POSTAL Study Package 2021

Production and Industrial Engineering

Objective Practice Sets

General Engineering
Volume - I

Engineering Materials

MADE EASY Publications

Engineering Materials

Q.1 In metals subjected to cold working, strain hardening effect is due to
(a) slip mechanism
(b) twining mechanism
(c) dislocation mechanism
(d) fracture mechanism

Q.2. Which of the following properties of a solid are dependent on crystal imperfections?
1. Yield stress 2. Melting point
3. Semiconductivity 4. Ductility
Select the correct answer using the codes given below:
(a) 1 and 3 (b) 1, 3 and 4
(c) 2, 3 and 4 (d) 2 and 4

Q.3 Match **List-I** (Material) with **List-II** (Structure) and select the correct answer using the codes given below the lists:

	List-I		List-II
A.	Charcoal	**1.**	F.C.C.
B.	Graphite	**2.**	H.C.P.
C.	Chromium	**3.**	Amorphous
D.	Copper	**4.**	B.C.C.

Codes:

	A	B	C	D
(a)	3	2	1	4
(b)	3	2	4	1
(c)	2	3	4	1
(d)	2	3	1	4

Q.4 A sample containing 3.1% carbon is cooled slowly from liquid phase to a temperature just above the eutectic temperature. The ratio of austenite to liquid phase amount for the sample at the same temperature is __________.

Q.5 Match **List-I** (Crystal structure) with **List-II** (Atomic packing factor) and select the correct answer using the codes given below the lists:

	List-I		List-II
A.	Simple cubic	**1.**	74%
B.	Body-Centred cubic	**2.**	74%
C.	Face-Centred cubic	**3.**	52%
D.	Hexagonal close packed	**4.**	68%

Codes:

	A	B	C	D
(a)	3	4	2	1
(b)	4	3	2	1
(c)	3	4	1	2
(d)	4	3	1	2

Q.6 Gibb's phase rule is given by
(F = number of degree of freedom
C = number of components
P = number of phases)
(a) $F = C + P$ (b) $F = C + P - 2$
(c) $F = C - P - 2$ (d) $F = C - P + 2$

Q.7 Atomic packing factor (APF) in the case of copper crystal is
(a) 0.52 (b) 0.68
(c) 0.74 (d) 1.633

Q.8 Match **List-I** (Name of the Element) with **List-II** (Crystal Structure) and select the correct answer using the codes given below the lists:

List-I
A. Fluorspar
B. Alpha-Iron
C. Silver
D. Zinc

List-II
1. Body-centred cubic
2. Hexagonal close packed
3. Simple cubic
4. Face-centred cubic

Codes:

	A	B	C	D
(a)	3	2	4	1
(b)	4	1	3	2
(c)	4	2	3	1
(d)	3	1	4	2

Q.9 The coordination number for FCC crystal structure is

(a) 4 (b) 8

(c) 12 (d) 16

Q.10 Match **List-I** (Crystal Structure) with **List-II** (Example) and select the correct answer using the codes given below the lists:

List-I

A. Simple Cubic

B. Body-centred Cubic

C. Face-centred Cubic

D. Hexagonal Close Packed

List-II

1. Zinc

2. Copper

3. Alpha iron at room-temperature

4. Manganese

Codes:

	A	B	C	D
(a)	4	3	1	2
(b)	4	3	2	1
(c)	3	4	2	1
(d)	3	4	1	2

Q.11 Which one of the following pairs is not correctly matched?

(a) Point defect in crystal lattice : Self interstitial

(b) Linear defect in crystal lattice : Grain boundary

(c) Planar defect in crystal lattice : External surface

(d) Volume defect in crystal lattice : Other phases

Q.12 Consider the following statements about FCC and HCP crystal structure:

1. Both have same coordination number and atomic packing fraction.
2. Both represent closely packed crystal structures.
3. Both structures are generated by stacking of close packed planes on top of one another, but only the stacking sequence is different.

Which of these statements are correct?

(a) 1 and 2 (b) 2 and 3

(c) 1, 2 and 3 (d) 1 and 3

Q.13 In Zinc Blende structure each atom is surrounded by four atoms of the opposite kind which are located at the corners of which one of the following?

(a) Tetrahedron (b) Hexahedron

(c) Cube (d) Orthorhombic

Q.14 What is the planar density of (100) plane in FCC (face-centred cubic) crystal with unit cell side a equal to?

(a) $\frac{1.484}{a^2}$ (b) $\frac{2}{a^2}$

(c) $\frac{1}{a^2}$ (d) $\frac{\sqrt{2}}{a^2}$

Q.15 What is the approximate strain energy expression for a dislocation of unit length, irrespective of its edge or screw character?

(a) $\frac{G^2b}{2}$ (b) $\frac{Gb^2}{2}$

(c) $\frac{G^2b}{4}$ (d) $\frac{Gb^2}{4}$

Q.16 Which one of the following is the correct ascending order of packing density for the given crystal structures of metals?

(a) Simple cubic – Face centred cubic – Body centred cubic

(b) Body centred cubic – Simple cubic – Face centred cubic

(c) Simple cubic – Body centred cubic – Face centred cubic

(d) Body centred cubic – Face centred cubic– Simple cubic

Q.17 In the atomic hard-sphere model of the crystal structure of Copper, what is the edge length of unit cell?

(a) $2 \times$ Atomic radius

(b) $(4/\sqrt{3}) \times$ Atomic radius

(c) $(2 \times \sqrt{2}) \times$ Atomic radius

(d) $\sqrt{2} \times$ Atomic radius

Q.18 Which one of the following statements is correct in the case of screw dislocations?

($\vec{b}$ = Burger's Vector; $\vec{t}$ = Imaginary Vector)

Answers Engineering Materials

1.	(c)	2.	(b)	3.	(b)	4.	(1.154)	5.	(a & c)	6.	(d)	7.	(c)	8.	(d)	9.	(c)
10.	(b)	11.	(b)	12.	(c)	13.	(a)	14.	(b)	15.	(b)	16.	(c)	17.	(c)	18.	(b)
19.	(c)	20.	(c)	21.	(d)	22.	(b)	23.	(a)	24.	(d)	25.	(b)	26.	(b)	27.	(a)
28.	(b)	29.	(d)	30.	(a)	31.	(c)	32.	(b)	33.	(c)	34.	(d)	35.	(d)	36.	(a)
37.	(d)	38.	(c)	39.	(b)	40.	(c)	41.	(b)	42.	(a)	43.	(b)	44.	(b)	45.	(a)
46.	(d)	47.	(c)	48.	(d)	49.	(d)	50.	(b)	51.	(c)	52.	(c)	53.	(d)	54.	(c)
55.	(c)	56.	(d)	57.	(d)	58.	(a)	59.	(d)	60.	(b)	61.	(c)	62.	(c)	63.	(d)
64.	(d)	65.	(c)	66.	(a)	67.	(a)	68.	(c)	69.	(b)	70.	(c)	71.	(a)	72.	(b)
73.	(b)	74.	(a)	75.	(d)	76.	(c)	77.	(c)	78.	(a)	79.	(b)	80.	(d)	81.	(d)
82.	(c)	83.	(b)	84.	(a)	85.	(c)	86.	(c)	87.	(d)	88.	(c)	89.	(b)	90.	(c)
91.	(a)	92.	(b)	93.	(a)	94.	(b)	95.	(d)	96.	(d)	97.	(b)	98.	(a)	99.	(d)
100.	(b)	101.	(c)	102.	(b)	103.	(c)	104.	(d)	105.	(b)	106.	(b)	107.	(b)	108.	(a)
109.	(b)	110.	(a)	111.	(d)	112.	(c)	113.	(c)	114.	(b)	115.	(a)	116.	(1.221)	117.	(d)
118.	(a)	119.	(a)	120.	(c)	121.	(c)	122.	(3.5)	123.	(160)	124.	(d)	125.	(b)	126.	(c)
127.	(d)	128.	(d)	129.	(c)	130.	(c)	131.	(a)	132.	(d)	133.	(b)	134.	(b)	135.	(a)
136.	(d)	137.	(d)	138.	(b)	139.	(c)	140.	(b)	141.	(c)	142.	(a)	143.	(c)	144.	(1.246)
145.	(4)	146.	(c)	147.	(d)	148.	(d)	149.	(32)								

Explanations Engineering Materials

1. (c)

Dislocation mechanism is responsible for strain hardening.

2. (b)

Melting point is not affected by crystal imperfection semiconductivity is affected by point defect.

3. (b)

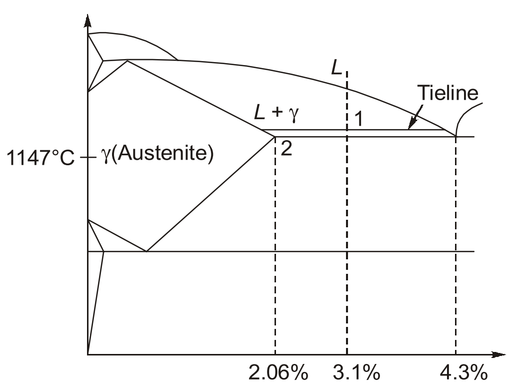
BCC : Li, Na, K, Rb, Cs, Fr, Cr, Fe (α iron and δ iron), Mo, Ta, W, V, Zr, Ti

FCC : Ac, Al, Ca, Ce, Cu, Au, Ir, Pb, Ni, Pd, Pt, Fe (γ iron), Rn, Rh, Ag, Sr, Th, Yb

HCP : Be, Cd, Co, Mg, Os, Re, Ti, Zn, Zr and He

Amporphous : Glass, Charcoal

4. (1.154)



Applying lever rule at (1)

$$C_\gamma = \frac{C_{Eutectic} - C_1}{C_{Eutectic} - C_2}$$

and $$C_L = \frac{C_1 - C_2}{C_{Eutectic} - C_2}$$

So, $$\frac{C_\gamma}{C_L} = \frac{C_{Eutectic} - C_1}{C_1 - C_2}$$

$$\frac{C_\gamma}{C_L} = \frac{4.3 - 3.1}{3.1 - 2.06} = 1.154$$

Sum = 8 + 12 + 12 = 32

5. (a & c)

Both (a) & (c) are correct.

Crystal structure :		APF
Simple cubic	:	0.52
BCC	:	0.68
FCC	:	0.74
HCP	:	0.74

6. (d)

$P + F = C + 2$ Gibb's phase rule

7. (c)

Copper is an example of FCC structure for which APF is 0.74

8. (d)

BCC : Li, Na, K, Rb, Cs, Fr, Cr, Fe (α iron and δ iron), Mo, Ta, W, V, Zr, Ti

FCC : Ac, Al, Ca, Ce, Cu, Au, Ir, Pb, Ni, Pd, Pt, Fe (γ iron), Rn, Rh, Ag, Sr, Th, Yb

HCP : Be, Cd, Co, Mg, Os, Re, Ti, Zn, Zr and He

Amporphous : Glass, Charcoal

9. (c)

Crystal Structure	Coordination No.
Simple cubic	6
BCC	8
FCC, HCP	12

10. (b)

11. (b)

Grain boundary is planar defect.

Point defect : Vacancy, interstitial impurity, substitutional impurity, self substitution, self interstitial. Frenkel

Line defect : Edge and screw dislocation

Planar defect : Grain boundary, twin boundary stacking fault. Low angle boundary

12. (c)

The correct option is (c) i.e., all the three statements are correct.

- As the metallic bond is non-directional, many metals tend to form highly symmetrical close-packed structures, which result in their relatively high densities. The most common and important are face centrad cubic (FCC) and hexagonal close packet (HCP) structures.