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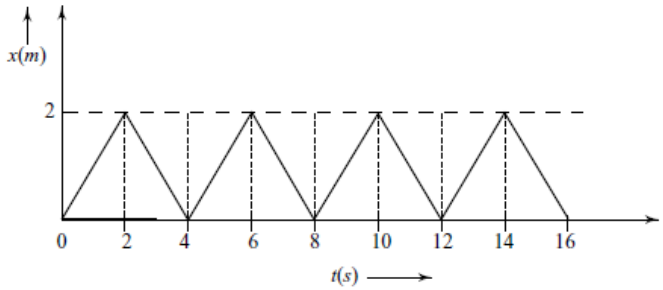
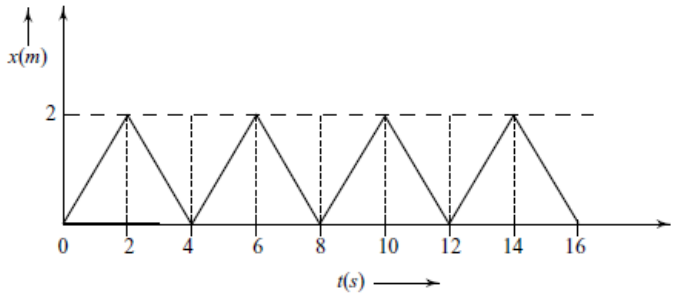
Class: XI
Subject: Physics
Topic: Laws of Motion
No. of Questions: 29

1. The given figure shows the position–time (x–t) graph of one-dimensional motion of a body of mass 0.4 kg.
What is the time interval between consecutive impulses received by the body?



A. 2 s
B. 4 s
C. 8 s
D. 16 s

2. **Directions:** The given figure shows the position–time (x–t) graph of one-dimensional motion of a body of mass 0.4 kg.
What is the magnitude of each impulse?



A. 0.2 Ns
B. 0.4 Ns
C. 0.8 Ns
D. 1.6 Ns

3. An aeroplane of mass M requires a speed v for takeoff. The length of the runway is s and the coefficient of friction between the tyres and the ground is μ. Assuming that the plane accelerates uniformly during the takeoff, the minimum force required by the engine of the plane for takeoff is given by

A. $M\left(\frac{v^2}{2s}+\mu g\right)$
B. $\left(\frac{v^2}{2s}-\mu g\right)$
C. $M\left(\frac{2v^2}{s}+2\mu g\right)$
D. $M\left(\frac{2v^2}{s}-2\mu g\right)$

4. A block of mass 5 kg is resting on an inclined plane. The inclination of the plane to the horizontal direction is gradually increased. It is found that when the angle of inclination is 30°, the block just begins to slide down the plane. The coefficient of sliding friction μ_s between the block and the plane is

A. $\mu_s = \sin 30^o$
B. $\mu_s = \cos 30^o$
C. $\mu_s = \tan 30^o$
D. $\mu_s = \cot 30^o$

5. Ten coins are placed on top of each other on a horizontal table. If the mass of each coin is 10 g and acceleration due to gravity is 10 ms^{-2}, what is the magnitude and direction of the force on the 7^{th} coin (counted from the bottom) due to all the coins above it?

A. 0.3 N downwards
B. 0.3 N upwards
C. 0.7 N downwards
D. 0.7 N upwards

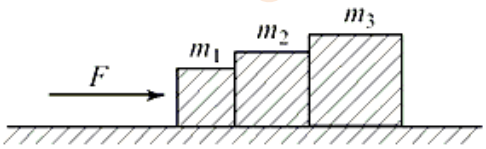
6. A given object takes as much time to slide down a 45° rough incline as it takes to slide down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is given by

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

7. A body is moving down a long inclined plane of angle of inclination θ. The coefficient of friction between the body and the plane varies as μ = 0.5 x, where x is the distance moved down the plane. The body will have the maximum velocity when it has travelled a distance x given by

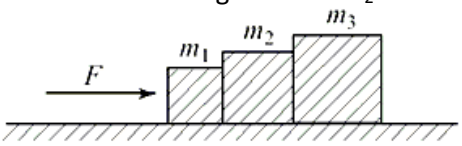
A. $x = 2 \tan\theta$
B. $x = \frac{2}{\tan\theta}$
C. $x = \sqrt{2} \cot\theta$
D. $x = \frac{\sqrt{2}}{\cot\theta}$

8. Three blocks of masses m_1 = 1 kg, m_2 = 2 kg and m_3 = 3 kg are placed in contact on a horizontal frictionless surface as shown in the figure. A force F = 12 N is applied to mass m_1 as shown. The acceleration of the system is



A. 12 ms^{-2}
B. 6 ms^{-2}
C. 4 ms^{-2}
D. 2 ms^{-2}

9. Three blocks of masses m_1 = 1 kg, m_2 = 2 kg and m_3 = 3 kg are placed in contact on a horizontal frictionless surface as shown in the figure. A force F = 12 N is applied to mass m_1 as show. The contact force acting on mass m_2 is



A. 12 N
B. 10 N
C. 8 N
D. 6 N

10. A car moving at a speed 'v' is stopped by a retarding force F over a distance 's'. If the retarding force were 3F, the car could have been stopped over a distance of

A. $\frac{s}{3}$
B. $\frac{s}{6}$
C. $\frac{s}{9}$
D. $\frac{s}{12}$

11. A simple pendulum of length r = 1 m and bob of mass 100 g is swinging with an angular amplitude of 60°. What is the tension in the string when the bob passes through the equilibrium position? Take g = 10 ms^{-2}.

A. 1 N
B. 2 N
C. 3 N
D. 4 N

12. The pilot of an aircraft, who is not tied to his seat, can loop a vertical circle in air without falling out at the top of the loop. What is the minimum speed required so that he can successfully negotiate a loop or radius 4 km? Take g = 10 ms^{-2}.

A. 100 ms^{-1}
B. 300 ms^{-1}
C. 200 ms^{-1}
D. 400 ms^{-1}

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13. A block of weight 200 N is pulled along a rough horizontal surface at a constant speed by a force of 100 N acting at an angle of 30° above the horizontal. The coefficient of friction between the block and the surface is

    A. 0.43
    B. 0.58
    C. 0.75
    D. 0.85

14. A body of mass M kg is on the top point of a smooth hemisphere of radius 5 m. It is released to slide down the surface of the hemisphere. It leaves the surface when its velocity is 5 m/s. At this instant, the angle made by the radius vector of the body with the vertical is (Take acceleration due to gravity = 10 ms^{-2})

    A. 30°
    B. 45°
    C. 60°
    D. 90°

15. A body of mass 0.5 kg is whirled in a vertical circle at an angular frequency of 10 rad s^{-1}. If the radius of the circle is 0.5 m, what is the tension in the string when the body is at the top of the circle? Take g = 10 ms^{-2}.

    A. 10 N
    B. 20 N
    C. 30 N
    D. 40 N

16. A body of mass 0.5 kg is whirled in a vertical circle at an angular frequency of 10 rad s^{-1}. If the radius of the circle is 0.5 m, what will be the tension in the string when the body is at the bottom of the circle?

    A. 10 N
    B. 30 N
    C. 20 N
    D. 40 N

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17. A simple pendulum having a bob of mass m swings with an angular amplitude of 40°. When its angular displacement is 20°, the tension in the string is

    A. mg cos 20°
    B. mg sin 20°
    C. greater than mg cos 20°
    D. greater than mg sin 20°

18. A cylinder rolls up an inclined plane, reaches some height, and then rolls down (without slipping throughout these motions). The directions of the frictional force acting on the cylinder are

    A. up the incline while ascending and down the incline while descending
    B. up the incline while ascending as well as descending
    C. down the incline while ascending and up the incline while descending
    D. down the incline while ascending as well as descending

19. A uniform chain of length L is lying on the horizontal surface of a table. If the coefficient of friction between the chain and the table top is μ = 0.25, what is the maximum percentage of the length of the chain that can hang over the edge of the table without disturbing the rest of the chain on the table?
    A. 8%
    B. $\frac{40}{3}\%$
    C. 20%
    D. 25%

20. A smooth inclined plane of angle of inclination 30° is placed on the floor of a compartment of a train moving with a constant acceleration a. When a block is placed on the inclined plane, it does not slide down or up the plane. The acceleration a must be

    A. g
    B. $\frac{g}{2}$
    C. $\frac{g}{\sqrt{2}}$
    D. $\frac{g}{\sqrt{3}}$

21. What is the unit of coefficient of friction?

22. Name the factor on which coefficient of friction depends?

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23. What provides the centripetal force to a car taking a turn on a level road?

24. Give the magnitude and direction of the net force acting on

    (a) A drop of rain falling down with constant speed.

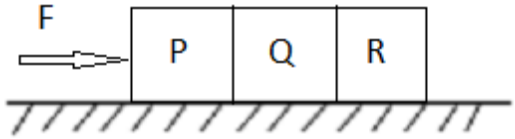
    (b) A kite skillfully held stationary in the sky.

25. Two blocks of masses m1, m2 are connected by light spring on a smooth horizontal surface. The two masses are pulled apart and then released. Prove that the ratio of their acceleration is inversely proportional to their masses."

26. A shell of mass 0.020kg is fired by a gun of mass 100kg. If the muzzle speed of the shell is 80m/s, what is the recoil speed of the gun?

27. A train runs along an unbanked circular bend of radius 30m at a speed of 54km/hr. The mass of the train is 106kg. What provides the necessary centripetal force required for this purpose? The engine or the rails? What is the angle of banking required to prevent wearing out of the rail?

28. Three identical blocks each having a mass m, are pushed by a force F on a frictionless table as shown in figure



    What is the acceleration of the blocks? What is the net force on the block P? What force does P apply on Q. What force does Q apply on R?

29. (a) Define impulse. State its S.I. unit?

    (b) State and prove impulse momentum theorem?