



POSTAL BOOK PACKAGE 2026

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MECHANICAL ENGINEERING

Objective Practice Sets

Engineering Mechanics

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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

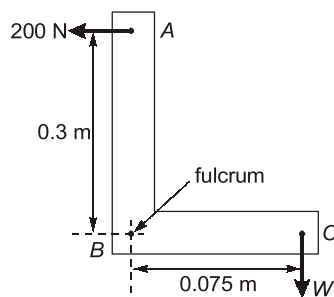
List-II

- 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

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

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

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

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

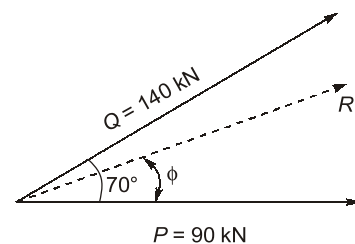
Q.4 The sum of the magnitudes of two forces acting at a point is 18 and the magnitude of their resultant is 12. If the resultant is 90° with the forces of smaller magnitude, the magnitude of forces are

- (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

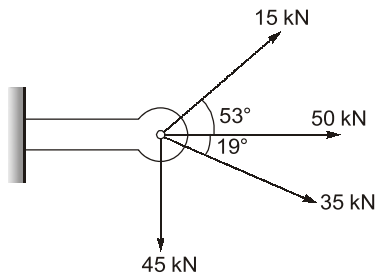
Q.6 The resultant R and angle of resultant ϕ for the given system of force will be respectively:



- (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, $72^\circ 14'$

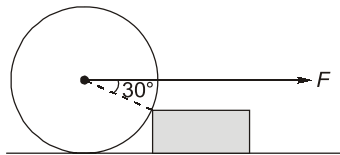
Q.7 In the above figure, four cable exerts tension as indicated on the eyebolt. It is intended to replace these cables by a single cable. The tension on

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



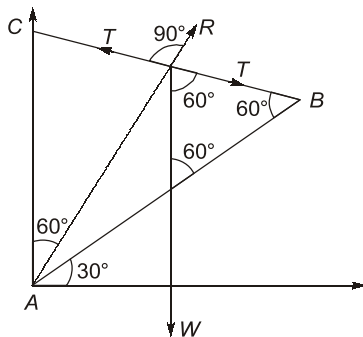
- (a) 102.27 kN, 64.36° (clockwise)
(b) 102.27 kN, 25.74° (clockwise)
(c) 100.5 kN, 25.74° (clockwise)
(d) 100.5 kN, 64.26° (clockwise)

- 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:

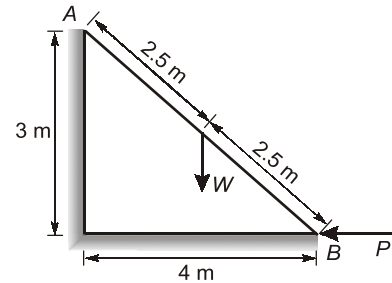


- (a) $\frac{W}{2}$ (b) W
(c) $\sqrt{3}W$ (d) $2W$

- 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.

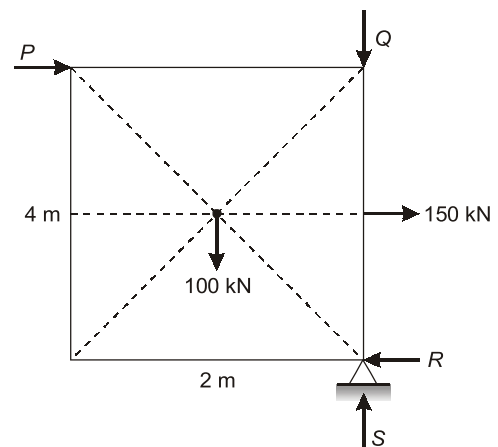


- Q.10** A ladder AB of length 5 m and weight (W) = 600 N is resting against a wall. Assuming frictionless contact at the floor (B), and the wall (A), the magnitude of force P (in Newton) required to maintain equilibrium of ladder is _____.



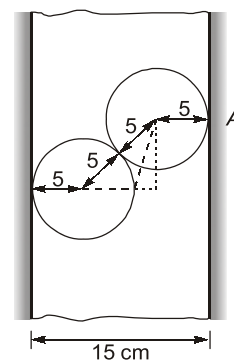
- Q.11** Weight of 120 kN is being supported by a tripod whose each leg of length of 13 m. If the vertical height of the point of attachment of the load is 12 m, the force on the tripod leg would be
(a) 37.67 kN (b) 40 kN
(c) 43.3 kN (d) 46.6 kN

- Q.12** A rectangular plate is held in equilibrium by then 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

Q.14 Three forces acting at a point 'O' are

$$P_1 = (3\hat{i} + 6\hat{j})N$$

$$P_2 = (-1.5\hat{i} + 4.5\hat{j})N$$

$$P_3 = (-10.5\hat{i} + 1.5\hat{j})N$$

If a fourth force P_4 is added such that the point 'O' is in equilibrium, then force P_4 will be

(a) $(-15\hat{i} + 15\hat{j})N$ (b) $(-9\hat{i} + 12\hat{j})N$

(c) $(-9\hat{i} + 12\hat{j})N$ (d) $(-15\hat{i} + 15\hat{j})N$

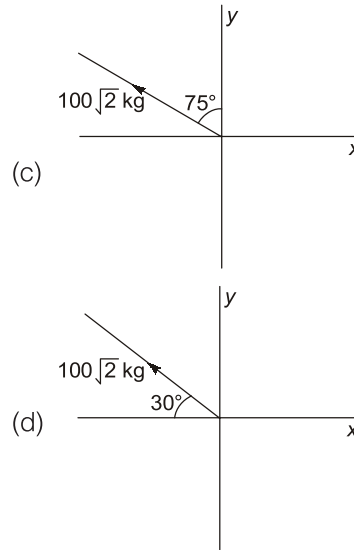
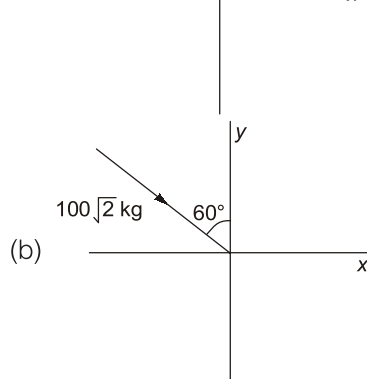
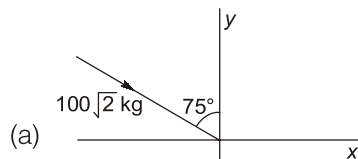
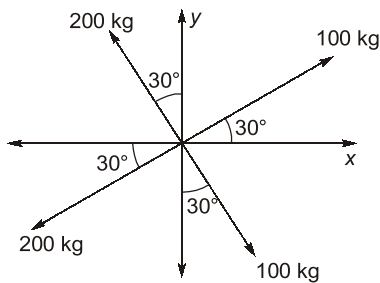
Q.15 Two non-collinear equal parallel forces acting in opposite direction will have

- (a) no resultant force and moment
(b) a moment but no resultant force
(c) a resultant force but no moment
(d) a moment and a resultant force

Q.16 The vector product of two non-zero vectors is zero if and only if the vectors are

- (a) perpendicular (b) concurrent
(c) parallel or collinear (d) co-planar

Q.17 Four coplanar forces acting at a point 'O' as shown in figure. The equilibrium of the force system acting at O is given by



Q.18 What is the torque of the force

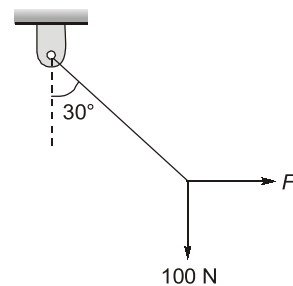
$$\vec{F} = (2\hat{i} + 4\hat{j} + 3\hat{k})N$$

$$\vec{r} = (3\hat{i} - 2\hat{j} + \hat{k})m$$

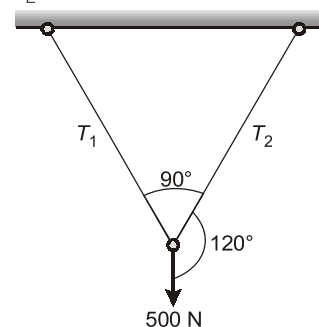
(a) $10\hat{i} + 7\hat{j} - 16\hat{k}$ (b) $-10\hat{i} - 7\hat{j} + 16\hat{k}$

(c) $6\hat{i} - 8\hat{j} + 6\hat{k}$ (d) $-6\hat{i} + 8\hat{j} - 6\hat{k}$

Q.19 A rigid ball of weight 100 N is suspended with the help of a string. The ball is pulled by a horizontal force F such that the string makes an angle of 30° with the vertical. The magnitude of force F (in N) is _____.

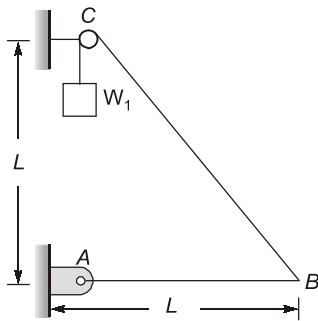


Q.20 A weight of 500 N is supported by two metallic ropes as shown in figure. The values of tensions T_1 and T_2 are respectively



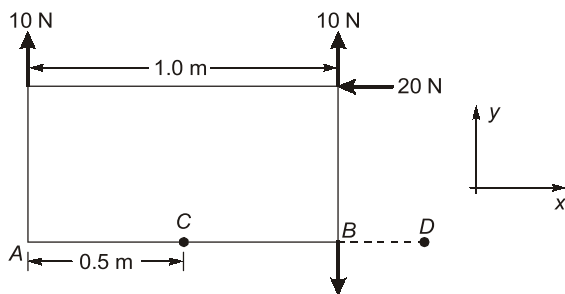
- (a) 433 N and 250 N (b) 250 N and 433 N
(c) 353.5 N and 250 N (d) 250 N and 353.5 N

Q.21 A uniform heavy rod AB of length L and weight W is hinged at A and tied to a weight W_1 by a string at B . The massless string passes over a frictionless pulley (of negligible dimension) at C shown in the figure. If the rod is in equilibrium at horizontal configuration, then



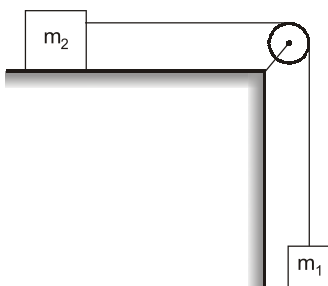
- (a) $W_1 = W$ (b) $W_1 = \frac{W}{2}$
(c) $W_1 = \sqrt{2}W$ (d) $W_1 = \frac{W}{\sqrt{2}}$

Q.22 A system of forces acting on a lamina is shown in the given figure. The resultant of the force system will meet AB at



- (a) A (b) B
(c) C (d) D

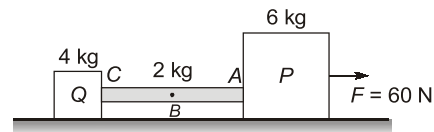
Q.23 In the given figure, two bodies of masses m_1 and m_2 are connected by a light inextensible string passing over a smooth pulley. Mass m_2 lies on a smooth horizontal plane. When mass m_1 moves downwards, the acceleration of the two bodies is equal to



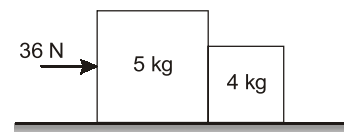
- (a) $\frac{m_1 g}{m_1 + m_2}$ (b) $\frac{m_2 g}{m_1 - m_2}$
(c) $\frac{m_2 g}{m_1 + m_2}$ (d) $\frac{m_1 g}{m_1 - m_2}$

Q.24 Two blocks of masses 2.9 kg and 1.9 kg are suspended from a rigid support by two inextensible wires each of length 1 m. The upper wire has uniform mass of 0.2 kg/m. The whole system of blocks, wires and supports have an upward acceleration of 0.2 m/s^2 . Acceleration due to gravity is 9.8 m/s^2 . The tension at mid point of upper wire is _____ N.

Q.25 Two block of masses 6 kg and 4 kg connected by a rope of mass 2 kg are resting on a frictionless floor as shown in figure. If a constant force of 60 N is applied to the 6 kg block, the tension in the rope at point 'c' _____ N.



Q.26 Two rigid bodies of mass 5 kg and 4 kg are at rest on a frictionless surface until acted upon by a force of 36 N as shown in the figure the contact force generated between the two bodies is:



- (a) 4.0 N (b) 7.2 N
(c) 9.0 N (d) 16.0 N

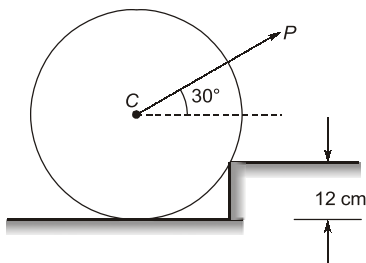
Q.27 Two blocks of masses m_1 and m_2 ($m_1 > m_2$) are connected by an inextensible string passing over a smooth pulley. If the acceleration of m_1 is $g/5$ downwards, then $\frac{m_1}{m_2}$ is _____.

Q.28 Three equal weights of mass m each are hanging on a string shown in figure passing over a fixed pulley. The tensions in the string connecting weight A to B.

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

Multiple Select Questions (MSQ)

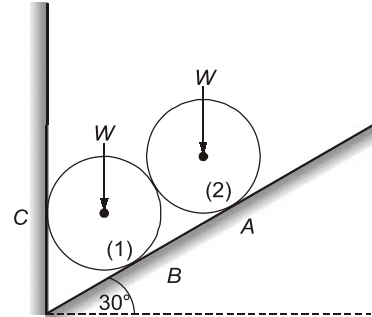
- Q.48** The force P applied at 30° to the horizontal is just necessary to start a roller having radius 50 cm over a obstruction 12 cm high, the roller is of mass 100 kg.



Which of the following statements is(are) correct?

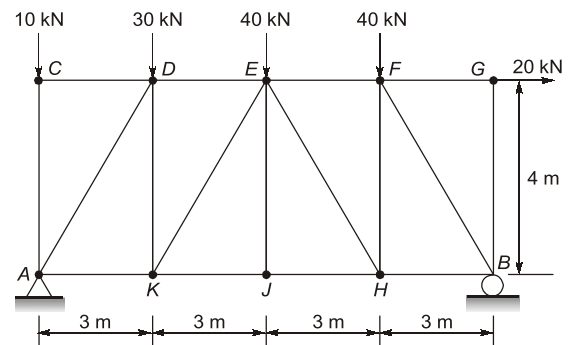
- (a) The magnitude of force P is 648.75 N
- (b) For minimum value of P , it must be at 40.54° from the horizontal.
- (c) The magnitude of required minimum force P is 621.24 N.
- (d) The magnitude of required minimum force P is 579.31 N.

- 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.

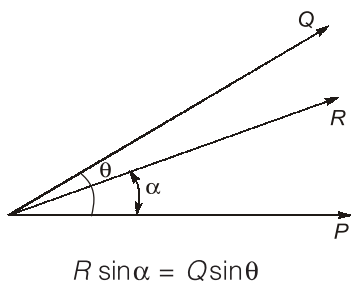
Varignon's Theorem: The moment about any point of the resultant of several concurrent forces is equal to the sum of the moments of the particular forces about the same point.

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)



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

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

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)

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

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

$$= 190.58 \text{ kN}$$