MSN ACADEMY

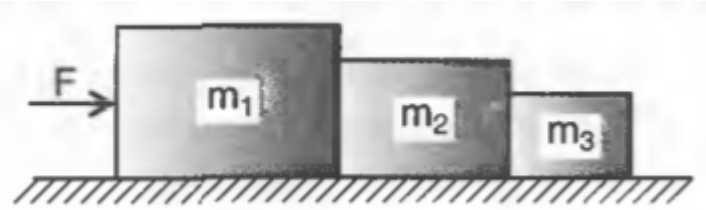
BELPAHAR, Jharsuguda, Odisha

NEWTON'S LAW OF MOTION

JEE main - Physics

Time Allowed: 3 hours **Maximum Marks: 100**

1. Three blocks of masses m_1, m_2 and m_3 kg are placed in contact with each other on a frictionless table. A force F is applied on the heaviest mass m_1; the acceleration of m_3 will be: **[4]**



a) $\frac{F}{(m_1+m_2+m_3)}$ b) $\frac{F}{(m_1+m_2)}$

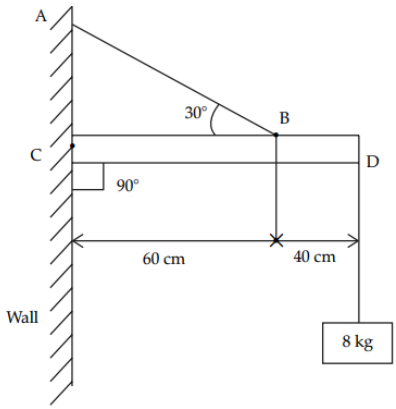
c) $\frac{F}{(m_2+m_3)}$ d) $\frac{F}{m_1}$

2. A string of length L and mass M is lying on a horizontal table. A force F is applied at one of its ends. Tension in the string at a distance y from the end at which the force is applied is: **[4]**

a) zero b) $\frac{F(L-y)}{L}$

c) $\frac{F(L-y)}{M}$ d) F

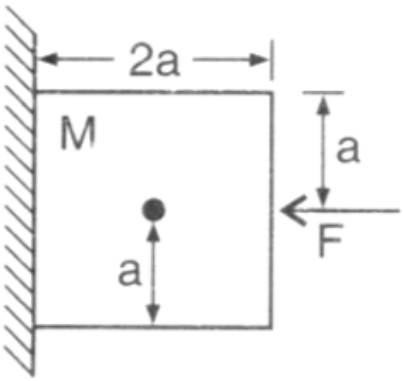
3. An object of mass 8 kg hanging from one end of a uniform rod CD of mass 2 kg and length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is: (Take $g = 10\, m/s^2$) **[4]**



a) 30 N b) 90 N

c) 240 N d) 300 N

4. In the figure shown, a cubical block is held stationary against a rough wall by applying a force 'F', then incorrect statement among the following is: **[4]**



a) F = N, N is normal reaction

b) frictional force, f = Mg

c) N does not apply any torque

d) F does not apply any torque

5. A stone tide to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed u. The magnitude of change in its velocity, as it reaches a position where the string is horizontal, is $\sqrt{x\left(u^2-gL\right)}$. The value of x is **[4]**

a) 1

b) 2

c) 3

d) 5

6. Two weights are suspended from a string thrown over a light frictionless pulley. The mass of one weight is 0.200 kg. If a heavyweight is attached to its other end, the tension in the string is: **[4]**

a) zero

b) 0.600 kgf

c) 0.400 kgf

d) 0.200 kgf

7. A small block slides down from the top of a hemisphere of radius r. It is assumed that there is no friction between the block and the hemisphere. At what height, h will the block lose contact with the surface of sphere? **[4]**

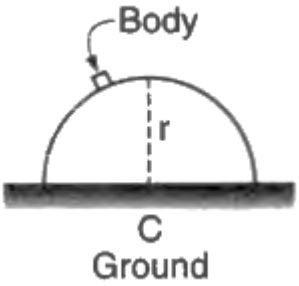
a) $\frac{r}{3}$

b) $\frac{r}{4}$

c) $\frac{r}{2}$

d) $\frac{2r}{3}$

8. A small body slides over the curved surface of a semicircular cylinder of radius r, kept horizontally on the ground as shown in the figure. At what height from the ground would the body lose contact with the surface? **[4]**



a) $\frac{3r}{4}$

b) $\frac{2r}{3}$

c) $\frac{r}{2}$

d) $\frac{2r}{5}$

9. A ball of weight W is thrown upwards with a velocity u. If air exerts an average resisting force F, the speed with which the ball returns back to the thrower is: **[4]**

a) $u\sqrt{\frac{W-F}{W+F}}$

b) $u\sqrt{\frac{W+F}{W-F}}$

c) $u\sqrt{\frac{W}{W+F}}$

d) $u\sqrt{\frac{W}{W-F}}$

10. **Statement I:** An elevator can go up or down with uniform speed when its weight is balanced with the tension of **[4]**

its cable.

Statement II: Force exerted by the floor of an elevator on the foot of a person standing on it is more than his/her weight when the elevator goes down with increasing speed.

a) Both Statement I and Statement II are false
b) Statement I is false but Statement II is true
c) Both Statement I and Statement II are true
d) Statement I is true but Statement II is false

11. A small sphere is suspended by a string from the ceiling of a car. If the car begins to move with a constant acceleration a, tension generated in the string is: **[4]**
(Where T_0 is the tension in the string when the car is at rest or moving with uniform velocity.)

a) $m\sqrt{g^2 - a^2}$
b) $m\sqrt{g^2 + a^2}$
c) $m\sqrt{g^2 + 2a^2}$
d) mg

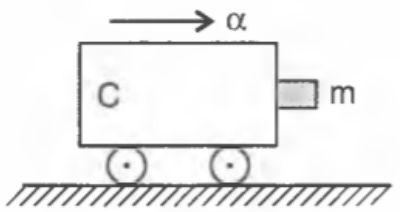
12. The time taken by an object to slide down 45° rough inclined plane is n times as it takes to slide down a perfectly smooth 45° incline plane. The coefficient of kinetic friction between the object and the incline plane is **[4]**

a) $\sqrt{1 - \frac{1}{n^2}}$
b) $1 - \frac{1}{n^2}$
c) $1 + \frac{1}{n^2}$
d) $\sqrt{\frac{1}{1-n^2}}$

13. A body is just being revolved in a vertical circle of radius R with a uniform speed. The string breaks when the body is at the highest point. The horizontal distance covered by the body after the string breaks are: **[4]**

a) R
b) 4R
c) 2R
d) $R\sqrt{2}$

14. A block of mass m is in contact with the cart C as shown in the figure. **[4]**
The coefficient of static friction between the block and the cart is μ. The acceleration α of the cart that will prevent the blocks from falling satisfies:



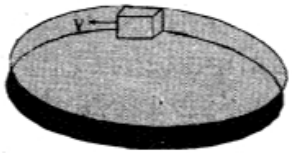
a) $\alpha < \frac{g}{\mu}$
b) $\alpha > \frac{mg}{\mu}$
c) $\alpha \geq \frac{g}{\mu}$
d) $\alpha > \frac{g}{\mu m}$

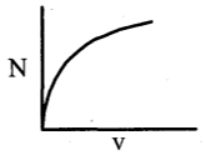
15. The water of density ρ kg/m^3 from a hosepipe of the area of cross-section **A** m^2 is emerging out with a velocity **u** m/s and strikes a wall for time **t** s. The impulse acting on the wall is: **[4]**

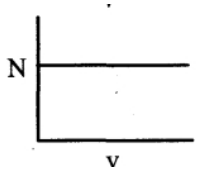
a) $\frac{Au^2t}{\rho}$
b) ρAu^2t
c) $\frac{Au\rho}{t}$
d) $\frac{Au^2}{\rho t}$

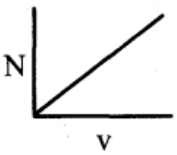
16. A smooth circular groove has a smooth vertical wall as shown in figure. A block of mass m moves against the wall with a speed v. Which of the following curve represents the correct relation between the normal reaction on **[4]**

the block by the wall (N) and speed of the block (v)?



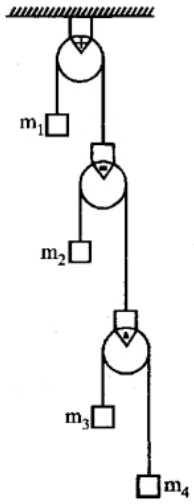
a) 

b) 

c) 

d) 

17. In the arrangement shown in figure a_1, a_2, a_3, and a_4 are the accelerations of masses m_1, m_2, m_3, and m_4 respectively. Which of the following relation is true for this arrangement? **[4]**



a) $4a_1 + 2a_2 + a_3 + a_4 = 0$

b) $a_1 + 4a_2 + 3a_3 + 2a_4 = 0$

c) $a_1 + 4a_2 + 3a_3 + a_4 = 0$

d) $2a_1 + 2a_2 + 3a_3 + a_4 = 0$

18. Two stars of masses m and $2m$ at a distance d rotate about their common centre of mass in free space. The period of revolution is **[4]**

a) $2\pi\sqrt{\frac{d^3}{3Gm}}$

b) $2\pi\sqrt{\frac{3Gm}{d^3}}$

c) $\frac{1}{2\pi}\sqrt{\frac{3Gm}{d^3}}$

d) $\frac{1}{2\pi}\sqrt{\frac{d^3}{3Gm}}$

19. A particle of mass M originally at rest is subjected to a force whose direction is constant but magnitude varies with time according to the relation **[4]**

$F = F_0\left[1 - \left(\frac{t-T}{T}\right)^2\right]$

Where F_0 and T are constants. The force acts only for the time interval 2T. The velocity v of the particle after time 2T is:

a) $F_0T/3M$

b) $4F_0T/3M$

c) $2F_0T/M$

d) $F_0T/2M$

20. A vehicle of mass m is moving on a rough horizontal road with momentum p. If the coefficient of friction **[4]**

between the tires and the road be μ, then the stopping distance is:

a) $\frac{p}{2\mu m^2 g}$ b) $\frac{p}{2\mu mg}$

c) $\frac{p^2}{2\mu mg}$ d) $\frac{p^2}{2\mu m^2 g}$

21. A body of mass m rests on a horizontal floor with which it has a coefficient of static friction μ. It is desired to make the body move by applying the minimum possible force F. The direction in which minimum force has to be applied is given by: **[4]**

a) $\theta = \tan^{-1}\left(\frac{\mu}{2}\right)$ b) $\theta = \cot^{-1}(\mu)$

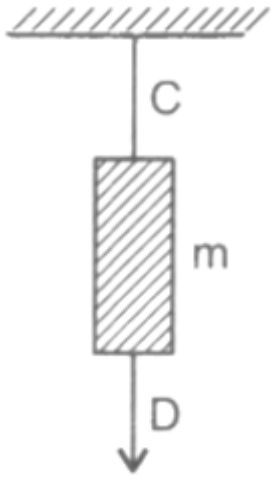
c) $\theta = \cot^{-1}\left(\frac{\mu}{2}\right)$ d) $\theta = \tan^{-1}(\mu)$

22. 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, m_3 are on a rough horizontal table (the co-efficient of friction = μ). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is (Assume $m_1 = m_2 = m_3 = m$) **[4]**

a) $\frac{g(1-2\mu)}{2}$ b) $\frac{g(1-g\mu)}{9}$

c) $\frac{2g\mu}{3}$ d) $\frac{g(1-2\mu)}{3}$

23. A block of mass m is supported by a cord C from the ceiling and another cord D is attached to the bottom of the block (see figure). If D is a pulley on steadily: **[4]**



a) Both break simultaneously b) C breaks earlier than D

c) Not possible to say which one will break earlier d) D breaks earlier than C

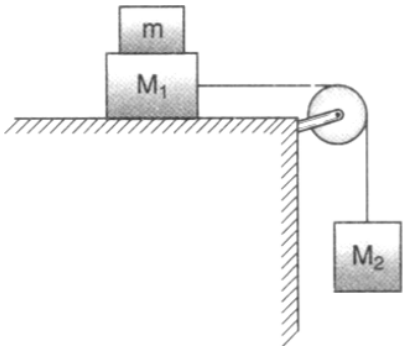
24. A block of mass m is placed on a rough floor of a lift. The coefficient of friction between the block and the floor is p. When the lift falls freely, the block is pulled horizontally on the floor. What will be the force of friction? **[4]**

a) $\frac{\mu mg}{2}$ b) μmg

c) 2μmg d) None of these

25. Two blocks of masses M_1 and M_2 are connected with a string passing over a pulley as shown in the following figure. The block M_1 lies on a horizontal surface. The coefficient of friction between the block M_1 and the horizontal surface is μ. The system accelerates. What additional mass m should be placed on the block M_1 so **[4]**

that the system does not accelerate?



a) $M_2 - \frac{M_1}{\mu}$

b) $\frac{M_2}{\mu} - M_1$

c) $\frac{M_2 - M_1}{\mu}$

d) $(M_2 - M_1)\mu$