

**STATICS ASSIGNMENT**

- The resultant of  $P$  and  $Q$  is  $R$ . If  $P$  is reversed,  $Q$  remaining the same, the resultant becomes  $R'$ . If  $R$  is perpendicular to  $R'$ , then
  - $2P = Q$
  - $P = Q$
  - $P = 2Q$
  - None of these
- $ABCD$  is a parallelogram, a particle  $P$  is attracted towards  $A$  and  $C$  by forces proportional to  $PA$  and  $PC$  respectively and repelled from  $B$  and  $D$  by forces proportional to  $PB$  and  $PD$ . The resultant of these forces is
  - $2\overrightarrow{PA}$
  - $2\overrightarrow{PB}$
  - $2\overrightarrow{PC}$
  - None of these
- A particle is acted upon by three forces  $P$ ,  $Q$  and  $R$ . It cannot be in equilibrium, if  $P : Q : R =$ 
  - $1 : 3 : 5$
  - $3 : 5 : 7$
  - $5 : 7 : 9$
  - $7 : 9 : 11$
- Forces of  $7\text{ N}$ ,  $5\text{ N}$  and  $3\text{ N}$  acting on a particle are in equilibrium, the angle between the pair of forces  $5$  and  $3$  is
  - $30^\circ$
  - $60^\circ$
  - $90^\circ$
  - $120^\circ$
- $ABCD$  is a quadrilateral. Forces represented by  $\overrightarrow{DA}$ ,  $\overrightarrow{DB}$ ,  $\overrightarrow{AC}$  and  $\overrightarrow{BC}$  act on a particle. The resultant of these forces is
  - $\overrightarrow{DC}$
  - $2\overrightarrow{DC}$
  - $\overrightarrow{CD}$
  - $2\overrightarrow{CD}$
- With two forces acting at a point, the maximum effect is obtained when their resultant is  $4\text{ N}$ . If they act at right angles, then their resultant is  $3\text{ N}$ . Then the forces are
  - $\left(2 + \frac{1}{2}\sqrt{3}\right)\text{ N}$  and  $\left(2 - \frac{1}{2}\sqrt{3}\right)\text{ N}$
  - $(2 + \sqrt{3})\text{ N}$  and  $(2 - \sqrt{3})\text{ N}$
  - $\left(2 + \frac{1}{2}\sqrt{2}\right)\text{ N}$  and  $\left(2 - \frac{1}{2}\sqrt{2}\right)\text{ N}$
  - $(2 + \sqrt{2})\text{ N}$  and  $(2 - \sqrt{2})\text{ N}$
- The resultant of two forces  $P$  and  $Q$  is equal to  $\sqrt{3}Q$  and makes an angle of  $30^\circ$  with the direction of  $P$ , then  $\frac{P}{Q} =$ 
  - 1 or 2
  - 3 or 5
  - 3 or 4
  - 4 or 5
- Two men carry a weight of  $240\text{ Newton}$  between them by means of two ropes fixed to the weight. One rope is inclined at  $60^\circ$  to the vertical and the other at  $30^\circ$ . The tensions in the ropes are
  - $120\text{ N}, 120\text{ N}$
  - $120\text{ N}, 120\sqrt{3}\text{ N}$
  - $120\sqrt{3}\text{ N}, 120\sqrt{3}\text{ N}$
  - None of these
- Three forces keep a particle in equilibrium. One acts towards west, another acts towards north-east and the third towards south. If the first be  $5\text{ N}$ , then other two are
  - $5\sqrt{2}\text{ N}, 5\sqrt{2}\text{ N}$
  - $5\sqrt{2}\text{ N}, 5\text{ N}$
  - $5\text{ N}, 5\text{ N}$
  - None of these
- A particle is attracted to three points  $A$ ,  $B$  and  $C$  by forces equal to  $\overrightarrow{PA}$ ,  $\overrightarrow{PB}$  and  $\overrightarrow{PC}$  respectively such that their resultant is  $\lambda\overrightarrow{PG}$ , where  $G$  is the centroid of  $\triangle ABC$ . Then  $\lambda =$ 
  - 1
  - 2
  - 3
  - None of these
- Three forces of magnitudes  $8\text{ Newton}$ ,  $5\text{ N}$  and  $4\text{ N}$  acting at a point are in equilibrium, then the angle between the two smaller forces is
  - $\cos^{-1}\left(\frac{23}{40}\right)$
  - $\cos^{-1}\left(\frac{-23}{40}\right)$
  - $\sin^{-1}\left(\frac{23}{40}\right)$
  - None of these
- $ABC$  is an equilateral triangle.  $E$  and  $F$  are the middle-points of the sides  $CA$  and  $AB$  respectively. Forces of magnitudes  $4\text{ N}$ ,  $2\text{ N}$ ,  $2\text{ N}$ ,  $2\text{ N}$  and  $2\text{ N}$  act at a point and are along the lines  $BC$ ,  $BE$ ,  $CA$ ,  $CF$  and  $AB$  respectively. If the system is in equilibrium, then
  - $P = 2\sqrt{3}\text{ N}, Q = 6\text{ N}$
  - $P = 6\text{ N}, Q = 2\sqrt{3}\text{ N}$
  - $P = \sqrt{3}\text{ N}, Q = 6\text{ N}$
  - $P = 2\sqrt{3}\text{ N}, Q = 3\text{ N}$
- The resultant of forces  $P$  and  $Q$  acting at a point including a certain angle  $\alpha$  is  $R$ , that of the forces  $2P$  and  $Q$  acting at the same angle is  $2R$  and that of  $P$  and  $2Q$  acting at the supplementary angle is  $2R$ . Then  $P : Q : R =$ 
  - $1 : 2 : 3$
  - $\sqrt{6} : \sqrt{2} : \sqrt{5}$
  - $\sqrt{2} : \sqrt{3} : \sqrt{5}$
  - None of these
- The resultant of  $P$  and  $Q$  is  $R$ . If  $Q$  is doubled,  $R$  is also doubled and if  $Q$  is reversed,  $R$  is again doubled. Then  $P : Q : R$  is given by
  - $1 : 1 : 1$
  - $\sqrt{2} : \sqrt{2} : \sqrt{3}$
  - $\sqrt{2} : \sqrt{3} : \sqrt{2}$
  - $\sqrt{3} : \sqrt{2} : \sqrt{2}$
- The resultant of two forces acting on a particle is at right angles to one of them and its magnitude is one third of the magnitude of the other. The ratio of the larger force to the smaller is
  - $3 : 2\sqrt{2}$
  - $3\sqrt{3} : 2$
  - $3 : 2$
  - $4 : 3$
- $ABCD$  is a rigid square, on which forces  $2$ ,  $3$  and  $5\text{ kg. wt}$ , act along  $AB$ ,  $AD$  and  $CA$  respectively. Then the magnitude of the resultant correct to one decimal place in  $\text{kg. wt}$  is
  - 1
  - 2
  - 16
  - None of these

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17. A uniform rod of weight  $W$  rests with its ends in contact with two smooth planes, inclined at angles  $\alpha$  and  $\beta$  respectively to the horizon, and intersecting in a horizontal line. The inclination  $\theta$  of the rod to the vertical is given by
- (a)  $2 \cot \theta = \cot \beta - \cot \alpha$  (b)  $\tan \theta = 2 \tan \alpha \tan \beta / (\tan \alpha - \tan \beta)$   
 (c)  $\cot \theta = \sin(\alpha - \beta) / 2 \sin \alpha \sin \beta$  (d) All of these
18. Two forces  $P + Q, P - Q$  make an angle  $2\alpha$  with one another and their resultant make an angle  $\theta$  with the bisector of the angle between them. Then
- (a)  $P \tan \theta = Q \tan \alpha$  (b)  $P \cot \alpha = Q \cot \theta$  (c)  $P \tan \alpha = Q \tan \theta$  (d) None of these
19. A heavy rod 15 cm long is suspended from a fixed point by strings fastened to its ends, their lengths being 9 and 12 cm. If  $\theta$  be the angle at which the rod is inclined to the vertical, then
- (a)  $\cos \theta = 7 / 25$  (b)  $\sin \theta = 8 / 9$  (c)  $\sin \theta = 19 / 20$  (d)  $\sin \theta = 24 / 25$
20. A uniform triangular lamina whose sides are of lengths 3 cm, 4 cm and 5 cm, is suspended by a string tied at the middle point of the largest side. In equilibrium position the inclination of this side to the vertical is
- (a)  $\sin^{-1}(24 / 25)$  (b)  $\sin^{-1}(12 / 25)$  (c)  $\cos^{-1}(7 / 25)$  (d) None of these
21. Three forces  $\vec{P}, \vec{Q}$  and  $\vec{R}$  acting along  $IA, IB$  and  $IC$ , where  $I$  is the incentre of a  $\Delta ABC$ , are in equilibrium. Then  $\vec{P} : \vec{Q} : \vec{R}$  is
- (a)  $\operatorname{cosec} \frac{A}{2} : \operatorname{cosec} \frac{B}{2} : \operatorname{cosec} \frac{C}{2}$  (b)  $\sec \frac{A}{2} : \sec \frac{B}{2} : \sec \frac{C}{2}$   
 (c)  $\sin \frac{A}{2} : \sin \frac{B}{2} : \sin \frac{C}{2}$  (d)  $\cos \frac{A}{2} : \cos \frac{B}{2} : \cos \frac{C}{2}$
22. If two forces  $P$  and  $Q$  act on such an angle that their resultant force  $R$  is equal to force  $P$ , then if  $P$  is doubled then the angle between new resultant force and  $Q$  will be
- (a)  $30^\circ$  (b)  $60^\circ$  (c)  $45^\circ$  (d)  $90^\circ$
23. What will be that force when applying along any inclined plane will stop 10 kilogram weight, it is given that force, reaction of plane and weight of body are in arithmetic series
- (a) 4 kilogram weight (b) 6 kilogram weight (c) 8 kilogram weight (d) 7 kilogram weight
24. A bead of weight  $W$  can slide on a smooth circular wire in a vertical plane, the bead is attached by a light thread to the highest point of the wire, and in equilibrium the thread is taut. Then the tension of the thread and the reaction of the wire on the bead, if the length of the string is equal to the radius of the wire, are
- (a)  $W, 2W$  (b)  $W, W$  (c)  $W, 3W$  (d) None of these
25. Forces  $P, 3P, 2P$  and  $5P$  act along the sides  $AB, BC, CD$  and  $DA$  of the square  $ABCD$ . If the resultant meets  $AD$  produced at the point  $E$ , then  $AD : DE$  is
- (a) 1 : 2 (b) 1 : 3 (c) 1 : 4 (d) 1 : 5
26. If  $R$  and  $R'$  are the resultants of two forces  $\frac{P}{Q}$  and  $\frac{Q}{P}$  ( $P > Q$ ) according as they are like or unlike such that  $R : R' = 25 : 7$ , then  $P : Q =$
- (a) 2 : 1 (b) 3 : 4 (c) 4 : 3 (d) 1 : 2
27. Two like parallel forces  $P$  and  $Q$  act on a rigid body at  $A$  and  $B$  respectively. If  $P$  and  $Q$  be interchanged in positions, show that the point of application of the resultant will be displaced through a distance along  $AB$ , where  $d =$
- (a)  $\frac{P+Q}{P-Q} AB$  (b)  $\frac{2P+Q}{2P-Q} AB$  (c)  $\frac{P-Q}{P+Q} AB$  (d)  $\frac{P-Q}{2P+Q} AB$
28. A rigid wire, without weight, in the form of the arc of a circle subtending an angle  $\alpha$  at its centre and having two weights  $P$  and  $Q$  at its extremities rests with its convexity downwards upon a horizontal plane. If  $\theta$  be the inclination to the vertical of the radius to the end at which  $P$  is suspended, then  $\tan \theta =$
- (a)  $\frac{Q \sin \alpha}{P + Q \cos \alpha}$  (b)  $\frac{P \sin \alpha}{Q + P \cos \alpha}$  (c)  $\frac{Q \cos \alpha}{P + Q \sin \alpha}$  (d)  $\frac{P \cos \alpha}{Q + P \sin \alpha}$
29.  $ABCD$  is a rectangle such that  $AB = CD = a$  and  $BC = DA = b$ . Forces  $P, P$  act along  $AD$  and  $CB$ , and forces  $Q, Q$  act along  $AB$  and  $CD$ . The perpendicular distance between the resultant of forces  $P, Q$  at  $A$  and the resultant of forces  $P, Q$  at  $C$  is
- (a)  $\frac{Pa + Qb}{\sqrt{P^2 + Q^2}}$  (b)  $\frac{Pa - Qb}{\sqrt{P^2 + Q^2}}$  (c)  $\frac{Pb + Qa}{\sqrt{P^2 + Q^2}}$  (d)  $\frac{Pb - Qa}{\sqrt{P^2 + Q^2}}$
30. A horizontal rod  $AB$  is suspended at its ends by two vertical strings. The rod is of length 0.6m and weighs 3 Newton. Its centre of gravity  $G$  is at a distance 0.4m from  $A$ . Then the tension of the string at  $A$  is
- (a) 0.2 N (b) 1.4 N (c) 0.8 N (d) 1 N
31. A horizontal rod of length 5m and weight 4 N is suspended at the ends by two strings. The weights of 8N, 12N, 16N and 20N are placed on the rod at distance 1 m, 2m, 3m and 4 m from one end of the rod. The tension in the strings are
- (a) 26 N, 34 N (b) 20 N, 30 N (c) 10 N, 40 N (d) None of these
32. Two unlike parallel forces  $P$  and  $Q$  act at points 5m apart. If the resultant force is 9N and acts at a distance of 10m from the greater force  $P$ , then

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- (a)  $P = 16N, Q = 7N$       (b)  $P = 15N, Q = 6N$       (c)  $P = 27N, Q = 18N$       (d)  $P = 18N, Q = 9N$
33. A force  $\sqrt{5}$  units act along the line  $(x - 3)/2 = (y - 4)/(-1)$ , the moment of the force about the point  $(4, 1)$  along z-axis is
- (a) 0      (b)  $5\sqrt{5}$       (c)  $-\sqrt{5}$       (d) 5
34. The height from the base of a pillar must be end  $B$  of a rope  $AB$  of given length be fixed so that a man standing on the ground and pulling at its other end with a given force may have the greatest tendency to make the pillar overturn is
- (a)  $AB$       (b)  $AB/2$       (c)  $AB/\sqrt{2}$       (d) None of these
35. In a triangle  $ABC$  right angled at  $C$ , the lengths of sides  $AC$  and  $BC$  are 3 cm and 4 cm respectively. Parallel forces each equal to  $P$  act at the vertices  $A, B, C$  and parallel forces each equal to  $2P$  act at the middle points of all the sides of the triangle. The distance of C.G. from the vertex  $C$  is
- (a)  $2/3$  cm      (b)  $4/3$  cm      (c)  $5/3$  cm      (d) None of these
36. A uniform rod  $BC$  of length 6 cm and weight 2 kg can turn freely about the fixed point  $B$ . The rod is attached to the point  $A$  by a string  $AC$  of length 8 cm. The points  $A$  and  $B$  are in a horizontal line at a distance 10 cm. The tension in the string is
- (a)  $3/5$  kg wt      (b)  $1/5$  kg wt      (c)  $2/5$  kg wt      (d) None of these
37. If each of the two unlike parallel forces  $P$  and  $Q$  ( $P > Q$ ) acting at a distance  $d$  apart be increased by  $S$ , then the point of application of the resultant is moved through a distance
- (a)  $\frac{d}{P - Q}$       (b)  $\frac{S}{P - Q}$       (c)  $\frac{Sd}{P - Q}$       (d)  $\frac{S}{d(P - Q)}$
38. Three forces  $P, Q$  and  $R$  act along the sides  $BC, AC$  and  $BA$  of an equilateral triangle  $ABC$ . If their resultant is a force parallel to  $BC$  through the centroid of the triangle  $ABC$ , then
- (a)  $P = Q = R$       (b)  $P = 2Q = 2R$       (c)  $2P = Q + 2R$       (d)  $2P = 2Q = R$
39. Two equal heavy rods, of weight  $W$  and length  $2a$  are freely hinged together and placed symmetrically over a smooth fixed sphere of radius  $r$ . The inclination  $\theta$  of each rod to the horizontal is given by
- (a)  $r \tan \theta \sec^2 \theta = a$       (b)  $r(\tan^3 \theta + \tan \theta) = a$       (c)  $r \sin \theta = a \cos^3 \theta$       (d) None of these
40. A couple is of moment  $\vec{G}$  and the force forming the couple is  $\vec{P}$ . If  $\vec{P}$  is turned through a right angle, the moment of the couple thus formed is  $\vec{H}$ . If instead, the force  $\vec{P}$  are turned an angle  $\alpha$ , then the moment of couple becomes
- (a)  $\vec{G} \sin \alpha - \vec{H} \cos \alpha$       (b)  $\vec{H} \cos \alpha + \vec{G} \sin \alpha$       (c)  $\vec{G} \cos \alpha + \vec{H} \sin \alpha$       (d)  $\vec{H} \sin \alpha - \vec{G} \cos \alpha$
41. A uniform rod  $AB$  movable about a hinge at  $A$  rests with one end in contact with a smooth wall. If  $\alpha$  be the inclination of the rod to the horizontal, then reaction at the hinge is
- (a)  $\frac{W}{2} \sqrt{3 + \cos^2 \alpha}$       (b)  $\frac{W}{2} \sqrt{3 + \sin^2 \alpha}$       (c)  $W \sqrt{3 + \cos^2 \alpha}$       (d) None of these
42. A uniform rod  $AB$ , 17m long whose mass is 120kg rests with one end against a smooth vertical wall and the other end on a smooth horizontal floor, this end being tied by a chord 8m long, to a peg at the bottom of the wall, then the tension of the chord is
- (a) 32 kg wt      (b) 16 kg wt      (c) 64 kg wt      (d) 8 kg wt
43. Forces of magnitudes 3,  $P$ , 5, 10 and  $Q$  Newton are respectively acting along the sides  $AB, BC, CD, AD$  and the diagonal  $CA$  of a rectangle  $ABCD$ , where  $AB = 4$  m and  $BC = 3$  m. If the resultant is a single force along the other diagonal  $BD$  then  $P, Q$  and the resultant are
- (a)  $4, 10 \frac{5}{12}, 12 \frac{11}{12}$       (b) 5, 6, 7      (c)  $3 \frac{1}{2}, 8, 9 \frac{1}{2}$       (d) None of these
44. A uniform rod  $AB$  of length  $a$  hangs with one end against a smooth vertical wall, being supported by a string of length  $l$ , attached to the other end of the rod and to a point of the rod vertically above  $B$ . If the rod rests inclined to the wall at an angle  $\theta$ , then  $\cos^2 \theta =$
- (a)  $(l^2 - a^2)/a^2$       (b)  $(l^2 - a^2)/2a^2$       (c)  $(l^2 - a^2)/3a^2$       (d) None of these
45. The resultant of two forces  $\sec B$  and  $\sec C$  along sides  $AB, AC$  of a triangle  $ABC$  is a force acting along  $AD$ , where  $D$  is
- (a) Middle point of  $BC$       (b) Foot of perpendicular from  $A$  on  $BC$   
 (c)  $D$  divides  $BC$  in the ratio  $\cos B : \cos C$       (d)  $D$  divides  $BC$  in the ratio  $\cos C : \cos B$
46. Three coplanar forces each of weight 10 kilogram are acting at a particle. If their line of actions make same angle, then their resultant force will be
- (a) Zero      (b)  $5\sqrt{2}$       (c)  $10\sqrt{2}$       (d) 20
47. The end of a heavy uniform rod  $AB$  can slide along a rough horizontal rod  $AC$  to which it is attached by a ring.  $B$  and  $C$  are joined by a string. If  $\angle ABC$  be a right angle, when the rod is on the point of sliding,  $\mu$  the coefficient of friction and  $\alpha$  the angle between  $AB$  and the vertical, then
- (a)  $\mu = 2 \tan \alpha / (2 + \tan^2 \alpha)$       (b)  $\mu = \tan \alpha / (2 + \tan^2 \alpha)$       (c)  $\mu = 2 \cot \alpha / (1 + \cot^2 \alpha)$       (d)  $\mu = \cot \alpha / (2 + \cot^2 \alpha)$
48. A solid cone of semi-vertical angle  $\theta$  is placed on a rough inclined plane. If the inclination of the plane is increased slowly and  $\mu < 4 \tan \theta$ , then

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- (a) Cone will slide down before toppling (b) Cone will topple before sliding down  
(c) Cone will slide and topple simultaneously (d) Cone will rest in limiting equilibrium
49. A circular cylinder of radius  $r$  and height  $h$  rests on a rough horizontal plane with one of its flat ends on the plane. A gradually increasing horizontal force is applied through the centre of the upper end. If the coefficient of friction is  $\mu$ , the cylinder will topple before sliding, if  
(a)  $r < \mu h$  (b)  $r \geq \mu h$  (c)  $r \geq 2\mu h$  (d)  $r = 2\mu h$
50. A uniform beam  $AB$  of weight  $W$  is standing with the end  $B$  on a horizontal floor and end  $A$  leaning against a vertical wall. The beam stands in a vertical plane perpendicular to the wall inclined at  $45^\circ$  to the vertical, and is in the position of limiting equilibrium. If the two points of contact are equally rough, then the coefficient of friction at each of them is  
(a)  $\sqrt{2} - 1$  (b)  $1/\sqrt{2}$  (c)  $1/\sqrt{3}$  (d) None of these

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