PHYSICS

Class **PUC 2nd Yr.**
AIPMT paper problems
Topic **NLM & Friction.** **September 2015**

1. The position vector of a particle as a function of time is given by $\vec{r} = 4\sin(2\pi t)\hat{i} + 4\cos(2\pi t)\hat{j}$ where r is in meters, t in seconds. Which of the following is wrong for the motion of the particle?

   (A) Magnitude of acceleration vector is $\frac{v^2}{r}$ where v is the speed of the particle.

   (B) Magnitude of velocity is 8 m/s

   (C) Path of the particle is a circle of radius 4 m

   (D) Acceleration vector is along $-\vec{r}$

2. A plank with a box on it at one end is slowly raised about the other end. As the angle with the horizontal slowly reaches 30^0 the block starts to slip and covers 4 m down the plank in 4 sec. The coefficient of static and kinetic friction between the block and the plank will be respectively,

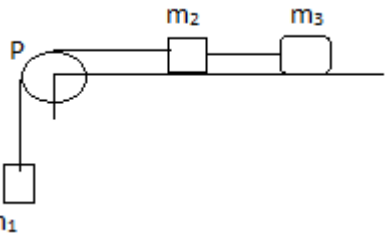
   (A) 0.6 and 0.5 (B) 0.5 and 0.6

   (C) 0.4 and 0.3 (D) 0.6 and 0.6

3. Two stones of masses m and 2m are whirled in horizontal circles, the heavier one in radius r/2 and the lighter in radius r. The tangential speed of the lighter one is n times that of the heavier one when they experience same centripetal forces. The value of n is

   (A) 3 (B) 4

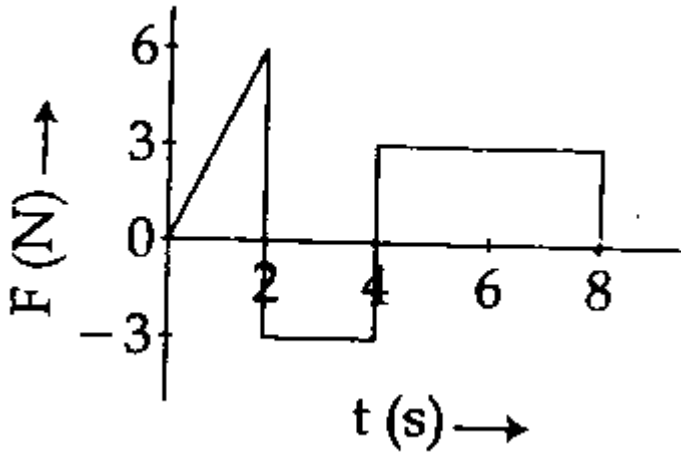
   (C) 1 (D) 2

4. 

   System consisting of three masses connected by a string passing over a pulley P is as shown. The table is rough with coefficient of friction μ. The pulley is frictionless and of negligible mass. The downward acceleration of m_1 is (take the three masses to be equal)

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

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

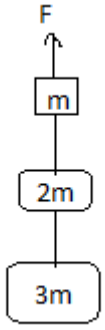


5. The force F acting on a particle of mass m is indicated by the force-time diagram as shown. The change in momentum of the particle over the time interval from 0 to 8 sec is

(A) 24 Ns (B) 20 Ns (C) 12 Ns (D) 6 Ns

6. A balloon of mass m is descending with an acceleration a less than g. How much mass must be removed from it so that it starts moving up with the same acceleration?

(A) $\frac{2ma}{g+a}$ (B) $\frac{2ma}{g-a}$ (C) $\frac{ma}{g+a}$ (D) $\frac{ma}{g-a}$



7. Three blocks shown in the figure connected with a string are moving upwards with a constant velocity v with the force F. What is the net force on the block of mass 2m? g is acceleration due to gravity.

(A) 0 (B) 2 mg (C) 3 mg (D) 6 mg

8. The upper half of an inclined plane of inclination θ smooth while lower half is rough. A block starting from rest from the top of the plane comes to rest at the bottom of the plane if the coefficient of friction between the block and the lower half of the plane is

(A) $\mu = \frac{1}{\tan\theta}$ (B) $\mu = \frac{2}{\tan\theta}$ (C) $\mu = 2\tan\theta$ (D) $\mu = \tan\theta$

9. A car of mass m is moving on a level circular track of radius R. If μ_s represents the static coefficient of friction between the road and the tyres of the car, the maximum speed of the car in circular motion is given by

(A) $\sqrt{\mu_s Rg}$ (B) $\sqrt{\mu_s mRg}$ (C) $\sqrt{\frac{Rg}{\mu_s}}$ (D) $\sqrt{\frac{mRg}{\mu_s}}$

10. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude P. The instantaneous velocity of the car is proportional to

(A) $\frac{t}{\sqrt{m}}$ (B) $t^2 P$ (C) $t^{1/2}$ (D) $t^{-1/2}$

11. A person of mass 60 kg is inside a lift of mass 940 kg. If the lift starts moving upwards with an acceleration of 1 ms^{-2} and g is 10 ms^{-2} the tension in the supporting cable is

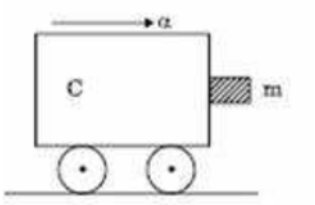
(A) 1200 N (B) 8600 N (C) 9680 N (D) 11000 N

12. A particle moves in a circle of radius 5 cm with constant speed and time period 0.2π sec. The acceleration of the particle in ms^{-2} is

(A) 5 (B) 15 (C) 25 (D) 36

13. A body of mass m hits normally a rigid wall with velocity v and returns with the same speed. The impulse experienced by the body is

(A) 0 (B) mv (C) 1.5 mv (D) 2 mv

14. 

A block of mass m is in contact with cart C as shown. The coefficient of friction between the block and the cart is μ. The acceleration a of the cart that will prevent the block from falling satisfies,

(A) $a > \frac{mg}{\mu}$ (B) $a > \frac{g}{m\mu}$ (C) $a \geq \frac{g}{\mu}$ (D) $a < \frac{g}{\mu}$

15. A man of 50 kg mass is standing in a gravity free space at a height of 10 m above the floor. He throws a stone of 0.5 kg mass downwards with a speed of 2 m/s. When the stone reaches the floor, the height of the man above the floor will be,

(A) 9.9 m (B) 10.1 m (C) 10 m (D) 20 m

16. Two particles which are initially at rest move towards each other under the action their mutual attraction. If their speeds are v and 2v at an instant, then the speed of their center of mass will be

(A) 2v (B) 1.5 v (C) v (D) 0

17. A gramophone record is revolving with an angular velocity ω. A coin is placed at a distance of r from its center. The static coefficient of friction is μ. The coin will rotate with the record if

(A) $r = \mu g \omega^2$ (B) $r < \frac{\omega^2}{\mu g}$ (C) $r < \frac{\mu g}{\omega^2}$ (D) $r \geq \frac{\mu g}{\omega^2}$

18. A ball moving with a velocity 2 m/s collides with a stationary ball of double the mass. If the coefficient of restitution is 0.5, their velocities in m/s after the collision will be

(A) 0, 1 (B) 1, 1 (C) 1, 0.5 (D) 0, 2

19. A body under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ acquires an acceleration of 1 ms^{-2}. He mass of this body in kg must be

(A) 10 (B) 20 (C) $10\sqrt{2}$ (D) $2\sqrt{10}$

20. The mass of a lift is 2000 kg. When tension in the supporting cable is 28000 N, then the acceleration of the lift in ms^{-2} is

(A) 4 upwards (B) 4 downwards (C) 14 upwards (D) 30 downwards

21. An explosion blows a rocket into 3 parts. Two of them with mass 1 kg and 2 kg go off at right angles to each other with velocities 12 m/s and 8 m/s respectively. If the third part flies off with a velocity 4 m/s, its mass would be

(A) 7 kg (B) 17 kg (C) 3 kg (D) 5 kg

22. A body of mass 1 kg is thrown upwards with a speed of 20 m/s. It momentarily comes to rest after reaching a height of 18 m. How much energy in joules is lost due to air friction (g = 10 ms^{-2})

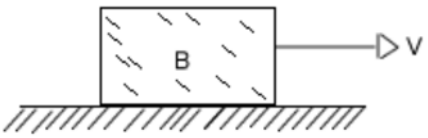
(A) 30 (B) 40 (C) 10 (D) 20

23. A shell of mass 200 g is ejected from a gun of mass 4 kg by an explosion that generates 1.05 kJ of energy. The initial velocity of the shell in m/s is

(A) 120 (B) 100 (C) 80 (D) 40

24. A roller coaster is designed such that the riders experience weightlessness as they go round the top of the hill with radius of curvature 20 m. The speed of the car at the top of the hill in m/s is in between

(A) 13 & 14 (B) 14 & 15 (C) 15 & 16 (D) 16 & 17

25. 

A block is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between the block and the surface, the block will come to rest after time t in sec equal to

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

26. A wheel has an angular acceleration of 3 rad/s^2 and an initial angular speed of 2 rad/s. In time 2 sec it will have rotated through an angle in radians equal to

(A) 4 (B) 6 (C) 10 (D) 12

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