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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018**

COURSE NAME : MATERIALS TECHNOLOGY AND SELECTION
COURSE CODE : BPC 21903
PROGRAMME CODE : BPB
EXAMINATION DATE : DECEMBER 2017 / JANUARY 2018
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1** (a) List **THREE (3)** examples of non-ferrous metals and its applications. (6 marks)
- (b) **Figure Q1** shows the periodic table of elements. Group X consists of world's most expensive materials.
- (i) Name the Group X. (1 mark)
- (ii) Identify **TWO (2)** exclusive properties of Group X. (2 marks)
- (iii) State **TWO (2)** examples of Group X. (2 marks)
- (iv) List **THREE (3)** applications of Group X. (3 marks)

1 H 1.008																	2 He 4.001														
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18														
11 Na 22.99	12 Mg 24.31							Group X																							
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80														
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3														
55 Cs 132.9	56 Ba 137.3	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 151.9	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 174.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	90 Th (232)	91 Pa (231)	92 U (238)	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 Ds (289)	103 Rg (271)	104 Cn (277)														

Figure Q1: Periodic table of elements.

- (c) Polymerisation is a chemical process that combines several monomers to form a polymer or polymeric compound.
- (i) List **TWO (2)** types of polymerisation. (2 marks)
- (ii) Explain the process of polymerisation with the aid of illustration by using ethylene (C₂H₄) as a sample. (4 marks)

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Q2 (a) Define ceramics.

(1 mark)

(b) **Figure Q2** demonstrates the common processing of ceramic.

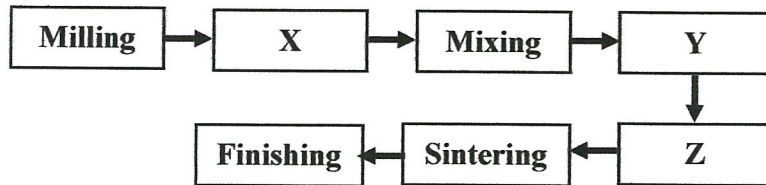


Figure Q2: Process flow chart for production of ceramics.

(i) Name the process X, Y, and Z.

(3 marks)

(ii) Explain **TWO (2)** importance of milling.

(4 marks)

(iii) Explain the microstructure changes of ceramic from milling process to finishing process with appropriate sketch.

(5 marks)

(c) Mr. Aizat could not obtained the required density for his compacted silicon carbide (SiC) block even though it has been sintered at 1500 °C for 24 hours. The melting temperature for SiC is 2700 °C.

(i) Identify the cause of this problem.

(2 marks)

(ii) Suggest **ONE (1)** solution to overcome his problem.

(5 marks)

Q3 (a) List **THREE (3)** types of composites materials.

(3 marks)

(b) Explain the function of matrix in composite materials.

(2 marks)

(c) Explain the function of reinforcement in composite materials.

(2 marks)

(d) State **TWO (2)** examples of reinforcement.

(2 marks)

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- (e) A metal matrix composite consisting of 50 vol % boron filament within an aluminium matrix is prepared. Given that modulus of elasticity boron and aluminium are 410 GPa and 69 GPa, respectively.

Calculate the composite modulus under:

- (i) Isostrain condition
(ii) Isostress condition

(6 marks)

- (f) Plot a graph of modulus elasticity, E versus volume fraction of filaments, V_p for the case of aluminium reinforced boron based on **Q3(e)**.

(5 marks)

- Q4** (a) Identify **FOUR (4)** types of Hardness Tests.

(4 marks)

- (b) Distinguish between Charpy Impact Test and Izod Impact Test.

(4 marks)

- (c) Describe briefly the function of materials characterisation techniques that listed below:

- (i) Atomic Absorption Spectroscopy (AAS)
(ii) Scanning Electron Microscope (SEM)
(iii) X-ray Diffraction (XRD)
(iv) Fourier-transform Infrared Spectroscopy (FTIR)
(v) Thermal Gravimetric Analysis (TGA)
(vi) Energy-dispersive X-ray Spectroscopy (EDS)

(12 marks)

- Q5** (a) Ir. Yunos is an aircraft design engineer. Currently, he is designing a landing gear of aircraft with high specific strength. There are two types of materials to be employed for his consideration, which are titanium alloys and tungsten alloys. By using σ_f / ρ selection chart in **Figure Q5(a)** (in Appendix), recommend Ir. Yunos the most suitable material for his design, by choosing between titanium alloys and tungsten alloys.

(8 marks)

- (b) Use the selection chart in Figure Q5(a) to determine the subset of materials with strength σ_f greater than 100 MPa and a performance index $M = \sigma_f / \rho^2$ greater than 100 MPam⁶/Mg². Show your work with a sketch on the selection chart. Attach **Figure Q5(a)** in Appendix together with answer booklet.

(12 marks)

- END OF QUESTIONS -

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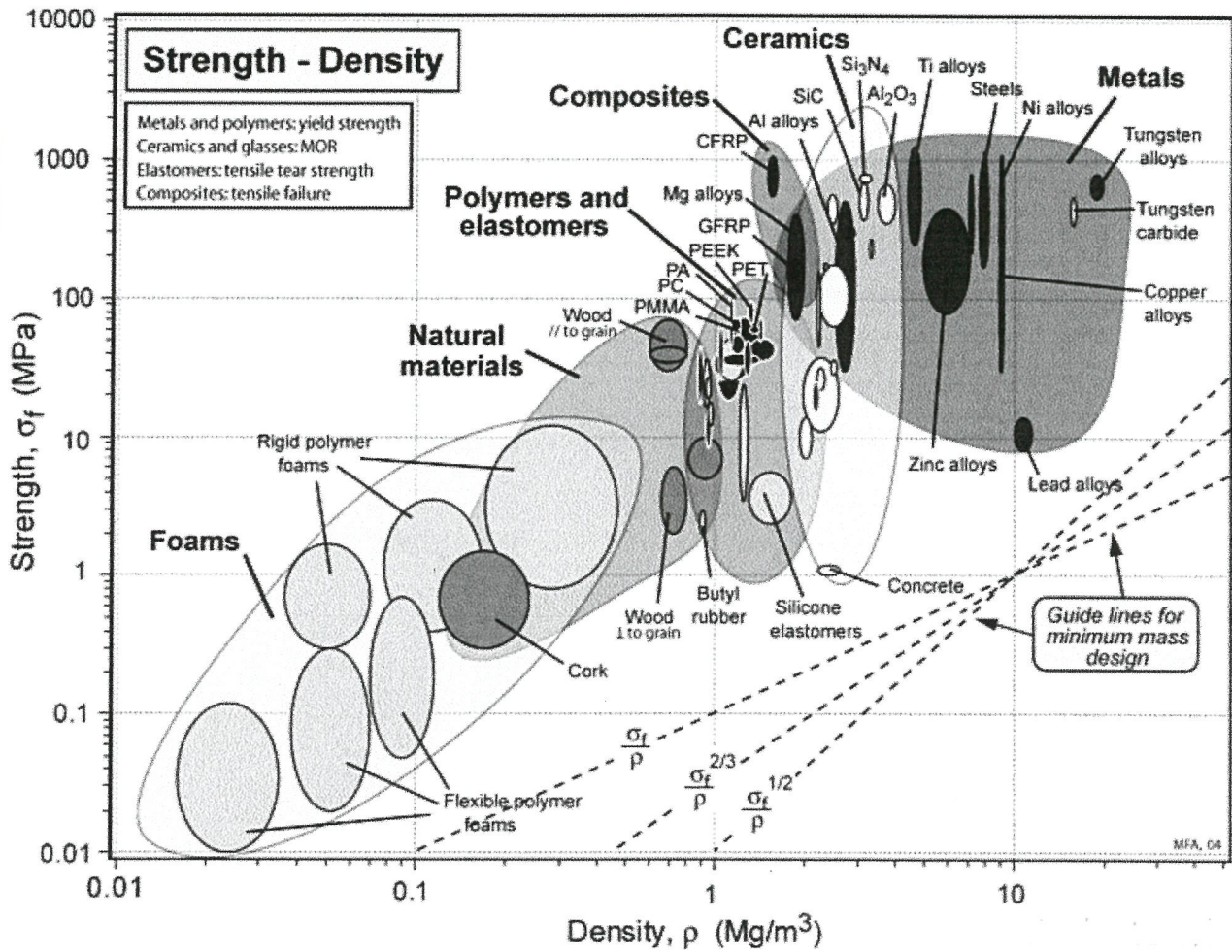


Figure Q5 (a): Materials selection chart.

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