

**FINAL  
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : January 2021

Programme : Diploma in Electrical & Electronic Engineering (DEEI)

Course : **EGM1182: Structures and Properties of Materials**

Date of Examination : 11 March 2021 (Thursday)

Time : 2.00pm – 5.00pm Reading Time : Nil

Duration : 3 Hours

**Special Instructions** :

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions.

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Material permitted : Non-Programmable Scientific Calculator

Materials provided : Periodic Table

Examiner(s) : **Johnny Wong Kee Hui**

Chief Moderator : Dr Aaron Edward Teo

*This paper consists of 6 printed pages, including the cover page*

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING PROGRAMME (DEEI)  
EGM1182: STRUCTURES AND PROPERTIES OF MATERIALS  
FINAL ALTERNATIVE ASSESSMENT: JANUARY 2021 SESSION

**Instructions:** This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions.

**Question 1**

- a) Aluminum foil used for storing food weighs about 0.3 grams per square inch. Compute the number of aluminum atoms that are contained in one  $\text{cm}^2$  of foil? (Note: 1 inch = 2.54 cm,  $N_A = 6.022 \times 10^{23}$  atoms/mol)

(6 marks)

- b) Determine Miller indices for the planes in the cubic unit cell shown in Figure Q1b.

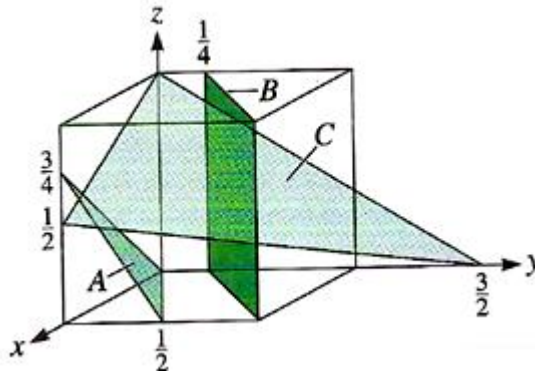


Figure Q1b

(9 marks)

- c) Briefly describe the following terms that related to mechanical test.

i. Ductility

(2 marks)

ii. Modulus of elasticity

(2 marks)

iii. Impact test and name an impact test.

(2 marks)

- d) State the electronic configuration of Sc and  $\text{Ni}^{2+}$ .

(4 marks)

**Question 2**

- (a) Tin substitutional atoms are introduced into a FCC copper crystal, producing an alloy with a lattice parameter of  $3.7589 \times 10^{-8}$  cm and a density of  $8.772 \text{ g/cm}^3$ . Calculate the atomic percentage of tin present in the alloy ( $N_A = 6.022 \times 10^{23}$  atoms/mol). (7 marks)
- (b) Briefly describe the following terms that related to fatigue test of materials.
- i. Endurance limit (3 marks)
  - ii. Fracture surface of fatigue failure (3 marks)
- (c) Calculate the linear atomic density in atoms per millimeter for the following direction in FCC iridium, which has a lattice constant of 0.38389 nm:
- i. [100]
  - ii. [110]
- (6 marks)
- (d) A cylindrical rod of copper ( $E = 110 \text{ GPa}$ ) having a yield strength of 240 MPa is to be subjected to a load of 6660 N. Calculate the diameter required if the length of the rod is 380 mm and an allowable elongation of 0.50 mm? (6 marks)

**Question 3**

- a) Referring to Figure Q3a, if 500 g of a 40 wt % Ag–60 wt % Cu alloy is slowly cooled from  $1000^\circ\text{C}$  to just below  $780^\circ\text{C}$ , calculate:
- i. how many grams of liquid and proeutectic alpha are present at  $850^\circ\text{C}$ ? (5 marks)
  - ii. how many grams of liquid and proeutectic alpha are present at  $780^\circ\text{C} + \Delta T$ ? (5 marks)
  - iii. how many grams of alpha are present in the eutectic structure at  $780^\circ\text{C} - \Delta T$ ? (4 marks)
  - iv. how many grams of beta are present in the eutectic structure at  $780^\circ\text{C} - \Delta T$ ? (4 marks)

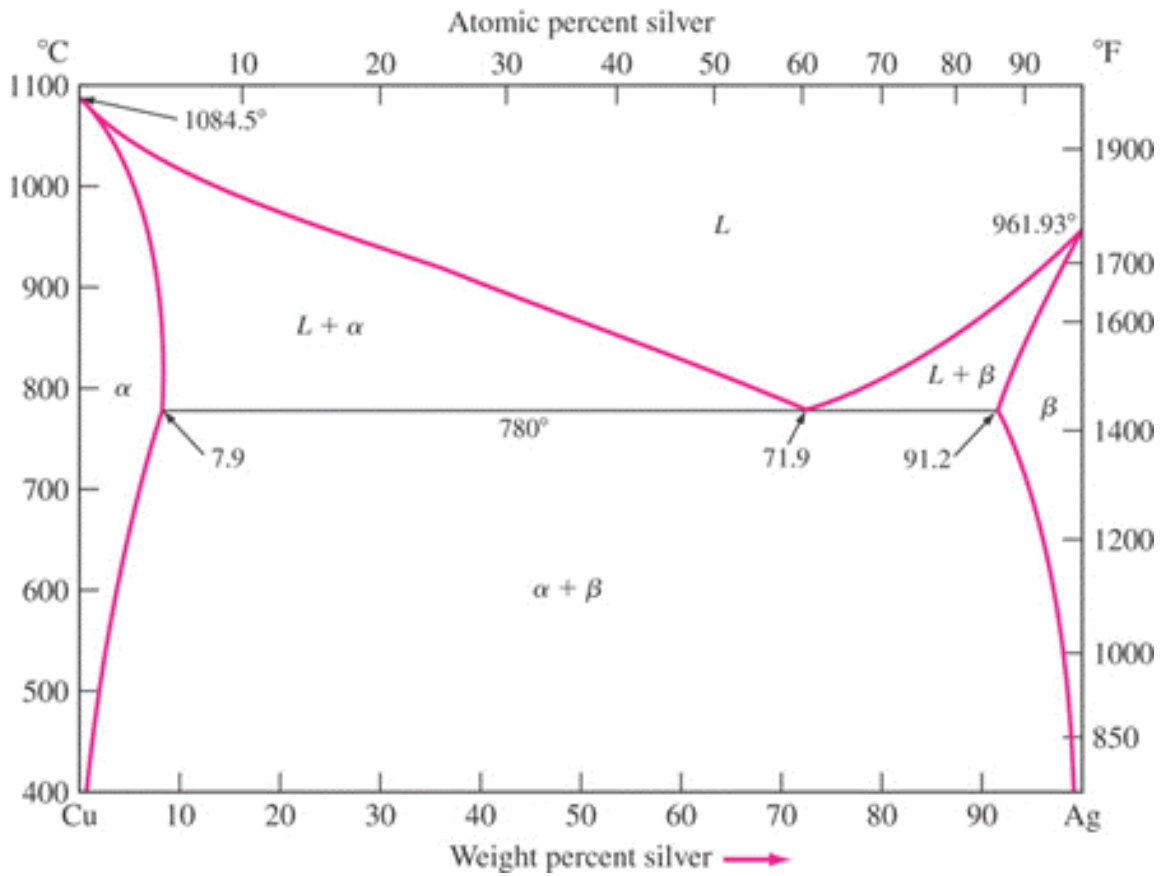


Figure for Q3a

b) Briefly explain the definition of the following polymeric materials and give one (1) example of an item made from it:

i. Plastics.

(3 marks)

ii. Elastomers.

(4 marks)

**Question 4**

- a) The degree of polymerization of polytetrafluoroethylene  $-\text{[C}_2\text{F}_4\text{]}_n-$  is 7500. If all of the polymer chains are the same length, calculate the molecular weight of the chains. (3 marks)
- b) Briefly describe the following terms that related to electrical properties of materials.
- i. Energy gap (3 marks)
  - ii. Valence band (2 marks)
  - iii. Hole (2 marks)
- c) If we wish to double the electrical conductivity of cobalt from the electrical conductivity at 0 °C. Calculate to what temperature must we cool the metal?(Given the coefficient of resistivity  $\alpha$  is 0.006  $\Omega/^\circ\text{C}$ ) (5 marks)
- d) Describe two characteristics of the component ions that determine the crystal structure for ceramic compound. (4 marks)
- e) Describe and illustrate with sketches the solidification process of a pure metal in terms of the nucleation and growth of crystals. (6 marks)

**~THE END~**

*EGM1182 (F)/ January 2021 Session/ formatted*

# PERIODIC TABLE OF ELEMENTS

1		2		PubChem																10		18																																																																																																																																																																																																																																																																																																																																																																																																					
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1	H	Hydrogen	1.0080	2	He	Helium	4.00260	3	Li	Lithium	7.0	4	Be	Beryllium	9.012183	5	B	Boron	10.81	6	C	Carbon	12.011	7	N	Nitrogen	14.007	8	O	Oxygen	15.999	9	F	Fluorine	18.99840316	10	Ne	Neon	20.180	11	Na	Sodium	22.9897693	12	Mg	Magnesium	24.305	13	Al	Aluminum	26.981538	14	Si	Silicon	28.085	15	P	Phosphorus	30.97376200	16	S	Sulfur	32.07	17	Cl	Chlorine	35.45	18	Ar	Argon	39.9	19	K	Potassium	39.098	20	Ca	Calcium	40.08	21	Sc	Scandium	44.95591	22	Ti	Titanium	47.87	23	V	Vanadium	50.941	24	Cr	Chromium	51.996	25	Mn	Manganese	54.93804	26	Fe	Iron	55.84	27	Co	Cobalt	58.93319	28	Ni	Nickel	58.693	29	Cu	Copper	63.55	30	Zn	Zinc	65.4	31	Ga	Gallium	69.72	32	Ge	Germanium	72.63	33	As	Arsenic	74.92159	34	Se	Selenium	78.97	35	Br	Bromine	79.90	36	Kr	Krypton	83.80	37	Rb	Rubidium	85.468	38	Sr	Strontium	87.6	39	Y	Yttrium	88.9058	40	Zr	Zirconium	91.22	41	Nb	Niobium	92.9064	42	Mo	Molybdenum	95.94	43	Tc	Technetium	97.90721	44	Ru	Ruthenium	101.1	45	Rh	Rhodium	102.9055	46	Pd	Palladium	106.4	47	Ag	Silver	107.868	48	Cd	Cadmium	112.41	49	In	Indium	114.82	50	Sn	Tin	118.7	51	Sb	Antimony	121.76	52	Te	Tellurium	127.6	53	I	Iodine	126.9045	54	Xe	Xenon	131.29	55	Cs	Cesium	132.9054520	56	Ba	Barium	137.33	57	La	Lanthanum	138.9055	58	Ce	Cerium	140.12	59	Pr	Praseodymium	140.9077	60	Nd	Neodymium	144.24	61	Pm	Promethium	144.91276	62	Sm	Samarium	150.4	63	Eu	Europium	151.96	64	Gd	Gadolinium	157.2	65	Tb	Terbium	158.92535	66	Dy	Dysprosium	162.50	67	Ho	Holmium	164.93033	68	Er	Erbium	167.26	69	Tm	Thulium	168.93422	70	Yb	Ytterbium	173.04	71	Lu	Lutetium	174.967	72	Hf	Hafnium	178.5	73	Ta	Tantalum	180.9479	74	W	Tungsten	183.8	75	Re	Rhenium	186.21	76	Os	Osmium	190.2	77	Ir	Iridium	192.22	78	Pt	Platinum	195.08	79	Au	Gold	196.96657	80	Hg	Mercury	200.59	81	Tl	Thallium	204.383	82	Pb	Lead	207	83	Bi	Bismuth	208.9804	84	Po	Polonium	209	85	At	Astatine	209	86	Rn	Radon	222.01758	87	Fr	Francium	223.01973	88	Ra	Radium	226.02541	89	Ac	Actinium	227.02775	90	Th	Thorium	232.038	91	Pa	Protactinium	231.0359	92	U	Uranium	238.0289	93	Np	Neptunium	237.04817	94	Pu	Plutonium	244.06420	95	Am	Americium	243.06138	96	Cm	Curium	247.07035	97	Bk	Berkelium	247.07031	98	Cf	Californium	251.07959	99	Es	Einsteinium	252.0830	100	Fm	Fermium	257.09511	101	Md	Mendelevium	258.09843	102	No	Nobelium	259.10100	103	Lr	Lawrencium	262.110

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