water table) is 2 m higher than the bottom of the footing. The *effective stress* under the footing is most nearly:

- a. 32 kPa
- b. 38 kPa
- c. 13 kPa

d. 19 kPa

55. Flow through an inclined soil column is shown. The mathematical expression for the *hydraulic gradient* is:



- a. h_1/L
- b. h/L
- c. $(z_1 - z_2)/L$
- d. None of the above

56. A soil sample has a void ratio of 0.72, moisture content 12% and $G_s = 2.72$. Its dry unit weight is nearly:

- a. 15 kN/m^3
- b. 20 kN/m^3
- c. 30 kN/m^3
- d. 25 kN/m^3

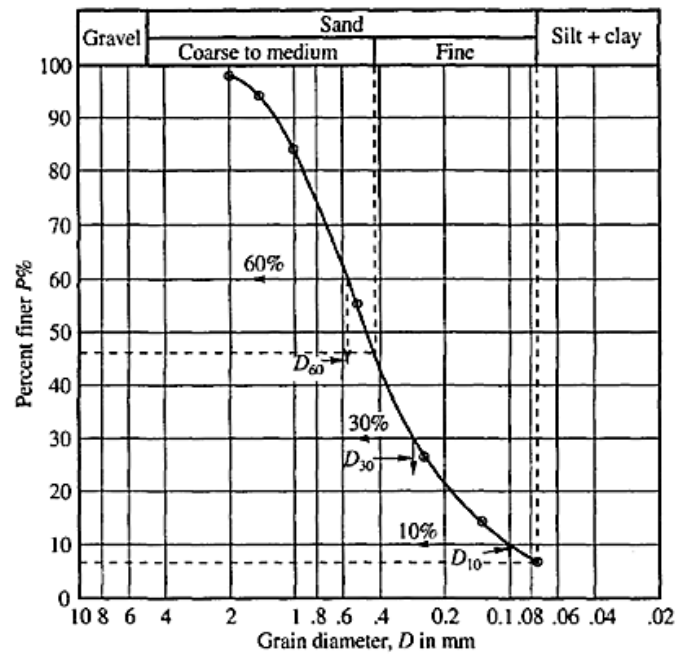
57. A retaining wall supports soil with a vertical height of 2 m. The soil has an angle of internal friction of 32° and a specific (unit) weight of 25 kN/m^3 . The *active* lateral soil resultant *force* is most nearly:

- a. 5 kN/m
- b. 15 kN/m
- c. 46 kN/m
- d. 92 kN/m

58. A sample of *saturated* clay ($S = 1$) from a consolidometer test has a total weight of 3.36 lb and a dry weight of 2.32 lb; the specific gravity of the solid particles is 2.7. For this sample, the total unit weight is nearly:

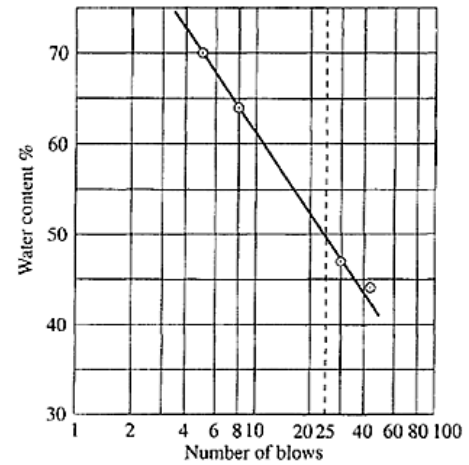
- a. 110 lb/ft³
- b. 290 lb/ft³
- c. 330 lb/ft³
- d. 96 lb/ft³

59. The *uniformity coefficient* for a dry sample based on the gradation plot shown is nearly:



- a. 2.4
- b. 2.9
- c. 5.9
- d. 3.4

60. The semi-log flow curve from a liquid limit test on a sample of clay is shown. According to the graph, the liquid limit is nearly:

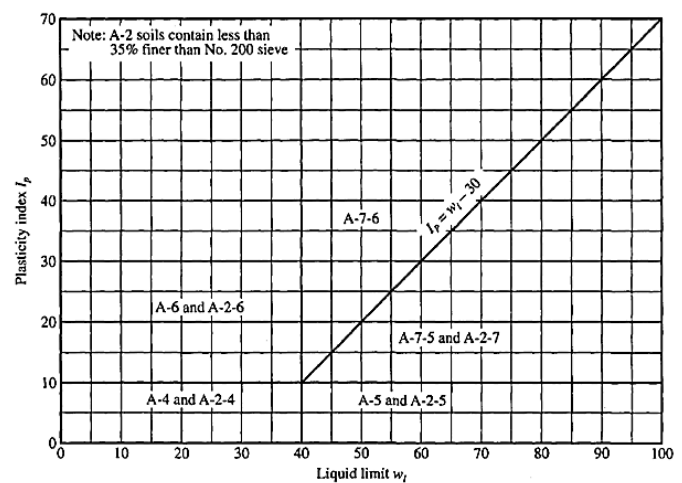


- a. 25%
- b. 30%
- c. 50%
- d. 60%

61. The natural moisture content of an excavated soil is 32%. Its liquid limit is 60% and plastic limit is 27%. The plasticity index of the soil is nearly:

- a. 33%
- b. 43%
- c. 52%
- d. 10%

62. The chart shown is used for:



- a. AASHTO Soil Classification System
- b. Unified Soil Classification System
- c. USDA Soil Classification System
- d. None of the above

63. Ethical behavior among professionals is established by:

- a. ASCE Code of Ethics
- b. Rules of play for professional sports
- c. Legal contracts
- d. Taxation regulations

64. Whistle blowing is best described as calling public attention to:

- a. Unethical behavior in a government agency you are monitoring as a private individual
- b. Secret illegal behavior by your employer
- c. Your own previous unethical behavior
- d. Unethical behavior of employees under your control

65. Why is a competitive bidding often considered to be counterproductive?

- a. The best design is not always the least expensive
- b. Competition among different design firms is unprofessional and unethical
- c. A design professional who reduces the final cost in order to be competitive may eliminate important design steps or features
- d. Competitive bidding may reduce the client's cost but will increase the design professional's cost

66. If a contract does not include the boilerplate cause, "Time is of the essence," which of the following is true?

- a. Damages for delay cannot be claimed
- b. Workers need to be paid for downtime in the project
- c. Standard industry time guideline apply
- d. It is difficult to recover losses for extra hours billed

67. Engineers are to uphold the health, safety, and public

- a. Welfare
- b. Trust
- c. Support
- d. Confidence

68. A “tort” is:

- a. A civil wrong committed against another person
- b. A section of a legal contract
- c. the breach of a contract
- d. None of the above

69. A registered engineer has applied for a promotion at a firm she has been working at for several years. During an interview for the new position, she is asked to contrast her qualifications with other registered engineers at the firm who have applied for the same position. She should

- a. Withdraw her application for the position
- b. Give a full accounting of all the ways her ability and experience are superior to those of the other applicants
- c. Demand to speak to the interviewer’s supervisor
- d. decline to compare her qualifications but offer to describe them

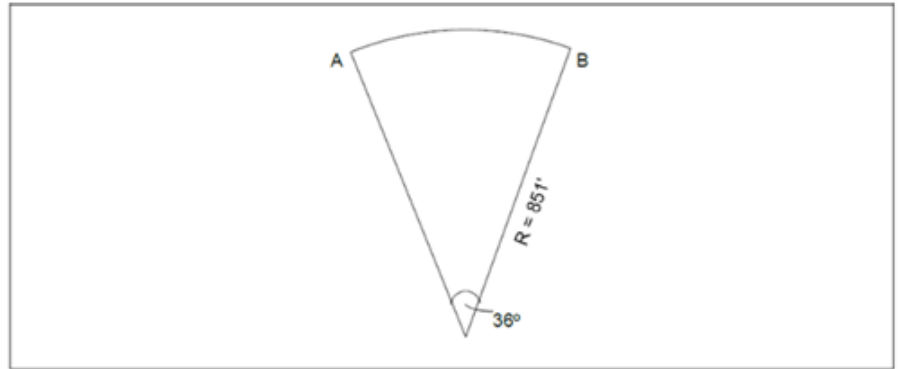
70. Registered engineers’ first obligation/consideration to society is

- a. Public welfare
- b. Public safety
- c. Steal cement and sale on Ebay
- d. To meet the needs of a particular enterprise

71. A horizontal curve for a section of a highway has a design speed of 60 mph. The terrain restricts the radius of the curve to 1200 ft, which therefore requires the super-elevation at the curve, in percent, to be most nearly:

- a. 8
- b. 6
- c. 4
- d. 10

72. A horizontal curve is defined by its radius of 851 feet, as shown below. The length of the chord AB, in feet, is most nearly:



- a. 515
- b. 525
- c. 535
- d. 525

73. A transition curve is to be used to implement a change in cross-section from a normally crowned section to a fully super-elevated section. The outer lane is to be gradually aligned from the normally crowned section to a straight level section at the Tangent-to-Spiral (T.S.) point. The full super-elevation is rotated about the centerline.

Degree of Curve (D) = 2.5°

Two 11-foot lanes

Design super-elevation = 0.08 ft/ft

Grade = $+1.50\%$

Crown = 0.015 ft/ft

T.S. Station = $100 + 00.00$

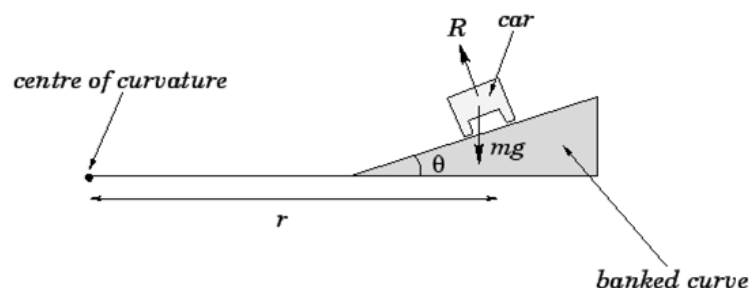
T.S. CL Elevation = $2,500.00 \text{ ft}$.

Length of spiral = 230 ft

The station (feet) where full super-elevation is reached is most nearly:

- a. $102 + 50$
- b. $101 + 00$
- c. $100 + 25$
- d. $100 + 00$

74. The radius of curvature $r = 60 \text{ m}$. The recommended speed around a curve is 40 km/h . The bank angle of the curve is nearly:

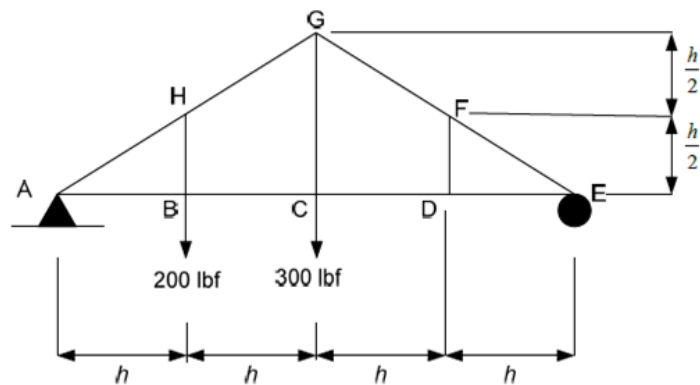


- a. 11.8 degrees
- b. 13.0 degrees
- c. 16.0 degrees
- d. 5.6 degrees

75. If you count 106 cars in 15 minutes in a suburban area (Area Multiplier, $F = 33$), the daily traffic count is nearly:

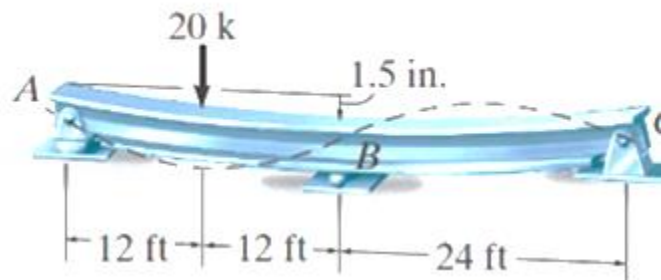
- a. 4500
- b. 3500
- c. 1600
- d. None of the above

76. The force in member AH is nearly:



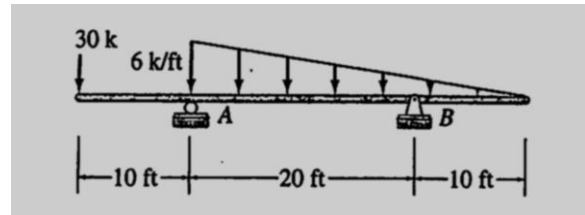
- a. 490 lb
- b. 350 lb
- c. 450 lb
- d. 670 lb

77. Support B settles by 1.5 in. The reaction at support B is most nearly:



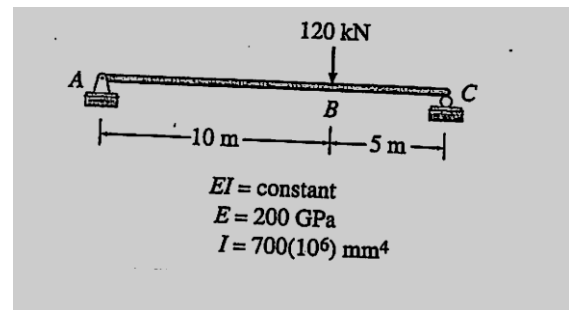
- a. 12.9 kip
- b. 9 kip
- c. 5.6 kip
- d. 6 kip

78. The support reactions for the beam shown are nearly:



- a. $A_x = 0$; $A_y = 90$; $B_y = 30$
- b. $A_x = 0$; $A_y = 60$; $B_y = 30$
- c. $A_x = 0$; $A_y = 94$; $B_y = 50$
- d. $A_x = 0$; $A_y = 35$; $B_y = 90$

79. The maximum deflection for the (horizontal) beam shown is nearly:



- a. 0.0517 m
- b. 0.0875 m
- c. 0.0659 m
- d. 0.0221 m

80. If a one-time amount of \$500 is invested at an annual interest rate of 8% (compounded annually), its future worth at the end of 30 years is nearly:

- a. \$5030
- b. \$7045
- c. \$8230
- d. \$9000

81. If you need to have \$800 in savings at the end of 4 years and your savings account yields 5% annual interest, the amount you need to deposit today is nearly:

- a. \$550
- b. \$660
- c. \$500
- d. None of the above

82. \$1000 is deposited in a savings account that pays 6% annual interest, and no money is withdrawn for three years. The account balance after three years is most nearly:

- a. \$1120
- b. \$1190
- c. \$1210
- d. 1280

83. A computer with a useful life of 12 years has an initial cost of \$2300 and a salvage value of \$350. The interest rate is 6%. Using straight line method, the total depreciation of the computer for the first five years is most nearly:

- a. \$760
- b. \$840
- c. \$920
- d. \$810

84. An asset is purchased for \$100,000. The estimated life is 7 years and the salvage value is \$15,000. Assuming a straight line depreciation method, the Book Value of the asset at the end of 3 years is most nearly:

- a. \$89,000
- b. \$110,000
- c. \$70,290
- d. \$63,570

85. The annual nominal interest rate on the unpaid portion of a contract is 17%. The effective annual interest rate, if the interest is compounded quarterly, is most nearly:

- a. 12%
- b. 9%
- c. 18%
- d. 12%

86. Sludge is digested after being removed from a secondary treatment tank. During the digestion process, the gas that is produced is mostly:

- a. Methane

- b. Butane
- c. Nitrogen oxide
- d. CO₂

87. A sample of influent water has a sludge volume index of 65 mL/L. After 30 min of settling, the sludge volume is 260 mL/L. What is most nearly the concentration of mixed liquor suspended solids (MLSS) in the sample?

- a. 4.0×10^3 mg/L
- b. 2.0×10^3 mg/L
- c. 3.0×10^3 mg/L
- d. 5.0×10^3 mg/L

88. Bench studies have determined that aluminum sulfate (alum) promotes acceptable floc formation at a dose of 23 mg/L when applied to a surface water source. Design standards for chemical flocculation require flash mixing at a minimum velocity gradient (G) of 900/s for 120 seconds. Electrical power costs \$0.05/kWh. The water demand is 19,000 m³/d. The water temperature is 20°C. The total tank volume required for flash mixing is nearly:

- a. 45 m³
- b. 27 m³
- c. 30 m³
- d. 25 m³

89. A treatment plant upgrade calls for design of sedimentation basins to handle a flow rate of 8 MGD. The basins are of Type I suspension with an overflow rate (q_o) of 650 gpd/ft², a length to width ratio of 4:1, a weir overflow rate (q_w) of 20,000 gpd/ft. The minimum settling zone depth is 10 ft and 1.5 ft is allowed for freeboard. If 3 tanks are chosen, the surface dimension (Length and Width) of each tank is most nearly:

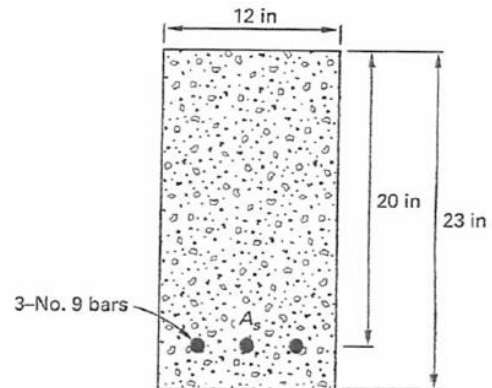
- a. L = 128 ft; W = 32 ft
- b. L = 120 ft; W = 26 ft
- c. L = 90 ft; W = 18 ft
- d. None of the above

90. A secondary clarifier accepts effluent from a bioreactor at a flow rate of 8300 m³/d and total suspended solids of 1600 mg/L. The solids loading rate is 2.6 kg/m².h, and the particle settling velocity is 1.29 m/h. The solids loading rate is most nearly:

- a. 16,000 kg/day
- b. 13,280 kg/day
- c. 17,300 kg/day
- d. None of the above

91. If the dead load shear force in the beam is 5 kips and the live load shear force in the beam is 15 kips, then the minimum amount of shear reinforcement needed for a center-to-center stirrup spacing of 8 inch based on ACI strength design is most nearly:

Given: $f'_c = 3000 \text{ lb/in}^2$, $f_y = 40,000 \text{ lb/in}^2$, $A_s = 3 \text{ in}^2$ [3 #9 bars] and $A_s' = 1 \text{ in}^2$
Assume the beam is under-reinforced!



- a. 0.1 in^2
- b. 0.12 in^2
- c. 0.14 in^2
- d. 0.18 in^2

92. A floor system consists of 30 reinforced concrete beams and a continuous 4 inch deck slab. A typical section is shown for the deck and two of the beams. Assume the beams are under-reinforced. Assume the effective flange width for this beam is 40 inch. If the area of reinforcing steel per beam is 6.00 in^2 , the nominal moment capacity of each beam based on ACI strength design is most nearly:

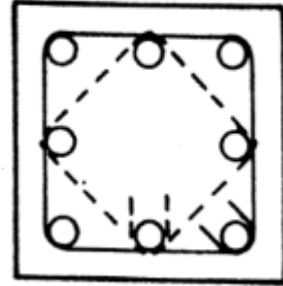
Given: $f'_c = 2800 \text{ lb/in}^2$, $f_y = 42,000 \text{ lb/in}^2$, $L = 30 \text{ ft}$ (simple span length, into the paper)

- a. 150 kip-ft
- b. 160 kip-ft
- c. 520 kip-ft
- d. 650 kip-ft

93. The long (RC) column definition under braced (non-sway) conditions is given by which of the following if M_1 and M_2 are the smaller and larger end moments:

- a. $(KL/r) > [34 - (12M_1/M_2)]$
- b. $(KL/r) > [34 + (12M_1/M_2)]$
- c. $(KL/r) > [34 - (20M_1/M_2)]$
- d. $(KL/r) > [34 + (20M_1/M_2)]$

94. Determine the capacity of a 16" x 16" square column with 8- #10 bars, tied. Grade 40 steel and 4000 psi concrete.

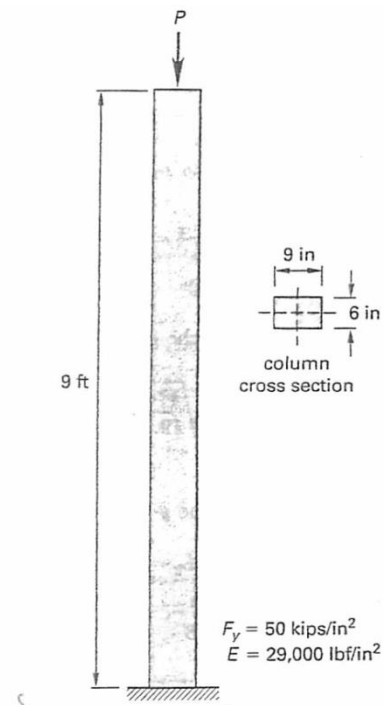


- a. 850 kips
- b. 900 kips
- c. 420 kips
- d. 646 kips

95. A short square tied column is to carry an axial dead load of 300 kip and a live load of 200 kip. The factored load is most nearly:

- a. 680 kips
- b. 400 kips
- c. 420 kips
- d. 390 kips

96. A solid **steel column** with a fixed bottom support and free upper end is concentrically loaded. Material and geometric properties are shown in the figure. The available axial compressive design stress is most nearly:



- a. 13 kips/in²
- b. 18 kips/in²
- c. 29 kips/in²
- d. 39 kips/in²

97. A steel column is built-in at one end and free to translate and rotate at the other end. The column uses a 12 ft long W12 X 45 beam. If the yield strength of the steel is 50 kips/in², the available design stress in the column is most nearly:

- a. 7.3 kips/in²
- b. 9.7 kips/in²
- c. 10 kips/in²
- d. 9 kips/in²

98. **Using LRFD**, Select an ASTM A992 ($F_y = 50$ ksi) W-shape column to carry an axial dead load of 140 kips and live load of 420 kips. The column is 30 ft long and is pinned top and bottom in both axes. Limit the column size to a nominal 14-in. shape.

- a. W14 X 132
- b. W 14 X 120
- c. W 14 X 110
- d. W14 X 90

99. Calculate the available strength of a W14×132 column with unbraced lengths of 30 ft in both axes. ASTM A992 ($F_y = 50$ ksi; $F_u = 65$ ksi; $A_g = 38.8$ in²; $r_x = 6.28$ in.; $r_y = 3.76$ in.). To carry an axial dead load of 140 kips and live load of 420 kips. The column is 30 ft long and is pinned top and bottom in both axes. **Use LRFD.**

- a. 840 kips
- b. 750 kips
- c. 810 kips
- d. 892 kips

100. The available flexural strength of the W18 x 50 ASTM A992 beam **using LRFD** ($F_y = 50$ ksi; $F_u = 65$ ksi; $Z_x = 101$ in³) is most nearly:

- a. 379 kip-ft
- b. 347 kip-ft
- c. 410 kip-ft
- d. 245 kip-ft

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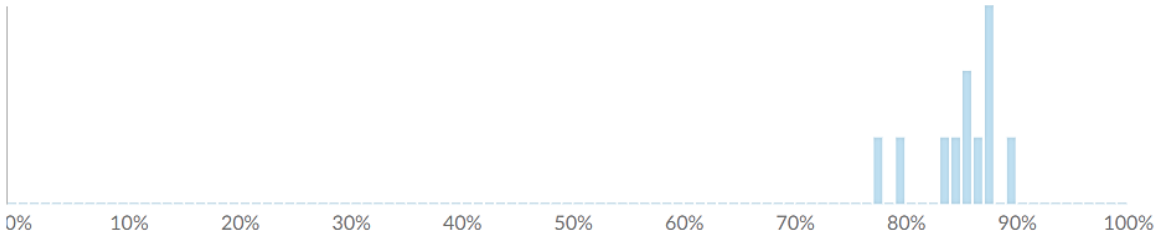
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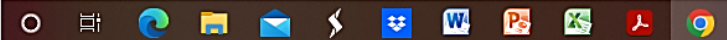


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