



POSTAL BOOK PACKAGE 2027

MECHANICAL ENGINEERING

OBJECTIVE PRACTICE SETS VOLUME - IV

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ENGINEERING MECHANICS

OBJECTIVE PRACTICE SETS

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FBD, Equilibrium, Plane Trusses and Virtual Work

MCQ and NAT Questions

Q.1 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- A. Lami's theorem
- B. Varignon's theorem
- C. Newton's first law of motion
- D. Polygon law of forces

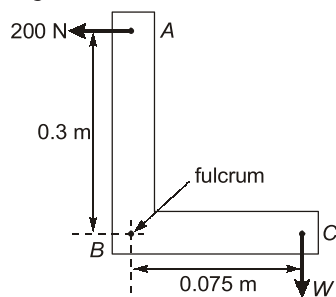
List-II

1. Determination of the position of resultant of parallel forces.
2. Definitions of the general condition of equilibrium.
3. Determination of resultant of non-parallel forces.
4. Estimation of the three forces on a body in equilibrium.

Codes:

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

Q.2 A horizontal force of 200 N is applied at A to lift the weight W at C as shown in the figure. The value of weight W , will be



- (a) 200 N
- (b) 400 N
- (c) 600 N
- (d) 800 N

Q.3 If two forces P and Q act at an angle θ the resultant of these two forces would make an angle α with P such that

$$(a) \tan \alpha = \frac{Q \sin \theta}{P - Q \sin \theta}$$

$$(b) \tan \alpha = \frac{P \sin \theta}{P + Q \sin \theta}$$

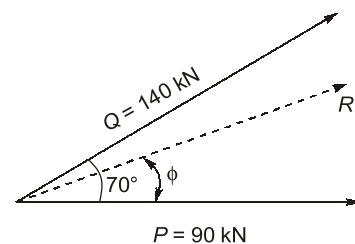
$$(c) \tan \alpha = \frac{Q \sin \theta}{P + Q \cos \theta}$$

$$(d) \tan \alpha = \frac{P \sin \theta}{Q - P \cos \theta}$$

- Q.4 The sum of the magnitudes of two forces acting at a point is 18 and the magnitude of their resultant is 12. If the resultant is 90° with the forces of smaller magnitude, the magnitude of forces are
- (a) 10 and 8
 - (b) 9 and 9
 - (c) 5 and 13
 - (d) 6 and 12

- Q.5 If the magnitude of maximum and minimum resultant forces of the two forces acting on a particle are 40 kN and 10 kN respectively, then the two forces would be
- (a) 25 kN and 15 kN
 - (b) 20 kN and 20 kN
 - (c) 20 kN and 10 kN
 - (d) 20 kN and 5 kN

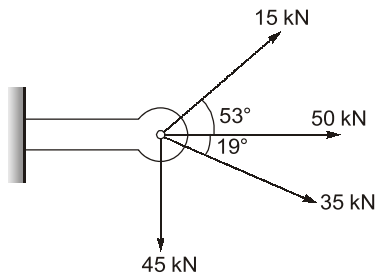
Q.6 The resultant R and angle of resultant ϕ for the given system of force will be respectively:



- (a) 190.58 kN; $43^\circ 39'$
- (b) 138.13 kN, $72^\circ 14'$
- (c) 166.43 kN; $47^\circ 51'$
- (d) 190.58 kN, $72^\circ 14'$

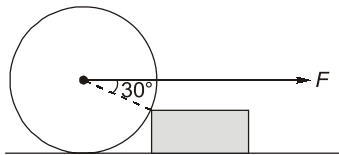
Q.7 In the above figure, four cable exerts tension as indicated on the eyebolt. It is intended to replace these cables by a single cable. The tension on

the single cable and angle at which it will be oriented with respect to the 50 kN (Assume coplanar force system).



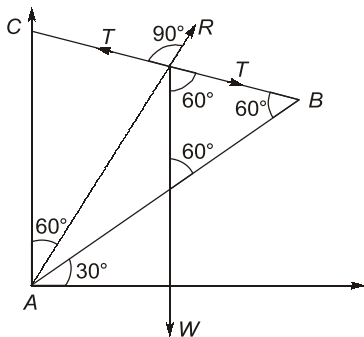
- (a) 102.27 kN, 64.36° (clockwise)
- (b) 102.27 kN, 25.74° (clockwise)
- (c) 100.5 kN, 25.74° (clockwise)
- (d) 100.5 kN, 64.26° (clockwise)

Q.8 A roller of weight W is rolled over the wooden block as shown in figure below. The pull F required to just cause the said motion is:

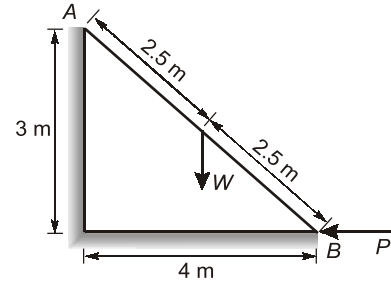


- (a) $\frac{W}{2}$
- (b) W
- (c) $\sqrt{3}W$
- (d) $2W$

Q.9 A uniform beam AB as shown in figure below is pinned at A and is held by a cable BC in the position shown. If the tension in the cable is 20 kgf, then the reaction of the pin at A on the beam will be _____ kgf.

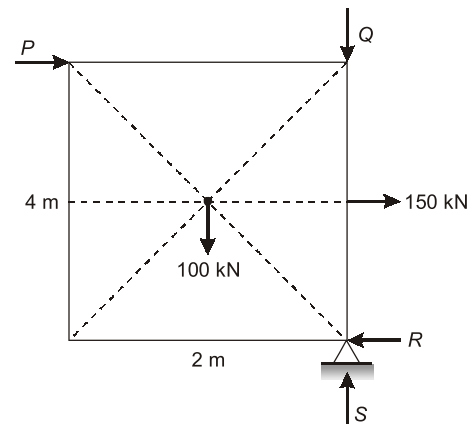


Q.10 A ladder AB of length 5 m and weight (W) = 600 N is resting against a wall. Assuming frictionless contact at the floor (B), and the wall (A), the magnitude of force P (in Newton) required to maintain equilibrium of ladder is _____.



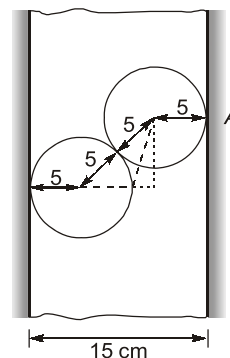
- Q.11** Weight of 120 kN is being supported by a tripod whose each leg of length of 13 m. If the vertical height of the point of attachment of the load is 12 m, the force on the tripod leg would be
- (a) 37.67 kN
 - (b) 40 kN
 - (c) 43.3 kN
 - (d) 46.6 kN

Q.12 A rectangular plate is held in equilibrium by the application of forces as shown in figure. What is the magnitude of the force P ?



- (a) 35 kN
- (b) 50 kN
- (c) 100 kN
- (d) 200 kN

Q.13 In the figure shown, consider the two identical spheres with radius 5 cm, weight 100 N each and the distance between the two walls as 15 cm. What is the reaction force at point A ?

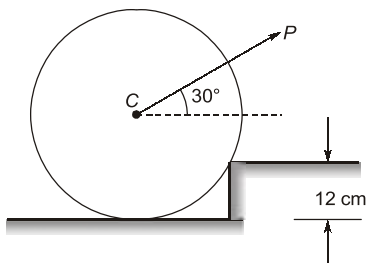


- (a) 173.2 N
- (b) 57.7 N
- (c) 100 N
- (d) 0 N

Member	Length (cm)
AC	20
CF	20
CE	20
CB	20
BD	20
DF	20

Multiple Select Questions (MSQ)

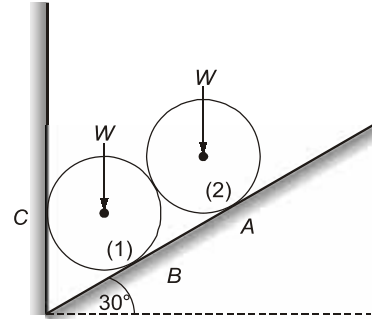
Q.48 The force P applied at 30° to the horizontal is just necessary to start a roller having radius 50 cm over a obstruction 12 cm high, the roller is of mass 100 kg.



Which of the following statements is(are) correct?

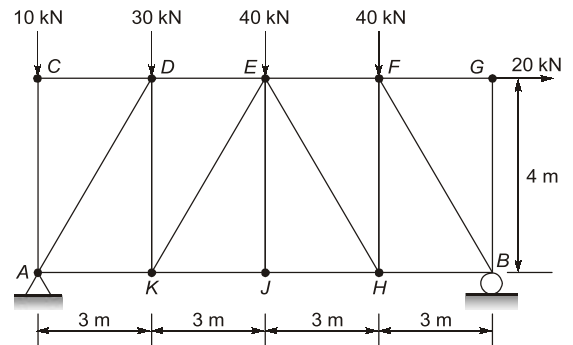
- (a) The magnitude of force P is 648.75 N
- (b) For minimum value of P , it must be at 40.54° from the horizontal.
- (c) The magnitude of required minimum force P is 621.24 N.
- (d) The magnitude of required minimum force P is 579.31 N.

Q.49 Two identical rollers, each of weight, $W = 445$ N, are supported by an incline plane and a vertical wall as shown in figure. Which of the following options is(are) correct, if the surfaces are smooth?



- (a) Reaction at support A will be 385.38 N.
- (b) Reaction at support B will be 642.3 N.
- (c) Reaction at support B will be 385.38 N.
- (d) Reaction at point of contact of two rollers is 222.5 N.

Q.50 A truss is loaded as shown in figure. All members are pin jointed.



- (a) Force in member AC is 10 kN (Compressive).
- (b) Force in member CD is 0.
- (c) Force in member BG is 0.
- (d) Force in member JE is 0.



Answers FBD, Equilibrium, Plane Trusses and Virtual Work

- 1. (a) 2. (d) 3. (c) 4. (c) 5. (a) 6. (a) 7. (b) 8. (c) 9. (346.4)
- 10. (400) 11. (c) 12. (b) 13. (b) 14. (b) 15. (b) 16. (c) 17. (a) 18. (b) 19. (57.74)
- 20. (a) 21. (c) 22. (b) 23. (a) 24. (50) 25. (20) 26. (d) 27. (1.5) 28. (d) 29. (b)
- 30. (b) 31. (c) 32. (d) 33. (84.3) 34. (b) 35. (c) 36. (a) 37. (c) 38. (70.71)
- 39. (d) 40. (a) 41. (0) 42. (5) 43. (20) 44. (a) 45. (c) 46. (c) 47. (10.606)
- 48. (a, b) 49. (a,b,d) 50. (a, b, c, d)

Explanations **FBD, Equilibrium, Plane Trusses and Virtual Work**

1. (a)

Lami's theorem: In statics, Lami's theorem is an equation relating the magnitudes of three coplanar, concurrent and non-collinear forces which keeps an object in static equilibrium, with the angles directly opposite to the corresponding forces,

$$\frac{A}{\sin\alpha} = \frac{B}{\sin\beta} = \frac{C}{\sin\gamma}$$

Where,

A, B, C are the magnitude of three coplanar, concurrent and non-collinear forces which keeps the object in static equilibrium, and α, β and γ are the angles directly opposite to the forces A, B and C respectively.

Polygon Law's of forces: If a number of forces acting simultaneously on a particle be represented in magnitude and direction by the sides of a polygon taken in order, their resultant may be represented in magnitude and direction by the closing side of the polygon taken in opposite order.

Newton's first Law of Motion: When viewed in an inertial reference frame, an object either remains at rest or moves with constant velocity, unless acted upon by an external force.

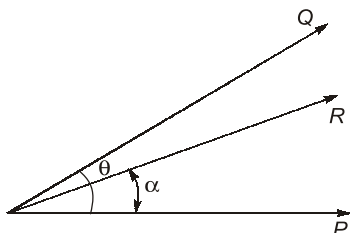
Varignon's Theorem: The moment about any point of the resultant of several concurrent forces is equal to the sum of the moments of the particular forces about the same point.

2. (d)

Taking moment about fulcrum B ,
 $200 \times 0.3 = W \times 0.075$

$$W = \frac{200 \times 0.3}{0.075} = 800 \text{ N}$$

3. (c)



$$R \sin\alpha = Q \sin\theta$$

$$R \cos\alpha = Q \cos\theta + P$$

$$\Rightarrow \tan\alpha = \frac{Q \sin\theta}{Q \cos\theta + P}$$

4. (c)

Let P be the smaller force,

$$P + Q = 18 \quad \dots(1)$$

$$R = (P^2 + Q^2 + 2PQ \cos\theta)^{1/2} = 12 \quad \dots(2)$$

Also,

$$\frac{Q \sin\theta}{P + Q \cos\theta} = \tan\alpha = \tan 90^\circ = \infty$$

$$\Rightarrow P + Q \cos\theta = 0 \quad \dots(3)$$

Subtracting eq. (3) eq. (1)

$$P + Q \cos\theta - P - Q = 0 - 18$$

$$Q(1 - \cos\theta) = 18 \quad \dots(4)$$

Now, operating square of eq. (2- eq. (1)

$$18^2 - (12)^2 = 2PQ(1 - \cos\theta)$$

$$180 = 2PQ(1 - \cos\theta) \quad \dots(5)$$

Operate eq. (4) subtract eq. (5)

$$\frac{Q(1 - \cos\theta)}{2PQ(1 - \cos\theta)} = \frac{18}{180}$$

$$2P = 10$$

$$P = 5$$

From eq. (1); $Q = 18 - 5 = 13$

So, magnitude of forces are 5 and 13.

5. (a)

Resultant of two forces,

$$R = \sqrt{P^2 + Q^2 + 2PQ \cos\theta}$$

R will be maximum when, $\cos\theta = 1$

$$R_{\max} = \sqrt{P^2 + Q^2 + 2PQ} = \sqrt{(P+Q)^2} = P + Q$$

R will be minimum when, $\cos\theta = -1$

$$R_{\min} = \sqrt{P^2 + Q^2 - 2PQ} = \sqrt{(P-Q)^2} = P - Q$$

$$P + Q = 40$$

$$P - Q = 10$$

$$2P = 50$$

$$P = 25 \text{ kN}; \quad Q = 15 \text{ kN}$$

6. (a)

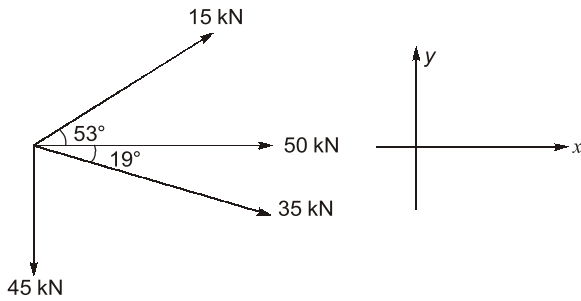
$$R = \sqrt{P^2 + Q^2 + 2PQ \cos\theta}$$

$$= \sqrt{(90)^2 + (140)^2 + 2 \times 140 \times 90 \times (\cos 70^\circ)}$$

$$= 190.58 \text{ kN}$$

$$\begin{aligned} \tan\phi &= \frac{Q\sin\theta}{P+Q\cos\theta} \\ &= \frac{140\sin 70^\circ}{90+140\cos 70^\circ} = 0.594 \\ \phi &= 43^\circ 39' \end{aligned}$$

7. (b)
Figure can be idealized as:

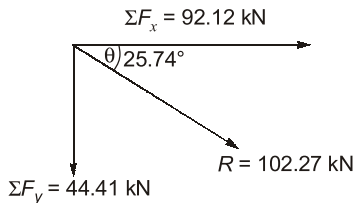


$$\begin{aligned} \Sigma F_x &= 50 + 15 \cos 53^\circ + 35 \cos 19^\circ = 92.12 \text{ kN} \\ \Sigma F_y &= 15 \sin 53^\circ - 45 - 35 \sin 19^\circ = -44.41 \text{ kN} \end{aligned}$$

Resultant,

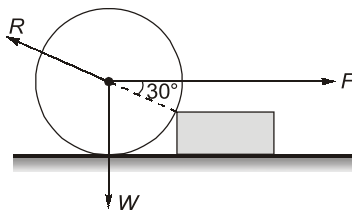
$$F_R = \sqrt{(92.12)^2 + (-44.41)^2} = 102.26 \text{ kN}$$

$$\tan\theta = \left(\frac{\Sigma F_y}{\Sigma F_x} \right)$$



$$\theta = \tan^{-1} \left(\frac{\Sigma F_y}{\Sigma F_x} \right) = \tan^{-1} \left(\frac{44.41}{92.12} \right) = 25.74^\circ$$

8. (c)



$$R \cos 60^\circ = W$$

$$R \times \frac{1}{2} = W$$

$$R = 2W$$

$$\text{Also, } F = R \cos 30^\circ = 2W \times \frac{\sqrt{3}}{2} = \sqrt{3} W$$

9. 346.4(345 to 347)

From Lami's theorem:

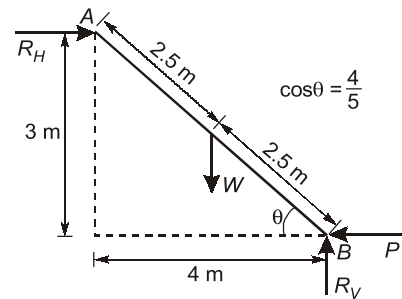
$$\frac{W}{\sin 90^\circ} = \frac{T}{\sin(90^\circ + 60^\circ)} = \frac{R}{\sin(90^\circ + 30^\circ)}$$

$$W = \frac{200 \times 2}{1} = \frac{R \times 2}{\sqrt{3}}$$

$$R = 200\sqrt{3} \text{ kgf} = 346.4 \text{ kg(f)}$$

10. 400 (399 to 401)

FBD diagram of the ladder:



Taking moment about B

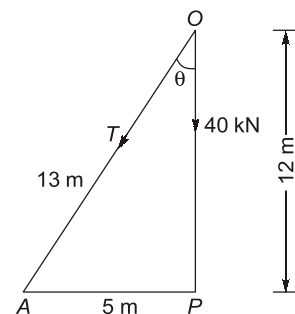
$$R_H \times 3 = W \times 2.5 \cos\theta$$

$$R_H = \frac{600 \times 2.5 \times \frac{4}{5}}{3} = 400 \text{ N}$$

$$\Sigma F_H = 0$$

$$R_H = P = 400 \text{ N}$$

11. (c)



The weight $W = 120 \text{ kN}$ would be equally shared by all the three legs.

MATERIAL SCIENCE

OBJECTIVE PRACTICE SETS

Page No. 56 - 109

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:

- It appears when there is an extra incomplete plane of atom in crystal.
- 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

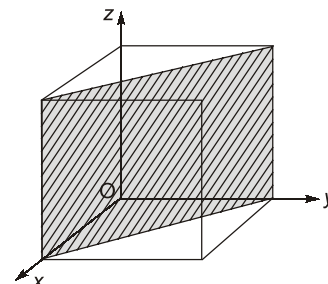
Q.19 The defect responsible for the phenomena of slip, by which most metals deform plastically, is known as

- (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

(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/cm³.
- (d) The density of Iodine is 3.96 g/cm³.

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/cm³. Which of the following statements is(are) correct?

- (a) If it contain 0.1% Schottky defect then its density will be 2.11239 g/cm³.
- (b) If it contain 0.1% Frenkel defect then its density will be 2.11239 g/cm³.
- (c) If it contain 0.1% Frenkel defect then its density will be 2.1145 g/cm³.
- (d) If it contain 0.1% Schottky defect then its density will be 2.1145 g/cm³.

■■■■

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)				

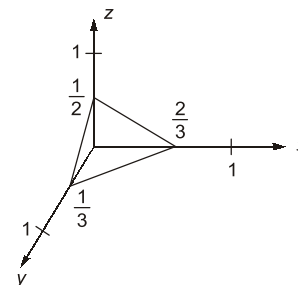
Explanations Structures of Metals and Alloys

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.

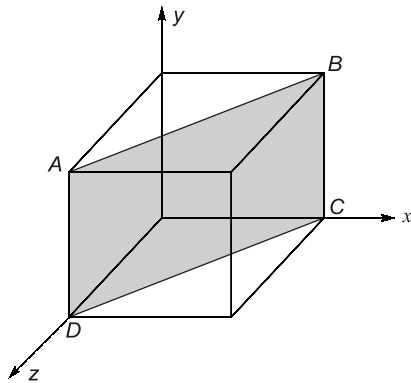
5. (b)

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

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

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.

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

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)

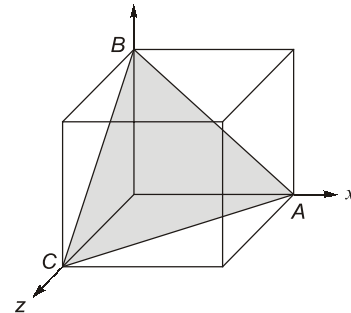
Phenomenon of cross-slip occurs in screw dislocation, in which burger vector is parallel to the dislocation line. Screw dislocations are so named because the atomic planes form a spiral ramp.

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

PRODUCTION AND MAINTENANCE ENGINEERING

OBJECTIVE PRACTICE SETS

Page No. 110 - 223

Metal Casting

MCQ and NAT Questions

- Q.1** Pattern for very large casting would require a tremendous amount of timber for full pattern. In such case which one of the following pattern can be used?
- Sweep pattern
 - Skeleton pattern
 - Segmental pattern
 - Shell pattern
- Q.2** In solidification of metal during casting, compensation for solid contraction is
- Provided by the oversize pattern
 - Achieved by properly placed riser
 - Obtained by promoting direction solidification
 - Made by providing chills
- Q.3** The allowances which are provided for by making a pattern slightly smaller than actual size is known as
- Shrinkage allowance
 - Draft allowance
 - Camber allowance
 - Rapping allowance
- Q.4** Which of the following material will require the largest size of riser for the same size of casting?
- aluminium
 - cast iron
 - steel
 - copper
- Q.5** Which one of the following is not a sand conditioning advantage?
- Binder is uniformly distributed around the sand grains
 - Properly controlled moisture content
 - decrease flowability of sand
 - foreign particles are separated and removed
- Q.6** Which one of the following is not an advantage of green sand mould?
- Good dimensional accuracy across the parting line
 - Less danger of hot tearing
 - Erosion does not occur in large casting
 - least expensive method of producing castings
- Q.7** Heated metal pattern in shell moulding is made of
- Aluminium
 - Medium carbon steel
 - Grey cast Iron
 - Bronze
- Q.8** Hot box moulding process is used to produce
- small casting in large quantities
 - small casting in small quantities
 - large casting in small quantities
 - large casting in large quantities
- Q.9** Which of the following are the requirements of an ideal gating system?
- The molten metal should enter the mould cavity with as high a velocity as possible.
 - It should facilitate complete filling of the mould cavity.
 - It should be able to prevent the absorption of air or gases from the surroundings on the molten metal while flowing through it.
- Select the correct answer using the codes given below:
- 1, 2 and 3
 - 1 and 2
 - 2 and 3
 - 1 and 3
- Q.10** A pattern material should be
- Less in weight
 - Dimensionally stable
 - Strong, hard & durable
 - Repairable
- Which of the above properties are correct for a pattern material?
- 1, 2 and 4
 - 2, 3 and 4
 - 1, 3 and 4
 - 1, 2, 3 and 4
- Q.11** Consider the following advantage of dry sand mould over green sand moulds

1. They are stronger than green sand moulds
2. Overall better dimensional accuracy
3. Better surface finish
4. Less susceptible to hot tears

Which of the above statements are correct?

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

Q.12 Directional solidification can be achieved by providing

- (a) chills and chaplets
(b) chaplets and padding
(c) chills and padding
(d) chills, chaplets and padding

Q.13 Misrun is a casting defect which occurs due to

- (a) very high pouring temperature of the metal.
(b) insufficient fluidity of the molten metal.
(c) absorption of gases by the liquid metal.
(d) improper alignment of the mould flasks.

Q.14 Poor machinability of centrifugally cast iron pipe is due to

- (a) Chilling
(b) Segregation
(c) Dense structure
(d) High mould rotation speed

Q.15 Casting defect 'Drop' can be avoided by

- (a) use of gagers & adequate strength of sand
(b) at pouring stage by use of strainer & a skim bob
(c) having proper venting & adequate permeability
(d) proper amount of volatile additives in the sand-mix

Q.16 The process of removing unwanted material from the casting is called

- (a) Fettling (b) Cleaning
(c) Finishing (d) Blowing

Q.17 The casting defect which is not caused by the high pouring temperature of melt is

- (a) Cuts (b) Metal penetration
(c) Fusion (d) Rat tails

Q.18 The main purpose of chaplets is

- (a) to ensure directional solidification
(b) to provide efficient venting
(c) for aligning the mould boxes
(d) to support the cores

Q.19 Scab is a

- (a) sand casting defect (b) machining defect
(c) welding defect (d) forging defect

Q.20 Vertical core print is constructed with considerable tapered on the cope side as compare to drag side is

- (a) larger (b) equal
(c) lesser (d) double

Q.21 An improper riser may give rise to a defect called

- (a) Shift (b) Misrun
(c) Penetration (d) Shrinkage cavity

Q.22 Thin-walled hollow castings can be made by permanent mould casting in a process called

- (a) Slush casting (b) Shell moulding
(c) Vacuum moulding (d) Lost-foam casting

Q.23 Which one of the following defect is due to the expansion of mould?

- (a) Blisters (b) Scab
(c) Buckle (d) Cold shut

Q.24 The casting defect caused by the erosion of sand

- (a) Drop (b) Wash
(c) Rat tail (d) Misrun

Q.25 When the molten metal is poured in a mould, it may pass through the following items in sequence

- (a) Sprue, runner, gate, top riser
(b) Runner, sprue, gate, top riser
(c) Top riser, runner, sprue, gate
(d) Gate, sprue, top riser, runner

Q.26 Which one of the following correctly described the word collapsibility used in casting?

- (a) ability of the mold to allow the shrinkage of the casting during solidification.
(b) ability to resist cracking and buckling when in contact with the molten metal.
(c) ability to maintain shape in the face of the flowing metal.
(d) ability of the mold to allow hot air and gases to escape from the cavity.

Q.27 Which one of following is correct about the effect of water content on flowability?

- (a) It increases as water content increases
(b) It decreases as water content increases
(c) It first increases & then decreases as water content increases
(d) It first decreases & then increases as water content increases

Which of the following is(are) correct?

- (a) The value of shape factor is 2.4.
- (b) The volume of the riser is 781.25 cm^3 .
- (c) Height of the riser is 10 cm.
- (d) Diameter of the riser is 10 cm.

Q.70 In a gating design, gating ratio is 3 : 2 : 1. It is used for producing a casting of mass 10 kg. Density of material is 2700 kg/m^3 . Filling time required is 9 second. Height of the liquid metal above the gate is 150 mm, coefficient of discharge is 0.97.

Which of the following is(are) correct?

- (a) Choke area for the given casting is 2.47 cm^2 .
- (b) Diameter of sprue is 2.51 cm.
- (c) Diameter of runner is 3.07 cm.
- (d) Given gating system is pressurized gating system.

Q.71 Which of the following statements is(are) correct about un-pressurized gating system?

- (a) There is no problem of turbulence and splashing.
- (b) It is preferred for the casting of ferrous materials.
- (c) There is no possibility of air aspiration.
- (d) Casting yield is less.

Q.72 Which of the following statements is(are) correct for shrinkage allowance?

- (a) Liquid and solidification shrinkages are compensated by providing riser.
- (b) Liquid and solidification shrinkage are given as % of shrinkage volume of the material.
- (c) Solid shrinkage is provided on pattern.
- (d) Solid shrinkage is expressed in terms of linear dimension.

Q.73 A slab casting of dimensions $40 \times 20 \times 10 \text{ cm}^3$ has to be produced by using a cylindrical side riser with ($h = d$) using modulus method.

Which of the following is(are) correct?

- (a) The modulus of casting is 2.857.
- (b) The modulus of riser is 3.43.
- (c) Height of the cylindrical side riser is 20.6 cm.
- (d) Volume of the cylindrical side riser is 3418 cm^3 .

Q.74 Which of the following statements is(are) correct?

- (a) True centrifugal casting is used for producing hollow cylindrical objects without using the core in mass production.
- (b) Semi centrifugal casting can be used for the production of pulleys, wheels and spoked wheels.
- (c) Cold chamber die casting is used for producing complex shape of the objects which are made up of Al, Cu and Brass.
- (d) Hot chamber die casting is used for producing complex shape of the objects which are made up of lead, tin and zinc.



Answers	Metal Casting					
1. (b)	2. (a)	3. (d)	4. (a)	5. (c)	6. (c)	7. (c)
8. (a)	9. (c)	10. (d)	11. (a)	12. (c)	13. (b)	14. (c)
15. (a)	16. (a)	17. (b)	18. (d)	19. (a)	20. (a)	21. (d)
22. (a)	23. (c)	24. (b)	25. (a)	26. (a)	27. (d)	28. (a)
29. (b)	30. (d)	31. (b)	32. (b)	33. (b)	34. (a)	35. (c)
36. (b)	37. (d)	38. (d)	39. (d)	40. (b)	41. (d)	42. (b)
43. (a)	44. (b)	45. (d)	46. (c)	47. (b)	48. (c)	49. (a)
50. (c)	51. (c)	52. (b)	53. (b)	54. (d)	55. (a)	56. (a)
57. (a)	58. (a)	59. (80.21)	60. (66.81)	61. (5.05)	62. (203.8)	63. (33.85)
64. (144.952)	65. (112.5)	66. (96.415)	67. (18)	68. (8.18)	69. (b, c, d)	
70. (a, d)	71. (a, d)	72. (a, b, c, d)	73. (a, b, c)	74. (a, b, c, d)		

Explanations **Metal Casting**

1. (b)
Skeleton pattern is used for very large size pattern. The pattern is produced with the help of wooden workpiece, wire mesh and loam sand.
2. (a)
Liquid and solidification shrinkage are compensated by riser and solid shrinkage are compensated by oversize pattern.
3. (d)
Rapping allowance
 - (i) Provide to make clearance between pattern and moulds.
 - (ii) Depends on the skill of operator and it is negative in nature.
4. (a)
Al will require largest size of riser because of its high liquid and solidification shrinkage.
5. (c)
Sand conditioning advantage: Increase in flowability of sand so that it can flow to the corner of box during ramming.
6. (c)
In green sand moulding there is chance of erosion in case of large casting.
7. (c)
Heated metal pattern is shell mouldings is made of gray cast iron. A two-piece metal pattern is created in the shape of the desired part, typically form iron or steel. Aluminum for low production volume and graphite for casting reactive materials.
8. (a)
Hot box moulding process is used to produce small casting in large quantities.
9. (c)
Objective of gating system
 - (i) Molten metal has to enter into the mould cavity with optimum velocity without eroding gating elements and mould cavity.
 - (ii) It should facilitate complete filling of mould cavity.
- (iii) It should be able to prevent the absorption of air or gases from the surroundings on the molten metal while flowing through it.
- (iv) Gating element should be designed in such a way that casting yield is maximum.
10. (d)
Properties of good pattern material:
 - light weight
 - easily worked, shaped and joined
 - strong, hard and durable
 - resistant to wear and abrasion
 - low cost
 - no moisture absorption and dimensionally stable.
11. (a)
Dry sand mould are more susceptible to hot tears.
12. (c)
The main function of chaplets is to support core in the mould. Chills and padding are used for directional solidification.
If in option only chills and padding is not available as separate option, then go for option (d).
13. (b)
Misrun is caused when the metal is unable to fill the mould cavity completely and thus leaving unfilled cavities.
14. (c)
Dense structure formed due to high chilling tendency because of metallic mould.
15. (a)
Gagger is a piece of iron imbedded in the sand of a mould to keep the sand in place.
They are pieces of wires or rods bent at one or both ends which are used for reinforcing the downward projecting sand mass in the cope. They support hanging bodies of sand. They are always used in cope. Its surface should be rough in order to have a good grip with the moulding sand.
16. (a)
The casting as obtained from the moulds are not fit for immediate use or for work in the machine shop as they carry unwanted metal attached in the form of gates and risers.

17. (b)

Metal penetration is not caused due to high pouring temperature. It is caused due to improper ramming of sand.

18. (d)

Main purpose of chaplets is to support cores although it also helps in directional solidification.

19. (a)

Scabs are rough, irregular projections on surface of castings containing embedded sand.

20. (a)

Vertical core is positioned both in cope and drag boxes usually top and bottom of the core is provided with a taper, but the amount of taper on the top is greater than that of the bottom.

21. (d)

Improper rise will have given rise to defect called shrinkage cavity.

22. (a)

Slush casting is used for thin-walled hollow castings.

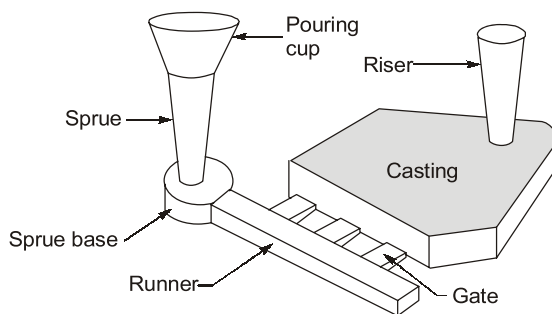
23. (c)

Casting defect scabs occurs when a portion on the face of mould or core lifts and metal flows underneath in a thin layer.

24. (b)

Cuts and washes appear as rough spots and areas of excess metal and are caused by the erosion of moulding sand by the flowing molten metal.

25. (a)



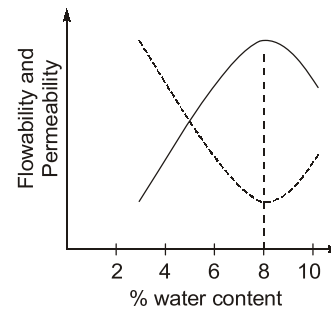
Components of gating system.

Hence metal passes through pouring basin-sprue-runner-gate-casting-top riser.

26. (a)

The ability of the sand mixture to collapse under force. Collapsibility is a very important property in this type of casting manufacture. Collapsibility of the mold will allow the metal casting to shrink freely during the solidification phase of the process. If the molding sand cannot collapse adequately for the casting's shrinkage, hot tearing or cracking will develop in the casting.

27. (d)



28. (a)

Centrifugal casting → pipes

Squeeze casting → wheels of automobile

Die casting → carburetors

29. (b)

The velocity of the flowing metal at the base of the sprue.

Velocity of flow,

$$V = \sqrt{2gh}$$

Velocity of flow,

$$V = \sqrt{2 \times 1000 \times 20} = 200 \text{ cm/s}$$

Volume flow rate,

$$Q = A \times V = 2.5 \text{ cm}^2 \times 200 \text{ cm/s} = 500 \text{ cm}^3/\text{s}$$

Time required to fill a mold cavity

$$= \frac{\text{Volume of mold cavity}}{\text{Volume flow rate}} = \frac{1800}{500} = 3.6 \text{ s}$$

30. (d)

Turbulent flow should be avoided for several reasons while pouring:

- It tends to accelerate the formation of metal oxides that can be entrapped during solidification.
- Turbulence also aggravates mold erosion.

INDUSTRIAL ENGINEERING

OBJECTIVE PRACTICE SETS

Page No. 224 - 313

Break-even Analysis

MCQ and NAT Questions

- Q.1** Which one of the following conditions warrants that a business should be closed?
- Flat variable cost line
 - Vertical variable cost line
 - Steep revenue line
 - Capacity utilization can never reach 100%
- Q.2** Which one of the following does not form a part of the direct cost of a component?
- Cost of special tooling used
 - Cost of material used
 - Cost of material wasted
 - Wages of the labour actually involved
- Q.3** Which of the following is the expression for the market price?
- Selling price + discount to distributor
 - Selling price – discount to distributor
 - Total cost + discount to distributor
 - Office cost + selling & distribution express
- Q.4** Which one of the following is the correct statements? In cost estimation at the break-even point, the cost of production is
- Greater than the sales
 - less than the sales
 - Equal to total sales
 - profit sales
- Q.5** If break-even point = Total fixed cost $\div \left(1 - \frac{\text{Variable Cost per unit}}{X}\right)$ then X is the
- Overheads
 - Price per unit
 - Direct cost
 - Materials cost
- Q.6** Process I requires 20 units of fixed cost and 3 units of variable costs per piece, while process II required 50 units of fixed costs and 1 unit of variable cost per piece. For a company producing 10 pieces per day
- process I should be chosen
 - process II should be chosen
 - either of the two processes should be chosen

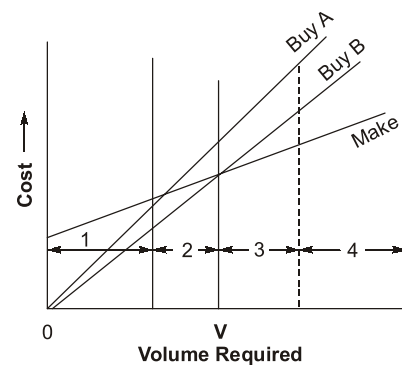
(d) a combination of process I and process II should be chosen

- Q.7** Two machine produce a specific part in batches. The setup cost per patch and the variable unit production cost are

Cost in Rupees	Semiautomatic	Automatic
Setup cost/batch	50.0	20.0
Unit variable cost	0.4	0.6

Which of the following alternative is advisable?

- Buy automatic machine if batch size is greater than 150 units
 - Buy automatic machine if batch size is greater than 140 units
 - Buy semi automatic machine if batch size is greater than 200 units
 - Buy semiautomatic machine if batch size is greater than 150 units.
- Q.8** Details of cost for make or buy decision are shown in the given graph. A discount is offered for volume of purchase above 'V'. Which one of the following ranges would lead to the economic decision?



- | Buy A, B | Make |
|-------------|---------|
| (a) 1 and 2 | 3 and 4 |
| (b) 1 and 3 | 2 and 4 |
| (c) 2 and 4 | 1 and 3 |
| (d) 1 and 4 | 2 and 3 |

Q.9 A company is producing circuit breaker. The fixed cost of land, building etc. is ₹ 40,000.

The variable cost is ₹10 per unit production. If the selling price is ₹ 20 per unit. The break-even is achieved at

- (a) 6000 units
- (b) 4000 units
- (c) 10,000 units
- (d) 4500 units

Q.10 It a company is producing circuit breaker has a fixed cost of ₹ 40,000 and variable cost of ₹10/- selling price of circuit breaker is ₹ 20/- per unit. The level of production for a profit of ₹ 10,000 is

- (a) 4000 units
- (b) 8000 units
- (c) 5000 units
- (d) 6000 units

Q.11 The fixed cost of ₹ 24,000 and a break-even quantity of 34,000 unit are estimated for a production. The profit at a sales volume of 50,000 unit is

- (a) 20000
- (b) 10290
- (c) 11295
- (d) 9000

Q.12 Which of the following form the overhead expenses?

1. Factory expenses
2. Material expenses
3. Administrative expenses
4. Sales and distribution expenses

Select the correct answer using the code given below:

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

Q.13 The low break-even point is due to which one of the following factors?

- (a) High productivity
- (b) Low revenue
- (c) Large angle of incidence
- (d) High revenue

Q.14 Break-even analysis can be used for which of the following?

1. Profit analysis
2. Production method cost comparison

Select the correct answer using the code given below:

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 and 2

Q.15 M/s. ABC & Co. is planning to use the most competitive manufacturing process to produce an ultramodern sports shoe. They can use a fully automatic robot-controlled plant with an investment of ₹ 100 million; alternately they can go in for a cellular manufacturing that has a fixed cost of ₹ 80 million. There is yet another choice of traditional manufacture that needs in investment of ₹ 75 million only. The fully automatic plant can turn out a shoe at a unit variable cost of ₹ 25 per unit, whereas the cellular and the job shop layout would lead to a variable cost of ₹ 40 and ₹ 50 respectively. The break-even analysis shows that the break-even quantities using automatic plant vs traditional plant are in the ratio of 1 : 2. The per unit revenue used in the break-even calculation is

- (a) ₹ 75
- (b) ₹ 87
- (c) ₹ 57
- (d) ₹ 65

Q.16 Following details for a small manufacturing company is available,

Actual sale = ₹45000

Fixed cost = ₹10000

Profit at given sale = ₹8000

What will be the profit when the sale is ₹125000?

- (a) ₹40000
- (b) ₹36000
- (c) ₹32000
- (d) ₹44000

Q.17 A factory produces three products such that

	Products		
	A	B	C
Sales (unit)	300	200	400
Unit selling price (Rs.)	5	8	7
Unit variable price (Rs.)	2	5	4

What will be the break-even sale for the factory if fixed cost of the products is Rs. 1200?

- (a) Rs. 400
- (b) Rs. 2670
- (c) Rs. 2620
- (d) Rs. 8000

Q.18 The profit to volume ratio for an item is 40% and margin of safety is 50%. The net profit and the breakeven point sale if the sales volume is ₹800000 are respectively,

- (a) ₹160000, ₹400000 (b) ₹160000, ₹80000
(c) ₹400000, ₹160000 (d) ₹80000, ₹160000

Direction (Q.19 to Q.20): The following questions consist of two statements, one labelled as 'Statement (I)' and the other labelled as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below.

Codes:

- (a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.19 Statement (I): A large margin of safety in break-even analysis is helpful for management decision.

Statement (II): If the margin of safety is large, it would indicate that there will be profit even when there is serious drop in production.

Q.20 Statement (I): It is possible to have more than one BEP in break-even charts.

Statement (II): All variable costs are directly variable with production.

Q.21 Statement (I): Indirect cost is more difficult to assess than direct cost.

Statement (II): Overhead cost apportioning is approximate and time consuming.

Q.22 Total monthly costs equations for production and distribution are as follows:

$$\text{Production cost} = 4x^2 - 19x + 25000$$

$$\text{Distribution cost} = 3x^2 - 37x + 26000$$

Number of units should be produced to minimize total cost is _____.

Q.23 For a product, the direct labour cost is ₹ 5 and direct material cost is ₹ 10. The annual cost of direct materials is expected to be ₹ 200000 and the annual overhead to be absorbed is ₹ 120000. The total cost of product (in ₹) is _____.

Q.24 The fixed costs for a year is ₹ 8 lakhs, variable cost per unit is ₹ 40 and the selling price of each unit is ₹ 200. If the annual estimated sales is ₹ 200000, then the break-even volume is _____.

Q.25 If a company's total sales is ₹ 50000 and (P/V) ratio is 50% and margin of safety percentage is 40%, then break-even point sale (in ₹) is _____.

Multiple Select Questions (MSQ)

Q.26 For a small manufacturing company following details are available:

Fixed cost = Rs. 20000

Profit at a sale of Rs. 100000 is Rs. 20000

Which of the following options is/are correct?

(a) Value of $\left(\frac{P}{V}\right)$ ratio is 0.4.

(b) Profit at a sale of Rs. 200000 is Rs. 45000.

(c) Profit at a sale of Rs. 200000 is Rs. 60000.

(d) Break-even point sale of Rs. 80000.

Q.27 The $\left(\frac{P}{V}\right)$ ratio of Pankaj enterprises is 50% and

margin of safety is 40%. The company sold 500 units for Rs. 100000.

Which of the following options is/are correct?

(a) Variable cost is Rs. 100/unit.

(b) Fixed cost is Rs. 30,000.

(c) Breakeven point quantity is 300 units.

(d) Profit earned at given sell is Rs. 30000.

Q.28 For a product selling price per unit is Rs.200 and total sale is Rs.80000. The fixed cost is Rs.20000 and contribution margin is Rs.35000.

Which of the following options is/are correct?

(a) The variable cost per unit is Rs.87.5.

(b) The profit earned for this sale is Rs.15000.

(c) The breakeven point sale quantity is 178 units.

(d) The breakeven point sale is Rs.45720 approx.



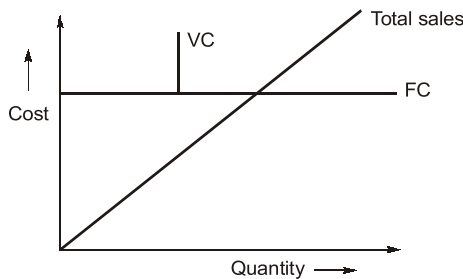
Answers Break-even Analysis

1. (b) 2. (c) 3. (a) 4. (c) 5. (b) 6. (a) 7. (d) 8. (a) 9. (b)
 10. (c) 11. (c) 12. (b) 13. (d) 14. (c) 15. (d) 16. (a) 17. (c) 18. (a)
 19. (a) 20. (d) 21. (a) 22. (4) 23. (420000) 24. (5000) 25. (30000) 26. (a, c)
 27. (a,b,c) 28. (b, d)

Explanations Break-even Analysis

1. (b)

A vertical variable cost means that the total cost would never be equal to the revenue and hence BEP would not be reached. So, the business should be closed.



2. (c)

Direct costs are costs which directly contribute to the final product and can be directly allocated to the manufacturing of a specific product. Direct costs include the cost of raw materials, labour processing the materials, cost of the equipment, special tooling and engineering costs used in the manufacturing of the product.

3. (a)

Selling price = Market price – discount
 Market price = Selling price + discount

4. (c)

At BEP, Profit = 0
 \therefore Cost of production = Total sales

5. (b)

At break-even point,

$$\text{Profit} = 0$$

$$\Rightarrow FC + n \times VC = n \times SC$$

when FC = Total fixed cost
 n = Number of units at BEP
 VC = Variable cost per unit

SC = Selling cost per unit

$$FC = n(SC - VC)$$

$$n = \frac{FC}{SC \left(1 - \frac{VC}{SC}\right)}$$

$$n \times SC = \frac{FC}{\left(1 - \frac{VC}{SC}\right)} = \text{BEP}$$

6. (a)

$$\text{Cost} = 20 + 3X \text{ (for Process 1)} = ₹50$$

$$\text{Cost} = 50 + 1X \text{ (for Process 2)} = ₹60$$

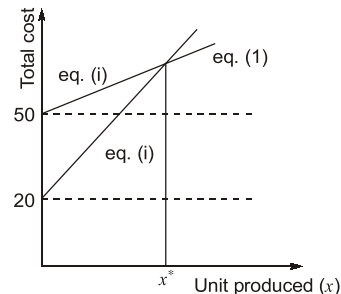
So, Process 1 is to be chosen

7. (d)

$$\begin{aligned} \text{Total cost by semiautomatic method,} \\ = 50 + 0.4x \quad \dots(i) \end{aligned}$$

where, x is the number of units produced.

$$\text{Total cost by automatic method} = 20 + 0.6x \quad \dots(ii)$$



Equating total cost at $x = x^*$

$$50 + 0.4x^* = 20 + 0.6x^*$$

$$\Rightarrow x^* = 150 \text{ units}$$

So, buying semiautomatic machine if batch size is greater than 150 units will be advisable.

8. (a)

For volume region 1 and 2, it is better to buy than to make, so buy A, B, while in region 3 and 4, it is right decision to make.

9. (b)

$$x = \left(\frac{F}{S-V} \right) = \frac{40000}{20-10} = 4000 \text{ units}$$

10. (c)

$$x = \left(\frac{F + \text{Profit}}{S - V} \right) = \frac{40000 + 10000}{20 - 10} = 5000 \text{ units}$$

11. (c)

$$\text{BEP} = \left(\frac{F}{S - V} \right)$$

$$S - V = \left(\frac{24000}{34000} \right) = \left(\frac{24}{34} \right)$$

Profit = (Sales in unit)(S - V) - fixed cost

$$= 50000 \times \frac{24}{34} - 24000 = 11295$$

12. (b)

Apart from material expenses, all other expenses mentioned come under overhead expenses category.

13. (d)

$$S_x = F + V_x + P$$

$$\therefore x = \frac{F + P}{S - V}$$

At BEP, $P = 0$

$$\therefore x = \frac{F}{S - V}$$

Higher the value of S, lesser will be x (i.e. BEP)

14. (c)

Both profit analysis and production method cost analysis can be done using break-even analysis.

15. (d)

$$(\text{BEP})_{\text{Automatic}} = \frac{100}{(s-25)}$$

$$(\text{BEP})_{\text{Traditional}} = \frac{75}{(s-50)}$$

$$\text{Given: } \frac{(\text{BEP})_{\text{Automatic}}}{(\text{BEP})_{\text{Traditional}}} = \frac{1}{2} = \frac{100}{(s-25)} \times \frac{(s-50)}{75}$$

$$8(s-50) = 3(s-25)$$

$$5s = 325$$

$$s = 65$$

Per unit revenue cost = ₹ 65.

16. (a)

$$\left(\frac{P}{V} \right)_{\text{ratio}} = \frac{\text{Contribution Margin}}{\text{Sales}} = \frac{S - V}{S} = \frac{F + P}{S}$$

$$= \left(\frac{10000 + 8000}{45000} \right) = 0.4 = \frac{F + P_1}{S_1} = \frac{F + P_2}{S_2}$$

$$= \frac{10000 + 8000}{45000} = \frac{10000 + P_2}{125000}$$

$$(0.4) \times 125000 - 10000 = P_2$$

$$P_2 = ₹40000$$

17. (c)

Break-even point,

$$= \frac{\text{Total fixed expenses}}{\left(\begin{array}{l} \text{Weighted average selling price} \\ - \text{weighted average variable expenses} \end{array} \right)}$$

Weighted average unit selling price,

$$= \frac{300}{900} \times 5 + \frac{200}{900} \times 8 + \frac{400}{900} \times 7 = \text{Rs. } 6.556$$

Weighted average unit variable expense,

$$= \frac{300}{900} \times 2 + \frac{200}{900} \times 5 + \frac{400}{900} \times 4 = \text{Rs. } 3.566$$

$$\text{Break-even point} = \frac{1200}{(6.556 - 3.566)} = 400 \text{ units}$$

Break-even sale = 400 × (weighted avg. selling price)

$$= 400 \times 6.556 = \text{Rs. } 2622.4 \approx \text{Rs. } 2620$$

18. (a)

Margin of safety percentage,

$$= \frac{\text{Actual sales} - \text{Breakeven sales}}{\text{Actual sales}} \times 100$$

$$\frac{50}{100} = \frac{800000 - \text{BES}}{800000}$$

$$\text{BES} = ₹400000$$

$$\text{BES} = \frac{\text{Fixed cost}}{P/V \text{ ratio}}$$

$$400000 = \frac{\text{Fixed cost}}{0.4}$$

$$\text{Fixed cost} = ₹160000$$

$$\text{Actual sales} = \frac{\text{Fixed cost} + \text{Profit}}{P/V \text{ ratio}}$$

$$800000 = \frac{160000 + \text{Profit}}{0.4}$$

$$\text{Profit} = ₹160000$$