04 - LAWS OF MOTION

(Answers at the end of all questions)

1) A smooth block is released at rest on a 45° incline and then slides a distance 'd'. The time taken to slide is 'n' times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

(a) $\mu_k = \sqrt{1 - \frac{1}{n^2}}$ (b) $\mu_k = 1 - \frac{1}{n^2}$ (c) $\mu_s = \sqrt{1 - \frac{1}{n^2}}$ (d) $\mu_s = 1 - \frac{1}{n^2}$

[AIEEE 2005]

2) The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by

(a) $2 \cos \phi$ (b) $2 \sin \phi$ (c) $\tan \phi$ (d) $2 \tan \phi$ [AIEEE 2005]

3) A particle of mass 0.3 kg is subjected to a force $F = -kx$ with $k = 15$ N / m. What will be its initial acceleration if it is released from a point 20 cm away from the origin ?

(a) 15 m/s^2 (b) 3 m/s^2 (c) 10 m/s^2 (d) 5 m/s^2 [AIEEE 2005]

4) Consider a car moving on a straight road with a speed of 100 m /s. The distance at which car can be stopped is [$\mu_k = 0.5$]

(a) 1000 m (b) 800 m (c) 400 m (d) 100 m [AIEEE 2005]

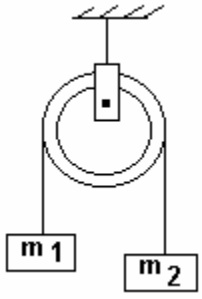
5) A machine gun fires a bullet of mass 40 g with a velocity of 1200 ms^{-1}. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most ?

(a) one (b) four (c) two (d) three [AIEEE 2004]

6) Two masses $m_1 = 5$ kg and $m_2 = 4.8$ kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when lift is free to move ? ($g = 9.8\ m/s^2$)

(a) 0.2 m/s^2 (b) 9.8 m/s^2
(b) 5 m/s^2 (d) 4.8 m/s^2

[AIEEE 2004]



7) A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take $g = 10\ m/s^2$)

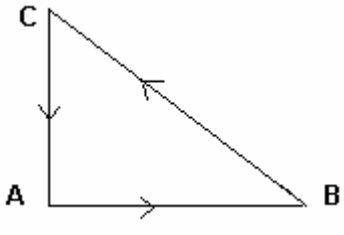
(a) 2.0 (b) 4.0 (c) 1.6 (d) 2.5 [AIEEE 2004]

8) Three forces start acting simultaneously on a particle moving with velocity $\vec{v}$. These forces are represented in magnitude and direction by the three sides of a triangle ABC as shown in the figure. The particle will now move with velocity

(a) less than $\vec{v}$ (b) greater than $\vec{v}$

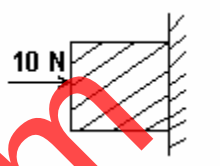
(c) $\vec{v}$ remaining unchanged

(d) $|\vec{v}|$ in the direction of the largest force BC



[AIEEE 2003]

9) A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is



(a) 2 N (b) 20 N (c) 50 N (d) 100 N [AIEEE 2003]

10) A marble block of mass 2 kg lying on ice when given a velocity of 6 m / s is stopped by friction in 10 sec. Then the coefficient of friction is
(Take g = 10 m/s^2)
(a) 0.01 (b) 0.02 (c) 0.03 (d) 0.04
[NOTE: All these answers are incorrect. Get correct answer yourself] [AIEEE 2003]

11) A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time t is proportional to
(a) $t^{1/2}$ (b) $t^{3/4}$ (c) $t^{3/2}$ (d) $t^{1/4}$ [AIEEE 2003]

12) A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N, when the lift is stationary. If the lift moves downwards with an acceleration of 5 m/s^2, the reading of the spring balance will be
(a) 15 N (b) 24 N (c) 49 N (d) 74 N [AIEEE 2003]

13) A rocket with a lift-off mass of 3.5×10^4 kg is blasted upwards with an acceleration of 10 m/s^2. The initial thrust of the blast is (take g = 10 m/s^2)
(a) 1.75×10^5 N (b) 3.5×10^5 N (c) 7.0×10^5 N (d) 14.0×10^5 N [AIEEE 2003]

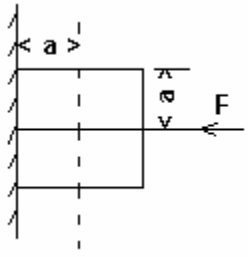
14) A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, then force exerted by the rope on the block is

(a) P (b) $\frac{Pm}{M+m}$ (c) $\frac{Pm}{M-m}$ (d) $\frac{PM}{M+m}$ [AIEEE 2003]

15) A box is lying on an inclined plane. If the box starts sliding when the angle of inclination is 60°, then the coefficient of static friction of the box and the plane is
(a) 2.732 (b) 1.732 (c) 0.267 (d) 0.176 [AIEEE 2002]

16) If the force on a rocket moving with a velocity of 300 m / s is 210 N, then the rate of fuel combustion is
(a) 0.7 kg / s (b) 1.4 kg / s (c) 2.8 kg / s (d) 10.7 kg / s [AIEEE 2002]

17) A force F is applied on the square block of edge length 2a so that the block remains stationary on the vertical wall. Then the incorrect statement is

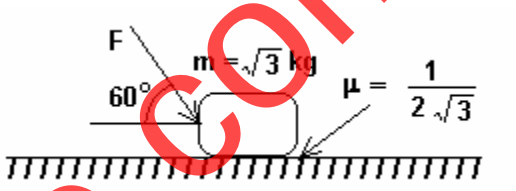


(a) f = mg, where f is the frictional force
(b) F = N where N is the normal reaction from the wall
(c) F does not produce any torque
(d) N does not produce any torque [IIT 2005]

18) A small block slides without friction down an inclined plane starting from rest. Let s_n be the distance traveled from time t = n - 1 to t = n. Then $\frac{s_n}{s_{n+1}}$ is

(a) $\frac{2n - 1}{2n}$ (b) $\frac{2n + 1}{2n - 1}$ (c) $\frac{2n - 1}{2n + 1}$ (d) $\frac{2n}{2n + 1}$ [IIT 2004]

19) What is the maximum value of the force F such that the block shown in the arrangement, does not move ?

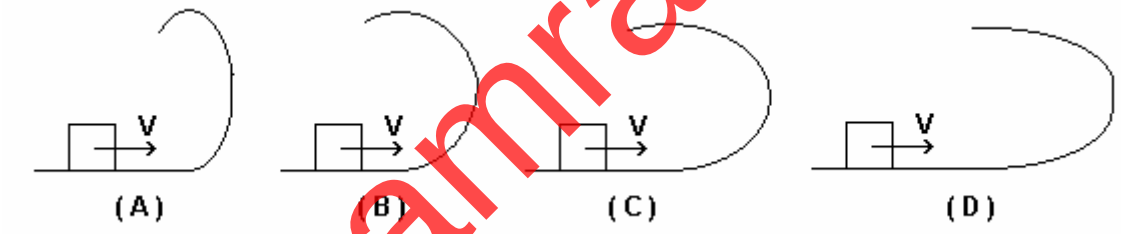


(a) 20 N (b) 10 N
(c) 12 N (d) 15 N

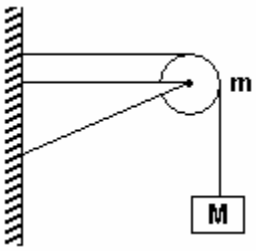
[IIT 2003]

20) A small block is shot into each of the four tracks as shown below. Each of the track rises through the same height. The speed with which the block enters the track is the same in all cases. At the highest point of the track, the normal reaction is maximum in:

[IIT 2001]



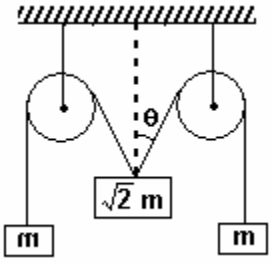
21) A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by:



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

[IIT 2001]

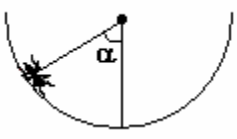
22) The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be



(a) 0° (b) 30° (c) 45° (d) 60°

[IIT 2001]

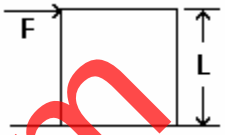
23) An insect crawls up a hemispherical surface very slowly (see the figure). The coefficient of friction between the surface and the insect is 1/3. If the line joining the centre of the hemispherical surface to the insect makes an angle α with the vertical, the maximum possible value of α is given by



(a) cot α = 3 (b) tan α = 3 (c) sec α = 3 (d) cosec α = 3

[IIT 2001]

24) A cubical block of side L rests on a rough horizontal surface with coefficient of friction μ. A horizontal force F is applied on the block as shown. If the coefficient of friction is sufficiently high so that the block does not slide before toppling, the minimum force required to topple the block is



(a) infinitesimal (b) $\frac{mg}{4}$ (c) $\frac{mg}{2}$ (d) $mg(1-\mu)$

[IIT 2000]

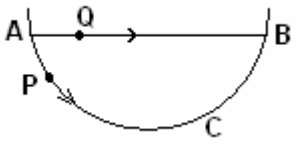
25) A closed compartment containing gas is moving with some acceleration in horizontal direction. Neglect effect of gravity. Then the pressure in the compartment is

(a) same everywhere (b) lower in front side
(c) lower in rear side (d) lower in upper side [IIT 1999]

26) A block of mass 0.1 kg 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 the frictional force acting on the block is

(a) 2.5 N (b) 0.98 N (c) 4.9 N (d) 0.49 N [IIT 1994]

27) A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at t = 0. At this instant of time, the horizontal component of its velocity is v. Friction between the bead and the string may be neglected. Let t_p and t_q be the respective times taken by P and Q to reach the point B. Then



(a) $t_p < t_q$ (b) $t_p = t_q$ (c) $t_p > t_q$ (d) $\frac{t_p}{t_q} = \frac{\text{length of arc ACB}}{\text{length of chord AB}}$ [IIT 1993]

28) A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m / s. A plumb bob is suspended from the roof of the car by a light rigid rod of length 1.00 m. The angle made by the rod with the track is

(a) zero (b) 30° (c) 45° (d) 60° [IIT 1992]

29) When a bicycle is in motion, the force of friction exerted by the ground on the two wheels is such that it acts

(a) in the backward direction on the front wheel and in the forward direction on the rear wheel
(b) in the forward direction on the front wheel and in the backward direction on the rear wheel
(c) in the backward direction on both the front and the rear wheels
(d) in the forward direction on both the front and the rear wheels [IIT 1990]

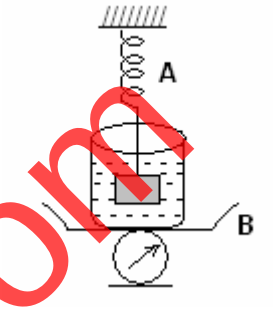
30) A reference frame attached to the earth:

(a) is an inertial frame by definition
(b) cannot be an inertial frame because the earth is revolving round the sun
(c) is an inertial frame because Newton's laws are applicable in this frame
(d) cannot be an inertial frame because the earth is rotating about its own axis

[IIT 1986]

(Answers at the end of all questions)

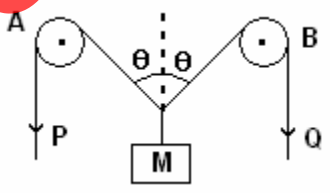
31) The spring balance A reads 2 kg with a block m suspended from it. A balance B reads 5 kg when a beaker with liquid is put on the pan of the balance. The two balances are now so arranged that the hanging mass is inside the liquid in the beaker as shown in the figure. In this situation



(a) the balance A will read more than 2 kg
(b) the balance B will read more than 5 kg
(c) the balance A will read less than 2 kg and B will read more than 5 kg
(d) the balance A and B will read 2 kg and 5 kg respectively

[IIT 1985]

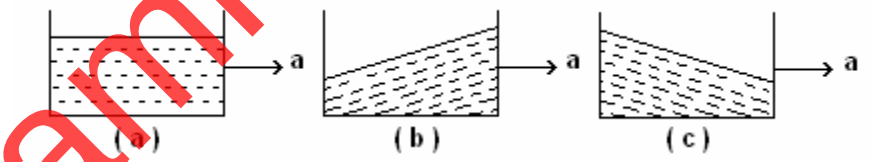
32) In the arrangement shown in the figure,the ends P and Q of an unstretchable string move downwards with uniform speed U. Pulleys A and B are fixed. Mass M moves upwards with a speed



(a) 2 U cos θ (b) U /cos θ
(c) 2 U / cos θ (d) U cos θ

[IIT 1982]

33) A vessel containing water is given a constant acceleration a towards the right, along a straight horizontal path. Which of the diagrams represents the surface of the liquid ?



[IIT 1981]

34) A ship of mass 3×10^7 kg, initially at rest, is pulled by a force of 5×10^4 N through a distance of 3 m. Assuming that the resistance due to water is negligible, the speed of the ship is

(a) 1.5 m / s (b) 60 m / s (c) 0.1 m / s (d) 5 m / s [IIT 1980]

35) A block of mass 2 kg rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between he block and the plane is 0.7. The frictional force on the block is

(a) 9.8 N (b) 0.7 x 9.8 x √3 N (c) 9.8 x √3 N (d) 0.7 x 9.8 N [IIT 1980]

Answers

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
b	d	c	a	d	a	a	c	a	#	c	b	c	d	b	a	d	c	a	a

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
d	c	a	c	b	b	a	c	a,c	b,d	b,c	b	c	c	d

All answers are incorrect. The correct answer is 0.06.