



POSTAL BOOK PACKAGE 2026

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MECHANICAL ENGINEERING

Objective Practice Sets

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Structures of Metals and Alloys

MCQ and NAT Questions

- Q.1** For Molybdenum, which has a body centered cubic lattice structure, the number of atoms per unit cell is
 (a) 1 (b) 2
 (c) 4 (d) 6
- Q.2** A plane intersects the coordinate axes at $x = \frac{2}{3}, y = \frac{1}{3}, z = \frac{1}{2}$, then its miller indices is
 (a) (932) (b) (452)
 (c) (413) (d) (364)
- Q.3** Assuming atoms to be perfect spheres, what is the value of the highest possible atomic packing factor (APF) in metals?
 (a) 0.95 (b) 0.74
 (c) 0.66 (d) 0.5
- Q.4** An infinite array of points in three-dimensional space in which each point is identically located with respect to the other is known as
 (a) Space lattice (b) Basis
 (c) Unit cell (d) Crystal
- Q.5** Atomic packing factor for chromium will be equal to
 (a) 0.523 (b) 0.68
 (c) 0.74 (d) 0.84
- Q.6** Miller indices (101) is
 (a) parallel to x-axis (b) parallel to y-axis
 (c) parallel to z-axis (d) None of the above
- Q.7** When a pair of one cation & one anion are absent from an ionic crystal, the defect is called as
 (a) Substitutional impurity
 (b) Interstitial impurity
 (c) Frenkel's defect
 (d) Schottky's defect
- Q.8** 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

- A. Simple cubic
 B. Body-Centred cubic
 C. Face-Centred cubic
 D. Hexagonal close packed

List-II

1. 74%
 2. 34%
 3. 52%
 4. 68%

Codes:

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

- Q.9** The ratio of long and short unit cell dimensions of ideal HCP crystal structure should be
 (a) 1.56 (b) 1.89
 (c) 1.633 (d) 1.59
- Q.10** Phenomenon of cross-slip occurs in
 (a) edge dislocation
 (b) screw dislocation
 (c) mixed dislocation
 (d) edge & mixed dislocation
- Q.11** Which one of the following is NOT correct about the characteristics of dislocation?
 (a) Edge dislocations travel much faster than screw dislocations
 (b) Two edge dislocations of opposite sign, of equal Burgers vector & on the same slip plane cancel out.
 (c) The elastic strain energy per unit length of a dislocation is directly proportional to the burgers vector 'b'
 (d) The sum of Burgers vectors meet at a point called nodal point, inside the crystal remains zero.
- Q.12** A miller indices of the diagonal plane of cube is
 (a) (200) (b) (111)
 (c) (010) (d) $(\bar{1} 10)$
- Q.13** The crystal structure of austenite is
 (a) body centered cubic

- (b) face centered cubic
- (c) hexagonal closed packed
- (d) body centered tetragonal

Q.14 Match **List-I** (Crystal Structure) with **List -II** (Example) and select the correct answer:

List-I	List-II
A. Simple Cubic	1. Zinc
B. Body-centered Cubic	2. Copper
C. Face-centered Cubic	3. Alpha iron at room temperature
D. Hexagonal Close packed	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.15 Consider the following statements about edge dislocation:

1. It appears when there is an extra incomplete plane of atom in crystal.
2. Burger's vector is perpendicular to the dislocation edge.

Which of the above statements are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

Q.16 Match **List-I** with **List-II** and select the correct answer given below the lists:

List-I	List-II
A. BCC	1. Zn
B. FCC	2. Po
C. SC	3. Ni
D. HCP	4. Na

Codes:

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

Q.17 Which one of the following is correct for 'Climb'?

- (a) Dislocation moves parallel to the slip plane
- (b) Dislocation moves perpendicular to the slip plane

- (c) Sliding of one plane of atoms over the other plane
- (d) Dislocation moves from a slip plane to another slip plane

Q.18 Match **List-I** with **List-II** and select the correct answer given below the lists:

List-I

- A. Point Imperfection
- B. Line Imperfection
- C. Surface or planer Imperfection
- D. Volume Imperfection

List-II

1. Pores
2. Twinning
3. Frenkel defect
4. Mixed imperfection/dislocation

Codes:

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

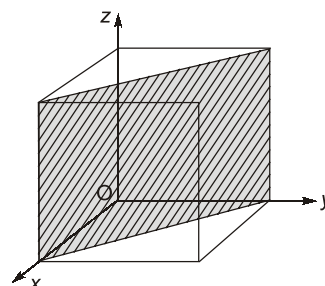
Q.19 The defect responsible for the phenomena of slip, by which most metals deform plastically, is known as

- (a) fracture
- (b) twinning
- (c) dislocation
- (d) strain hardening

Q.20 The effective number of lattice points in the unit cell of simple cubic, body centered cubic and face centered cubic space lattices respectively are

- (a) 1, 2, 2
- (b) 1, 2, 4
- (c) 2, 3, 4
- (d) 2, 4, 4

Q.21 Miller Indices for the hatched plane in the below unit cell are represented as



- (a) (1 0 0)
- (b) (1 1 0)
- (c) (1 1 1)
- (d) (1 0 1)

Q.22 Line imperfection in a crystal is called

- (a) Miller defect (b) Frenkel defect
(c) Schottky defect (d) Edge dislocation

Q.23 X-ray with a wavelength λ are used for calculating d_{200} in nickel. The reflection angle is 8° and the order of reflection is 1. What will be the lattice parameter?

- (a) 5.3890λ (b) 0.1391λ
(c) 3.5926λ (d) 7.1853λ

Q.24 Motion of dislocation in screw dislocation and edge dislocations are termed as

- (a) climb and glide respectively
(b) glide and climb respectively
(c) glide and glide respectively
(d) climb and climb respectively

Q.25 Match **List-I** with **List-II** and select the correct answer given below the lists:

List-I	List-II
A. Allotropy	1. Identical properties at all direction in a body
B. Isotropic	2. A continuous body with no void
C. Anisotropic	3. Doesn't have identical properties
D. Homogeneous	4. Element in more than one lattice form

Codes:

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

Q.26 Consider the following statements about FCC and HCP crystal structure:

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

Which of the statements given above are correct?

- (a) 1 and 2 (b) 2 and 3
(c) 1, 2 and 3 (d) 1 and 3

Q.27 If atomic radius of copper is 1.278 \AA , lattice constant will be equal to

- (a) 2.556 \AA (b) 3.61 \AA
(c) 2.95 \AA (d) 3.95 \AA

Q.28 The Miller indices of a material in a plane are proportional to

- (a) the reciprocal of numerical parameters of the intercepts
(b) the square of unit cell dimensions
(c) the intercepts of the planes on the coordinate axes
(d) the interplanar spacing

Q.29 A metal has lattice parameter of 2.9 \AA , density of 7.87 g/cc , atomic weight of 55.85 , and Avogadro's number is 6.0238×10^{23} . The number of atoms per unit cell will be nearly

- (a) 1 (b) 2
(c) 8 (d) 16

Q.30 Which one of the following pairs of axis lengths (a, b, c) and inter axial angles (α, β, γ) represents the tetragonal crystal system?

- (a) $a = b = c, \alpha = \beta = \gamma = 90^\circ$
(b) $a = b \neq c, \alpha = \beta = \gamma = 90^\circ$
(c) $a \neq b \neq c, \alpha = \beta = \gamma = 90^\circ$
(d) $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$

Q.31 A screw dislocation

- Lies parallel to its Burger's vector
- Lies perpendicular to its Burger's vector
- Moves in a perpendicular direction to the Burger's vector
- Moves in an inclined direction to the Burger's vector

Select the correct answer using the codes given below:

- (a) 1 and 4 (b) 1 and 3
(c) 2 and 3 (d) 2 and 4

Q.32 Match **List-I** (Element) with **List-II** (Crystal structure) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Alpha Iron	1. Hexagonal closed packed
B. Copper	2. Body-centered cubic
C. Zinc	3. Amorphous
D. Glass	4. Face-centered cubic

Q.55 For BCC-iron, for the (2 2 0) set of planes, the lattice parameter for Fe is 0.29 nm and a monochromatic radiation having a wavelength of 0.18 nm is used, and the order of reflection is 1. Which of the following statements is(are) correct?
(a) Interplanar spacing for given plane is 0.1025 nm.
(b) The diffraction angle is 122.80° .
(c) Atomic radius of BCC-iron is 0.1256 nm.
(d) If everything else remains same except the plane, then the interplanar spacing for (1 1 1) set of planes will be 0.1674 nm.

Q.56 Iodine has an orthorhombic unit cell for which the a , b and c lattice parameters are 0.479 nm, 0.725 nm and 0.978 nm, respectively. The atomic packing factor and atomic radius are 0.547 and 0.177 nm, respectively. Atomic weight of Iodine is 126.9 g/mol. Which of the following statements is(are) correct?
(a) Number of atoms in each unit cell is 8.
(b) Number of atoms in each unit cell is 4.
(c) The density of Iodine is 4.96 g/cm^3 .
(d) The density of Iodine is 3.96 g/cm^3 .

Q.57 Which of the following statements is(are) correct?
(a) Unit plastic deformation is called slip and it always appear in the direction of applied load.
(b) In edge dislocation Burger vector is perpendicular to the dislocation line.
(c) In screw dislocation movement of dislocation is referred as climb.
(d) If dislocation comes out of the material, it is termed as failure of material.

Q.58 An alkali halide is having NaCl structure and having density as 2.1145 g/cm^3 . Which of the following statements is(are) correct?
(a) If it contain 0.1% Schottky defect then its density will be 2.11239 g/cm^3 .
(b) If it contain 0.1% Frenkel defect then its density will be 2.11239 g/cm^3 .
(c) If it contain 0.1% Frenkel defect then its density will be 2.1145 g/cm^3 .
(d) If it contain 0.1% Schottky defect then its density will be 2.1145 g/cm^3 .

■■■■

Answers		Structures of Metals and Alloys				
1. (b)	2. (d)	3. (b)	4. (a)	5. (b)	6. (b)	7. (d)
8. (a)	9. (c)	10. (b)	11. (c)	12. (b)	13. (b)	14. (b)
15. (c)	16. (a)	17. (b)	18. (d)	19. (c)	20. (b)	21. (b)
22. (d)	23. (d)	24. (a)	25. (b)	26. (a)	27. (b)	28. (a)
29. (c)	30. (b)	31. (b)	32. (c)	33. (a)	34. (c)	35. (d)
36. (c)	37. (a)	38. (d)	39. (d)	40. (a)	41. (c)	42. (c)
43. (a)	44. (d)	45. (d)	46. (0.68)	47. (a, c, d)	48. (a, b, d)	49. (a, d)
50. (a, d)	51. (c, d)	52. (c)	53. (b, c, d)	54. (a, c)	55. (a, b, c, d)	56. (a, c)
57. (a, b, c, d)		58. (a, c)				

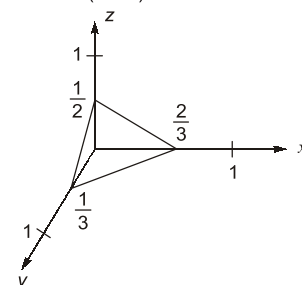
Explanations Structures of Metals and Alloys

1. (b)

Crystal structure	Effective No. of atoms in unit cell
* Diamond cubic	8
* Simple cubic	1
* Face centered	4
* HCP	6
* BCC	2

2. (d)

Taking reciprocal of intercepts on x , y and z axis, we have $\left(\frac{3}{2}, 3, 2\right)$ and forming fractions into integer, we have (364) as miller indices of this plane.



3. (b)

The atomic packing factor of simple cubic = 0.52
 Atomic packing factor of BCC = 0.68
 Atomic packing factor of FCC = 0.74
 Atomic packing factor of HCP = 0.74
 Atomic packing factor of diamond structure = 0.34

4. (a)

An infinite array of points in three-dimensional space in which each point is identically located with respect to the other is called space lattice.

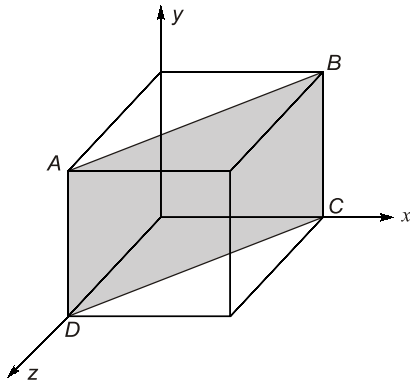
5. (b)

$$APF = \frac{4\pi r^3 \times Ne}{3V} = \frac{4\pi r^3 \times 2}{3a^3}$$

$$= \frac{4\pi r^3 \times 2}{3(4r/\sqrt{3})^3} \quad \left(\because r = \frac{a\sqrt{3}}{4} \right) = 0.68$$

6. (b)

Miller indicates (101), will not any intercept on y-axis so will be parallel to plane y-axis.

**7. (d)**

If in an ionic crystal of the type A^+B^- equal number of cations and anions are missing from their lattice site, so that the electrical neutrality is maintained, it is called Schottky's defect. It is a point defect.

8. (a)

In crystallography, atomic packing factor (APF) or packing efficiency is the fraction of volume in a crystal structure that is occupied by the constituent particles. It is a dimensionless quantity.

$$APF = \frac{N_{\text{atoms}} \times V_{\text{atoms}}}{V_{\text{unit cell}}}$$

APF for different structures is given below:

Crystal structure : APF

Simple cubic	:	0.52
BCC	:	0.68
FCC	:	0.74
HCP	:	0.74

9. (c)

For the ideal HCP packing, the ratio of c/a is $\sqrt{\frac{8}{3}}$

i.e. 1.633. The actual HCP metals deviate from ideal c/a ratio.

10. (b)

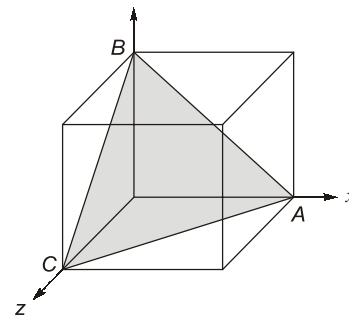
Phenomenon of cross-slip occurs in screw dislocation, in which burger vector is parallel to the dislocation line. Screw dislocations are so named because the atomic planes form a spiral ramp.

11. (c)

Elastic strain energy per unit length of a dislocation is directly proportional to the square of burger's vector ' b '.

12. (b)

The miller indicates of the diagonal plane (ABC) of cube is (111).

**13. (b)**

Austenite is the solid solution of ferrite and iron carbide in gamma iron which is formed when steel contains carbon upto 1.8% at 1130°C temperature. It is non-magnetic in nature and its crystal structure is FCC.

14. (b)

Diamond cubic - Si, Ge, Grey - Tin

BCC - Li, Na, K, Mo, α - Fe, α - Cr, α - W, δ - Fe, β - Ti

FCC - Al, Cu, Ag, Au, γ - Fe, β - Co, β - Ni, etc

HCP - Mg, Zn, Cd, Ca, γ - Ti, Ba etc