Batch – S3
M.M. – 120

IIT PHYSICS CENTRE

Date – 17/09/23
Time – 1.00 Hr.

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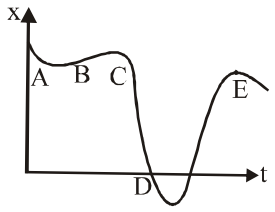
JEE MAIN

(FOUNDATION)

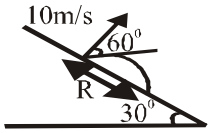
(Single Correct Choice Type)

This section contains 30 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.(4, -1)

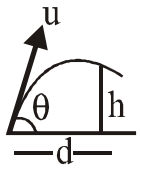
1. **In a race for 100 m dash, the first and the second runners have a gap of one meter at the mid way stage. Assuming the first runner goes steady, by what percentage should the second runner increases his speed just to win the race.**
   (A) 2% **(B) 4%**
   (C) more then 4% **(D) less than 4%**
2. **A point initially at rest moves along x-axis. Its acceleration varies with time** $\sim = (6t+5) m/s^2$ **as . If it starts from origin, the distance covered in 2 s is**
   (A) 20 m **(B) 18 m** **(C) 16 m** **(D) 25 m**
3. **A graph of x versus t is shown in figure. Choose correct alternatives from below.**



   (A) The particle was relateased from rest at t = 0
   (B) At B, the acceleration a > 0
   (C) At C, the velocity and the acceleration vanish
   (D) The speed at D exceeds that at E
4. **A projectile is launched with a speed of 10 m/s at an angle** $60°$ **with the horizontal from a sloping surface of inclination** $30°$**. The range R is (Take, g =** $10 m/s^2$**)**

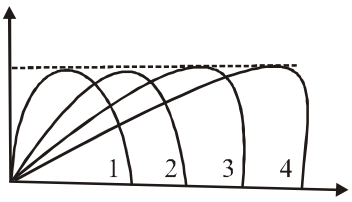


   (A) 4.9 m **(B) 13.3 m** **(C) 9.1 m** **(D) 12.6 m**
5. **If a stone is to hit at a point which is at a distance d away and at a height h above the point from where the stone starts, than what is the values of initial speed v, if the stone is launched at an angle ¯ ?**

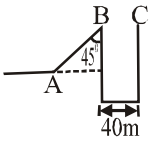


   (A) $\frac{g}{\cos^{-}}\sqrt{\frac{d}{2(d\tan^{-}-h)}}$ **(B)** $\frac{d}{\cos^{-}}\sqrt{\frac{g}{2(d\tan^{-}-h)}}$

   (C) $\sqrt{\frac{gd^2}{h\cos^{2}-}}$ **(D)** $\sqrt{\frac{2gd^2}{h\cos^{2}-}}$
6. **Figure shows four paths for a kicked football ignoring the effects of air on the rank the paths according to the initial horizontal velocity component highest first**



   (A) 1, 2, 3, 4 **(B) 2, 3, 4, 1**
   (C) 3, 4, 1, 2 **(D) 4, 3, 2, 1**
7. **A body is projected up smooth inclined plane with a velocity** $¬_0$ **from the point A as shown figure. The angle of inclination is** $45°$ **and top B of the plane is connected to a well of diameter 40 m. If the body just manages to cross the well, what is the value of** $¬_0$ **? Length of the inclined plane is** $20\sqrt{2}m$ **and** $g = 10 ms^{-2}$



   (A) $20\ ms^{-1}$ **(B)** $20\sqrt{2}\ ms^{-1}$
   (C) $40\ ms^{-1}$ **(D)** $40\sqrt{2} ms^{-1}$
8. **A particle of mass m is moving in circular path of constant radius r such that its centripetal acceleration** a_c **is varying with time t as** $a_c = k^2 rt^2$**. The power delivered to the particle by the forcesacting on it is**

(A) $2\pi mk^2r^2t$ **(B)** mk^2r^2t

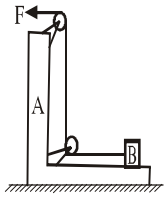
(C) $\frac{mk^4r^2t^5}{3}$ **(D) zero**

9. A body of mass m is moving with a uniform speed v along a circle of radius r, what is the average acceleration in going from A to B ?

(A) $2v^2/\pi r$ **(B)** $2\sqrt{2}v^2/\pi r$

(C) $v^2/\pi r$ **(D) None of these**

10. A horizontal force F = 2N is applied on the system shown in the figure. All surface are smooth. All pulleys and string are ideal. Mass of A and B each is 1kg. What is the acceleration of B with respect to A ?

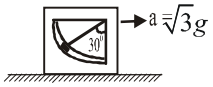


(A) $1m/s^2$ **(B)** $4m/s^2$ **(C)** $2m/s^2$ **(D) Zero**

11. During the return journey the sculpture falls off gently when it was at the lowest point. Maximum height reached by the ball in the subsequent motion is :

(a) $\frac{10}{3}m$ (b) 3 m (c) $\frac{20}{9}m$ (d) 5 m

12. A wedge with a rough groove in the shape of a quarter of a circle is kept on a smooth table (see figure). A disc is placed in the groove with a small clearance. Friction exists between groove and disc. The wedge is moved with an acceleration $\sqrt{3g}$. If disc is to remain stationary relative to groove, the coefficient of friction required can be.



(A) $\frac{1}{3}$ **(B)** $\frac{1}{4}$ **(C)** $\frac{1}{5}$ **(D)** $\frac{9}{10}$

13. A projectile is fired at an angle of $30°$ to the horizontal such that the vertical component of its initial velocity is 80 ms^{-1}. Its time of flight is T. Its velocity at the momentum t = T/4, has a magnitude of nearly

(A) 200 ms^{-1} (B) 160 ms^{-1} (C) 150 ms^{-1} (D) 140 ms^{-1}

14. 'A' and 'B' moving along same straight line in opposite direction, each with speed 4m/s with respect to ground. 'A' sees that the rain drops falling vertically while 'B' sees the rain drops falling at an angle $45°$ with te vertical. The speed of rain w.r.t ground, is :

(a) $4\sqrt{2}m/s$ **(b)** $4\sqrt{5}m/s$

(c) 4m/s **(d)** $8\sqrt{2}m/s$

15. A dot makes a turn in a circle 5 times in a second. The radius of the circle is 5 cm and the dot moves uniformaly. What is the acceleration of the dot in m/s^2 ?

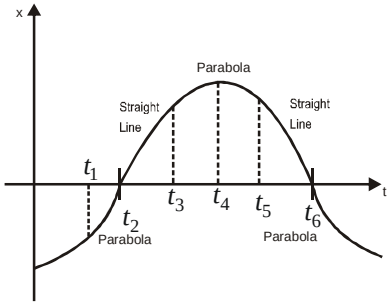
(a) $\frac{\pi^2}{125}$ **(b)** $2\pi^2$ **(c) zero** **(d)** $5\pi^2$

16. A passenger on a ship travelling due to east with a speed of 18 km/hr observes that smoke from the ship makes an angle of $30°$ with the ship's direction of motion. The wind is blowing from south to north. Assume that the smoke acquires a velocity (with respect to the earth) equal to the velocity of the wind, as soon as it leaves the ship. Find the velocity of the wind.

(a) $18\sqrt{3}km/hr$ **(b)** $\frac{18}{\sqrt{3}}km/hr$

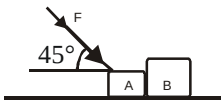
(c) $9km/hr$ **(d) None of these**

17. Figure shows a graph of position versus time graph for a particle moving x-axis.



Column-I		Column- II	
(A)	Slowing down	(P)	$t_1 \to t_2$
(B)	Returning towards origin	(Q)	$t_2 \to t_3$
(C)	Moving away from origin	(R)	$t_3 \to t_4$
(D)	Speeding up	(S)	$t_4 \to t_5$
		(T)	$t_5 \to t_6$

18. Two block A and B of masses 2kg and 3kg are placed on horizontal surface. The coefficient of friction between block A and horizontal surface is 0.5 while the block B is smooth. A force $F = (\sqrt{2}t)$ N is applied on block A as shown in the figure. Match te Column I with Column II and choose the correct option from the given below.



Column-I **Column-II**

i t = 4 s (P) The acceleration of block B is zero

ii t =20 s (Q) Friction on block A is more than 20 N.

iii t = 40 s (R) The acceleration of block A is 2 m/s²

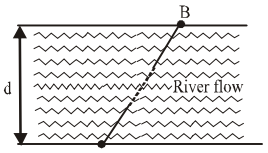
iv t = 60 s (S) Normal contact force between block A and B is non-zero

19. **A particle is moving on a circle of radius 1 m and its speed is changing as $v = 2t$. The magnitude of the acceleration of particle at t = 1 sec is :**

(A) $4m/s^2$ **(B)** $2m/s^2$

(C) $2\sqrt{3}\ m/s^2$ **(D)** $2\sqrt{5}\ m/s^2$

20. **Figure shows two swimmers starting from point A and B on opposite banks. They started at same instant with a constant velocity. Both of them are swimming in a direction parallel to line AB always. The river flows towards east.**



(A) Swimmers A and B cannot collide.

(B) Swimmers A and B will definitely collide some where on line AB.

(C) Swimmers A and B will definitely collide some where to the east of line AB

(D) Swimmers A and B will definitely collide some where to the west of line AB.

21. **A Cost Guard ship is travelling at a constant velocity of 12.50 m/s, due west, relative to the water. On his radar screen the navigator detects an object is located at a distance of 2500m with respect to the ship, in a direction $53°$ south of east. One minute later, he notes that the object's position relative to the ship has changed to 1250 m, $37°$ west of north. What are the magnitude and direction of the velocity of the object relative to the water ? Express the direction as an angle with respect to west.**

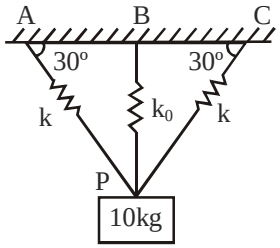
(A) $50\sqrt{2}m/s\ at\ 45°$ **(B)** $50m/s\ at\ 30°$

(C) $50\sqrt{3}m/s\ at\ 60°$ **(D) None of these**

22. A particle of mass m is moving under the variable force $\vec{F}$. If $|\vec{F}|$ is constant, then the possible path of the particle can never be:
(A) rectilinear (B) circular (C) parabolic (D) elliptical

23. Two blocks of mass m = 5kg and M = 10kg are connected by a string passing over a pulley B as shown. Another string connects the centre of pulley B to the floor and passes over another pulley A as shown. An upward force F is applied at the centre of pulley A. Both the pulley are massless.
The accelerations of blocks m and M if F is 300 N ..... g = 10m/s²)

24. A block of mass 10 kg is hanging with three identical massless springs (as shown in fig.).
will the bead stay above the ground level OX, if this semicircular arc revolves with angular velocity

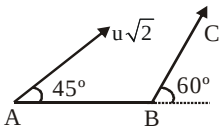


Find the magnitude of acceleration of the block at the moment, the right spring CP breaks. Assume that elongation in spring BP is 5 cm and its spring constant is 1000 N/m. (g = 10 m/s²)
(A) zero (B) 5 m/s² (C) 4.33 m/s² (D) 2.5 m/s²

25. **A particle is displaced to position $\left(3\hat{i}+2\hat{j}-2\hat{k}\right)$ from $\left(2\hat{i}-\hat{j}+\hat{k}\right)$ under the action of a force $\left(2\hat{i}+\hat{j}-\hat{k}\right)$ newton. The work done by the force is**
(A) 8 (B) 10 (C) 12 (D) 36

26. **A lift of height 3m starts moving down with a constant acceleration of 4 m/s² and at the same instant a particle starts falling from the ceilling of the lift. The distance moved by the particle in the ground frame when it strikes the floor of lift.**
(A) 1 m (B) 4 m (C) 5 m (D) 3 m

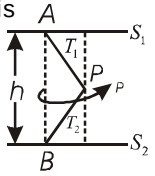
27. **A particle is projected from a point A with velocity $u\sqrt{2}$ at an angle of 45° with horizontal as shown in Fig.**



It strikes the plane BC at right angles. The velocity of the particle at the time of collision is :

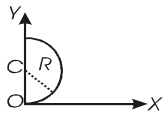
(A) $\frac{\sqrt{3}u}{2}$ (B) $\frac{u}{2}$ (C) $\frac{2u}{\sqrt{3}}$ (D) u

28. Two idential string with fixed ends separated by height h have their other ends tied to body P of mass m as shown in figure. When the body rotates with uniform angular speed $2\sqrt{2g/h}$ in a horizontal plane about the vertical axis the ratio ..... T_1/T_2) in the string is

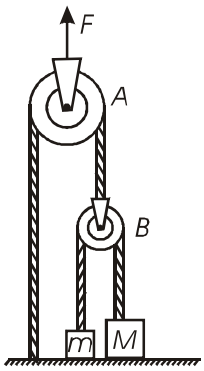


(A) $\frac{2}{3}$ (B) $\frac{5}{3}$ (C) $\frac{2}{5}$ (D) $\frac{5}{2}$

29. A bead of mass 5g can move without friction on a piece of wire bent in the form of a semicircular ring of radius 0.10 m, as



shown in the adjacent figure. This ring can freely ..... OY. At what height



(A) 5m/s^2, zero (B) zero, 5m/s^2
(C) zero, zero (D) 5m/s^2, 5m/s^2

30. x y z are the cartesan axes of an inertial frame of resistance. A particle of mass 1 kg moves with a uniform velocity of 1 m/s from A (0, 3m , 0) to B (4m, 0, 0). The motion of the particle is observed from a frame K which rotates with constant angular velocity μ about the z-axis by an observed O located at(0, 0, 7m) in x y z system. What is the magnitude of average pseudo force that observed O should consider as acting on the particle during its motion from A to B, if $\vec{\mu} = \frac{3®}{10}\hat{k}$ rad / s; $\hat{k}$ being a unit vector in the direction of positive z-axis ?

(A) zero (B) $\frac{3®}{10}N$ (C) $\frac{3®}{50}N$ (D) $\frac{5}{2}\left(\frac{3®}{10}\right)^2 N.$