Code: Phy/NLM-1/O/001

Newton's Laws of Motion : Objective Questions (Typical)

No of Questions:30 **Time Allotted: $1\frac{1}{2}$ Hours**

All questions are compulsory

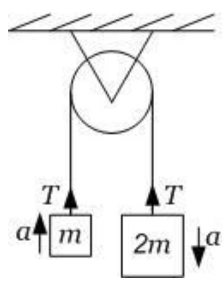
Q-01 Two trains are moving on rails, on equator in opposite directions, one from East to West and other from West to East. The force Exerted on rails by train from West to East as compared to that in opposite direction is :

(a) Greater **(b)** Lesser

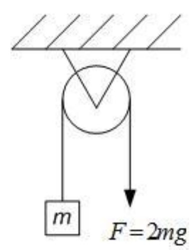
(c) Equal **(d)** Information is incomplete for answer

Q-02 Two pulley arrangement shown in the figures **(i)** and **(ii)** having rope of negligible mass. Acceleration of mass m in arrangement **(i)** is -

(i)



(ii)

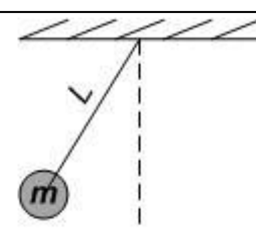


(a) Greater than in (ii) **(b)** Lesser than in (ii)

(c) (Equal to that in (ii) **(d)** Information is incomplete for answer

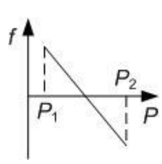
Q-03 A ball of mass 0.5 kg is attached to the end of a string of length 0.5 m. The ball is rotated on a horizontal circular path about its vertical line of free suspension. Maximum tension that string can bear is 324 N. Maximum possible value of angular velocity of ball is -

(a) $9\ rad \cdot \sec^{-1}$ **(b)** $18\ rad \cdot \sec^{-1}$ **(c)** $27\ rad \cdot \sec^{-1}$ **(d)** $36\ rad \cdot \sec^{-1}$

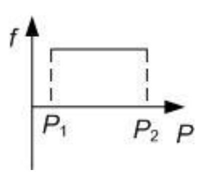


Q-04 A block of mass m is on a plane inclined at an angle θ with horizontal. Coefficient of friction between the block and the plane is μ and $tan\theta = \mu$. The block is held stationary by applying a force P parallel to the plane. As P is varied from $P_1 = mg(sin\theta - \mu\, cos\theta)$ to $P_1 = mg(sin\theta + \mu\, cos\theta)$ the frictional force f varies P as shown in -

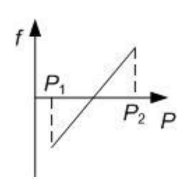
(a)



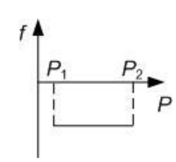
(b)

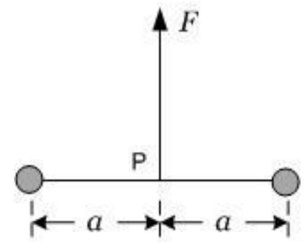
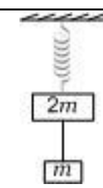
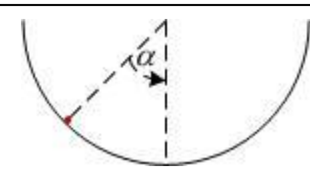
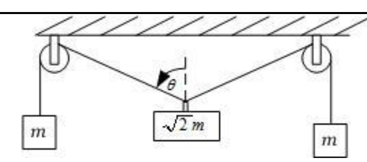
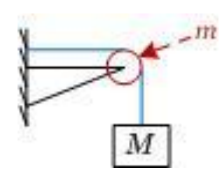


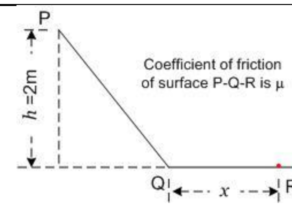
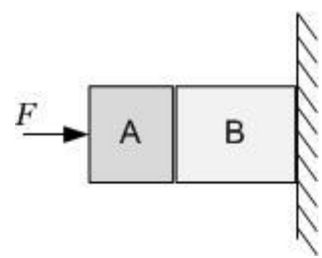
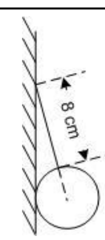
(c)

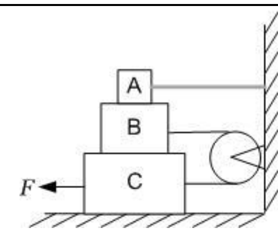
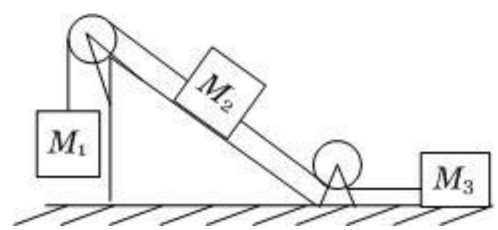


(d)



Q-05	A piece of wire is bent in the shape of a parabola $y = kx^2$ where X-axis is horizontal and Y-axis is vertical. A bead of mass m on it can slide without friction. The bead is at lowest position when the wire stays at rest. The wire-bead arrangement is now is now given an acceleration a parallel to X-axis. The bead shall be shall be in equilibrium w.r.t wire after a displacement - **(a)** $\frac{a}{gk}$ **(b)** $\frac{a}{2gk}$ **(c)** $\frac{2a}{gk}$ **(d)** $\frac{a}{4gk}$
Q-06	A particle moves in X-Y plane under the influence of a force such that its linear momentum is $\vec{p} = A[\cos(kt)\,\hat{\imath} - \sin(kt)\,\hat{\jmath}]$. where A and k are constants. The angle between the force and the momentum is- **(a)** 0^0 **(b)** 30^0 **(c)** 45^0 **(d)** 90^0
Q-07	Two particles of mass m each are tied at ends of a light string of length $2a$. The whole system is kept on a friction-less horizontal surface with the string held straight so that each mass is at a distance a from its center P. Now the mid point of the string is pulled vertically upward with a small constant force F such that particles move towards each other on the surface. the magnitude of acceleration, when the separation, when distance between the Two balls becomes $2x$ is -  **(a)** $\frac{F}{2m}\cdot\frac{a}{\sqrt{a^2-x^2}}$ **(b)** $\frac{F}{2m}\cdot\frac{x}{\sqrt{a^2-x^2}}$ **(c)** $\frac{F}{2m}\cdot\frac{x}{a}$ **(d)** $\frac{F}{2m}\cdot\frac{\sqrt{a^2-x^2}}{x}$
Q-08	Two blocks A and B of masses $2m$ and m, respectively, are connected by a mass-less and in-extensible string. The whole system is suspended by a mass-less spring as shown in the figure. Magnitude of acceleration of A and B, immediately after the string is cut, respectively, are –  **(a)** $g, \frac{g}{2}$ **(b)** $\frac{g}{2}, g$ **(c)** g, g **(d)** $\frac{g}{2}, \frac{g}{2}$
Q-09	An insect crawls up a hemispherical surface slowly, as shown in the figure. The coefficient of friction between the surface and insect is $\frac{1}{3}$. If the line joining the center of the hemisphere to the insect makes an $\angle\theta$ with the vertical, then insect can crawl upto maximum possible value of $\angle\theta$ is –  **(a)** $\cot^{-1} 3$ **(b)** $\tan^{-1} 3$ **(c)** $\sec^{-1} 3$ **(d)** $\text{cosec}^{-1} 3$
Q-10	A system of pulleys and string of negligible mass. System shall remain in equilibrium when $\angle\theta$ is -  **(a)** 0^0 **(b)** 30^0 **(c)** 45^0 **(d)** 60^0
Q-11	A pulley of mass m is pivoted on a clamp as shown in the figure. A string of negligible mass with a mass of M tied at one end passes over the pulley and its other end is tied to wall. The force of reaction offered by the clamp on pulley is –  **(a)** $\sqrt{2}Mg$ (b) $\sqrt{2}mg$ (c) $\sqrt{(M+m)^2+m^2}\cdot g$ (d) $\sqrt{(M+m)^2+M^2}\cdot g$
Q-12	A long horizontal rod is at rest, has a bead which can slide along its length, and initially placed at a distance L from one end A of the rod. The rod is set in a horizontal angular acceleration α. If coefficient of friction between the rod and bead is μ, and gravity is neglected, then the time after which the bead starts slipping is – **(a)** $\sqrt{\frac{\mu}{\alpha}}$ **(b)** $\frac{\mu}{\sqrt{\alpha}}$ **(c)** $\frac{1}{\sqrt{\mu\alpha}}$ **(d)** Infinitesimal

Q-13	A block of mass 100 gm is held against a wall by applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.5. The magnitude of frictional force acting on the block is – **(a)** 2.5 N **(b)** 0.98 N **(c)** 4.9 N **(d)** 0.49 N
Q-14	A car is moving on a circular-horizontal track of radius 10 m with constant speed of 10 ms^{-1}. A plumb bob is suspended from the roof of the car by a light thread of length 1.0 m. The angle made by the rod with track is – **(a)** Zero **(b)** 30^0 **(c)** 45^0**(d)** 30^0
Q-15	A ship of mass 3×10^7kg initially at set is pulled by a force 5×10^4N through a distance of 3 m. Assuming that the resistance due to water is negligible, the speed of the ship is - **(a)** 1.5 ms^{-1} **(b)** 60 ms^{-1} **(c)** 0.1 ms^{-1} **(d)** 5 ms^{-1}
Q-16	A particle of mass m moves along a track P-Q-R which is uniformly rough as shown in the figure. The coefficient of friction, between the particle and the track is μ. The particle is released, from rest, from the point P and it comes to rest at a point R. The energies lost by the ball over parts of the track P-Q and Q-R are equal and no other loss of energy along the track P-Q-R. The values of μ and distance x are, respectively close to -  **(a)** 0.2 and 3.5 m **(b)** 0.29 and 3.5 m **(c)** 0.29 and 6.5 m **(d)** 0.2 and 6.5 m
Q-17	Given in the figure are Two blocks A and B of weight 20 N and 100 N, respectively. These are being pressed against a wall by a force F as shown. If the coefficient of friction between blocks is 0.1 and between Block B and the wall is 0.15, the frictional force applied by the wall on the block is -  a) 80 N **(b)**120 N **(c)** 150 N **(d)** 120 N
Q-18	A heavy box is to pushed along a rough horizontal floor, for which a person A pushes it with a force F_A at an angle 30^0 and other person B pushes it with a force F_A at an angle 60^0. If coefficient of friction between the box and the floor is $\frac{\sqrt{3}}{5}$ then ratio $\frac{F_A}{F_B}$ is - ***(a)*** $\sqrt{3}$ **(b)** $\frac{5}{\sqrt{3}}$ **(c)** $\sqrt{\frac{3}{2}}$ **(d)** $\frac{1}{2\sqrt{3}}$
Q-20	A block of mass 5 kg is acted upon by a force $\vec{F} = F_x\hat{\imath} + F_y\hat{\jmath}$ has at $t = 0$ a velocity $\vec{v} = 6\hat{\imath} - 2\hat{\jmath}$ ms^{-1} and velocity at at $t = 10$s is $\vec{v} = 6\hat{\jmath}$. Then the Force $\vec{F}$ is – **(a)** $\frac{3}{5}\hat{\imath} - \frac{4}{5}\hat{\jmath}$ N **(b)** $-3\hat{\imath} + 4\hat{\jmath}$ N **(c)** $3\hat{\imath} - 4\hat{\jmath}$ N **(d)** $-\frac{3}{5}\hat{\imath} + \frac{4}{5}\hat{\jmath}$ N
Q-21	A uniform sphere of weight W and radius 5 cm is being held by a string as shown in the figure. The tension in the string will be – **(a)** $\frac{12}{3}W$ **(b)** $\frac{5}{12}W$ **(c)** $\frac{13}{5}W$ **(d)** $\frac{13}{12}W$ 

Q-22	A particle in unform circular motion at a speed V on a circle of radius R, with its center at $(0,0)$, at a point $P(R,\theta)$, polar coordinates, is experiencing an acceleration $\vec{a}$ equal to – **(a)** $-\frac{V^2}{R}\cos\theta\,\hat{\imath}+\frac{V^2}{R}\sin\theta\,\hat{\jmath}$ **(b)** $-\frac{V^2}{R}\sin\theta\,\hat{\imath}+\frac{V^2}{R}\cos\theta\,\hat{\jmath}$ **(c)** $-\frac{V^2}{R}\cos\theta\,\hat{\imath}-\frac{V^2}{R}\sin\theta\,\hat{\jmath}$ **(d)** $\frac{V^2}{R}\hat{\imath}+\frac{V^2}{R}\hat{\jmath}$
Q-23	A smooth block is released at rest on a 45^0 incline and then slides a distance d. The time taken to slide is n times as much to the slide on a rough incline. The coefficient of friction of rough incline is – **(a)** $\mu_k = 1-\frac{1}{n^2}$ **(b)** $\mu_k = \sqrt{1-\frac{1}{n^2}}$ **(c)** $\mu_s = 1-\frac{1}{n^2}$ **(d)** $\mu_s = \sqrt{1-\frac{1}{n^2}}$
Q-24	As shown in the figure the Blocks A, B, and C are of masses 3 kg, 4 kg and 8 kg respectively. The coeffecient of sliding friction between any two surfaces is 0.25. A is held at rest by a massless rigid rod fixed to the wall., while B and C are connected by a light flexible cord passing around a fixed frictionless pulley. Assume that the arrangement shown in figure remains unchanged during the exeriment. The n the orce F necessary to drag C along horizontal surface to the left at a constant speed is –  **(a)** 40 N **(b)** 60N **(c)** 80 N **(d)** 100 N
Q-25	Masses M_1, M_2 and M_3 are connected by massless strings passing over passless and frictionless pulleys P_1 and P_2 as shwn in the figure. The masses move such that the portion of the string between P_1 and P_2 is parallel to the inclined plane and the portion of the string between P_2 and M_2 are horizontal. The masses M_2 and M_3 are 4.0 kg each and the coefficient of kinetic friction masses and the surface is 0.25. Then inclination of plane is 27^0 and mass M_1 moves downwards with a uniform velocity then, mass M_1 and tension in horizontal portion of the string (given that $g = 10\,\text{Nms}^{-2}$ $\sin 37^0 = 0.6$) are -  **(a)** 10 kg, 4.2 N **(b)** 5 kg, **(c)** **(d)** 4.2 kg, 10 N