Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JULY 2010 SESSION

SUBJECT CODE	:	**FTB 12102**
SUBJECT TITLE	:	**FUNDAMENTAL METALLURGY**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**08.00 pm – 10.00 pm** **(2 HOURS)**
DATE	:	**15 NOVEMBER 2010**

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.
6. Answer all questions in English.

THERE ARE 5 PAGES OF QUESTIONS AND 2 PAGES OF APPENDICES, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions only.

Please the answer booklet provided.

Question 1

(a) Give **THREE (3)** types of iron ore and their percentage of iron and iron compounds respectively.

(9 marks)

(b) Steelmaking from scrap metal involves melting scrap metal, removing impurities and casting into a desired shape. This process does not require the three step refinement as needed to produce steel from ore. Sketch and describe the furnace process in the presence of pure oxygen.

(10 marks)

(c) Explain the function of limestone in pig iron processing and describe the processing of pig iron.

(6 marks)

Question 2

(a) Show that the atomic packing factor for body centered tetragonal is 0.704. Assume c=1.25a.

(10 marks)

(b) Molding and mounting is one of the important techniques in metallographic method.

(i) Explain the purpose of molding and mounting in metallographic method.

(5 marks)

(ii) Describe the purpose and the process of etching.

(10 marks)

Question 3

(a) Describe hypoeutectoid alloy.

(4 marks)

(b) For a 99.55 wt% Fe–0.45 wt% C alloy at a temperature just below the eutectoid, determine the following. Refer figure 1.

a. The fractions of total ferrite and cementite phases.
b. The fractions of the proeutectoid ferrite and pearlite.
c. The fraction of eutectoid ferrite.

(15 marks)

(c) Sketch the microstructure at A, B and C points in Figure 1 of an iron-carbon alloy of hypereutectoid composition C_1 (containing between 0.76 and 2.14 wt% C), as it is cooled from within the austenite phase region to below the eutectoid temperature. Refer figure 1.

(6 marks)

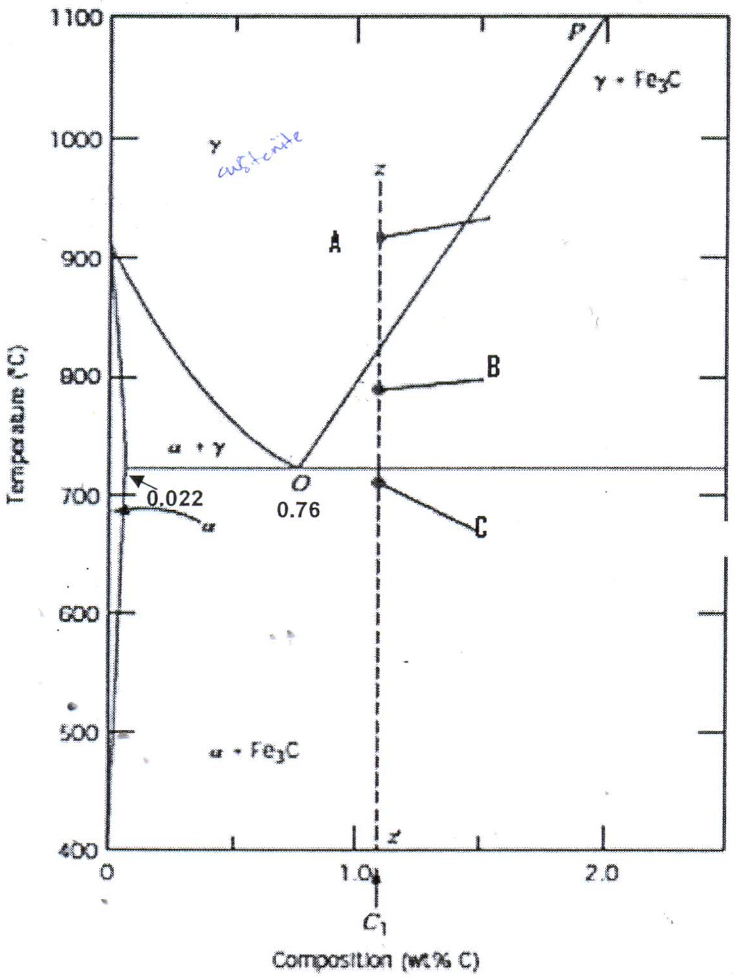

Figure 1: Iron Carbon Diagram

Question 4

(a) Draw a specimen for Izod impact test. Label its dimensions clearly.

(3 marks)

(b) Describe the differences between 3-point bend test and 4-point bend test.

(4 marks)

(c) For a bronze alloy, the stress at which plastic deformation begins is 275 MPa, and the modulus of elasticity is 115 GPa.

(i) What is the maximum load that may be applied to a specimen with a cross-sectional area of 325 mm^2 without plastic deformation?

(4 marks)

(ii) If the original length is 115mm, what is the maximum length to which it may be stretched without causing plastic deformation?

(4 marks)

(d) A steel bar of rectangular cross-section, 5 cm by 2 cm, carries an axial load of 70 kN. Estimate the average tensile stress over a normal cross section of the bar.

(5 marks)

(e) Calculate the Vickers hardness number (VHN) for a material where a diagonal length of 0.42 mm was produced using a 10 kg loads. Sketch the top view of the indentation.

(5 marks)

Question 5

(a) Uranium has an orthorhombic unit cell, with a, b, and c lattice parameters of 0.286, 0.587 and 0.495 nm, respectively. Given: the density: 1905 gcm^{-3}, atomic weight: 238.03 gmol^{-1}, and atomic radius: 0.1385 nm. Based on this information, calculate the atomic packing factor (APF) and compare that APF quantitatively with that of a BCC metal.

(6 marks)

(b) A Vickers hardness measurement using a square base diamond indenter and 50 kg load, produces an indentation of 0.45 mm on welded joint area. The maximum Vickers Hardness Number can be accepted for use in sea environment is VHN 350. Determine the Vickers Hardness Number (VHN) for the welded joint area and give your comment on the welded joint after comparing the result obtained with standard value.

(3 marks)

(c) A part of metal has been heated to a high temperature and then has been cooled. Suggest and explain the most suitable cooling process to produce the softest part of metal.

(7 marks)

(d) (i) Identify the types of corrosion failure for the sample in Figure 2.

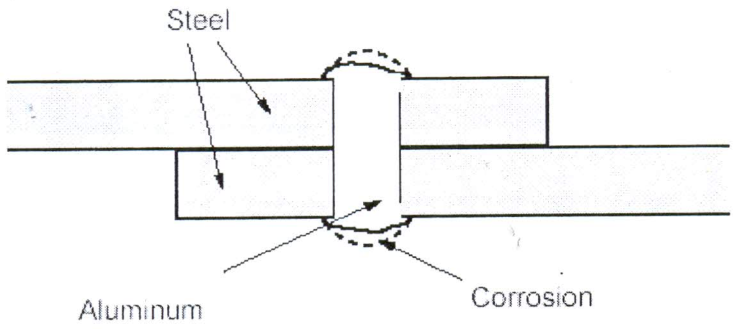

Figure 2: Failure

(1 marks)

(ii) Suggest the prevention method to the corrosion.

(8 marks)

END OF QUESTION

APPENDICES

Key

29 ← Atomic number
Cu ← Symbol
63.54 ← Atomic weight

☐ Metal

▨ Nonmetal

◩ Intermediate

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
1 H 1.0080																	2 He 4.0026
3 Li 6.939	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.183
11 Na 22.990	12 Mg 24.312											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.91	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 (99)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30
55 Cs 132.91	56 Ba 137.34	Rare earth series	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.98	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	Acti-nide series															

Rare earth series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
Actinide series	89 Ac (227)	90 Th 232.04	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (254)	103 Lw (257)

$$APF = (n)(\frac{4\pi r^3}{3})(\frac{1}{a^3})$$

$$\rho = \frac{nA}{V_c N_A}$$

$$N = \frac{N_A \rho}{A}$$

$$N_v = N \exp(\frac{-Q}{kT})$$

$$a_{fcc} = \frac{4r}{\sqrt{2}}$$

$$a_{bcc} = \frac{4r}{\sqrt{3}}$$

$$a_{sc} = 2r$$

$$D = D_o \exp(\frac{-Q_d}{RT})$$

$$m_\alpha \, phase = \frac{m_\beta - m_x}{m_\beta - m_\alpha} x Total\ Mass$$

$$m_\beta \, phase = \frac{m_x - m_\alpha}{m_\beta - m_\alpha} x Total\ Mass$$

$$m_L \, phase\% = \frac{m_s\% - m_x\%}{m_s\% - m_{L\%}} x100$$

$$m_s \, phase\% = \frac{m_x\% - m_L\%}{m_s\% - m_{L\%}} x100$$

$$\rho_\alpha = \frac{100}{\frac{C_{A(\alpha)}}{\rho_A} + \frac{C_{B(\alpha)}}{\rho_B}}$$

$$\rho_\beta = \frac{100}{\frac{C_{A(\beta)}}{\rho_A} + \frac{C_{B(\beta)}}{\rho_B}}$$

$$V_\alpha = \frac{\frac{m_\alpha}{\rho_\alpha}}{\frac{m_\alpha}{\rho_\alpha} + \frac{m_\beta}{\rho_\beta}}$$

$$V_\beta = \frac{\frac{m_\beta}{\rho_\beta}}{\frac{m_\alpha}{\rho_\alpha} + \frac{m_\beta}{\rho_\beta}}$$

$$\sigma = \frac{F}{A_o}$$

$$\varepsilon = \frac{\Delta l}{l_o}$$

$$E = \frac{\sigma}{\varepsilon}$$

$$\%elongation = \frac{\Delta l}{l_o} x100\%$$

$$\%\ area\ reduction = \frac{\Delta A}{A_o} x100\%$$

$$BHN = \frac{F}{\frac{\pi D}{2}(D - \sqrt{D^2 - d^2})}$$

$$VHN = \frac{1.85F}{d^2}$$