

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING
CHEG 2301 – MATERIALS SCIENCE
FALL 2021**

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- II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS**
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Above Average (Graded original work)
Average (Graded original work)
Below Average (Graded original work)
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Original Quiz Questions & Master Solution/grading scheme used
Above Average (Graded original work)
Average (Graded original work)
Below Average (Graded original work)
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Above Average (Graded original work)
Average (Graded original work)
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Above Average (Graded original work)
Average (Graded original work)
Below Average (Graded original work)
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Summary of Topics Covered by Project
Project Problem Statement and Grading Scheme
Above Average (Graded original work)
Average (Graded original work)
Below Average (Graded original work)

[Include any other evaluation used and omit any method above method (Test, Quizzes, Homework, Laboratory and Project reports) that was not used]

(Note: All Pages shown in Yellow should be printed on YELLOW PAPER)
(Note: All Pages shown in Blue should be printed on BLUE PAPER)

Course Description in ABET Format

CHEMICAL ENGINEERING DEPARTMENT CHEG 2301 MATERIALS SCIENCE

Please use the following format for the course syllabi (2 pages maximum in Times New Roman 12 point font)

- | | |
|---|--|
| 1. Course number and name: | CHEG 2301 MATERIALS SCIENCE |
| 2. Credits and contact hours: | 3 credit hours; 3 contact hours |
| 3. Instructor's or course coordinator's name: | Dr. Keisha Antoine |
| 4. Text book: Title:
Author:

Publisher, Year & Edition: | Materials Science and Engineering, An Introduction
William D. Callister, Jr., David G. Rethwisch

Wiley, 2019 10 th Edition |
| a. Other Supplemental material | "The Science and Engineering of Materials", Askeland, Donald R. and Pradeep Phule, Fifth Edition, 2005, Brooks/Cole-Thompson Learning, Inc. |
| 5. Specific course information | |
| a. Brief description of the content of the course (catalog description) | CHEG 2301 Materials Science: 3 semester hours.
Chemical bonding, atomic order and disorder, transport properties, single phase and multiphase materials, heat treatment, corrosion, and composites. |
| b. Prerequisites or Co-requisites | CHEM 1304 General Chemistry II or CHEM 1403 Chemistry for Engineers |
| c. *Indicate whether a required, elective, or selected elective (as per definition provided) course in the program | Required |
| 6. a. Specific goals for the course specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

<i>Students will be able to:</i> | b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

<i>The specific goals for the course specific outcomes listed on the left column will address the following student learning outcomes:</i> |
| 1. An ability to apply conservation laws. | |
| 2. An ability to present and report basic | |

engineering information.

3. An ability to analyze, formulate and solve mass balances with and without chemical reactions.

4. An ability to analyze, formulate and solve energy balances.

Outcome D1

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

7 Brief list of topics to be covered

1. Structure, Property and Processing (3 hours)
2. Atomic Structure and Interatomic Bonding (9 hours)
3. The Structure of Crystalline Solids (9 hours)
4. Imperfections in solids (6 hours)
5. Diffusion (8 hours)
6. Mechanical Properties of Metals (7 hours)
7. Mechanisms of Failure (6 hours)

***Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group

II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS

Program Outcomes Assessed in this course

Outcome D1:

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

Assessment Summary of Class Semester Averages for Outcomes (Should be provided for Fall 2019 through Spring 2022 Assessment Period)

Outcomes	D1
Semester	Semester Class Average (%)
Fall 2021	67.2
Spring 2021	78.7
Spring 2020	74.5
Fall 2019	71
Comments on Trend of Data (Improving or deteriorating)	The class average for this outcome has been consistently increasing.

*Expected Semester Class Average = 75% (or as defined by the program)
Ideal Semester Class Average = 75% (or as defined by the program)

End of Semester Course Assessment Reports Fall 2021 and Last Three Assessment Periods.

Each summary contains the following Information

1. Performance Statistics

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

2. Implementation Summary

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

3. Perceived Problems

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

4. New Plans for Addressing Problems

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

5. Overall Trend over last three assessment periods

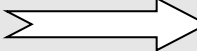
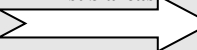
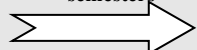
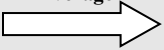
- Instructors summary of overall performance trend for each outcome measured over the last three periods.

5. Were Expectations Met?

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

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
CHEG 2301 P01 MATERIAL SCIENCE and ENGINEERING: FALL 2021 SEMESTER

Report Prepared by: Dr. KEISHA ANTOINE Report Date: December 17, 2021

Semester	Analysis Type	Number of Students	Outcome D1			
			An ability to identify, formulate, and solve fundamental engineering problems by applying principles of engineering, science, and mathematics.			
			Expected Class Average	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2021	Direct	15	75	70	69.4	33.3
Spring 2021	Direct	13	75	70	78.7	69.2
Spring 2020	Direct	23	75	70	74.5	56.5
Fall 2019	Direct	20	75	70	71	55
Spring 2019	Direct	11	75	70	79	73
Fall 2018	Direct	37	75	70	72	74
FALL 2017	Direct	46	75	70	68	38
SPRING 2017	Direct	40	75	70	67	56
FALL 2016	Direct	53	75	70	77	60
Implementation Summary	Items implemented from previous report or after meeting previous instructor 	This semester marked a resumption to in-person classes. The class whiteboard was used extensively to engage students during formulation and solving problems. As before, students' basic concepts on physics and chemistry were tested in the first exam, then course-specific content was the focus after that exam. Almost every assessment had a question to strengthen their ability to read graphs (cartesian and logarithmic) to abstract information. Homework is assigned (although not graded), and homework problems are reviewed in class. Some iteration of the homework problems appears in the exams to test their understanding of the course content.				
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them 	This cohort of students seemed to move at a slower pace and took longer to understand the material when compared to previous cohorts. They struggled with problem identification and formulation, so additional time was allocated to in-class, instructor-led problem-solving on the whiteboard. Perhaps this is due to many of the students experiencing in-person college courses for the first time.				
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas 	The instructor spent more contact hours to emphasize general knowledge concepts and to relate them to crystal structure, bonding and their effects on material properties. Many homework problems are worked in class. The tests are reflective of the homework assigned. Students have begun to pay attention to the homework as a result.				
Overall Trend over Periods	Ascertain if there were improvements over previous semesters 	Students' performance fell below expected class average.				
Were Expectations Met?	Class Average $\geq 75\%$ and $\geq 70\%$ of Students Performed at or Above Expected Average. 	Class average $\rightarrow$ no % of students $\rightarrow$ no				

**MATERIALS SCIENCE
FALL 2021**

Title of Assignment: TEST 1

TOPICS COVERED IN TEST 1

Test 1 covered the following topics:

1. Structure, Property and Processing
2. Atomic Structure and Interatomic Bonding

**MATERIALS SCIENCE
SPRING 2021**

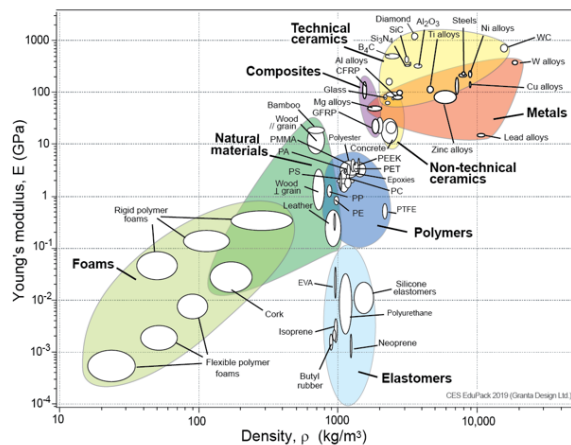
**SAMPLE TEST QUESTIONS, SOLUTIONS,
AND GRADING SCHEME FOR TEST 1**

1. Match the terms to the correct concepts. [20 points]

No.	Term	No.	Concept
1	Atomic mass		The chemical make-up of a material
2	Composition		The mass of an atom expressed as 1/12 the mass of a carbon atom
3	Physical properties		Generally has good ductility, strength and electrical conductivity
4	Metal		The energy required to separate two atoms from their equilibrium spacing to an infinite distance apart.
5	Structure		The sum of the protons and neutrons
6	Atomic mass unit		Electrons that participate in bonding or chemical reactions
7	Binding energy		Atoms are arranged in a periodic fashion exhibiting long-range order
8	Crystalline materials		A relative distance or range of distances used to describe materials-related structure, properties or phenomena
9	Length-scale		Description of the arrangements of atoms or ions in a material
10	Valence electrons		Describe characteristics such as color, elasticity, electrical or thermal conductivity, magnetism and optical behavior

2. Using the periodic table attached, calculate the percent ionic character of the interatomic bonds for MgCl_2 [10 points]

3. Your client is looking for some material recommendations for weights that can potentially keep an object submerged in water, i.e., it must be heavier than water ($\rho = 1000 \text{ kg/m}^3$). The materials must be mechanically strong, having a stiffness (i.e., Young's modulus) greater than 500 GPa. List three (3) materials that you would recommend to the client. The Ashby chart below has been provided for your reference. [15 points]



4. What type(s) of bonding would be expected for nichrome (an alloy containing nickel and chromium)? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

5. What type(s) of bonding would be expected for rubber? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

6. What type(s) of bonding would be expected for a) calcium fluoride (CaF_2)? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

7. What type(s) of bonding would be expected for silicon oxide single crystal (SiO_2)? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

8. Calculate the radius of an iridium (Ir) atom, given that Ir has an FCC crystal structure, a density of 22.4 g/cm³ and an atomic weight of 192.2 g/mol. [25 points]

9. Construct a unit cell showing the (111) plane and the $[1\ \frac{1}{2}\ 1]$ direction. [10 points]



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•lanthanides

****actinides**

Element	Phase	Temperature (K)	Pressure (GPa)	Volume (Å ³)	Crystal structure	Space group	Ref.
57 La	PM	105	1.1	115	PM	PMN23	70
58 Ce	PM	144	1.1	115	PM	PMN23	70
59 Pr	PM	144	1.1	115	PM	PMN23	70
60 Nd	PM	144	1.1	115	PM	PMN23	70
61 Pm	PM	150	1.1	115	PM	PMN23	70
62 Sm	PM	150	1.1	115	PM	PMN23	70
63 Eu	PM	157	1.1	115	PM	PMN23	70
64 Gd	PM	157	1.1	115	PM	PMN23	70
65 Tb	PM	157	1.1	115	PM	PMN23	70
66 Dy	PM	162	1.1	115	PM	PMN23	70
67 Ho	PM	164	1.1	115	PM	PMN23	70
68 Er	PM	164	1.1	115	PM	PMN23	70
69 Tm	PM	168	1.1	115	PM	PMN23	70
70 Yb	PM	174	1.1	115	PM	PMN23	70
71 Lu	PM	174	1.1	115	PM	PMN23	70
72 Hf	PM	182	1.1	115	PM	PMN23	70
73 Ta	PM	182	1.1	115	PM	PMN23	70
74 W	PM	182	1.1	115	PM	PMN23	70
75 Re	PM	182	1.1	115	PM	PMN23	70
76 Os	PM	182	1.1	115	PM	PMN23	70
77 Ir	PM	182	1.1	115	PM	PMN23	70
78 Pt	PM	182	1.1	115	PM	PMN23	70
79 Au	PM	182	1.1	115	PM	PMN23	70
80 Hg	PM	182	1.1	115	PM	PMN23	70
81 Tl	PM	182	1.1	115	PM	PMN23	70
82 Pb	PM	182	1.1	115	PM	PMN23	70
83 Bi	PM	182	1.1	115	PM	PMN23	70
84 Po	PM	182	1.1	115	PM	PMN23	70
85 At	PM	182	1.1	115	PM	PMN23	70
86 Rn	PM	182	1.1	115	PM	PMN23	70
87 Fr	PM	182	1.1	115	PM	PMN23	70
88 Ra	PM	182	1.1	115	PM	PMN23	70
89 Ac	PM	182	1.1	115	PM	PMN23	70
90 Th	PM	182	1.1	115	PM	PMN23	70
91 Pa	PM	182	1.1	115	PM	PMN23	70
92 U	PM	280	1.1	115	PM	PMN23	70
93 Np	PM	231	1.1	115	PM	PMN23	70
94 Pu	PM	231	1.1	115	PM	PMN23	70
95 Am	PM	231	1.1	115	PM	PMN23	70
96 Cm	PM	231	1.1	115	PM	PMN23	70
97 Bk	PM	231	1.1	115	PM	PMN23	70
98 Cf	PM	231	1.1	115	PM	PMN23	70
99 Es	PM	231	1.1	115	PM	PMN23	70
100 Fm	PM	231	1.1	115	PM	PMN23	70
101 Md	PM	231	1.1	115	PM	PMN23	70
102 No	PM	231	1.1	115	PM	PMN23	70
103 Lr	PM	231	1.1	115	PM	PMN23	70

[illegible]

Lanthanide Series

Actinide Series

1481.12	1480.97	1481.24	1481.42	1481.60	1481.78	1481.96	1482.14	1482.32	1482.50	1482.68	1482.86	1483.04	1483.22	1483.40	1483.58	1483.76	1483.94	1484.12	1484.30	1484.48	1484.66	1484.84	1485.02	1485.20	1485.38	1485.56	1485.74	1485.92	1486.10	1486.28	1486.46	1486.64	1486.82	1487.00	1487.18	1487.36	1487.54	1487.72	1487.90	1488.08	1488.26	1488.44	1488.62	1488.80	1488.98	1489.16	1489.34	1489.52	1489.70	1489.88	1490.06	1490.24	1490.42	1490.60	1490.78	1490.96	1491.14	1491.32	1491.50	1491.68	1491.86	1492.04	1492.22	1492.40	1492.58	1492.76	1492.94	1493.12	1493.30	1493.48	1493.66	1493.84	1494.02	1494.20	1494.38	1494.56	1494.74	1494.92	1495.10	1495.28	1495.46	1495.64	1495.82	1496.00	1496.18	1496.36	1496.54	1496.72	1496.90	1497.08	1497.26	1497.44	1497.62	1497.80	1497.98	1498.16	1498.34	1498.52	1498.70	1498.88	1499.06	1499.24	1499.42	1499.60	1499.78	1499.96	1500.14	1500.32	1500.50	1500.68	1500.86	1501.04	1501.22	1501.40	1501.58	1501.76	1501.94	1502.12	1502.30	1502.48	1502.66	1502.84	1503.02	1503.20	1503.38	1503.56	1503.74	1503.92	1504.10	1504.28	1504.46	1504.64	1504.82	1505.00	1505.18	1505.36	1505.54	1505.72	1505.90	1506.08	1506.26	1506.44	1506.62	1506.80	1506.98	1507.16	1507.34	1507.52	1507.70	1507.88	1508.06	1508.24	1508.42	1508.60	1508.78	1508.96	1509.14	1509.32	1509.50	1509.68	1509.86	1510.04	1510.22	1510.40	1510.58	1510.76	1510.94	1511.12	1511.30	1511.48	1511.66	1511.84	1512.02	1512.20	1512.38	1512.56	1512.74	1512.92	1513.10	1513.28	1513.46	1513.64	1513.82	1514.00	1514.18	1514.36	1514.54	1514.72	1514.90	1515.08	1515.26	1515.44	1515.62	1515.80	1515.98	1516.16	1516.34	1516.52	1516.70	1516.88	1517.06	1517.24	1517.42	1517.60	1517.78	1517.96	1518.14	1518.32	1518.50	1518.68	1518.86	1519.04	1519.22	1519.40	1519.58	1519.76	1519.94	1520.12	1520.30	1520.48	1520.66	1520.84	1521.02	1521.20	1521.38	1521.56	1521.74	1521.92	1522.10	1522.28	1522.46	1522.64	1522.82	1523.00	1523.18	1523.36	1523.54	1523.72	1523.90	1524.08	1524.26	1524.44	1524.62	1524.80	1524.98	1525.16	1525.34	1525.52	1525.70	1525.88	1526.06	1526.24	1526.42	1526.60	1526.78	1526.96	1527.14	1527.32	1527.50	1527.68	1527.86	1528.04	1528.22	1528.40	1528.58	1528.76	1528.94	1529.12	1529.30	1529.48	1529.66	1529.84	1530.02	1530.20	1530.38	1530.56	1530.74	1530.92	1531.10	1531.28	1531.46	1531.64	1531.82	1532.00	1532.18	1532.36	1532.54	1532.72	1532.90	1533.08	1533.26	1533.44	1533.62	1533.80	1533.98	1534.16	1534.34	1534.52	1534.70	1534.88	1535.06	1535.24	1535.42	1535.60	1535.78	1535.96	1536.14	1536.32	1536.50	1536.68	1536.86	1537.04	1537.22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
35	Ce	58	Pr	59	Nd	60	Pu	92	Th	90	Pa	91	Np	93	Pu	94	Am	95	Cm	96	Cf	98	Bk	99	Cm	100	Gd	65	Eu	66	Gd	67	Tb	68	Dy	69	Ho	70	Er	71	Tm	72	Yb	73	Lu	74	Hf	75	Ta	76	W	77	Re	78	Os	79	Ir	80	Pt	81	Au	82	Hg	83	Tl	84	Pb	85	Bi	86	Po	87	At	88	Rn	89	Fr	90	Ra	91	Ac	92	Th	93	Pa	94	U	95	Np	96	Pu	97	Am	98	Cm	99	Bk	100	Cf	101	Es	102	Fm	103	Md	104	No	105	Lr	106	Uub	107	Uut	108	Uuq	109	Uuh	110	Uus	111	Uut	112	Uub	113	Uut	114	Uuq	115	Uuh	116	Uus	117	Uut	118	Uub	119	Uut	120	Uuq	121	Uuh	122	Uus	123	Uut	124	Uub	125	Uut	126	Uuq	127	Uuh	128	Uus	129	Uut	130	Uub	131	Uut	132	Uuq	133	Uuh	134	Uus	135	Uut	136	Uub	137	Uut	138	Uuq	139	Uuh	140	Uus	141	Uut	142	Uub	143	Uut	144	Uuq	145	Uuh	146	Uus	147	Uut	148	Uub	149	Uut	150	Uuq	151	Uuh	152	Uus	153	Uut	154	Uub	155	Uut	156	Uuq	157	Uuh	158	Uus	159	Uut	160	Uub	161	Uut	162	Uuq	163	Uuh	164	Uus	165	Uut	166	Uub	167	Uut	168	Uuq	169	Uuh	170	Uus	171	Uut	172	Uub	173	Uut	174	Uuq	175	Uuh	176	Uus	177	Uut	178	Uub	179	Uut	180	Uuq	181	Uuh	182	Uus	183	Uut	184	Uub	185	Uut	186	Uuq	187	Uuh	188	Uus	189	Uut	190	Uub	191	Uut	192	Uuq	193	Uuh	194	Uus	195	Uut	196	Uub	197	Uut	198	Uuq	199	Uuh	200	Uus	201	Uut	202	Uub	203	Uut	204	Uuq	205	Uuh	206	Uus	207	Uut	208	Uub	209	Uut	210	Uuq	211	Uuh	212	Uus	213	Uut	214	Uub	215	Uut	216	Uuq	217	Uuh	218	Uus	219	Uut	220	Uub	221	Uut	222	Uuq	223	Uuh	224	Uus	225	Uut	226	Uub	227	Uut	228	Uuq	229	Uuh	230	Uus	231	Uut	232	Uub	233	Uut	234	Uuq	235	Uuh	236	Uus	237	Uut	238	Uub	239	Uut	240	Uuq	241	Uuh	242	Uus	243	Uut	244	Uub	245	Uut	246	Uuq	247	Uuh	248	Uus	249	Uut	250	Uub	251	Uut	252	Uuq	253	Uuh	254	Uus	255	Uut	256	Uub	257	Uut	258	Uuq	259	Uuh	260	Uus	261	Uut	262	Uub	263	Uut	264	Uuq	265	Uuh	266	Uus	267	Uut	268	Uub	269	Uut	270	Uuq	271	Uuh	272	Uus	273	Uut	274	Uub	275	Uut	276	Uuq	277	Uuh	278	Uus	279	Uut	280	Uub	281	Uut	282	Uuq	283	Uuh	284	Uus	285	Uut	286	Uub	287	Uut	288	Uuq	289	Uuh	290	Uus	291	Uut	292	Uub	293	Uut	294	Uuq	295	Uuh	296	Uus	297	Uut	298	Uub	299	Uut	300	Uuq	301	Uuh	302	Uus	303	Uut	304	Uub	305	Uut	306	Uuq	307	Uuh	308	Uus	309	Uut	310	Uub	311	Uut	312	Uuq	313	Uuh	314	Uus	315	Uut	316	Uub	317	Uut	318	Uuq	319	Uuh	320	Uus	321	Uut	322	Uub	323	Uut	324	Uuq	325	Uuh	326	Uus	327	Uut	328	Uub	329	Uut	330	Uuq	331	Uuh	332	Uus	333	Uut	334	Uub	335	Uut	336	Uuq	337	Uuh	338	Uus	339	Uut	340	Uub	341	Uut	342	Uuq	343	Uuh	344	Uus	345	Uut	346	Uub	347	Uut	348	Uuq	349	Uuh	350	Uus	351	Uut	352	Uub	353	Uut	354	Uuq	355	Uuh	356	Uus	357	Uut	358	Uub	359	Uut	360	Uuq	361	Uuh	362	Uus	363	Uut	364	Uub	365	Uut	366	Uuq	367	Uuh	368	Uus	369	Uut	370	Uub	371	Uut	372	Uuq	373	Uuh	374	Uus	375	Uut	376	Uub	377	Uut	378	Uuq	379	Uuh	380	Uus	381	Uut	382	Uub	383	Uut	384	Uuq	385	Uuh	386	Uus	387	Uut	388	Uub	389	Uut	390	Uuq	391	Uuh	392	Uus	393	Uut	394	Uub	395	Uut	396	Uuq	397	Uuh	398	Uus	399	Uut	400	Uub	401	Uut	402	Uuq	403	Uuh	404	Uus	405	Uut	406	Uub	407	Uut	408	Uuq	409	Uuh	410	Uus	411	Uut	412	Uub	413	Uut	414	Uuq	415	Uuh	416	Uus	417	Uut	418	Uub	419	Uut	420	Uuq	421	Uuh	422	Uus	423	Uut	424	Uub	425	Uut	426	Uuq	427	Uuh	428	Uus	429	Uut	430	Uub	431	Uut	432	Uuq	433	Uuh	434	Uus	435	Uut	436	Uub	437	Uut	438	Uuq	439	Uuh	440	Uus	441	Uut	442	Uub	443	Uut	444	Uuq	445	Uuh	446	Uus	447	Uut	448	Uub	449	Uut	450	Uuq	451	Uuh	452	Uus	453	Uut	454	Uub	455	Uut	456	Uuq	457	Uuh	458	Uus	459	Uut	460	Uub	461	Uut	462	Uuq	463	Uuh	464	Uus	465	Uut	466	Uub	467	Uut	468	Uuq	469	Uuh	470	Uus	471	Uut	472	Uub	473	Uut	474	Uuq	475	Uuh	476	Uus	477	Uut	478	Uub	479	Uut	480	Uuq	481	Uuh	482	Uus	483	Uut	484	Uub	485	Uut	486	Uuq	487	Uuh	488	Uus	489	Uut	490	Uub	491	Uut	492	Uuq	493	Uuh	494	Uus	495	Uut	496	Uub	497	Uut	498	Uuq	499	Uuh	500	Uus	501	Uut	502	Uub	503	Uut	504	Uuq	505	Uuh	506	Uus	507	Uut	508	Uub	509	Uut	510	Uuq	511	Uuh	512	Uus	513	Uut	514	Uub	515	Uut	516	Uuq	517	Uuh	518	Uus	519	Uut	520	Uub	521	Uut	522	Uuq	523	Uuh	524	Uus	525	Uut	526	Uub	527	Uut	528	Uuq	529	Uuh	530	Uus	531	Uut	532	Uub	533	Uut	534	Uuq	535	Uuh	536	Uus	537	Uut	538	Uub	539	Uut	540	Uuq	541	Uuh	542	Uus	543	Uut	544	Uub	545	Uut	546	Uuq	547	Uuh	548	Uus	549	Uut	550	Uub	551	Uut	552	Uuq	553	Uuh	554	Uus	555	Uut	556	Uub	557	Uut	558	Uuq	559	Uuh	560	Uus	561	Uut	562	Uub	563	Uut	564	Uuq	565	Uuh	566	Uus	567	Uut	568	Uub	569	Uut	570	Uuq	571	Uuh	572	Uus	573	Uut	574	Uub	575	Uut	576	Uuq	577	Uuh	578	Uus	579	Uut	580	Uub	581	Uut	582	Uuq	583	Uuh	584	Uus	585	Uut	586	Uub	587	Uut	588	Uuq	589	Uuh	590	Uus	591	Uut	592	Uub	593	Uut	594	Uuq	595	Uuh	596	Uus	597	Uut	598	Uub	599	Uut	600	Uuq	601	Uuh	602	Uus	603	Uut	604	Uub	605	Uut	606	Uuq	607	Uuh	608	Uus	609	Uut	610	Uub	611	Uut	612	Uuq	613	Uuh	614	Uus	615	Uut	616	Uub	617	Uut	618	Uuq	619	Uuh	620	Uus	621	Uut	622	Uub	623	Uut	624	Uuq	625	

ABOVE AVERAGE

Above Average Student Original Graded Assignment

Student Name: Maya Scott

1. Match the terms to the correct concepts. [20 points]

No.	Term	No.	Concept
1	Composition ✓	1	The chemical make-up of a material
2	Atomic mass ✓	6	The mass of an atom expressed as 1/12 the mass of a carbon atom
3	Physical properties ✓	4	Generally has good ductility, strength and electrical conductivity
4	Metal ✓	7	The energy required to separate two atoms from their equilibrium spacing to an infinite distance apart.
5	Crystalline materials ✓	2	The sum of the protons and neutrons
6	Atomic mass unit ✓	9	Electrons that participate in bonding or chemical reactions
7	Binding energy ✓	5	Atoms are arranged in a periodic fashion exhibiting long-range order
8	Structure ✓	10	A relative distance or range of distances used to describe materials-related structure, properties or phenomena
9	Valence electrons ✓	8	Description of the arrangements of atoms or ions in a material
10	Length-scale ✓	3	Describe characteristics such as color, elasticity, electrical or thermal conductivity, magnetism and optical behavior

Student Name: _____

2. Using the periodic table attached, calculate the percent ionic character of the interatomic bonds for MgBr_2 [10 points]

$$\begin{aligned}\% \text{ic} &= \left\{ 1 - \exp \left[(-0.25)(\chi_A - \chi_B)^2 \right] \right\} \times 100 \\ &= \left\{ 1 - \exp \left[(-0.25)(1.2 - 2.8)^2 \right] \right\} \times 100 \\ &= (1 - e^{-0.64}) \times 100 \\ &= .473 \times 100\end{aligned}$$

$$\% \text{ic} = 47\%$$

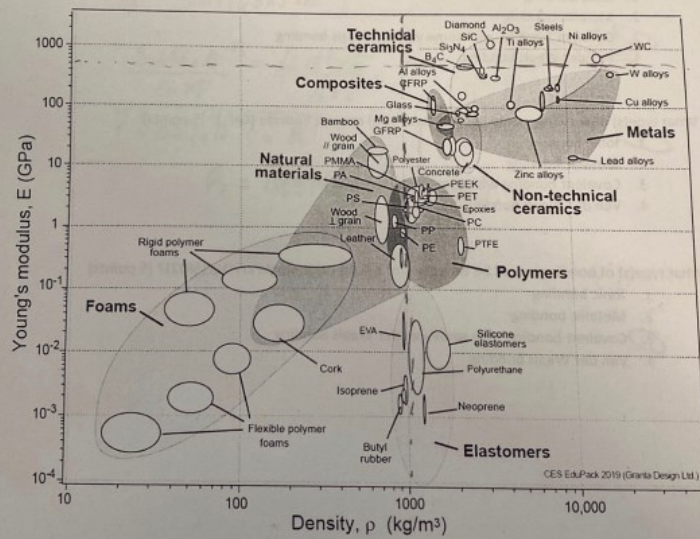
$$\begin{aligned}\chi_A &= \chi_{\text{Mg}} = 1.2 \\ \chi_B &= \chi_{\text{Br}} = 2.8\end{aligned}$$

Student Name: _____

3. Your client is looking for some material recommendations for weights that can potentially keep an object submerged in water, i.e., it must be heavier than water ($\rho = 1000 \text{ kg/m}^3$). The materials must be mechanically strong, having a stiffness (i.e., Young's modulus) greater than 500 GPa. List three (3) materials that you would recommend to the client. The Ashby chart below has been provided for your reference. [15 points]

WC
Diamond
B₄C

$> 1000 \text{ kg/m}^3$
 $> 500 \text{ GPa}$



Student Name: _____

4. What type(s) of bonding would be expected for nichrome (an alloy containing nickel and chromium)? [5 points]
1. Ionic bonding
 2. ☒ Metallic bonding
 3. Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding
5. What type(s) of bonding would be expected for rubber? [5 points]
1. Ionic bonding
 2. Metallic bonding
 3. ☒ Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding
6. What type(s) of bonding would be expected for a) calcium fluoride (CaF_2)? [5 points]
1. ☒ Ionic bonding
 2. Metallic bonding
 3. Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding
7. What type(s) of bonding would be expected for silicon oxide single crystal (SiO_2)? [5 points]
1. Ionic bonding
 2. Metallic bonding
 3. ☒ Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding

Student Name: _____

8. Calculate the radius of an iridium (Ir) atom, given that Ir has an FCC crystal structure, a density of 22.4 g/cm^3 and an atomic weight of 192.2 g/mol . [25 points]

$$\rho = 22.4 \text{ g/cm}^3 \quad \rho = \frac{N_A A_{Ir}}{V_c N_A} \rightarrow V_c = \frac{N_A A_{Ir}}{\rho N_A}$$

$$A_{Ir} = 192.2 \text{ g/mol}$$

$$N = 4 \text{ atoms/cell}$$

$$V_c = \frac{4(192.2)}{22.4(6.023 \times 10^{23})} = 5.698 \times 10^{-23}$$

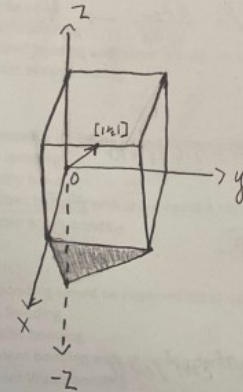
$$\frac{5.698 \times 10^{-23}}{16\sqrt{2}} = \frac{16R^3\sqrt{2}}{16\sqrt{2}}$$

$$\sqrt[3]{5.037 \times 10^{-24}} = R^3$$

$$R = 1.361 \times 10^{-8} \text{ cm}^3/\text{cell}$$

Student Name: _____

9. Construct a unit cell showing the $(11\bar{1})$ plane and the $[1\frac{1}{2}1]$ direction. [10 points]



AVERAGE

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Student Name: Juan Pedro Bibang Nguema Ayana

1. Match the terms to the correct concepts. [20 points]

No.	Term	No.	Concept
1	Composition ✓	1	The chemical make-up of a material
2	Atomic mass	6	The mass of an atom expressed as 1/12 the mass of a carbon atom
3	Physical properties ✓	4	Generally has good ductility, strength and electrical conductivity
4	Metal ✓	7	The energy required to separate two atoms from their equilibrium spacing to an infinite distance apart.
5	Crystalline materials ✓	2	The sum of the protons and neutrons
6	Atomic mass unit ✓	9	Electrons that participate in bonding or chemical reactions
7	Binding energy ✓	5	Atoms are arranged in a periodic fashion exhibiting long-range order
8	Structure ✓	10	A relative distance or range of distances used to describe materials-related structure, properties or phenomena
9	Valence electrons ✓	8	Description of the arrangements of atoms or ions in a material
10	Length-scale ✓	3	Describe characteristics such as color, elasticity, electrical or thermal conductivity, magnetism and optical behavior

Student Name: Juan Pedro Bibang Nguema Ayana

2. Using the periodic table attached, calculate the percent ionic character of the interatomic bonds for MgBr₂ [10 points]

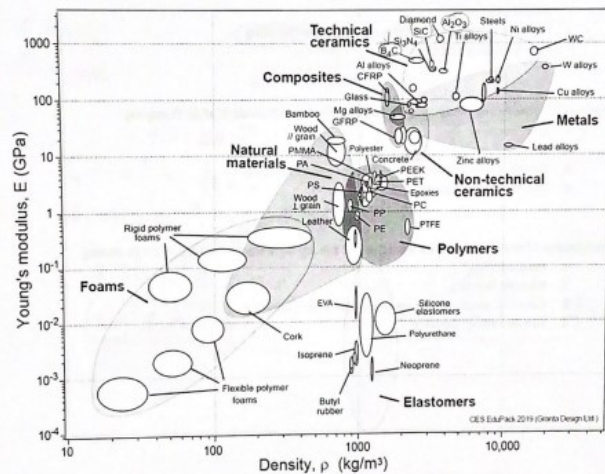
$$\begin{aligned}
 M_g &= 1.2 \quad (x_A) \\
 Br &= 2.8 \quad (x_B) \\
 \% \text{ ionic character} &= \left[1 - e^{-\frac{(x_A - x_B)^2}{4}} \right] \times (100\%) \Rightarrow \\
 \% \text{ ionic character} &= \left[1 - e^{-\frac{(2.8 - 1.2)^2}{4}} \right] \times (100\%) = \\
 \left[1 - e^{-\frac{2.56}{4}} \right] \times (100\%) \Rightarrow \% \text{ ionic character} &= \boxed{47.3\%}
 \end{aligned}$$

Student Name: Juan Pedro Ribarg Nasserma Oyama.

3. Your client is looking for some material recommendations for weights that can potentially keep an object submerged in water, i.e., it must be heavier than water ($\rho = 1000 \text{ kg/m}^3$). The materials must be mechanically strong, having a stiffness (i.e., Young's modulus) greater than 500 GPa. List three (3) materials that you would recommend to the client. The Ashby chart below has been provided for your reference. [15 points]

 B_4C
$$\text{Si}_3\text{N}_4$$

Sic



Student Name: Juan Pedro Bibing Ugerra Yoran

4. What type(s) of bonding would be expected for nichrome (an alloy containing nickel and chromium)? [5 points]
1. Ionic bonding
 2. Metallic bonding
 3. Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding
5. What type(s) of bonding would be expected for rubber? [5 points]
1. Ionic bonding
 2. Metallic bonding
 3. Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding
6. What type(s) of bonding would be expected for a) calcium fluoride (CaF_2)? [5 points]
1. Ionic bonding
 2. Metallic bonding
 3. Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding
7. What type(s) of bonding would be expected for silicon oxide single crystal (SiO_2)? [5 points]
1. Ionic bonding
 2. Metallic bonding
 3. Covalent bonding with some van der Waals bonding
 4. Van der Waals bonding

Student Name: Juan Pablo Bibary Nguema Dymon

8. Calculate the radius of an iridium (Ir) atom, given that Ir has an FCC crystal structure, a density of 22.4 g/cm^3 and an atomic weight of 192.2 g/mol . [25 points]

For FCC $\left\{ \begin{array}{l} n = 4 \end{array} \right.$

Given:

$$\rho = 22.4 \text{ g/cm}^3$$

$$A = 192.2 \text{ g/mol}$$

FCC

$$\rho = \frac{n \cdot A}{V_c \cdot N_A} \Rightarrow V_c = \frac{n \cdot A}{\rho \cdot N_A} \Rightarrow$$

$$\left(\frac{4 \text{ atoms}}{\text{cell}} \right) (192.2 \text{ g/mol})$$

$$(22.4 \text{ g/cm}^3) (6.023 \times 10^{23} \frac{\text{atoms}}{\text{mol}})$$

$$V_c = 5.698 \times 10^{-23} \text{ cm}^3/\text{cell}$$

$$a = 2R\sqrt{2}$$

$$V_c = a^3 = (2R\sqrt{2})^3 \Rightarrow$$

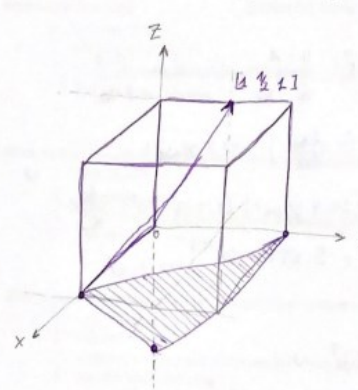
$$5.698 \times 10^{-23} \text{ cm}^3/\text{cell} = (2R\sqrt{2})^3 \Rightarrow$$

$$2R\sqrt{2} = 3.848 \times 10^{-8} \Rightarrow R = \frac{3.848 \times 10^{-8}}{2\sqrt{2}} \Rightarrow$$

$$R = 1.36 \times 10^{-8} \text{ cm}$$

Student Name: Juan Pablo Bibary Nguema Dymon

9. Construct a unit cell showing the $(11\bar{1})$ plane and the $[1\frac{1}{2}1]$ direction. [10 points]



a) $\begin{array}{ccc} h & k & l \\ (1 & 1 & \bar{1}) \end{array} \quad \begin{array}{l} h=1 \\ k=1 \\ l=\bar{1} \end{array}$
assuming $n=1$

$$x: A = \frac{n \cdot a}{h} = \frac{1 \cdot a}{1} = a$$

$$y: B = \frac{n \cdot b}{k} = \frac{1 \cdot b}{1} = b$$

$$z: C = \frac{n \cdot c}{l} = \frac{1 \cdot c}{\bar{1}} = -c$$

b) $[u \ v \ w]$

$$u = n(x_2 - x_1)/a = 1$$

$$v = n(y_2 - y_1)/b = \frac{1}{2}$$

$$w = n(z_2 - z_1)/c = 1$$

CHEG 2301 P01
10/11/2021

Materials Science & Engineering
Test 1

Dr. Antoine

Student Name: Juan Pablo Zubizarri Aguirre

The Modern Periodic Table of the Elements

Periodic Table of Elements

Average relative masses are rounded to two decimal places. The atomic masses of elements with stable isotopes are given in atomic mass units (amu). The atomic masses of elements with no stable isotopes are given in parentheses and are based on the most stable isotope.																	
Electronegativity																	
Atomic #																	
Element name																	
Symbol																	
Avg Mass																	
Electronegativity																	
Mercury ← 80 ← Atomic #																	
Hg																	
200.59																	
1.9																	
Lanthanides																	
Actinides																	

BELOW AVERAGE

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CHEG 2301 P01
10/11/2021

Materials Science & Engineering
Test 1

Dr. Antoine

Student Name: Mykes Johnson

1. Match the terms to the correct concepts. [20 points]

No.	Term	No.	Concept
1	Composition	1	The chemical make-up of a material
2	Atomic mass	6	The mass of an atom expressed as 1/12 the mass of a carbon atom
3	Physical properties	4	Generally has good ductility, strength and electrical conductivity
4	Metal	7	The energy required to separate two atoms from their equilibrium spacing to an infinite distance apart.
5	Crystalline materials	2	The sum of the protons and neutrons
6	Atomic mass unit	9	Electrons that participate in bonding or chemical reactions
7	Binding energy	5	Atoms are arranged in a periodic fashion exhibiting long-range order
8	Structure	10	A relative distance or range of distances used to describe materials-related structure, properties or phenomena
9	Valence electrons	8	Description of the arrangements of atoms or ions in a material
10	Length-scale	3	Describe characteristics such as color, elasticity, electrical or thermal conductivity, magnetism and optical behavior

CHEG 2301 P01
10/11/2021

Materials Science & Engineering
Test 1

Dr. Antoine

Student Name: _____

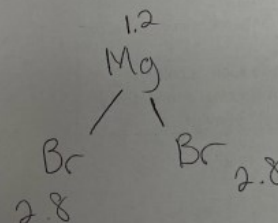
2. Using the periodic table attached, calculate the percent ionic character of the interatomic bonds for MgBr_2 [10 points]

$$\% \text{ IC} = \{1 - \exp[-0.25(X_A - X_B)^2]\} \times 100$$

$$1 - \exp[-0.25(1.2 - 2.8)^2] \times 100$$

$$= 1 - \exp[-0.25(1.6)^2]$$

$$= 1 - \exp[-0.64]$$

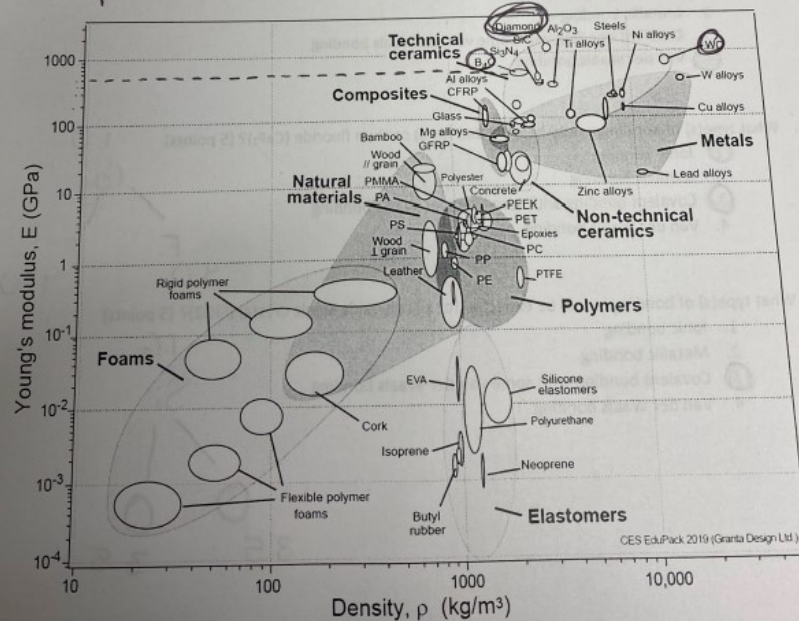


Student Name: _____

3. Your client is looking for some material recommendations for weights that can potentially keep an object submerged in water, i.e., it must be heavier than water ($\rho = 1000 \text{ kg/m}^3$). The materials must be mechanically strong, having a stiffness (i.e., Young's modulus) greater than 500 GPa. List three (3) materials that you would recommend to the client. The Ashby chart below has been provided for your reference. [15 points]

WC

Diamond

 B_4C 

Dr. Antoine

Student Name: _____

- Student Name: _____
4. What type(s) of bonding would be expected for nichrome (an alloy containing nickel and chromium)? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

5. What type(s) of bonding would be expected for rubber? [5 points]

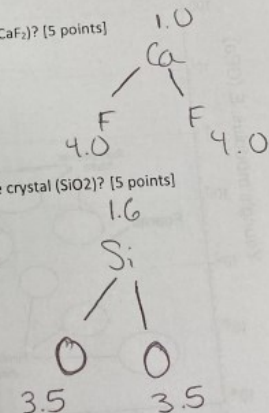
1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

6. What type(s) of bonding would be expected for a) calcium fluoride (CaF_2)? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

7. What type(s) of bonding would be expected for silicon oxide single crystal (SiO_2)? [5 points]

1. Ionic bonding
2. Metallic bonding
3. Covalent bonding with some van der Waals bonding
4. Van der Waals bonding

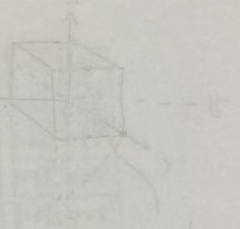


CHEG 2301 P01
10/11/2021Materials Science & Engineering
Test 1

Dr. Antoine

Student Name: _____

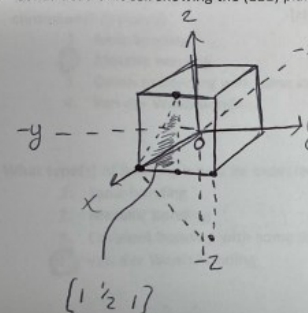
8. Calculate the radius of an iridium (Ir) atom, given that Ir has an FCC crystal structure, a density of 22.4 g/cm^3 and an atomic weight of 192.2 g/mol . [25 points]

CHEG 2301 P01
10/11/2021Materials Science & Engineering
Test 1

Dr. Antoine

Student Name: _____

9. Construct a unit cell showing the $(1\bar{1}\bar{1})$ plane and the $[1\frac{1}{2}1]$ direction. [10 points]



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MATERIALS SCIENCE SPRING 2021

Title of Assignment: FINAL EXAM

TOPICS COVERED IN FINAL EXAM

Final Exam covered the following topics:

1. The Structure of Crystalline Solids
2. Imperfections in solids
3. Diffusion
4. Mechanical Properties of Metals

**MATERIALS SCIENCE
SPRING 2021**

**SAMPLE TEST QUESTIONS, SOLUTIONS,
AND GRADING SCHEME FOR FINAL EXAM**

$$N = N_i + \frac{N_f}{2} + \frac{N_c}{8} \quad V_{\text{sphere}} = \frac{4}{3}\pi R^3 \quad D = D_0 \exp\left(-\frac{Q_d}{RT}\right) \quad J = \frac{M}{At} = -D \frac{dC}{dx}$$

$$\text{concentration gradient} = \frac{dC}{dx} = \frac{\Delta C}{\Delta x} = \frac{C_A - C_B}{x_A - x_B} \quad \frac{C_x - C_0}{C_s - C_0} = 1 - \operatorname{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

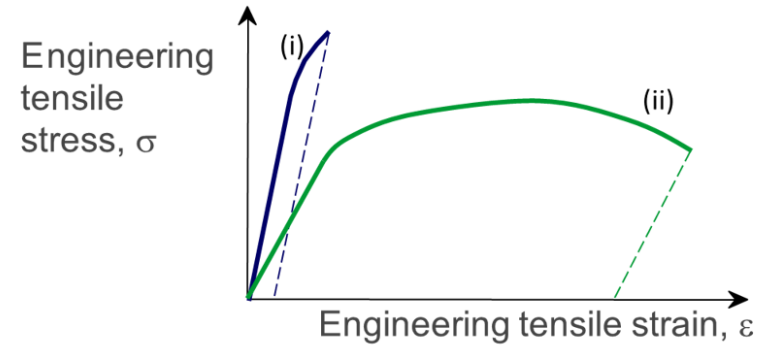


- What is the composition in weight percent of an alloy that consists of 94.1 at% Ag and 5.9 at% Cu? The atomic weights of Ag and Cu are 107.87 g/mol and 63.55 g/mol, respectively:
 - 9.6 wt% Ag and 90.4 wt% Cu
 - 3.6 wt% Ag and 96.4 wt% Cu
 - 90.4 wt% Ag and 9.6 wt% Cu
 - 96.4 wt% Ag and 3.6 wt% Cu
- What factor affects the number of vacancies in a metal? Choose the correct answer. [5 points]
 - Time
 - Light intensity
 - Temperature
 - pH
- A pristine ingot of gold at room temperature has vacancies. TRUE or FALSE [5 points]
- Diffusion has a linear relationship with temperature. TRUE FALSE [5 points]
- Which of the following is a crystalline solid?
 - Copper wire
 - Glass bottle
 - Polythene bag
 - Rubber ball
- What type(s) of bonding would be expected for a) calcium fluoride (CaF₂)? [5 points]
 - Ionic bonding
 - Metallic bonding
 - Covalent bonding with some van der Waals bonding
 - Van der Waals bonding
- A table showing the dependence of diffusivity on temperature is shown below. What is the value of temperature for $D = 2.315 \times 10^{-11} \text{ m}^2/\text{s}$? [5 points]

T (K)	D (m ² /s)
1300	1.075E-11
1400	1.414E-11
1500	1.794E-11
1600	2.208E-11
1700	2.653E-11
1800	3.123E-11

- a. 1632
- b. 1599
- c. 1620
- d. 1624

8. The stress strain curves of two materials are given in the sketch below. Choose which material has higher ductility (i) or (ii). [5 points]

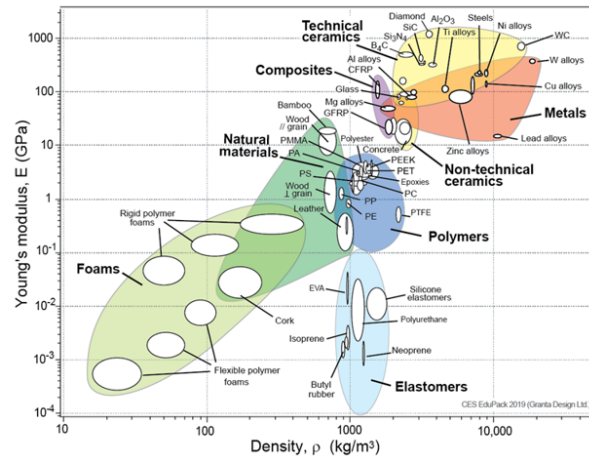


- a. (i)
- b. (ii)

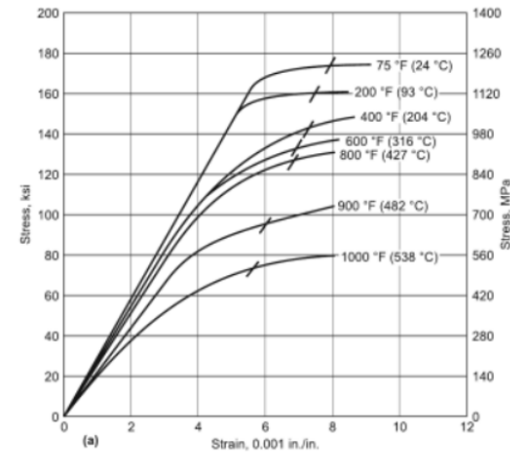
9. A specimen of steel has a rectangular cross-section 20 mm wide and 40 mm thick, an elastic modulus of 207 GPa, and a Poisson's ratio of 0.30. If this specimen is pulled in tension with a force of 60,000 N, what is the change in width if deformation is totally elastic? [5 points]

- a. Increase in width of 7.24×10^{-3} m
- b. Decrease in width of 2.18×10^{-6} m
- c. Increase in width of 7.24×10^{-6} m
- d. Decrease in width of 2.18×10^{-3} m

10. The Ashby Chart is a tool that can be used in the Material Selection process; it compares two or more properties of many materials or classes of materials. The Ashby Chart below compares Young's Modulus against density for different materials. From the Ashby Chart shown below, state which of the materials you think is stronger –
- (i) rigid polymer foams or
 - (ii) silicone elastomers? [5 points]

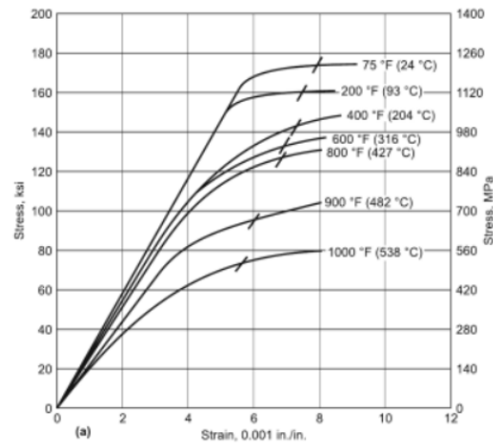


11. An unspecified alloy specimen of square cross-section (0.175 in. on a side) exhibits the stress-strain behavior shown in Fig. 1. The specimen is 12 in. long. NOTE: the strain is given in units of 0.001 in./in. Therefore "8" is 8 x 0.001 in./in. or 0.008 in./in.



- a) Recall that the technical definition for yield strength, σ_y , is the value of the engineering stress where the engineering strain, $\epsilon_y = 0.002$. Using this definition, what is the yield strength of the metal alloy at 200°F? [10 points]

11. An unspecified alloy specimen of square cross-section (0.175 in. on a side) exhibits the stress-strain behavior shown in Fig. 1. The specimen is 12 in. long. NOTE: the strain is given in units of 0.001 in./in. Therefore "8" is 8 x 0.001 in./in. or 0.008 in./in.



- a) Recall that the technical definition for yield strength, σ_y , is the value of the engineering stress where the engineering strain, $\epsilon_y = 0.002$. Using this definition, what is the yield strength of the metal alloy at 200°F? [10 points]

- b) Compute the Young's modulus of this alloy at 200°F. Report units in US Customary units or English units. [10 points]

c) Compute the magnitude of the load necessary to produce an elongation of 0.018 in. [10 points]

d) Using the concept of safe stress or working stress, σ_w , we know that the safe stress is based on the yield strength of the material and is defined by:

$$\sigma_w = \frac{\sigma_y}{N} \quad (6.24)$$

Where N is the factor of safety.

For a factor of safety equal to five (5), compute the working stress corresponding to the yield stress you found in part a. [10 points]



e) For a nail to be driven into the metal with a hammer, what is the force that must be applied? Assume that the tip of a nail has an area of 0.01 in². [10 points]

ABOVE AVERAGE

Above Average Student Original Graded Assignment

NO SAMPLES HAVE MET THE CRITERIA

AVERAGE

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Student Name: Kefah Mongare

89/100

This Test is OPEN BOOK, OPEN NOTES.

You are being tested on the material from chapters 4 and 5 of the text. There are EIGHT (8) questions.

Short answer, multiple choice

Question 1 – 10: 50 points (5 points each)

Essay question

Question 11: 50 points

Student Name: _____

1	IA	H	IIA	Be	3	IIIB	B	IVA	C	N	O	VA	F	Ne	VIIA	He
2		Li														
3		Na		Mg	IIIB	YB	Y	IVB	Ti	V	Cr	VB	Mn	Fe	Co	Ni
4		K		Ca	IIIB	Sc		IVB	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
5		Rb		Sr	IIIB	Y		IVB	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag
6		Cs		Ba	IIIB	La		IVB	Hf	Ta	W	Re	Os	Ir	Pt	Au
7		Fr		Ra	IIIB	Ac		IVB								Hg

<https://www.grandinetti.org/resources/teaching/Chem121/lectures/ThePeriodicTable/ColorPeriodicTable.gif>

$$a = 2R\sqrt{2} \text{ (FCC)} \quad a = \frac{4R}{\sqrt{3}} \text{ (BCC)} \quad N_A = 6.022 \times 10^{23} \text{ atoms/mol} \quad V = a^3$$

$$N = N_i + \frac{N_f}{2} + \frac{N_c}{6} \quad V_{\text{sphere}} = \frac{4}{3}\pi R^3 \quad D = D_0 \exp\left(-\frac{Q_d}{RT}\right) \quad J = \frac{M}{A\tau} = -D \frac{dc}{dx}$$

$$\text{concentration gradient} = \frac{dc}{dx} = \frac{\Delta c}{\Delta x} = \frac{c_A - c_B}{x_A - x_B} \quad \frac{c_x - c_0}{c_s - c_0} = 1 - \operatorname{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

Student Name: _____

1. What is the composition in weight percent of an alloy that consists of 94.1 at% Ag and 5.9 at% Cu? The atomic weights of Ag and Cu are 107.87 g/mol and 63.55 g/mol, respectively:

- a. 9.6 wt% Ag and 90.4 wt% Cu
b. 3.6 wt% Ag and 96.4 wt% Cu
c. 90.4 wt% Ag and 9.6 wt% Cu
d. 96.4 wt% Ag and 3.6 wt% Cu

$$Ag \Rightarrow \frac{94.1 \times 107.87}{94.1 \times 107.87 + 5.9 \times 63.55} \times 100 = 90.4\%$$

$$Cu = 9.6\%$$

2. What factor affects the number of vacancies in a metal? Choose the correct answer. [5 points]

- a. Time
b. Light intensity
c. Temperature
d. pH

3. A pristine ingot of gold at room temperature has vacancies. TRUE or FALSE [5 points]

True

4. Diffusion has a linear relationship with temperature. TRUE FALSE [5 points]

False

5. Which of the following is a crystalline solid?

- a. Copper wire
b. Glass bottle
c. Polythene bag
d. Rubber ball

6. What type(s) of bonding would be expected for a) calcium fluoride (CaF₂)? [5 points]

- a. Ionic bonding
b. Metallic bonding
c. Covalent bonding with some van der Waals bonding
d. Van der Waals bonding

7. A table showing the dependence of diffusivity on temperature is shown below. What is the value of temperature for $D = 2.315 \times 10^{-12} \text{ m}^2/\text{s}$? [5 points]

T (K)	D (m ² /s)
1300	1.075E-11
1400	1.414E-11
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1800	3.123E-11

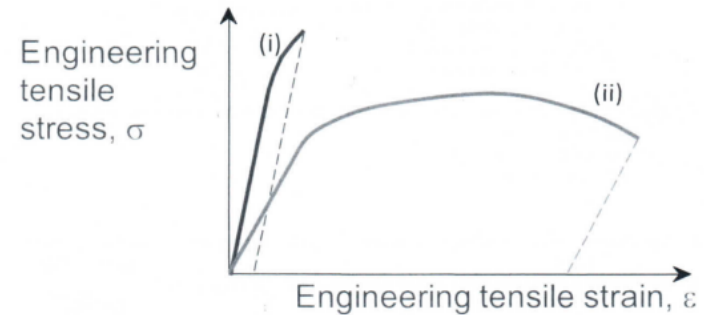
- a. 1632
b. 1599
c. 1620
d. 1624

$$T = 1600 + \left(\frac{2.315 - 2.208}{2.653 - 2.208} \right) 100$$

$$= 1624$$

Student Name: _____

8. The stress strain curves of two materials are given in the sketch below. Choose which material has higher ductility (i) or (ii). [5 points]



- a. (i)
b. (ii)

9. A specimen of steel has a rectangular cross-section 20 mm wide and 40 mm thick, an elastic modulus of 207 GPa, and a Poisson's ratio of 0.30. If this specimen is pulled in tension with a force of 60,000 N, what is the change in width if deformation is totally elastic? [5 points]

- a. Increase in width of $7.24 \times 10^{-3} \text{ m}$
b. Decrease in width of $2.18 \times 10^{-6} \text{ m}$
c. Increase in width of $7.24 \times 10^{-6} \text{ m}$
d. Decrease in width of $2.18 \times 10^{-3} \text{ m}$

Find ΔL

Given: $L = 20 \text{ mm}$, $W = 40 \text{ mm}$, $E = 207 \text{ GPa}$, $V = 0.30$, $F = 60,000 \text{ N}$

$$\sigma = \frac{F}{A} = \frac{60,000 \text{ N}}{(20 \text{ mm})(40 \text{ mm})} = \frac{60,000 \text{ N}}{800 \text{ mm}^2} = 7.5 \times 10^7 \text{ N/m}^2$$

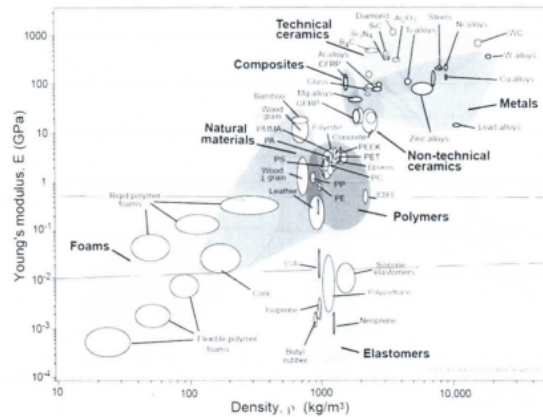
$$\epsilon = \frac{\sigma}{E} = \frac{7.5 \times 10^7 \text{ Pa}}{207 \times 10^9 \text{ Pa}} = 3.623 \times 10^{-4}$$

$$\Delta L = \epsilon \cdot L_0 = 3.623 \times 10^{-4} \cdot 20 \text{ mm} = 7.246 \times 10^{-6} \text{ m} \approx 7.24 \times 10^{-6} \text{ m}$$

Student Name: Kefah Mongre

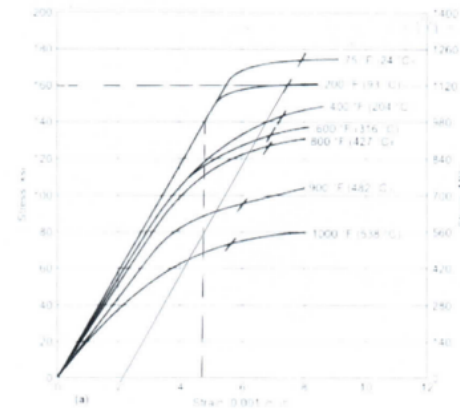
10. The Ashby Chart is a tool that can be used in the Material Selection process; it compares two or more properties of many materials or classes of materials. The Ashby Chart below compares Young's Modulus against density for different materials. From the Ashby Chart shown below, state which of the materials you think is stronger --

- (i) rigid polymer foams or Have greater young's modulus.
(ii) silicone elastomers? [5 points]



Student Name: _____

11. An unspecified alloy specimen of square cross-section (0.175 in. on a side) exhibits the stress-strain behavior shown in Fig. 1. The specimen is 12 in. long. NOTE: the strain is given in units of 0.001 in/in. Therefore "8" is 8×0.001 in./in. or 0.008 in./in.



- a) Recall that the technical definition for yield strength, σ_y , is the value of the engineering stress where the engineering strain, $\epsilon_y = 0.002$. Using this definition, what is the yield strength of the metal alloy at 200°F? [10 points]

160 Ksi

✓ 5 10

- b) Compute the Young's modulus of this alloy at 200°F. Report units in US Customary units or English units. [10 points]

$$E = \frac{\sigma}{\epsilon} = \frac{\Delta \sigma}{\Delta \epsilon} = \frac{140 - 0}{(4.8 - 0)(0.001)} = 29200 \text{ Ksi}$$

✓ 10

Student Name: _____

- c) Compute the magnitude of the load necessary to produce an elongation of 0.018 in. [10 points]

10
$$\begin{aligned} \text{Elongation} &= \Delta L = 0.018 \text{ in} \\ \epsilon &= \frac{\Delta L}{L_0} = \frac{0.018 \text{ in}}{12 \text{ in}} = 0.0015 \frac{\text{in}}{\text{in}} \end{aligned} \quad \left. \begin{array}{l} \sigma = \frac{F}{A_0} \\ \text{part C done at the} \\ \text{back page.} \end{array} \right\}$$

- d) Using the concept of safe stress or working stress, σ_w , we know that the safe stress is based on the yield strength of the material and is defined by:

$$\sigma_w = \frac{\sigma_y}{N} \quad (6.24)$$

Where N is the factor of safety.

For a factor of safety equal to five (5), compute the working stress corresponding to the yield stress you found in part a. [10 points]

$$\begin{aligned} \sigma_y &= 160 \text{ Ksi} \\ N &= 5 \\ \sigma_w &= ? \end{aligned} \quad \left| \quad \begin{aligned} \sigma_w &= \frac{\sigma_y}{N} \\ &= \frac{160 \text{ Ksi}}{5} = 32 \text{ Ksi} \end{aligned} \right.$$

✓ 10

- e) For a nail to be driven into the metal with a hammer, what is the force that must be applied? Assume that the tip of a nail has an area of 0.01 in². [10 points]

$$\begin{aligned} F &= ? \\ A_0 &= 0.01 \text{ in}^2 = \\ \sigma &= 32 \text{ Ksi} \quad \text{no!} \quad \sigma_y \text{ needs to be used here} \\ \sigma &= \frac{F}{A_0} \\ F &= \sigma \cdot A_0 = 32 \times 10^3 \frac{\text{N}}{\text{m}^2} \times 0.01 \text{ in}^2 \left(\frac{0.0254 \text{ m}}{1 \text{ in}} \right)^2 \\ &= 0.206 \text{ N} \end{aligned}$$

9/10

Student Name: Kefah Mongare

11. (C)
$$\epsilon = \frac{\Delta L}{L_0} = \frac{0.018 \text{ in}}{12 \text{ in}} = 0.0015 \frac{\text{in}}{\text{in}}$$

$$\sigma = \frac{F}{A_0}, \quad A_0 = (0.175 \text{ in})^2 = 0.030625 \text{ in}^2$$

$$\begin{aligned} E &= \frac{\sigma}{\epsilon}, \quad \sigma = E \epsilon \\ &= (29200 \times 10^3 \frac{\text{lb}_f}{\text{in}^2}) (0.0015 \frac{\text{in}}{\text{in}}) \\ &= 43.8 \times 10^3 \text{ psi} \\ &= 43.8 \text{ Ksi} \end{aligned}$$

✓

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BELOW AVERAGE

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Student Name: Kennedy Meeks

This Test is OPEN BOOK, OPEN NOTES.

You are being tested on the material from chapters 4 and 5 of the text. There are EIGHT (8) questions.

Short answer, multiple choice

Question 1 – 10: 50 points (5 points each)

Essay question

Question 11: 50 points

$$\frac{35\frac{1}{2}}{100}$$

Student Name: _____

IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA	IXA	XA	XIA	XIIA
1	H	Li	Be	B	C	N	O	F	Ne		
2	Na	Mg	Al	Si	P	S	Cl	Ar			
3	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu
4	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Au
5	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au
6	Fr	Rd	Ac								

<http://www.grandinetti.org/resources/Teaching/Chem121/Lectures/ThePeriodicTable/ColorPeriodicTable.gif>

$$a = 2R\sqrt{2} \text{ (FCC)} \quad a = \frac{4R}{\sqrt{3}} \text{ (BCC)} \quad N_A = 6.022 \times 10^{23} \text{ atoms/mol} \quad V = a^3$$

$$N = N_i + \frac{N_f}{2} + \frac{N_c}{n} \quad V_{sphere} = \frac{4}{3}\pi R^3 \quad D = D_0 \exp\left(-\frac{Q_d}{RT}\right) \quad j = \frac{M}{At} = -D \frac{dC}{dx}$$

$$\text{concentration gradient} = \frac{dC}{dx} = \frac{\Delta C}{\Delta x} = \frac{C_A - C_B}{x_A - x_B} \quad \frac{C_x - C_0}{C_5 - C_0} = 1 - \operatorname{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

Student Name: _____

1. What is the composition in weight percent of an alloy that consists of 94.1 at% Ag and 5.9 at% Cu? The atomic weights of Ag and Cu are 107.87 g/mol and 63.55 g/mol, respectively:
- a. 9.6 wt% Ag and 90.4 wt% Cu
b. 3.6 wt% Ag and 96.4 wt% Cu
c. 90.4 wt% Ag and 9.6 wt% Cu
d. 96.4 wt% Ag and 3.6 wt% Cu

F. / %	ATOMIC WT	(x - x)	(x - x)
Ag 94.1 %	107.87	10	150.567
Cu 5.9 %	63.55	374.945	

2. What factor affects the number of vacancies in a metal? Choose the correct answer. [5 points]

- a. Time
b. Light intensity
c. Temperature
d. pH

3. A pristine ingot of gold at room temperature has vacancies. (TRUE) or FALSE [5 points]

4. Diffusion has a linear relationship with temperature. (TRUE) FALSE [5 points]

5. Which of the following is a crystalline solid?

- a. Copper wire
b. Glass bottle
c. Polythene bag
d. Rubber ball

6. What type(s) of bonding would be expected for a) calcium fluoride (CaF_2)? [5 points]

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7. A table showing the dependence of diffusivity on temperature is shown below. What is the value of temperature for $D = 2.315 \times 10^{-11} \text{ m}^2/\text{s}$? [5 points]

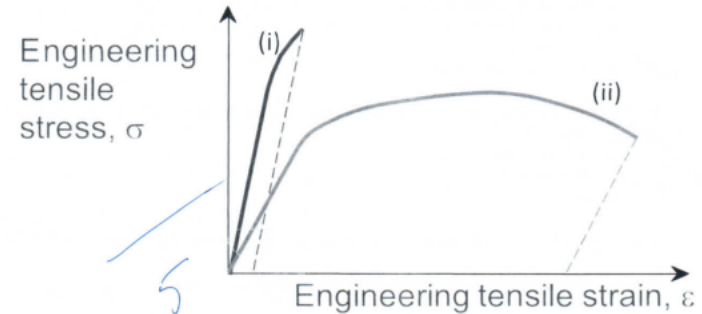
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1700	2.653E-11
1800	3.123E-11

- a. 1632
b. 1599
c. 1620
d. 1624

$$D = 2.315 \times 10^{-11} \text{ m}^2/\text{s}$$

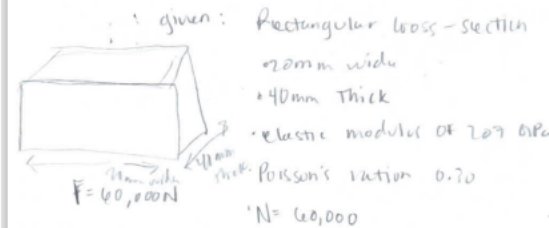
Student Name: _____

8. The stress strain curves of two materials are given in the sketch below. Choose which material has higher ductility (i) or (ii). [5 points]



9. A specimen of steel has a rectangular cross-section 20 mm wide and 40 mm thick, an elastic modulus of 207 GPa, and a Poisson's ratio of 0.30. If this specimen is pulled in tension with a force of 60,000 N, what is the change in width if deformation is totally elastic? [5 points]

- a. Increase in width of $7.24 \times 10^{-3} \text{ m}$
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c. Increase in width of $7.24 \times 10^{-6} \text{ m}$
d. Decrease in width of $2.18 \times 10^{-3} \text{ m}$



$$A_0 = 20 \text{ mm} \times 40 \text{ mm} = 800 \text{ mm}^2$$

$$\text{Poisson's ratio} = 0.30$$

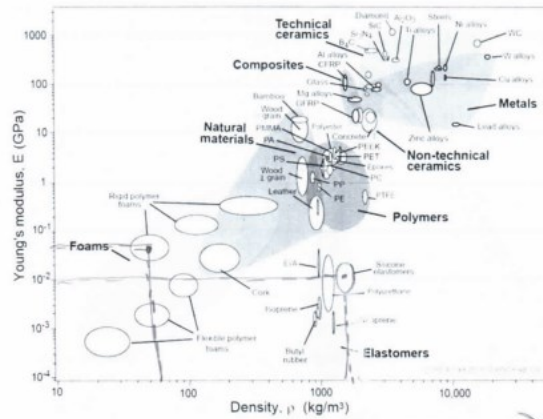
$$\epsilon = \frac{\Delta L}{L_0} = \frac{F}{A_0 E} = \frac{60,000 \text{ N}}{800 \text{ mm}^2 \times 207 \text{ GPa}} = 3.6 \times 10^{-5}$$

$$\Delta w = -\nu \epsilon w_0 = -0.30 \times 3.6 \times 10^{-5} \times 20 \text{ mm} = -2.16 \times 10^{-5} \text{ m}$$

Student Name: _____

10. The Ashby Chart is a tool that can be used in the Material Selection process; it compares two or more properties of many materials or classes of materials. The Ashby Chart below compares Young's Modulus against density for different materials. From the Ashby Chart shown below, state which of the materials you think is stronger –

- (i) rigid polymer foams or
(ii) silicone elastomers? [5 points]

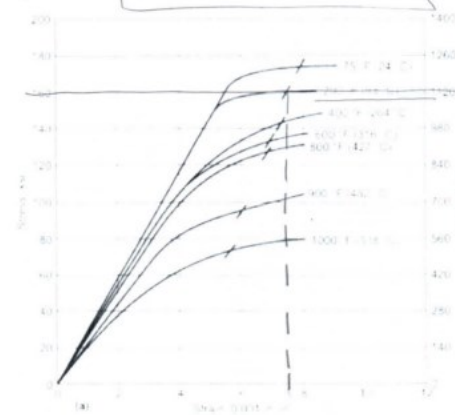


density = heavier = stronger
silicone elastomers
• density greater than 100 kg/m³
• $GPa \cdot 10^{-2}$

Rigid polymer foams
• density less than 100 kg/m³
• GPa between $10^{-2} - 10^{-1}$

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11. An unspecified alloy specimen of square cross-section (0.175 in. on a side) exhibits the stress-strain behavior shown in Fig. 1. The specimen is 12 in. long. NOTE: the strain is given in units of 0.001 in./in. Therefore "8" is 8×0.001 in./in. or 0.008 in./in.



a) Recall that the technical definition for yield strength, σ_y , is the value of the engineering stress where the engineering strain, $\epsilon_y = 0.002$. Using this definition, what is the yield strength of the metal alloy at 200°F? [10 points]

Given: what is all this?
engineering strain: $\epsilon_y = 0.002$
metal alloy at 200°F = 1160 MPa
 $\epsilon_y = 0.002$
 $0.002 = \Delta l / l_0$
 $0.002 = \Delta l / 12$
 $\Delta l = 0.024$
 $0.002 = \Delta l / 12$
 $\Delta l = 0.024$

b) Compute the Young's modulus of this alloy at 200°F. Report units in US Customary units or English units. [10 points]

200°F
 $E = \frac{\sigma_y}{\epsilon_y}$
 $E = \frac{1160 \text{ MPa}}{0.002}$
not to be used in this calculation
Calculate slope of linear region
 $D = 12 \text{ in. long}$
 $\frac{D}{10}$

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- c) Compute the magnitude of the load necessary to produce an elongation of 0.018 in. [10 points]

9/10

- d) Using the concept of safe stress or working stress, σ_w , we know that the safe stress is based on the yield strength of the material and is defined by:

$$\sigma_w = \frac{\sigma_y}{N} \quad (6.24)$$

Where N is the factor of safety.

For a factor of safety equal to five (5), compute the working stress corresponding to the yield stress you found in part a. [10 points]

$$\sigma_w = \frac{\sigma_y}{N} \quad \sigma_w = \frac{1120 \text{ MPa}}{5} = 224 \text{ MPa}$$

0/10

- e) For a nail to be driven into the metal with a hammer, what is the force that must be applied? Assume that the tip of a nail has an area of 0.01 in². [10 points]

0/10

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