Module-Test-9
(Physics-NEET)

January 8, 2023

Section-A

There are 35 questions in this section. All are compulsory to do.

1. The angular speed of a flywheel making 120 rev min^{-1} is
(a) 2 π rad s^{-1} (b) 4 π^2 rad s^{-1}
(c) π rad s^{-1} (d) 4 π rad s^{-1}

2. The ratio of angular speeds of minute hand and hour hand of a watch is
(a) 1 : 12 (b) 6 : 1 (c) 12 : 1 (d) 1 : 6

3. The wheel of a toy car rotates about a fixed axis. It slows down from 400 rps to 200 rps in 2 s. Then, its angular retardation (in rad s^{-2}) is (rps = revolutions per second)
(a) 200 π (b) 100 π
(c) 400π (d) None of these

4. A wheel is rotating at 900 rpm about its axis. When the power is cut off, it comes to rest in 1 min. The angular retardation (in rad s^{-2}) is
(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{8}$

5. The motor of an engine is rotating about its axis with an angular velocity of 100 rev min^{-1}. It comes to rest in 15 s after being switched off, assuming constant angular deceleration. What is the number of revolutions made by it before coming to rest?
(a) 12.5 (b) 40 (c) 32.6 (d) 15.6

6. A body is moving in a circular path with acceleration a. If its speed gets doubled, find the ratio of centripetal acceleration after and before the speed is changed.
(a) 1 : 4 (b) 1 : 2 (c) 2 : 1 (d) 4 : 1

7. The circular orbit of two satellites have radii r_1 and r_2 respectively ($r_1 < r_2$). If angular velocities of satellites are same, then their centripetal accelerations are related as
(a) $a_1 > a_2$ (b) $a_1 = a_2$
(c) $a_1 < a_2$ (d) Data insufficient

8. A particle is moving on a circular track of radius 30 cm with a constant speed of 6 ms^{-1}. Its acceleration is
(a) zero (b) 120 ms^{-2} (c) 1.2 ms^{-2} (d) 36 ms^{-2}

9. A particle starts moving along a circle of radius (20/π) m with constant tangential acceleration. If velocity of the particle is 50 m/s at the end of the second revolution after motion has began, the tangential acceleration (in ms^{-2}) is
(a) 1.6 (b) 4 (c) 15.6 (d) 31.25

10. Let a_r and a_t represent radial and tangential accelerations. The motion of a particle may be circular, if
(a) $a_r = 0, a_t = 0$ (b) $a_r = 0, a_t \neq 0$
(c) $a_r \neq 0, a_t = 0$ (d) None of these

11. A point starts from rest and moves along a circular path with a constant tangential acceleration. After one rotation, the ratio of its radial acceleration to its tangential acceleration will be equal to
(a) 1 (b) 2π (c) $\frac{1}{2}\pi$ (d) 4π

12. A particle is moving on a circular path of 10 m radius. At any instant of time, its speed is 5 ms^{-1} and the speed is increasing at a rate of 2 ms^{-2}. At this instant, the magnitude of the net acceleration will be
(a) 3.2 ms^{-2} (b) 2 ms^{-2} (c) 2.5 ms^{-2} (d) 4.3 ms^{-2}

13. A point on the rim of a flywheel has a peripheral speed of 10 ms^{-1} at an instant when it is decreasing at the rate of 60 ms^{-2}. If the magnitude of the total acceleration of the point at this instant is 100 ms^{-2}, the radius of the flywheel is
(a) 1.25 m (b) 12.5 m
(c) 25 m (d) 2.5 m

14. A particle moves in a circular path of radius R with an angular velocity $\omega = a - bt$, where a and b are positive constants and t is time. The magnitude of the acceleration of the particle after time $\frac{2a}{b}$ is
(a) $\frac{a}{R}$ (b) a^2R (c) $R(a^2 + b)$ (d) $R\sqrt{a^4 + b^2}$

15. The distance of a particle moving on a circle of radius 12 m measured from a fixed point on the circle is given by $s = 2t^3$ (in metre). The ratio of its tangential to centripetal acceleration at t = 2s is
(a) 1 : 1 (b) 1 : 2 (c) 2 : 1 (d) 3 : 1

16. A body is moving on a circle of radius 80 m with a speed 20 m/s which is decreasing at the rate 5 ms^{-2} at an instant. The angle made by its acceleration with its velocity is
(a) 45° (b) 90°
(c) 135° (d) 0°

17. The limiting value of static friction between two surfaces in contact is
(a) proportional to normal force between the surfaces in contact
(b) independent of area of contact
(c) depends on the microscopic area of constant magnitude
(d) All of the above

18. A mass placed on an inclined plane is just in equilibrium. If $\propto$ is coefficient of friction of the surface, then maximum inclination of the plane with the horizontal is
(a) $\tan^{-1} \propto$ (b) $\tan^{-1} (\propto/2)$
(c) $\sin^{-1} \propto$ (d) $\cos^{-1} \propto$

19. A 30 kg block rests on a rough horizontal surface. A force of 200 N is applied on the block. The block acquires a speed of 4 ms^{-1}, starting from rest in 2 s. What is the value of coefficient of friction?
(a) $\frac{10}{3}$ (b) $\frac{\sqrt{3}}{10}$
(c) 0.47 (d) 0.184

20. A car having a mass of 1000 kg is moving at a speed of 30 ms^{-1}. Brakes are applied to bring the car to rest. If the frictional force between the tyres and the road surface is 5000 N, the car will come to rest in
(a) 5 s (b) 10 s
(c) 12 s (d) 6 s

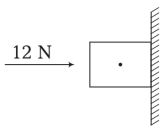
21. A 100 N force acts horizontally on a block of mass 10 kg placed on a horizontal rough table of coefficient of friction $\propto = 0.5$. If g at the place is 10 ms^{-2}, the acceleration of the block is
(a) zero (b) 10 ms^{-2}
(c) 5 ms^{-2} (d) 5.2 ms^{-2}

22. A block of mass 2 kg is placed on the floor. The coefficient of static friction is 0.4. If a force of 2.8 N is applied on the block parallel to the floor, the force of friction between the block and floor is
(Take, $g = 10\ ms^{-2}$)
(a) 2.8 N (b) 8 N (c) 2 N (d) zero

23. A body is projected along a rough horizontal surface with a velocity 6 ms^{-1}. If the body comes to rest after travelling 9 m, then coefficient of sliding friction is (Take, $g = 10\ ms^{-2}$)
(a) 0.5 (b) 0.4 (c) 0.6 (d) 0.2

24. The coefficient of friction between the tyres and road is 0.4. The minimum distance covered before attaining a speed of 8 ms^{-1} starting from rest is nearly (Take, $g = 10\ ms^{-2}$)
(a) 8 m (b) 4 m
(c) 10 m (d) 16 m

30. A block of weight 5 N is pushed against a vertical wall by a force 12 N. The coefficient of friction between the wall and block is 0.6. The magnitude of the force exerted by the wall on the block is



(a) 12 N (b) 5 N
(c) 7.2 N (d) 13 N

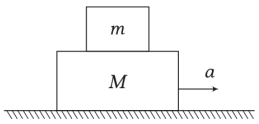
31. A body of mass 10 kg is placed on rough surface, pulled by a force F making an angle of 30° above the horizontal. If the angle of friction is also 30°, then the minimum magnitude of force F required to move the body is equal to
(Take, $g = 10 ms^{-2}$)
(a) 100 N (b) $50\sqrt{2}$ N
(c) $100\sqrt{2}$ N (d) 50 N

32. A block of mass 2 kg rests on a rough inclined plane making an angle of 30Ywith the horizontal. The coefficient

25. A block is gently placed on a conveyor belt moving horizontally with constant speed. After t = 4 s, the velocity of the block becomes equal to the velocity of the belt.
If the coefficient of friction between the block and the belt is $\propto = 0.2$, then the velocity of the conveyor belt is
(a) 8 ms^{-1} (b) 4 ms^{-1}
(c) 6 ms^{-1} (d) 18 ms^{-1}

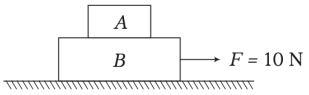
26. The breaking strength of the cable used to pull a body is 40 N. A body of mass 8 kg is resting on a table of coefficient of friction $\propto = 0.2$. The maximum acceleration which can be produced by the cable connected to the body is (Take, $g = 10 ms^{-2}$)
(a) 6 ms^{-2} (b) 3 ms^{-2}
(c) 8 ms^{-2} (d) 8 ms^{-2}

27. A block of mass m is placed on the top of another block of mass M as shown in the figure . The coefficient of friction between them is $\propto$.



The maximum acceleration with which the block M may move, so that m also moves along with it, is
(a) $\propto g$ (b) $\propto \frac{M}{m} g$
(c) $\propto \frac{m}{M} g$ (d) $\frac{g}{\propto}$

28. In the shown arrangement, mass of A = 1 kg and mass of B = 2 kg. Coefficient of friction between A and B = 0.2.



There is no friction between B and ground. The frictional force exerted by A on B equals
(a) 2 N (b) 3 N
(c) 4 N (d) 5 N

29. A block of mass 4 kg is placed on a rough horizontal plane. A time dependent force $F = kt^2$ acts on the block, where k = 2 Ns^{-2} and coefficient of friction $\propto = 0.8$.
Force of friction between block and the plane at t = 2 s is
(a) 8 N (b) 4 N
(c) 2 N (d) 32 N

of static friction between the block and the plane is 0.7. The frictional force on the block is
(a) 9.8 N (b) $0.7 \times 9.8 \times \sqrt{3}$ N
(c) $9.8 \times \sqrt{3}$ N (d) 0.7×9.8 N

33. A minimum force F is applied to a block of mass 102 kg to prevent it from sliding on a plane with an inclination angle 30Ywith the horizontal. If the coefficients of static and kinetic friction between the block and the plane are 0.4 and 0.3 respectively, then the force F is
(a) 157 N (b) 224 N
(c) 315 N (d) zero

34. A box of mass 8 kg is placed on a rough inclined plane of inclination θ. Its downward motion can be prevented by applying an upward pull F and it can be made to slide upwards by applying a force $2F$. The coefficient of friction between the box and the inclined plane is
(a) $\frac{1}{3}\tan\theta$ (b) $3\tan\theta$
(c) $\frac{1}{2}\tan\theta$ (d) $2\tan\theta$

35. Which of the following statement(s) is/are true for a particle moving in a circle with a constant angular acceleration ?

(a) The magnitude of acceleration is constant

(b) The acceleration vector is along the tangent to the circle

(c) The velocity vectors points along tangent to the circle

(d) The velocity and acceleration vectors are always perpendicular to each other.

Section-B

There are 15 questions in this section. Only 10 questions are required to do.

1. A cyclist moves uniformly on a horizontal circular track of radius $100m$. If the coefficient of friction is 0.1. At which of the following speed(s) can he travel without slipping:

a) $5m/s$ b) $9m/s$

c) $14m/s$ d) None of these

2. What is the average angular speed of the second hand on a clock (in rad/s) ?

a) 6.28 b) 0.105

c) 0.0167 d) 1.745×10^{-3}

3. A bicycle wheel starts at rest and has a constant angular acceleration α. At time t, it has rotated through an angle θ and has an angular velocity ω. What are ω and α in terms of θ and t :

a) $\omega=\dfrac{\theta}{t},\alpha=\dfrac{\theta}{t^2}$ b) $\omega=\dfrac{2\theta}{t},\alpha=\dfrac{2\theta}{t}$

c) $\omega=\dfrac{2\theta}{t},\alpha=\dfrac{2\theta}{t^2}$ d) None of these

4. In figure particle is shown travelling counter-clockwise in circle of radius $10m$. The acceleration vector is indicated at a specific time. Find the value of 'v' at this time.

(a) $10m/s$ (c) $20m/s$

(b) $15m/s$ (d) $7m/s$

5. A car travels at a constant speed around a circular track whose radius is $3.6km$. The car goes once around the track in $60s$. What is the approximate magnitude of the acceleration of the car towards the centre of the track at any instant ?

(a) zero (c) $20m/s^2$

(b) $40m/s^2$ (d) $10m/s^2$

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

(a) $4m/s^2$ (c) $2\sqrt{3}m/s^2$

(b) $2m/s^2$ (d) $2\sqrt{5}m/s^2$

7. A jet of water hits a flat stationary plate perpendicular to its motion. The jet ejects 500 g of water per second with a speed of $1\,\mathrm{m\,s^{-1}}$. Assuming that after striking, the water flows parallel to the plate, then the force exerted on the plate is

a) 5 N b) 1 N

c) 0.5 N d) 10 N

8. A force F_1 accelerates a particle from rest to a velocity v. Another force F_2 decelerates the same particle from v to rest, then

a) F_1 is always equal to F_2

b) F_2 is greater than F_1

c) F_2 may be smaller than, greater than or equal to F_1

d) F_2 cannot be equal to F_1

9. A block of mass 4 kg is placed on a rough horizontal plane. A time dependent horizontal force $F = kt$ acts on the block. Here $k = 2\,\text{N/s}$. The frictional force between the block and plane at time $t = 2\,\text{s}$ is ($\mu = 0.2$)

a) 4 N

b) 8 N

c) 12 N

d) 10 N

10. Convert 60 rev min^{-1} into rad/s .

a) 2π

b) 4π

c) 60π

d) 120π

11. Tangential acceleration is caused by

a) increasing radial acceleration

b) increasing tangential speed

c) increasing angular displacement

d) None of these

12. A particle is performing a circular motion and its angular displacement is changing as $\theta = t^2 - 2t$, then its angular velocity at $t = 1\,\text{s}$ is

a) zero

b) Non-zero

c) couldn't be found

d) None of these

13. A particle is moving on a circular track with constant speed then, which of the following statement is true?

a) $a_t = 0$

b) $a_r = 0$

c) $v_t = 0$

d) None of these

14. What is the linear velocity, if angular velocity vector $\vec{\omega} = 3\hat{i} - 4\hat{j} + k$ and position vector $\vec{r} = 5\hat{i} - 6\hat{j} + 6\hat{k}$?

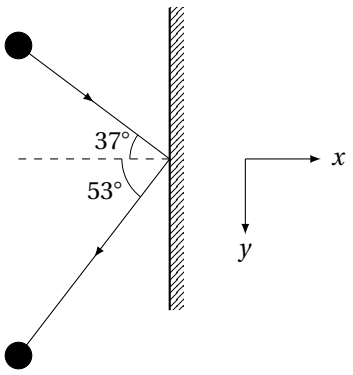
a) $6\hat{i} + 2\hat{j} - 3\hat{k}$

b) $-18\hat{i} - 13\hat{j} + 2\hat{k}$

c) $18\hat{i} + 13\hat{j} - 2\hat{k}$

d) $6\hat{i} - 2\hat{j} + 8\hat{k}$

15. A ball of mass m moving with velocity v_0 collides a wall as shown in figure. After impact it rebounds with a velocity $\frac{3}{4}v_0$. The impulse acting on ball during impact is



a) $-\frac{1}{2}mv_0\hat{j}$

b) $-\frac{3}{4}mv_0\hat{i}$

c) $-\frac{5}{4}mv_0\hat{i}$

d) None of these

ANSWER

Section-A

1. (d)
2. (c)
3. (a)
4. (a)
5. (a)
6. (d)
7. (c)
8. (b)
9. (d)
10. (c)
11. (d)
12. (a)
13. (a)
14. (d)
15. (b)
16. (c)
17. (d)
18. (a)
19. (c)
20. (d)
21. (c)
22. (a)
23. (d)
24. (a)
25. (a)
26. (b)
27. (a)
28. (a)
29. (a)
30. (d)
31. (d)
32. (a)
33. (a)
34. (a)
35. (c)

Section-B

1. (d)
2. (b)
3. (c)
4. (c)
5. (b)
6. (d)
7. (c)
8. (a)
9. (b)
10. (a)
11. (b)
12. (a)
13. (a)
14. (b)
15. (c)