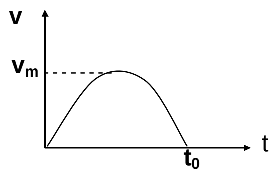
1. The velocity of a particle moving in a straight line varies with time in such a manner that v versus t graph is represented by one–half of an ellipse. The maximum velocity is v_m and the total time of motion is t_0 ;

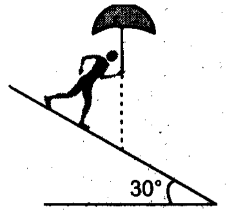


i) average velocity of the particle is $\frac{\pi}{4}v_m$;

(ii) such motion cannot be realized in practical terms

(A) only (i) is correct
(B) only (ii) is correct
(C) both (i) and (ii) are correct
(D) both (i) and (ii) are wrong

2. A man is coming down an incline of angle 30^0. When he walks with speed $2\sqrt{3}$ m/s he has to keep his umbrella vertical to protect himself from rain. The actual speed of rain is 5m/s. At what angle with vertical should be kept his umbrella when he is at rest so that he does not get drenched?



(A) 53^0
(B) 37^0
(C) 45^0
(D) none of these

3. The distance r from the origin of a particle moving in x – y plane varies with time as, r = 2t and the angle made by the radius vector with positive x-axis is θ = 4t. Here, t is in second, r in metres and θ in radian. The speed of the particle at t = 1s is
(A) 12 m/s
(B) 10 m/s
(C) 5 m/s
(D) none of these

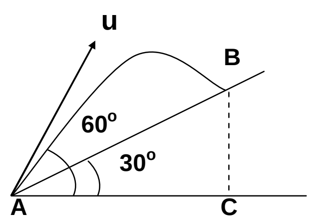
4. A particle is projected vertically upwards from the ground at time $t = 0$ and reaches a height h at $t = T$. The greatest height reached by the particle will be

(A) $\frac{(2h + gT^2)^2}{8gT^2}$
(B) $\frac{gT^2}{8}$
(C) $\frac{(2h + gT)^2}{6g}$
(D) 2h

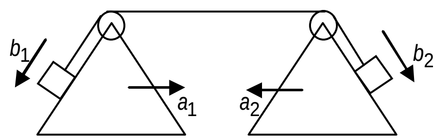
5. The velocity of an object moving rectilinearly is given as a function of time by $v = 4t - 3t^2$, where v is in m/s and t is in seconds. The average velocity of particle between t = 0 to t = 2 second is
(A) 0
(B) –2 m/s
(C) – 4m/s
(D) none of these

6. Time taken by the projectile to reach from A to B is *t*. Then the distance AB is equal to

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

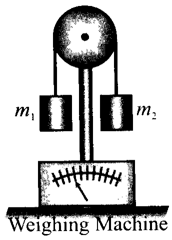


7. Accelerations of different bodies a_1, a_2, b_1 and b_2 are as shown in the figure. Then the correct relation is



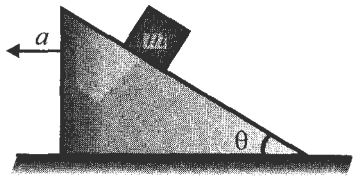
(A) $a_1 - a_2 + b_1 - b_2 = 0$
(B) $a_1 + a_2 - b_1 - b_2 = 0$
(C) $a_1 + a_2 + b_1 + b_2 = 0$
(D) $a_1 + b_2 = a_2 + b_1$

8. Two masses m_1 and m_2 which are connected with a light string, are placed over a frictionless pulley. This set up is placed over a weighing machine, as shown. Three combination of masses m_1 m_2 are used, in first case m_1 = 6kg and m_2 = 2kg, in second case m_1 = 5 kg and m_2 = 3kg and in third case m_1 = 4kg and m_2 = 4kg. Masses are held stationary initially and then released. If the readings of the weighing machine after the release in three cases are W_1, W_2 and W_3 respectively then



(A) $W_1 > W_2 > W_3$ (B) $W_1 < W_2 < W_3$ (C) $W_1 = W_2 = W_3$ (D) $W_1 = W_2 < W_3$

9. A block of mass m is resting on a wedge or angle θ as shown in the figure. With what minimum acceleration a should the wedge move so that the mass m falls freely?

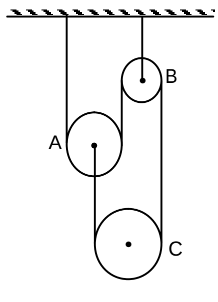


(A) g (B) g cos θ
(C) g cot θ (D) g tan θ

10. The length of an elastic string is l_1 when stretched by a force F_1 and the length is l_2 when the stretching force is F_2. The length of the string, when it is stretched by force $F_1 + F_2$, is

(A) $l_1 + l_2$ (B) $\frac{F_2 l_2 + F_1 l_1}{F_2 - F_1}$ (C) $\frac{F_2 l_2 - F_1 l_1}{F_2 + F_1}$ (D) $\frac{F_2 l_1 - F_1 l_2}{F_1 + F_2}$

11. In the arrangement shown in figure pulley A and B are massless and the thread is inextensible. Mass of pulley C is equal to m. If friction in all the pulleys is negligible, then



(A) tension in thread is equal to $\frac{1}{2}mg$

(B) acceleration of pulley C is equal to $\frac{g}{2}$ (downward)

(C) acceleration of pulley A is equal to $\frac{g}{2}$ (upward)

(D) acceleration of pulley A is equal to 2g (upward)

12. Two blocks at rest of masses m_1 and m_2 are acted upon by the same force F. If the force F acts for the same displacement x, then

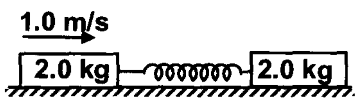
(A) their kinetic energies are in the ratio $\frac{K_1}{K_2} = \frac{m_1}{m_2}$ (B) their kinetic energies are in the ratio $\frac{K_1}{K_2} = \frac{m_2}{m_1}$

(C) their speeds are in the ratio $\frac{v_1}{v_2} = \sqrt{\frac{m_1}{m_2}}$ (D) their speeds are in the ratio $\frac{v_1}{v_2} = \sqrt{\frac{m_2}{m_1}}$

13. The work done by a force $F = 2x + x^2 + 4$ N acting on a body of mass 2 kg initially at rest during its displacement from x = 2 m to x = 4 m is

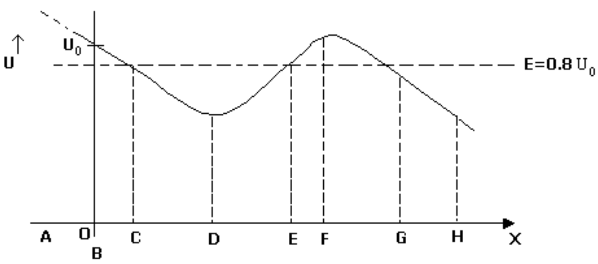
(A) 38.6 J (B) 44 J (C) 55.6 J (D) none of these

14. A block of mass 2.0 kg is moving on a frictionless horizontal surface with a velocity of 1.0 m/s in the figure towards another block of equal mass kept at rest. The spring constant of the spring fixed at one end is 100 N/m. The maximum compression of the spring is



(A) 5 cm (B) 10 cm (C) 15 cm (D) 20 cm

15. A particle moves in a straight line in response to a conservative force. The corresponding potential energy diagram for the particle motion is shown. The energy of the particle is $E = +0.8U_0$



(A) The particle experiences force in the +x direction at points C, G & H
(B) The speed of particle is greatest at point D
(C) The particle can never be found at points A, B & F
(D) At points C & E the speed of particle is zero

16. Velocity of a body of mass 2 kg moving in x – y plane is given by $\vec{v} = \left(2\hat{i} + 4t\hat{j}\right) m/s$, where t is the time in second. The power delivered to the body by the resultant force acting on it at $t = 5$ sec is
(A) 80 m/s^2 (B) 160 m/s^2 (C) 40 m/s^2 (D) 100 m/s^2

17. A block is suspended by an ideal spring of spring constant K. If the block is pulled down by constant force F and if maximum displacement of block from it's initial position of rest is z, then
(A) z = F/K (B) z = 2F/K
(C) work done by force F is equal to 2Fz (D) increase in potential energy of the spring is $\frac{1}{2}Kz^2$

18. At what angle should the two forces $2P$ and $\sqrt{2}P$ acts so that the resultant force is $P\sqrt{10}$
(A) 45^0 (B) 60^0 (C) 90^0 (D) 120^0

19. Two billiard balls are rolling on a flat table. One has velocity component $v_x = 1$ m/sec, $v_y = \sqrt{3}$ m/sec and the other has components $v_x = 2$ m/sec, $v_y = 2$ m/sec along two perpendicular direction. If both the balls start moving from same point, then angle between their path is
(A) 60^0 (B) 45^0 (C) 22.5^0 (D) 15^0

20. The value of following expressions $\hat{i}.\left(\hat{j}\times\hat{k}\right)+\hat{j}.\left(\hat{i}\times\hat{k}\right)+\hat{k}.\left(\hat{j}\times\hat{i}\right)$ is
(A) 0 (B) 1 (C) -1 (D) 3

INTEGER TYPE

21. A particle moves on a rough horizontal ground with some initial velocity say v_0. If ¾th of its kinetic energy is lost due to friction in time t_o. Then the coefficient of friction between the particle and the ground is $\frac{4v_0}{kt_0 g}$. The value of k is__________

22. A particle is moving with initial velocity of 30 m/sec along positive $x-$axis. An acceleration of 10 m/sec^2 acts along negative $x-$axis. The particle starts from $x = 35$ m at time $t = 0$. The particle will be at the origin at time t_0 (in seconds). Find t_0.

23. In a hemispherical bowl of radius R, a rod of mass $\frac{\sqrt{3}}{2}$ kg is placed horizontally. Length of rod is R. Normal reaction at any end of rod is ____________ N. (consider $g = 10$ m/s^2)

24. A boy standing on a weighing machine notices his weight as 400 N. When he suddenly jumps upward the weight shown by the machine becomes 600 N. The acceleration with which the boy jumps up (in S.I units)

25. The potential energy of a particle is determined by the expression $U = \alpha\left(x^2 + y^2\right)$, where α is a positive constant. The particle begins to move from a point with the co-ordinates (3, 3) only under the action of potential fields force. When it reaches the point (1, 1) its kinetic energy is $4K\alpha$. Find the value of K.

KEY

1.	**C**	**2.**	**B**	**3.**	**D**	**4.**	**A**	**5.**	**A**
6.	**A**	**7.**	**B**	**8.**	**B**	**9.**	**C**	**10.**	**B**
11.	**D**	**12.**	**D**	**13.**	**A**	**14.**	**B**	**15.**	**D**
16.	**B**	**17.**	**B**	**18.**	**A**	**19.**	**D**	**20.**	**C**
21.	**8**	**22.**	**7**	**23.**	**5**	**24.**	**5**	**25.**	**4**