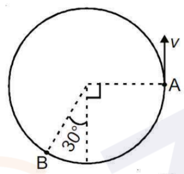
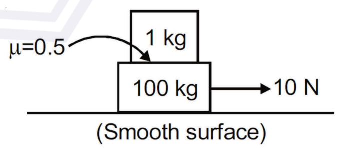
11^{th} Engineering

1. A particle of mass m moves with constant speed v on a circular path of radius r as shown in figure. The average force on it during its motion from A to B is



(A) $\frac{\sqrt{3}mv^2}{2\pi r}$ (B) $\frac{mv^2}{r}$ (C) $\frac{2\sqrt{3}mv^2}{\pi r}$ (D) $\frac{3\sqrt{3}mv^2}{4\pi r}$

2. The frictional force acting on 1 kg block is



(A) 0.1 N (B) 2 N (C) 0.5 N (D) 5 N

3. An object of mass 2 kg at rest at origin starts moving under the action of a force

$\vec{F} = (3t^2\hat{i} + 4t\hat{j})N$

The velocity of the object at t = 2 s will be

(A) $(3\hat{i} + 2\hat{j})m/s$ (B) $(2\hat{i} + 4\hat{j})m/s$ (C) $(4\hat{i} + 4\hat{j})m/s$ (D) $(3\hat{i} - 4\hat{j})m/s$

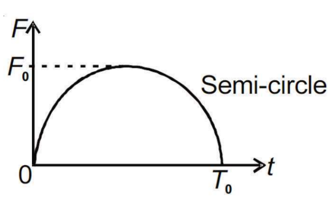
4. A block of mass m takes time t to slide down on a smooth inclined plane of angle of inclination θ and height h. If same block slide down on a rough inclined plane of same angle of inclination and some height and takes time n times of initial value, then coefficient of friction between block and inclined plane is

(A) $[1+n^2]\tan\theta$ (B) $\left[1-\frac{1}{n^2}\right]\tan\theta$ (C) $[1-n^2]\tan\theta$ (D) $\left[1+\frac{1}{n^2}\right]\tan\theta$

5. A person stands in contact against the inner wall of a rotor of radius r. The coefficient of friction between the wall and the clothing is μ and the rotor is rotating about vertical axis. The minimum speed of the rotor so that the person does not slip downward is

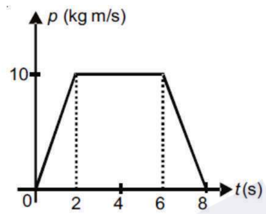
(A) $\sqrt{\frac{\mu g}{r}}$ (B) $\sqrt{\frac{\mu r}{g}}$ (C) $\sqrt{\frac{g}{\mu r}}$ (D) $\sqrt{\mu r g}$

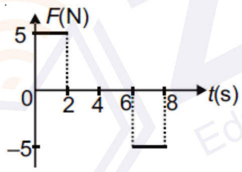
6. The magnitude of force acting on a particle moving along x-axis varies with time (t) as shown in figure. If at t = 0 the velocity of particle is v_0, then its velocity at t = T_0 will be

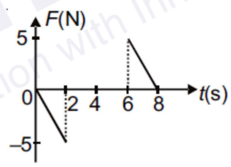


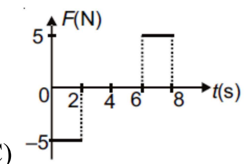
(A) $v_0 + \frac{\pi F_0 T_0}{4m}$ (B) $v_0 + \frac{\pi F_0}{2m}$ (C) $v_0 + \frac{\pi T_0^2}{4m}$ (D) $v_0 + \frac{\pi F_0 T_0}{m}$

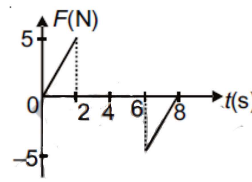
7. The momentum p of an object varies with time (t) as shown in figure. The corresponding force (F)-time (t) graph is



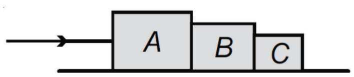
(A) 

(B) 

(C) 

(D) 

8. Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is

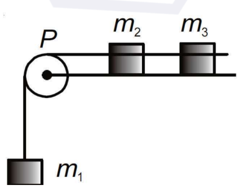


(A) 18 N (B) 2 N (C) 6 N (D) 8 N

9. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of kinetic friction between the block and table is μ_k When the block A is sliding on the table, the tension in the string is

(A) $\frac{m_1 m_2 (1-\mu_k)g}{(m_1+m_2)}$ (B) $\frac{(m_2+\mu_k m_1)g}{(m_1+m_2)}$ (C) $\frac{(m_2-\mu_k m_1)g}{(m_1+m_2)}$ (D) $\frac{m_1 m_2 (1+\mu_k)g}{(m_1+m_2)}$

10. A system consists of three masses m_1, m_2 and m_3 connected by a string passing over a pulley P. The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (The coefficient of friction $=\mu$). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is: (Assume $m_1 = m_2 = m_3 = m$)



(A) $\frac{g(1-g\mu)}{9}$ (B) $\frac{2g\mu}{3}$ (C) $\frac{g(1-2\mu)}{3}$ (D) $\frac{g(1-2\mu)}{2}$

11. A man of mass 60 kg records his wt. on a weighing machine placed inside a lift. The ratio of wts. of man recorded when lift ascending up with a uniform speed of 2 m/s to when it is descending down with a uniform speed of 4 m/s

will be

(A) 0.5 (B) 1 (C) 2 (D) None of these

12. A smooth block is released at rest on a 45° incline and then slides a distance'd'. The time taken to slide is 'n' times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

(A) $\mu_k = \sqrt{1 - \frac{1}{n^2}}$ (B) $\mu_k = 1 - \frac{1}{n^2}$ (C) $\mu_s = \sqrt{1 - \frac{1}{n^2}}$ (D) $\mu_s = 1 - \frac{1}{n^2}$

13. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with a speed of 3 m/s. At what height, did he bail out?

(A) 182 m (B) 91 m (C) 111 m (D) 293 m

14. An 80 kg person is parachuting and is experiencing a downward acceleration of 2.8 m/s^2. The mass of the parachute is 5 kg. The upward force on the open parachute is (Take g = 9.8 m/s^2)

(A) 595 N (B) 675 N (C) 456 N (D) 925 N

15. When a horse pulls a wagon, the force that causes the horse to move forward is the force

(A) The ground exerts on it (B) it exerts on the ground

(C) The wagon exerts on it (D) it exerts on the wagon

16. A gardener holds a hosepipe through which water is gushing out at a rate of 4kg s^{-1} with speed 2 ms^{-1}. The moment the speed of water is increased to 3 ms^{-1}, the gardener will experience a jerk of:

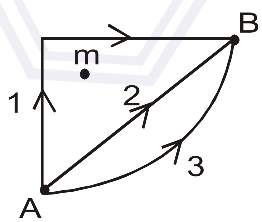
(A) 20 Ns in backward direction (B) 18 Ns in forward direction

(C) 10 Ns in backward direction (D) 10 Ns in forward direction

17. A 150 g tennis ball coming at a speed of 40 m/s is hit straight back by a bat to a speed of 60 m/s. The magnitude of the average force F on the ball, when it is in contact for 5 ms, is:

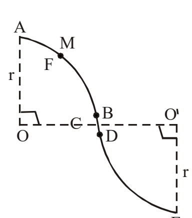
(A) 2500 N (B) 3000 N (C) 3500 N (D) 4000 N

18. If W_1, W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2 and 3 respectively (as shown) in the gravitational field of a point mass m, find the correct relation between W_1, W_2 and W_3.



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

19. ABCDE as a smooth iron track in the vertical plane. The sections ABC and CDE are quarter circles. Points B and D are very close to C. M is a small magnet of mass m. The force of attraction between M and the track is F, which is constant and always normal to the track. M starts form rest at A.



I. If M does not leave the track at C then $F \geq 2mg$

II. At B, the normal reaction of the track is $F - 2mg$

III. At D, the normal reaction of the track is $F + 2mg$

IV. the normal reaction of the track is equal to F at some point between A and B

(A) I, II and III are correct (B) I, II are correct

(C) I, III & IV are correct (D) All correct

20. Four identical rods, each of mass m and length ℓ are joined to form a rigid square frame. The frame lies in the xy plane, with its centre at the origin and the sides parallel to the x and y axes. Its moment of inertia about :

I. The x –axis is $\frac{2}{3}m\ell^2$ II. The z-axis is $\frac{4}{3}m\ell^2$

III. an axis parallel to the z-axis and passing through a corner is $\frac{10}{3}m\ell^2$

IV. One side is $\frac{5}{3}m\ell^2$

(A) I, II and III are correct (B) I, II are correct

(C) I, III & IV are correct (D) All correct

21. A steel tape gives correct measurement at 20°C. A piece of wood is being measured with the steel tape at 0°C. The reading is 25 cm on the tape, the real length of the given piece of wood must be:

(A) 25 cm (B) <25 cm (C) >25 cm (D) cannot say

22. A metallic rod l cm long with a square cross-section (A) is heated through t°C. If Young's modulus of elasticity of the metal is E and the mean coefficient of linear expansion is α per degree Celsius, then the compressional force required to prevent the rod from expanding along its length is :(Neglect the change of cross-sectional area)

(A) $EA\alpha t$ (B) $EA\alpha t/(1 + \alpha t)$ (C) $EA\alpha t/(1-\alpha t)$ (D) $E/\alpha t$

23. A metal ball immersed in Alcohol weights W_1 at 0°C and W_2 at 50°C. The coefficient of cubical expansion of the metal $(\gamma)_m$ is less than that of alcohol $(\gamma)_{Al}$. Assuming that density of metal is large compared to that of alcohol, it can be shown that

(A) $W_1 > W_2$ (B) $W_1 = W_2$ (C) $W_1 < W_2$ (D) any of (A) , (B) or (C)

24. The coefficient of apparent expansion of a liquid in a copper vessel is C and in a silver vessel is S. The coefficient of volume expansion of copper is γ_c. What is the coefficient of linear expansion of silver?

(A) $\frac{C+\gamma_C+S}{3}$ (B) $\frac{C-\gamma_C+S}{3}$ (C) $\frac{C+\gamma_C-S}{3}$ (D) $\frac{C-\gamma_C-S}{3}$

25. If α is the coefficient of linear expansion, the change in the period t of a physical pendulum with temperature change of ΔT is

(A) $\frac{\alpha t\Delta T}{2}$ (B) $\frac{\alpha t\Delta T}{4}$ (C) $\frac{3\alpha t\Delta T}{4}$ (D) $\frac{\alpha t\Delta T}{3}$

ANSWER KEY

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