Engineering Daily 27 [Home Practice] EV

Statics + Motion of a Particle in a Plane

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks

1. The resultant of two equal forces acting at the same point is $\sqrt{3}$ times each force. What is the angle between the forces?

Ⓐ 60° Ⓑ 30° Ⓒ 90° Ⓓ 120°

2. The resultant of two like parallel forces acting at A and B is 24 N, and its line of action divides AB internally at C in the ratio AC : CB = 3 : 5. What are the forces at A and B respectively?

Ⓐ 16 N and 8 N Ⓑ 9 N and 15 N

Ⓒ 15 N and 9 N Ⓓ 12 N and 12 N

3. Two forces P and Q act at a point at an angle α. If the direction of Q is reversed, the magnitude of the resultant remains unchanged. What is α?

Ⓐ 60° Ⓑ 45° Ⓒ 120° Ⓓ 90°

4. Three forces of 6 N, 10 N and 14 N act on a body and keep it in equilibrium. What is the angle between the 6 N and 10 N forces?

Ⓐ 45° Ⓑ 90° Ⓒ 120° Ⓓ 60°

5. One force is twice the other. The square of the magnitude of their resultant is found to be exactly three times the product of the two forces. Find the angle between their lines of action.

Ⓐ $\cos^{-1}\left(\frac{1}{4}\right)$ Ⓑ $\cos^{-1}\left(-\frac{1}{4}\right)$

Ⓒ $\cos^{-1}\left(\frac{1}{2}\right)$ Ⓓ $\cos^{-1}\left(\frac{3}{4}\right)$

6. Three forces of 2, 4 and 6 N act at a point in the same order, each at 60° to the next. What is the magnitude of their resultant?

Ⓐ $\sqrt{57}$ N Ⓑ $2\sqrt{13}$ N

Ⓒ $2\sqrt{19}$ N Ⓓ $4\sqrt{3}$ N

7. The resultant of two forces acting at a point is $\sqrt{37}$ N and the angle between them is 60°. If one force is 3 N, what is the other?

Ⓐ 4 N Ⓑ $\sqrt{28}$ N Ⓒ 5 N Ⓓ 7 N

8. A body of mass 10 kg on a smooth plane inclined at 30° to the horizontal is held at rest by a horizontal force. What is the reaction of the plane?

Ⓐ 113.16 N Ⓑ 98.0 N

Ⓒ 84.87 N Ⓓ 56.58 N

9. The fulcrum of a seesaw divides the plank in the ratio 2 : 5. The father sits on the shorter arm and the son on the longer arm, keeping the seesaw horizontal and balanced. If the father's mass is 45 kg more than the son's, what is the son's mass? (Neglect the mass of the plank.)

Ⓐ 75 kg Ⓑ 30 kg Ⓒ 18 kg Ⓓ 45 kg

10. The resultant of two forces P and Q acting at a point is 2Q and it makes an angle of 30° with the direction of P. What is P?

Ⓐ 2Q Ⓑ $\frac{Q}{\sqrt{3}}$ Ⓒ $\sqrt{3}Q$ Ⓓ Q

11. Forces of 5, 3 and 2 N act at a point along the sides AB, AC and BC (in the directions shown in the figure) of an equilateral triangle ABC. What is the magnitude of the resultant?

Ⓐ 7 N Ⓑ $\sqrt{19}$ N Ⓒ $\sqrt{43}$ N Ⓓ $5\sqrt{3}$ N

12. A uniform plank AB of length 8 m and mass 120 kg rests on two supports A and C, where CB = 3 m. If a boy can walk to the end B without tipping the plank, what is the maximum mass of the boy?

Ⓐ 24 kg Ⓑ 60 kg Ⓒ 40 kg Ⓓ 30 kg

13. Two forces of equal magnitude (P) act on a particle in such a way that their combined effect is equivalent to a single force of magnitude $P\sqrt{2-\sqrt{2}}$. At what angle are the lines of action of the forces inclined to each other?

Ⓐ 150° Ⓑ 45° Ⓒ 112.5° Ⓓ 135°

14. A light rod rests on two smooth pegs P and Q at the same horizontal level. A heavy load is hung from the point R of the rod, where PR = 2RQ. If the pressure at Q is 240 N greater than that at P, what is the weight of the load?

Ⓐ 480 N Ⓑ 960 N Ⓒ 720 N Ⓓ 360 N

15. Two parallel forces of 10 N and 4 N act 42 cm apart. If they act first as like forces and then as unlike forces, what is the distance between the lines of action of the resultants in the two cases?

Ⓐ 54 cm Ⓑ 28 cm Ⓒ 40 cm Ⓓ 16 cm

16. The resultant of two unlike parallel forces is 10 N, and its line of action is 5 cm and 7 cm from the two forces respectively. What are the magnitudes of the forces?

Ⓐ 35 N and 25 N Ⓑ 70 N and 60 N

Ⓒ 25 N and 15 N Ⓓ 14 N and 4 N

17. $\vec{A}, \vec{B}, \vec{C}$ are three forces with $|\vec{A}| = |\vec{B}|$, $|\vec{C}| = \sqrt{3}|\vec{A}|$ and $\vec{A}+\vec{B}+\vec{C}=\vec{0}$. What is the angle between $\vec{A}$ and $\vec{C}$?

Ⓐ 60° Ⓑ 150° Ⓒ 120° Ⓓ 135°

18. Two forces acting at 100° to each other have a resultant of 50 N, which makes an angle of 60° with the smaller force. What are the magnitudes of the forces?

Ⓐ 25.0 N and 43.3 N Ⓑ 32.64 N and 43.97 N

Ⓒ 43.97 N and 50.77 N Ⓓ 28.87 N and 38.89 N

19. The resultant of two forces P and Q is R. If Q is doubled, R is doubled; and if the direction of Q is reversed, R becomes three times as large. What is P : Q : R?

Ⓐ $2 : \sqrt{7} : \sqrt{3}$ Ⓑ $\sqrt{2} : \sqrt{3} : \sqrt{2}$

Ⓒ $2\sqrt{2} : \sqrt{7} : \sqrt{3}$ Ⓓ $\sqrt{7} : 2\sqrt{2} : \sqrt{3}$

20. Forces of 6 N and 8 N act at O along OA and OB, inclined at 60°. A straight line meets OA, OB and the line of action of the resultant at L, M, N respectively, where OL = 3 m and OM = 4 m. What is ON?

Ⓐ 12.17 m Ⓑ 3.5 m Ⓒ 3.04 m Ⓓ 2.5 m

21. Three concurrent forces of $2\sqrt{2}$ N, 4 N and 4 N act at angles 45°, 180° and −60° respectively to the positive x-axis. What are the magnitude and direction of the resultant?

Ⓐ zero (equilibrium)

Ⓑ $\left(2\sqrt{3} - 2\right)$ N, along the positive y-axis

Ⓒ 2 N, along the negative x-axis

Ⓓ $\left(2\sqrt{3} - 2\right)$ N, along the negative y-axis

22. A light tabletop 12 m long rests on two legs at its ends. A mass of 150 kg is placed at the midpoint of the top and a mass of 30 kg at 9 m from the left end. What are the reactions of the left and right legs respectively?

Ⓐ 882 N and 882 N Ⓑ 808.5 N and 955.5 N

Ⓒ 735 N and 1029 N Ⓓ 955.5 N and 808.5 N

23. Two unlike parallel forces of 20 N and 12 N act at the ends of a rod 30 cm long. When an equal force is added to each (in its own direction), the resultant shifts 10 cm from its former position. What is the added force?

Ⓐ $\frac{10}{3}$ N Ⓑ 4 N Ⓒ 2 N Ⓓ $\frac{8}{3}$ N

24. A heavy uniform rod stays horizontal on a support 0.5 m from one end when a mass of 10 kg is hung at that end. When a mass of 4 kg is hung at the same end, the support must be placed 0.8 m from that end. What is the mass of the rod?

Ⓐ 8 kg Ⓑ 6 kg Ⓒ 5.4 kg Ⓓ 4 kg

25. A body of mass 12 kg is suspended from a fixed point by a light string 13 m long. A horizontal force holds the body at rest 5 m away from the vertical line through the fixed point. What is the horizontal force?

Ⓐ 13 kg-wt Ⓑ 12 kg-wt

Ⓒ $\frac{60}{13}$ kg-wt Ⓓ 5 kg-wt

26. A particle projected vertically upward from the top of a tower at 14.7 ms^{-1} falls to the foot of the tower after 4 s. What is the height of the tower?

Ⓐ 39.2 m Ⓑ 19.6 m Ⓒ 58.8 m Ⓓ 78.4 m

27. A bomb explodes on the ground and its fragments fly off in all directions at 14 ms^{-1}. Over what maximum area of the ground will the fragments be scattered?

Ⓐ 20π m^2 Ⓑ 200π m^2

Ⓒ 400π m^2 Ⓓ 100π m^2

28. Three particles A, B, C were initially at the same point. B moved 6 units east, 8 units north and 4 units upward from there. C moved 4 units east, 2 units south and 5 units upward. If the final positions of B and C are joined to A, what is the angle between AB and AC?

Ⓐ $\cos^{-1}\left(\frac{14}{3\sqrt{145}}\right)$ Ⓑ $\cos^{-1}\left(-\frac{14}{3\sqrt{145}}\right)$

Ⓒ $\cos^{-1}\left(\frac{28}{3\sqrt{145}}\right)$ Ⓓ $\cos^{-1}\left(\frac{7}{3\sqrt{145}}\right)$

29. A swimmer swims at 13 kmh^{-1} in still water and the current in the river is 5 kmh^{-1}. He takes time t_1 to cross the river straight across and time t_2 to go a distance equal to the river's width along the bank with the current. What is $t_1 : t_2$?

Ⓐ 13 : 12 Ⓑ 9 : 4 Ⓒ 3 : 2 Ⓓ 2 : 3

30. A car covers the first half of a route at 30 kmh^{-1} and the second half at 70 kmh^{-1}. What is the average speed of the car over the whole route?

Ⓐ 40 kmh^{-1} Ⓑ 45 kmh^{-1}

Ⓒ 50 kmh^{-1} Ⓓ 42 kmh^{-1}

31. Three velocities act simultaneously on a particle: 6 ms^{-1} towards the east, 8 ms^{-1} towards the north and 5 ms^{-1} towards the south-west. What is the magnitude of the resultant velocity of the particle?

Ⓐ 10.00 ms^{-1} Ⓑ 5.10 ms^{-1}

Ⓒ 6.40 ms^{-1} Ⓓ 5.00 ms^{-1}

32. A, B, C, D are four equally spaced points on a vertical line. A body falling from rest at A covers the part AB in 2 s. How long will it take to cover the part CD?

Ⓐ $2\left(\sqrt{3} - \sqrt{2}\right)$ s Ⓑ $2\left(\sqrt{2} - 1\right)$ s

Ⓒ $2\sqrt{3}$ s Ⓓ $2\left(2 - \sqrt{3}\right)$ s

33. The resultant of two velocities u and v is 20 ms^{-1}, making angles of 30° with u and 45° with v. What is u?

Ⓐ 14.64 ms^{-1} Ⓑ 17.32 ms^{-1}

Ⓒ 12.25 ms^{-1} Ⓓ 10.35 ms^{-1}

34. A bomb is released from an aeroplane rising vertically at constant speed and hits the ground 6 s later. Even without knowing the aeroplane's speed, the height of the aeroplane at the instant the bomb touches the ground can be found. What is that height?

Ⓐ 176.4 m Ⓑ 58.8 m

Ⓒ cannot be determined Ⓓ 88.2 m

35. A stone falling freely from the top of a tower has fallen 2 m when another stone is released from rest from a point 14 m below the top. Both stones reach the ground together. What is the height of the tower?

Ⓐ 28 m Ⓑ 36 m Ⓒ 16 m Ⓓ 32 m

36. A parachutist falls freely for 40 m and then opens the parachute. His speed then decreases at 2.5 ms^{-2} and he reaches the ground at 4 ms^{-1}. From what height did he jump?

Ⓐ 153.6 m Ⓑ 193.6 m

Ⓒ 156.8 m Ⓓ 196.8 m

37. From a point at a certain height, one body is projected vertically upward and another vertically downward with the same initial speed. The first reaches the ground after 6 s and the second after 1.5 s. If a body is allowed to fall freely from that point, in what time will it reach the ground?

Ⓐ 4.5 s Ⓑ 3 s Ⓒ 3.75 s Ⓓ 2.25 s

38. A body is projected at 45° from a point on the ground 12 m from the foot of a vertical wall. It just passes over the wall and lands on the ground 6 m beyond the wall on the other side. What is the height of the wall?

Ⓐ 8 m Ⓑ 4 m Ⓒ 6 m Ⓓ 3 m

39. A stone is to be thrown at 45° to the horizontal from a point on the ground 45 m from the foot of a vertical wall. If the wall is 20 m high, what minimum initial speed is needed for the stone to clear the wall?

Ⓐ 21.0 ms^{-1} Ⓑ 28.17 ms^{-1}

Ⓒ 31.5 ms^{-1} Ⓓ 22.0 ms^{-1}

40. A rifle has a maximum horizontal range of 640 m on the ground. If the same rifle is fired forward at 45° with the same speed relative to the rifle from a car moving forward at 15 ms^{-1}, what is the range relative to the ground?

Ⓐ 640.0 m Ⓑ 725.7 m

Ⓒ 982.9 m Ⓓ 811.4 m

41. A stuntman runs horizontally across the roof of a building and jumps horizontally from its edge to land on a roof 3.6 m lower across a gap of 4 m. What is the minimum speed of his run?

Ⓐ 4.67 ms^{-1} Ⓑ 4.0 ms^{-1}

Ⓒ 3.43 ms^{-1} Ⓓ 5.42 ms^{-1}

42. A particle moves along a straight line at 5 ms^{-1}. After 4 s a velocity of 12 ms^{-1} perpendicular to its motion is added. How far from the starting point will the particle be 3 s later?

Ⓐ 50.21 m Ⓑ 39.0 m

Ⓒ 56.0 m Ⓓ 47.42 m

43. A ship is sailing east at 12 kmh^{-1}. To a passenger on the ship the wind appears to blow exactly from the north at 16 kmh^{-1}. What is the actual velocity of the wind?

Ⓐ 4 kmh^{-1}, from the north

Ⓑ 20 kmh^{-1}, from $\tan^{-1}\left(\frac{3}{4}\right)$ east of north

Ⓒ 20 kmh^{-1}, from $\tan^{-1}\left(\frac{3}{4}\right)$ west of north

Ⓓ 28 kmh^{-1}, from the north-west

44. A body projected from the ground passes through a point at a horizontal distance of 10 m from the point of projection and a height of 5 m, and lands 30 m away. What is the angle of projection?

Ⓐ $\tan^{-1}\left(\frac{3}{4}\right)$ Ⓑ $\tan^{-1}\left(\frac{1}{2}\right)$

Ⓒ $\tan^{-1}\left(\frac{4}{3}\right)$ Ⓓ $\tan^{-1}\left(\frac{2}{3}\right)$

45. An object is released from an aeroplane flying horizontally at 288 kmh^{-1} at a height of 4.9 km above the ground. What is the straight-line distance from the release point to the place where the object lands?

Ⓐ 7429.8 m Ⓑ 4900.0 m

Ⓒ 2529.8 m Ⓓ 5514.5 m

46. A stone is thrown horizontally at 20 ms^{-1} from the top of a tower 44.1 m high. What angle does the stone's velocity make with the horizontal at the instant it hits the ground?

Ⓐ $\tan^{-1}$ (2.205) Ⓑ 45°

Ⓒ $\tan^{-1}$ (0.68) Ⓓ $\tan^{-1}$ (1.47)

47. A body is projected at 30 ms^{-1} at 60° to the horizontal. When will its velocity first make an angle of 30° with the horizontal?

Ⓐ 0.88 s Ⓑ 1.77 s Ⓒ 3.53 s Ⓓ 2.65 s

48. A car A moves north at 30 kmh^{-1} and another car B moves along a path inclined at 60° east of north at 40 kmh^{-1}. What is the magnitude of the velocity of B relative to A?

Ⓐ 50 kmh^{-1} Ⓑ $10\sqrt{13}$ kmh^{-1}

Ⓒ $10\sqrt{37}$ kmh^{-1} Ⓓ 10 kmh^{-1}

49. A player can throw a ball a maximum horizontal distance of 160 m. If he throws it vertically upward with the same speed, to what maximum height will the ball rise?

Ⓐ 113 m Ⓑ 160 m Ⓒ 40 m Ⓓ 80 m

50. A body falling freely from rest covers a certain distance in the 3rd second. What fraction of the total distance covered in the first 3 seconds is this?

Ⓐ $\frac{5}{14}$ Ⓑ $\frac{1}{3}$ Ⓒ $\frac{5}{9}$ Ⓓ $\frac{4}{9}$