UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION

JANUARY 2016 SEMESTER

COURSE CODE	:	JQD 20102
COURSE TITLE	:	BASIC MATERIALS SCIENCE
PROGRAMME LEVEL	:	DIPLOMA
DATE	:	26 MAY 2016
TIME	:	2.30 PM – 5.30 PM
DURATION	:	3 HOURS

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. This question paper consists of TWO (2) sections.
4. Answer ALL questions in Section A. Choose THREE (3) questions in section B.
5. Please write your answers on the answer booklet provided.
6. Table and formula are enclosed as reference.
7. Please answer all questions in English only.

THERE ARE 8 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions

Please use the answer booklet provided

1. The object of 'normalising' a steel specimen is
   A. To reduce hardness
   B. To relieve stresses
   C. To refine structure
   D. To improve ductility.

2. The melting point of steel increases with
   A. Reduced carbon content
   B. Increased carbon content
   C. None of these.

3. Repeatable entity of a crystal structure is known as
   A. Crystal
   B. Lattice
   C. Unit cell
   D. Miller indices

4. The ability of a material to absorb energy in the plastic range is called
   A. Resilience
   B. Creep
   C. Fatigue strength
   D. Toughness

5. Closed packed hexagonal space lattice is found in
   A. Zinc, magnesium, cobalt, cadmium, antimony and bismuth
   B. Gamma-iron, aluminium, copper, lead, silver and nickel
   C. Alpha-iron, tungsten, chromium and molybdenum
   D. None of the above

6. The hardness and tensile strength in austenitic stainless steel can be increased by
   A. Hardening and cold working
   B. Normalising
   C. Martempering
   D. Full annealing

7. Aluminium alloys find use in aircraft industry because of
   A. High strength
   B. Low sp. Gravity
   C. Good corrosion resistance
   D. Good weldability.

8. The unit cells;
   A. Contain the smallest number of atoms which when taken together have all the properties of the crystals of the particular metal
   B. Have the same orientation and their similar faces are parallel
   C. May be defined as the smallest parallelopiped which could be transposed in three coordinate directions to build up the space lattice
   D. All of the above

9. Atomic packing factor is
   A. Distance between two adjacent atoms
   B. Projected area fraction of atoms on a plane
   C. Volume fraction of atoms in cell
   D. None

10. The alloying element which increases residual magnetism and coercive magnetic force in steel for magnets is
   A. Chromium
   B. Nickel
   C. Vanadium
   D. Cobalt

11. The heat treatment process used for softening hardened steel is
   A. Carburising
   B. Normalising
   C. Annealing

D. Tempering

12. The hardness of steel increases if it contains
    A. Pearlite
    B. Ferrite
    C. Cementite
    D. Martensite

13. The lower critical temperature
    A. Decreases as the carbon content in steel increases
    B. Increases as the carbon content in steel increases
    C. Is same for all steels
    D. Depends upon the rate of heating

14. The property of a material due to which it breaks with little permanent distortion, is called
    A. Brittleness
    B. Ductility
    C. Malleability
    D. Plasticity

15. What type of bonding makes up ceramic materials?

    A. Covalent bonds
    B. London dispersion forces
    C. metallic bonds
    D. Ionic bonds

16. The maximum attainable stress for a metal is called:
    A. Yield stress
    B. Fracture stress
    C. Maximum stress
    D. Ultimate tensile stress

17. All are attributes of ceramics, except:
    A. Covalent bonded
    B. Low melting point
    C. High stiffness
    D. High hardness

18. All are not attributes of metals, except:
    A. Electrical insulators
    B. Thermal insulators
    C. High melting points
    D. Ductile

19. The hardness and tensile strength in austenitic stainless steel can be increased by
    A. Hardening and cold working
    B. Martempering
    C. Normalising
    D. Full annealing

20. Due to which of the following reasons aluminium does not corrode in atmosphere?
    A. Aluminum is a noble metal
    B. Atmospheric oxygen can only diffuse very slowly through the oxide layer
    C. No reaction with oxygen occurs at any of above

21. The covalent bond is formed by
    A. Transfer of electrons between atoms
    B. Sharing of electrons between atoms
    C. Sharing of variable number of electrons by a variable number of atoms
    D. None of the above

22. The conductivity of a conductor can be increased by
    A. Decreasing its temperature
    B. Increasing its temperature
    C. Decreasing its vibration
    D. Increasing its vibration

23. _____ is a negatively charged particle present in an atom

A. Proton

B. Neutron

C. Electron

D. None of the above

24. The co-ordination number of a simple cubic structure is

A. 2

B. 4

C. 6

D. 8

25. A perfect conductor has

A. Zero conductivity

B. Unity conductivity

C. Infinite conductivity

D. None of the above

SECTION B (Total: 75 marks)

INSTRUCTION: Choose THREE (3) questions only
Please use the answer booklet provided

Question 1

Atomic bonding is determined partly by how the valences associated with each atom interact. Types of bonds include metallic, covalent, ionic and van der Waals.

(a) Based on your understanding, list **FIVE (5)** properties of materials that exhibit covalency in their structure.

(10 marks)

(b) Draw the bonding structure of:

i. Calcium Bromide, $CaBr_2$:

ii. Boron trifluoride, BF_3:

(6 marks)

(c) Explain the reasons of modulus of elasticity for thermoplastic polymers, is expected to be very low compared with metals and ceramics.

(6 marks)

(d) Would you expect Aluminum Oxide (Al_2O_3) or Aluminum (Al) material have higher coefficient of thermal expansion? Explain.

(3 marks)

Question 2

Automobile and aircraft manufacturing are typical examples of major industries in which the substitution of material is ongoing activity. As example, in automobile industry certain components of metal body nowadays are replaced with plastic and reinforced-plastic parts.

(a) Estimate **FIVE (5)** possible reasons for substituting materials in existing products.

(5 marks)

(b) In selecting materials for a product, it is essential to have a clear understanding of the functional requirements for each of its individual components. Identify the factors that are involved in the material design and selection of products. Explain the importance of each factor.

(10 marks)

(c) Based on material design and selection of products knowledge, analyze **FIVE (5)** material design consideration and requirement need for the fabrication of a car bumper.

(10 marks)

Question 3

Diffusion is one of the fundamental processes by atom moves. It is thus important in biology and medicine, chemistry and geology, engineering and physics, and in just about every aspect of our lives.

(a) Explain the concept of "interdiffusion" and "selfdiffusion" mechanism.

(8 marks)

(b) Distinguish between "vacancy diffusion mechanism" and "interstitial diffusion mechanism".

(8 marks)

(c) Give **ONE (1)** example application of diffusion concept in material processing. Justify your answer.

(9 marks)

Question 4

Annealing is a heat treatment process used to eliminate some or all of the effects of cold working by restoring the ductility of a workpiece and thus allows the workpiece to be worked further without breaking.

(a) Explain the procedure and the purpose of annealing process.

(5 marks)

(b) There are **THREE (3)** possible stages in annealing process. Discuss each of stage involved.

(9 marks)

(c) Discuss the process of "normalizing", "full annealing" and "spheroidizing" in Annealing

(5 marks)

(d) Describe the correlation between the manufacturing process, structure and mechanical properties of material. Give **ONE (1)** example of a product to support your answer.

(6 marks)

END OF EXAMINATION PAPER

Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.00794																	2 He Helium 4.002602
2	3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
3	11 Na Sodium 22.98976928	12 Mg Magnesium 24.3050											13 Al Aluminium 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
5	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.96	43 Tc Technetium (97.9072)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.293
6	55 Cs Caesium 132.9054519	56 Ba Barium 137.327	57–71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (208.9824)	85 At Astatine (209.9871)	86 Rn Radon (222.0176)
7	87 Fr Francium (223)	88 Ra Radium (226)	89–103	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Cn Copernicium (285)	113 Uut Ununtrium (284)	114 Fl Flerovium (289)	115 Uup Ununpentium (288)	116 Lv Livermorium (292)	117 Uus Ununseptium	118 Uuo Ununoctium (294)

C Solid
Hg Liquid
H Gas
Rf Unknown

Metals: Alkali metals; Alkaline earth metals; Lanthanoids; Actinoids; Transition metals; Poor metals
Nonmetals: Other nonmetals; Noble gases

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	La Lanthanum 138.90547	Ce Cerium 140.116	Pr Praseodymium 140.90765	Nd Neodymium 144.242	Pm Promethium (145)	Sm Samarium 150.36	Eu Europium 151.964	Gd Gadolinium 157.25	Tb Terbium 158.92535	Dy Dysprosium 162.500	Ho Holmium 164.93032	Er Erbium 167.259	Tm Thulium 168.93421	Yb Ytterbium 173.054	Lu Lutetium 174.9668
	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Ac Actinium (227)	Th Thorium 232.03806	Pa Protactinium 231.03588	U Uranium 238.02891	Np Neptunium (237)	Pu Plutonium (244)	Am Americium (243)	Cm Curium (247)	Bk Berkelium (247)	Cf Californium (251)	Es Einsteinium (252)	Fm Fermium (257)	Md Mendelevium (258)	No Nobelium (259)	Lr Lawrencium (262)

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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