Engineering Daily 27 [Set 04] EV

Statics + Motion of a Particle in a Plane

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

MCQ 50 marks

1. If the resultant of two forces of 6 N and 8 N is 10 N, what is the angle between the forces?

Ⓐ 60° Ⓑ 120° Ⓒ 0° Ⓓ 90°

2. A body of weight 8 N is held at rest by a horizontal force and another force acting upward at 45° to the horizontal. What is the magnitude of the oblique force?

Ⓐ 16 N Ⓑ $8\sqrt{2}$ N Ⓒ 8 N Ⓓ $4\sqrt{2}$ N

3. Two forces act at a point at an angle of 135°. The greater force is 12 N and their resultant is at right angles to the smaller force. What is the smaller force?

Ⓐ $6\sqrt{2}$ N Ⓑ $4\sqrt{3}$ N Ⓒ $12\sqrt{2}$ N Ⓓ 6 N

4. The resultant of two forces acting on a particle is perpendicular to one force and its magnitude is $\frac{3}{5}$ of the other force. What is the ratio of the magnitudes of the forces (smaller : greater)?

Ⓐ 4 : 5 Ⓑ 3 : 4 Ⓒ 3 : 5 Ⓓ $2\sqrt{2} : 3$

5. Two forces of 15 N and 5 N act at a point at such an angle that their resultant makes an angle of 30° with the bisector of the angle between them. What is the angle between the forces?

Ⓐ $2\tan^{-1} 2$ Ⓑ 60°

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

6. Three forces P, Q and R acting at a point are in equilibrium. The angle between P and Q is 120° and the angle between Q and R is 150°. What is the ratio Q : R?

Ⓐ 2 : 1 Ⓑ 1 : 2 Ⓒ $2 : \sqrt{3}$ Ⓓ $\sqrt{3} : 2$

7. Three forces of magnitudes P, $\sqrt{2}$P and P act at a point and are in equilibrium. What is the angle between the first two forces?

Ⓐ 150° Ⓑ 135° Ⓒ 90° Ⓓ 120°

8. In a rectangle ABCD, AB = 8 m and BC = 6 m. Forces of 8, 6, 8, 6 N act along AB, BC, CD, DA respectively (in the same sense of rotation). What are the forces equivalent to?

Ⓐ zero (equilibrium)

Ⓑ a couple of moment 192 N m

Ⓒ a couple of moment 48 N m

Ⓓ a couple of moment 96 N m

9. The diagonals of a rhombus ABCD meet at O. Forces of 3, 5, 7 and 4 N act along OA, OB, OC, OD respectively. What is the magnitude of the resultant?

Ⓐ $\sqrt{41}$ N Ⓑ $\sqrt{17}$ N Ⓒ $\sqrt{13}$ N Ⓓ 5 N

10. A uniform horizontal board of length 3 m and mass 50 kg is supported by a pivot 1 m from its left end and by a weighing scale at its right end. A child of mass 30 kg sits at what distance from the left end so that the scale reads zero?

Ⓐ $\frac{1}{2}$ m Ⓑ $\frac{1}{6}$ m Ⓒ $\frac{5}{6}$ m Ⓓ $\frac{1}{3}$ m

11. A boat is to be pulled ashore by two ropes so that the resultant force of 120 N lies along a fixed line aa. The tension T in one rope is inclined at 40° to the line aa. What is the minimum value of the tension P in the other rope?

Ⓐ 60.0 N Ⓑ 91.93 N Ⓒ 100.7 N Ⓓ 77.13 N

12. A uniform horizontal bar of length 10 ft and weight 40 lb rests on supports at its ends A and B. Two children weighing 60 lb and 80 lb hang at 3 ft and 7 ft from A. What are the reactions at A and B respectively?

Ⓐ 90 lb and 90 lb Ⓑ 94 lb and 86 lb

Ⓒ 80 lb and 100 lb Ⓓ 86 lb and 94 lb

13. A body of weight 25 N on a smooth plane inclined at $\alpha = \sin^{-1}\left(\frac{5}{13}\right)$ to the horizontal is held at rest by a force of 3 N up the plane together with a horizontal force F. What is the horizontal force?

Ⓐ 7.17 N Ⓑ 9.62 N Ⓒ 5.42 N Ⓓ 6.62 N

14. A bob of weight 50 N hangs from a fixed point by a light string. A horizontal force applied to the bob pulls the string away from the vertical. If the string can bear a maximum tension of 80 N, what is the maximum value of the horizontal force?

Ⓐ 62.45 N Ⓑ 80.0 N Ⓒ 94.34 N Ⓓ 30.0 N

15. A uniform beam AB of length 8 m and weight 120 N carries loads of 50 N and 90 N hanging from ends A and B respectively. At what distance from A should a single support be placed so that the beam stays horizontal?

Ⓐ 5.14 m Ⓑ 4.0 m Ⓒ 4.62 m Ⓓ 3.38 m

16. Two strings tied to points A and B (AB = 25 cm) of a horizontal ceiling meet at point C, where AC = 7 cm and BC = 24 cm. When a mass of 50 kg is hung at C, what is the tension in the string CA?

Ⓐ 14 kg-wt Ⓑ 25 kg-wt

Ⓒ 48 kg-wt Ⓓ 35.4 kg-wt

17. A downward resultant force of 500 N is needed to hold a balloon at rest. The force is applied through two ropes AB and AC inclined at 50° and 35° to the vertical on either side. What is the force in the rope AB?

Ⓐ 384.49 N Ⓑ 331.4 N Ⓒ 250.0 N Ⓓ 287.88 N

18. A body of mass 25 kg hangs from a ceiling by two strings making angles of 40° and 60° with the vertical on either side of it. Neither string can bear more than 300 N. What is the maximum number of discs of mass 2 kg that can be attached to the body? ($g = 9.8\ ms^{-2}$)

Ⓐ 5 Ⓑ 3 Ⓒ 6 Ⓓ 4

19. Two equal forces acting at an angle 2α give a certain resultant; when they act at an angle 2β the resultant is $\sqrt{3}$ times as large. If $\alpha - \beta = 30°$, what is the angle between the forces in the first case?

Ⓐ 60° Ⓑ 90° Ⓒ 120° Ⓓ 150°

20. In $\triangle ABC$, $A = 50°$, $B = 60°$, $C = 70°$. Forces of $10\cos A$, $10\cos B$, $10\cos C$ N act along BC, CA, AB respectively (in the same order). What is the magnitude of the resultant?

Ⓐ 3.47 N Ⓑ 5.18 N Ⓒ 1.21 N Ⓓ 14.85 N

21. A uniform bridge of length 30 m and weight 8 ton rests on pillars A and B at its ends. A truck weighing 4 ton stands at $\frac{1}{3}$ of the bridge's length from A. What are the pressures on pillars A and B respectively?

Ⓐ 7.2 ton-wt and 4.8 ton-wt

Ⓑ 6.67 ton-wt and 5.33 ton-wt

Ⓒ 6 ton-wt and 6 ton-wt

Ⓓ 5.33 ton-wt and 6.67 ton-wt

22. Two bodies of mass 18 kg and 30 kg hang from the ends of a light rod 6 m long. A man wants to carry the rod on his shoulder in a horizontal position. At what distance from the lighter mass must he place his shoulder?

Ⓐ 3.6 m Ⓑ 2.25 m Ⓒ 3.75 m Ⓓ 3.0 m

23. A uniform rod 10 m long has a body of mass 12 kg hung from one end. The rod balances horizontally on a peg 2 m from that end. What is the mass of the rod?

Ⓐ 12 kg Ⓑ 6 kg Ⓒ 4.8 kg Ⓓ 8 kg

24. The ends of a string are tied to points A and B on a horizontal line. A smooth ring of weight 30 N can slide freely along the string. A horizontal force P is applied to the ring so that it stays vertically below B, with the other part of the string making an angle of 60° with the vertical. What is the tension in the string?

Ⓐ 17.32 N Ⓑ 30 N Ⓒ 15 N Ⓓ 20 N

25. Two ships leave a port at the same time, one sailing east at $20\ kmh^{-1}$ and the other sailing north-east at $25\ kmh^{-1}$, at 60° to the east. If the maximum range of their wireless sets is 300 km, for how long can they stay in contact?

Ⓐ 13.09 h Ⓑ 15.0 h

Ⓒ 9.37 h Ⓓ 6.67 h

26. The speed of the current in a river is $3\ kmh^{-1}$. A boat's speed relative to the water is $8\ kmh^{-1}$. What is its speed relative to the bank when it moves against the current?

Ⓐ $8\ kmh^{-1}$ Ⓑ $5\ kmh^{-1}$

Ⓒ $11\ kmh^{-1}$ Ⓓ $\sqrt{73}\ kmh^{-1}$

27. In an isosceles right-angled triangle ABC, $\angle A = 90°$ and $AB = AC = 5$ m. The moments (in the same sense) of a force acting in the plane of the triangle about A, B, C are 15, 15 and 35 N m respectively. What are the magnitude and position of the force?

Ⓐ 4 N; parallel to AB, 3.75 m from AB (on the side opposite C)

Ⓑ 4 N; parallel to AC, 3.75 m from AC

Ⓒ $4\sqrt{2}$ N; parallel to BC, 3.75 m from A

Ⓓ 2 N; parallel to AB, 7.5 m from AB

28. A man walks 8 km east at $4\ kmh^{-1}$ and then walks 6 km north in 1 hour 30 minutes. What is the magnitude of his average velocity for the whole journey?

Ⓐ $\frac{10}{3}\ kmh^{-1}$ Ⓑ $2\ kmh^{-1}$

Ⓒ $\frac{20}{7}\ kmh^{-1}$ Ⓓ $4\ kmh^{-1}$

29. The horizontal range of a projectile is 3 times its maximum height. What is the angle of projection?

Ⓐ $\tan^{-1}\left(\frac{4}{3}\right)$ Ⓑ $\tan^{-1} 3$ Ⓒ $\tan^{-1}\left(\frac{3}{4}\right)$ Ⓓ 45°

30. A projectile has a time of flight of 6 s for a horizontal range of 120 m. What is the angle of projection?

Ⓐ $\tan^{-1}(2.94)$ Ⓑ $\tan^{-1}(0.735)$

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

31. A boat is steered perpendicular to the current at three times the speed of the current. It reaches the opposite bank 1.2 km downstream of the point directly opposite the starting point. What is the width of the river?

Ⓐ 3.6 km Ⓑ 1.2 km Ⓒ 0.4 km Ⓓ 2.4 km

32. In still water a swimmer can cross a river 120 m wide straight across in 2 minutes. With a current, it takes 2.5 minutes to cross straight across. What is the speed of the current?

Ⓐ $0.2\ ms^{-1}$ Ⓑ $0.8\ ms^{-1}$ Ⓒ $0.6\ ms^{-1}$ Ⓓ $1.0\ ms^{-1}$

33. A swimmer swims perpendicular to the current at $4\ kmh^{-1}$ across a river 200 m wide. If the current is $2.5\ kmh^{-1}$, how far from the point directly opposite the starting point will he land?

Ⓐ 100 m Ⓑ 320 m Ⓒ 200 m Ⓓ 125 m

34. A body moving with uniform acceleration covers 60 m in the first 4 s. The acceleration then ceases and the body covers 64 m in the next 4 s. What is the initial velocity of the body?

Ⓐ $15\ ms^{-1}$ Ⓑ $14\ ms^{-1}$ Ⓒ $16\ ms^{-1}$ Ⓓ $12\ ms^{-1}$

35. An aeroplane flying horizontally at 180 kmh^{-1} at a height of 2450 m above the ground releases an object. At what horizontal distance from the point vertically below the release point will the object land?

Ⓐ 1225 m Ⓑ 1118 m Ⓒ 4025 m Ⓓ 790.6 m

36. A ship A sails east with speed u. Another ship B sails with speed 3u along a line inclined at an angle θ north of east. To the passengers on A, B appears to be moving exactly north-east. What is θ (θ < 45°)?

Ⓐ $\frac{1}{2}\sin^{-1}\left(\frac{8}{9}\right)$ Ⓑ $\frac{1}{2}\sin^{-1}\left(\frac{3}{4}\right)$

Ⓒ $\frac{1}{2}\cos^{-1}\left(\frac{8}{9}\right)$ Ⓓ $\frac{1}{2}\sin^{-1}\left(\frac{1}{9}\right)$

37. Rain falls vertically at 8 kmh^{-1} and a wind blows from west to east at 30 kmh^{-1} (the raindrops acquire the wind's velocity). To the driver of an east-bound car the rain appears to fall from the front at 45° to the vertical. What is the speed of the car?

Ⓐ 46 kmh^{-1} Ⓑ 30 kmh^{-1}

Ⓒ 38 kmh^{-1} Ⓓ 22 kmh^{-1}

38. A bullet loses $\frac{1}{5}$ of its velocity in passing through a plank. If the retardation is uniform, how many identical planks placed one after another will it pierce completely before stopping?

Ⓐ 4 Ⓑ 3 Ⓒ 5 Ⓓ 2

39. Seeing a bus start from rest with a uniform acceleration of 2 ms^{-2}, a man starts running after it from behind at a uniform speed of 10 ms^{-1}. What is the maximum distance from the bus at which the man can still catch it?

Ⓐ 12.5 m Ⓑ 50 m Ⓒ 25 m Ⓓ 20 m

40. A man sees a bus 72 m ahead start from rest with a uniform acceleration. At that moment he starts running towards it at a uniform speed and, running at the minimum speed required, catches the bus exactly 24 s later. What is the man's speed?

Ⓐ 3 ms^{-1} Ⓑ 6 ms^{-1}

Ⓒ 4.5 ms^{-1} Ⓓ 9 ms^{-1}

41. A body moving with uniform retardation covers 120 m in the first 4 s and 72 m in the next 4 s. What distance will it cover in the following 2 s?

Ⓐ 12 m Ⓑ 36 m Ⓒ 24 m Ⓓ 18 m

42. A particle moving with uniform retardation covers 18 m in the 3rd second and comes to rest after going some more distance. If in the last second it covers $\frac{1}{49}$ of the total distance, what is the total time of motion?

Ⓐ 8 s Ⓑ 9 s Ⓒ 6 s Ⓓ 7 s

43. A particle moving in a straight line with uniform acceleration covers 6.25 m in the half-second after 4 s and 19 m in the 8th second. What is its acceleration?

Ⓐ 2 ms^{-2} Ⓑ 4 ms^{-2}

Ⓒ 2.5 ms^{-2} Ⓓ 1.5 ms^{-2}

44. A train stops at two stations 1.5 km apart on a straight track and takes 3 minutes to go from one to the other. If it moves with uniform acceleration x km min^{-2} for the first part and uniform retardation y km min^{-2} for the rest, what is the value of $\frac{1}{x}+\frac{1}{y}$?

Ⓐ 6 Ⓑ 3 Ⓒ 2 Ⓓ 4

45. A body falling freely from rest passes two points 44.1 m apart in 1.5 s. From what height above the upper point did it start to fall?

Ⓐ 24.81 m Ⓑ 22.05 m

Ⓒ 19.6 m Ⓓ 29.4 m

46. A particle is projected vertically upward at 49 ms^{-1} and 2 s later another particle is projected vertically upward from the same place. They meet at the greatest height of the first particle. What is the initial velocity of the second particle?

Ⓐ 49.0 ms^{-1} Ⓑ 55.53 ms^{-1}

Ⓒ 61.25 ms^{-1} Ⓓ 40.83 ms^{-1}

47. A lift is rising with a uniform acceleration of 1.2 ms^{-2}. A ball is thrown vertically upward from the floor of the lift with a velocity of 5.5 ms^{-1} relative to the lift. After how long will the ball return to the floor?

Ⓐ 1.0 s Ⓑ 0.5 s Ⓒ 1.12 s Ⓓ 1.28 s

48. A ball of mass 50 g falls from a height of 4.9 m, penetrates 7 cm into sand and stops. What is the average resisting force of the sand on the ball?

Ⓐ 35.28 N Ⓑ 34.79 N

Ⓒ 0.49 N Ⓓ 34.3 N

49. A body is projected from the ground at 45° to the horizontal. It just touches the tops of two posts, 4.8 m high and 6 m apart, as it passes them. What is the horizontal range?

Ⓐ 24.6 m Ⓑ 20.92 m

Ⓒ 19.2 m Ⓓ 18.0 m

50. The horizontal range of a projectile projected with a given initial speed is $\frac{4}{5}$ of its maximum range. What is the smaller value of the angle of projection?

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

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