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CONTENTS

CIVIL ENGINEERING

Objective Practice Sets

Engineering Mechanics

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1 CHAPTER
FBD, Equilibrium, Plane Trusses and Virtual Work

Q.1 Varignon's theorem is applicable only when the forces are:
(a) coplanar (b) concurrent
(c) non-concurrent (d) parallel

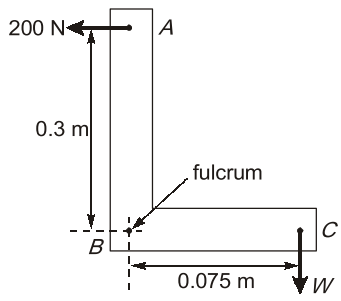
Q.2 Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:

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.3 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.4 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) $\tan\alpha = \dfrac{Q\sin\theta}{P - Q\sin\theta}$

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

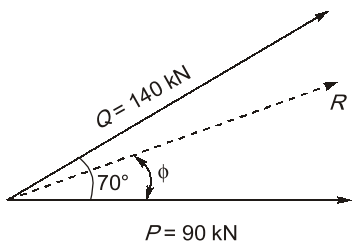
(c) $\tan\alpha = \dfrac{Q\sin\theta}{P + Q\cos\theta}$

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

Q.5 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

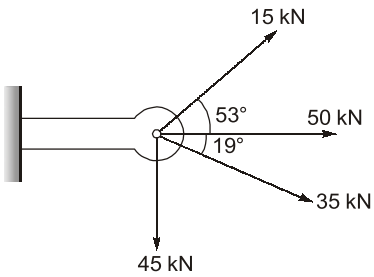
Q.6 If the magnitude of maximum and minimum resultant forces of the two forces acting on a particle are 40 kN and 10 kN respectively, then the two forces would be
(a) 25 kN and 15 kN
(b) 20 kN and 20 kN
(c) 20 kN and 10 kN
(d) 20 kN and 5 kN

Q.7 The resultant R and angle of resultant ϕ for the given system of force will be respectively:



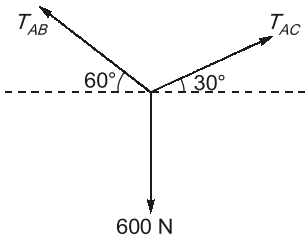
(a) 190.58 kN; 43° 39′ (b) 138.13 kN, 72°14′
(c) 166.43 kN; 47°51′ (d) 190.58 kN, 72°14′

Q.8 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 w.r.t. the 50 kN (Assume coplanar force system).



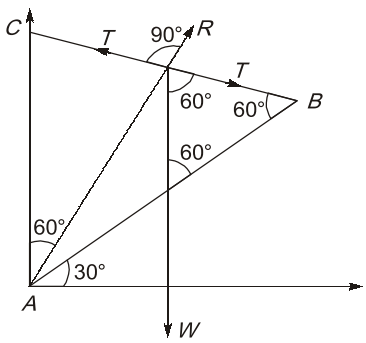
(a) 102.27 kN, 64.36° (clockwise)
(b) 102.27 kN, 25.74° (clockwise)
(c) 100.5 kN, 25.74° (clockwise)
(d) 100.5 kN, 64.26° (clockwise)

Q.9 If a point *A* is in equilibrium under the action of the applied forces, the value of tensions T_{AB} and T_{AC} are respectively

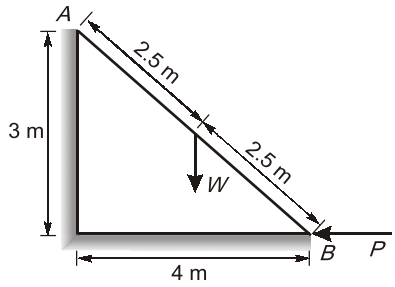


(a) 520 N and 300 N (b) 300 N and 520 N
(c) 450 N and 150 N (d) 150 N and 450 N

Q.10 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.

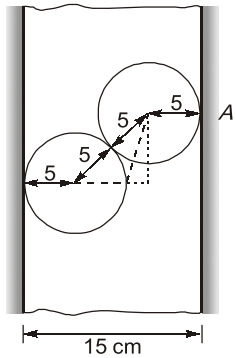


Q.11 A ladder *AB* of length 5 m and weight (W) = 600 N is resting against a wall. Assuming frictionless contact at the floor (B), and the wall (A), the magnitude of force P(in Newton) required to maintain equilibrium of ladder is _____.



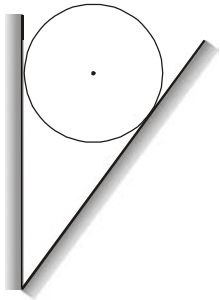
Q.12 Weight of 120 kN is being supported by a tripod whose each leg of length of 13 m. If the vertical height of the point of attachment of the load is 12 m, the force on the tripod leg would be
(a) 37.67 kN (b) 40 kN
(c) 43.3 kN (d) 46.6 kN

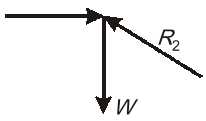
Q.13 In the figure shown, consider the two identical spheres with radius 5 cm, weight 100 N each and the distance between the two walls as 15 cm. What is the reaction force at point *A*?

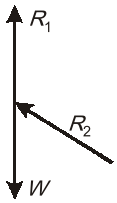


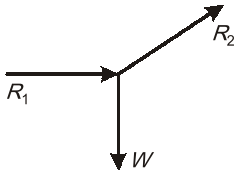
(a) 173.2 N (b) 57.7 N
(c) 100 N (d) 0 N

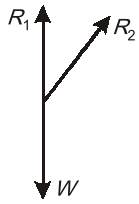
Q.14 A ball of weight W is supported on smooth planes as shown in figure. The correct FBD will be given by:



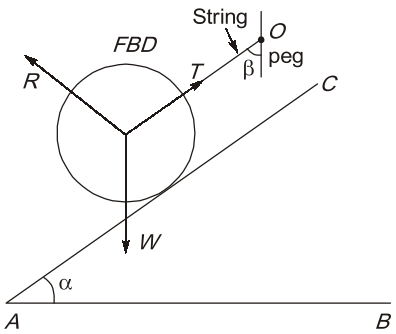
(a) 

(b) 

(c) 

(d) 

Q.15 In the system shown in figure forces W, T and R are related as:



(a) $\frac{W}{\sin(180+(\alpha+\beta))}=\frac{T}{\sin(90°-\alpha)}=\frac{R}{\sin(90°-\beta)}$

(b) $\frac{W}{\sin(\alpha+\beta)}=\frac{T}{\sin\alpha}=\frac{R}{\sin\beta}$

(c) $\frac{W}{\sin(90°-(\alpha-\beta))}=\frac{T}{\sin\alpha}=\frac{R}{\sin\beta}$

(d) $\frac{W}{\sin(\alpha+\beta)}=\frac{T}{\sin\alpha}=\frac{R}{\sin\beta}$

Q.16 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.17 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

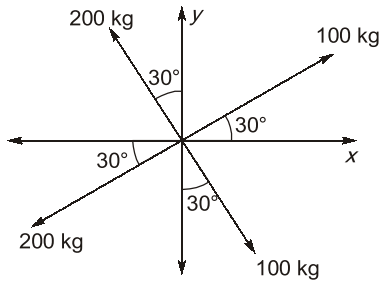
(d) a moment and a resultant force

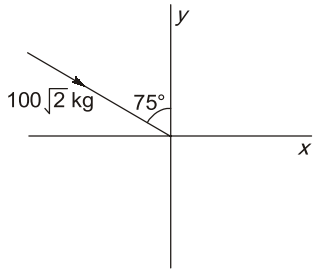
Q.18 The vector product of two non-zero vectors is zero if and only if the vectors are

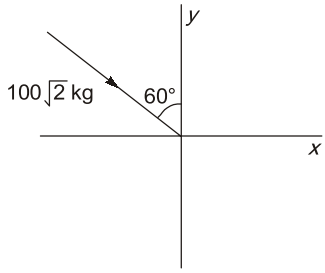
(a) perpendicular (b) concurrent

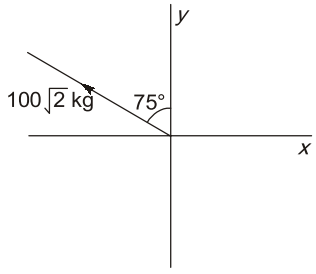
(c) parallel or collinear (d) co-planar

Q.19 Four coplanar forces acting at a point 'O' as shown in figure. The equilibrium of the force system acting at O is given by

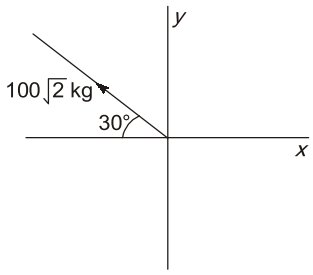


(a) 

(b) 

(c) 

(d)

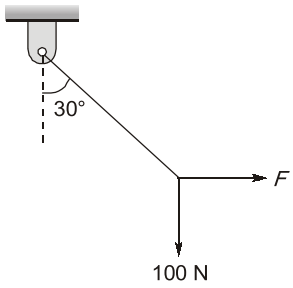


Q.20 What is the torque of the force $\vec{F} = (2\hat{i} + 4\hat{j} + 3\hat{k})N$, which acts at a point $\vec{r} = (3\hat{i} - 2\hat{j} + \hat{k})m$ about the origin?

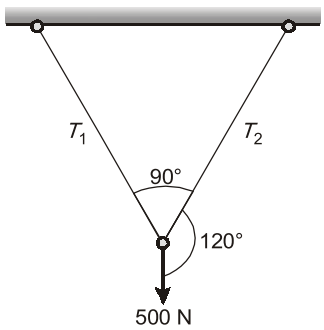
(a) $10\hat{i} + 7\hat{j} - 16\hat{k}$ (b) $-10\hat{i} - 7\hat{j} + 16\hat{k}$

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

Q.21 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 _____.



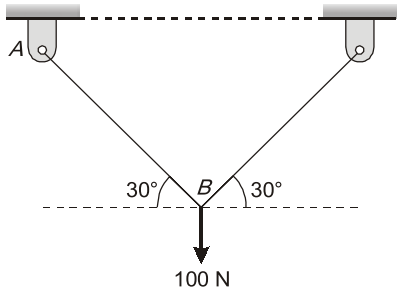
Q.22 A weight of 500 N is supported by two metallic ropes as shown in figure. The values of tensions T_1 and T_2 are respectively



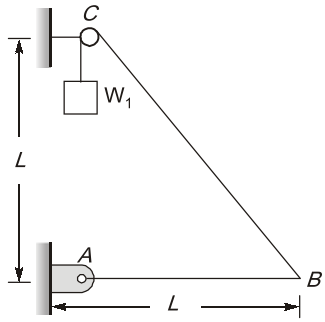
(a) 433 N and 250 N (b) 250 N and 433 N

(c) 353.5 N and 250 N (d) 250 N and 353.5 N

Q.23 Two identical trusses support a load of 100 N as shown in figure. The length of each truss is 1.0 m cross-sectional area is 200 mm^2, Young's modulus E = 200 GPa. The force in the truss AB(in N) is___



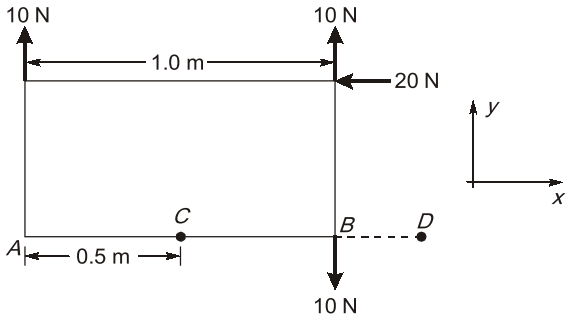
Q.24 A uniform heavy rod AB of length L and weight W is hinged at A and tied to a weight W_1 by a string at B. The massless string passes over a frictionless pulley (of negligible dimension) at c shown in the figure. If the rod is in equilibrium at horizontal configuration, then



(a) $W_1 = W$ (b) $W_1 = \frac{W}{2}$

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

Q.25 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