PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

LAWS OF MOTION

Jee Main 5 Years At A Glance

1. A disc rotates about its aixs of symmetry in a horizontal plane at a steady rate of 3.5

revolutions per second A coin placed at a distance fo 1.25 cm form the axis of ratation remains at rest on the disc The coefficient of friction between the coin and the disc is : $\left(g = 10/s^2\right)$

A. 0.5

B. 0.7

C. 0.3

D. 0.6

Answer: D

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2. A given object taken n time more time to slide down 45° rough inclined plane as it taken to slide down a perfectly smooth 45° incline The coefficient of kintic friction between the object and the incline is .

A. $\sqrt{1-\frac{1}{n^2}}$

B. $1-\frac{1}{n^2}$

C. $\frac{1}{2-n^2}$

D. $\sqrt{\frac{1}{1-n^2}}$

Answer: B

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3. Two masses $m_1 = 5kg$ and $m_2 = 10kg$, connected by an inextensible string over a frictionless pulley, are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. The minimum weight m that should be put on top of my to stop the motion is:

A. 18.3 kg

B. 27.3 kg

C. 43.3 kg

D. 10.3 kg

Answer: B

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4. A conical pendulum of length 1 m makes an anlge $\theta = 45^\circ$ w.r.t. Z-axis and moves in a circle in the XY plane. The radius of the circle is

0.4 m and its centre is vertically below O. The speed of the pendulum, in its circular path, will be :(Take $= 10ms^{-2}$)

A. 0.4m/s

B. 4m/s

C. 0.2m/s

D. 2m/s

Answer: D

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5. Two blocks A and B of masses 3 m and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively: [2017]

A. $\frac{g}{3}, g$

B. g,g

C. $\frac{g}{3}, \frac{g}{3}$

D. $g, \frac{g}{3}$

Answer: A

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6. A rocket is fired vertically from the earth with an acceleration of 2g, where g is the gravitational acceleration. On an inclined plane inside the tocket, making an angle θ with the horizontal, a point object of mass m

is kept, the minimum coefficient of friction $\mu_{\min}$ between the mass and the inclined suface such that the mass does not move is:

A. $\tan 2\theta$

B. $\tan \theta$

C. $\tan \theta$

D. $2 \tan \theta$

Answer: B

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7. 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 the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is:

A. 120N

B. 150N

C. 100N

D. 80N

Answer: A

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8. A body of mass 5 kg under the action of constant force $\vec{F} = F_x\hat{i} + F_y\hat{j}$ has velocity at t=0 s as $\vec{v} = \left(6\hat{i} - 2\hat{j}\right)$ m/s and at t=10s as $\vec{v} = +6\hat{j}$ m/s. The force $\vec{F}$ is:

A. $\left(-3\hat{i} + 4\hat{j}\right)N$

B. $\left(-\frac{3}{5}\hat{i}+\frac{4}{5}\hat{j}\right)N$

C. $\left(3\hat{i}-4\hat{j}\right)N$

D. $\left(\frac{3}{5}\hat{i}-\frac{4}{5}\hat{j}\right)N$

Answer: A

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9. A balloon with mass m is descending down with an acceleration a $(wherea < g)$. How much mass should be removed from it so that it starts moving up with an acceleration a?

A. $\frac{2ma}{g+a}$

B. $\frac{2ma}{g-a}$

C. $\frac{ma}{g+a}$

D. $\frac{ma}{g-a}$

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 1 I Il Illrd Laws Of Motion

1. An object will continue moving uniformly until

A. on it is increasing continuously

B. is at right angles to its rotation

C. on it is zero

D. on it begins to decrease

Answer: C

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2. When a body is stationary :

A. there is no force acting on it

B. the force acting on it is not in contact with it

C. the combination of forces acting on it balances each other

D. the body is in vacuum

Answer: C

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

A. $15m/s^2$

B. $3m/s^2$

C. $10m/s^2$

D. $5m/s^2$

Answer: C

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4. If a ship of mass 4×10^7 kg initially at rest is pulled by a force of 5×10^4 N through a distance of 4 m, then the speed of the ship will be (resistance due to water is negligible)

A. 1.5 m/sec

B. 60m/sec.

C. 0.1m/sec.

D. 5m/sec.

Answer: C

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5. A 600 kg rocket is set for vertical firing. If the exhaust speed is 1000m/s, the mass of the gas ejected per second to supply the thrust needed to overcome the weight of rocket is

A. $117.6kgs^{-1}$

B. $58.6kgs^{-1}$

C. $6kgs^{-1}$

D. $76.\ kgs^{-1}$

Answer: C

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6. An object of mass 20 kg moves at a constant speed of $5ms^{-1}$. A constant force, that acts for 2 sec on the object, gives it a speed of $3ms^{-1}$ in opposite direction. The force acting on the object is

A. 8N

B. $-80N$

C. $-8N$

D. 80N

Answer: B

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7. A satellite in a force - free space sweeps stationary interplanetary dust at a rate $dM/dt = \alpha v$, where M is the mass , $v$is the

velocity of the satellite and α is a constant. What is the deacceleration of the satellite ?

A. $\frac{-2\alpha v^2}{M}$

B. $\frac{-\alpha v^2}{M}$

C. $\frac{-\alpha v^2}{2M}$

D. $-\alpha v^2$

Answer: B

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8. A jet plane flies in the air because

A. the gravity does not act on bodies moving with high speeds

B. the thrust of the jet compensates for the force of gravity

C. the flow of air around the wings causes an upward force, which compensates for the force of gravity

D. the weight of air whose volume is equal to the volume of the plane is more than the weight of the plane

Answer: D

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9. A player stops a football weighing 0.5 kg which comes flying towards him with a velocity of $10m/s$. If the impact lasts for $1/50$th sec.

and the ball bounces back with a velocity of 15 m/s, then the average force involved is

A. 250N

B. 1250N

C. 500N

D. 625N

Answer: D

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10. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force. (Consider $g = 10m/s^2$).

A. 4 N

B. 16 N

C. 20 N

D. 22N

Answer: D

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11. A block of mass kg 5 is moving horizontally at a speed of $1.5m/s$. A perpendicular force of 5 N acts on it for 4 sec. What will be the distance of the block from the point where the force started acting

A. 2m

B. 6m,

C. 8m

D. 10m

Answer: D

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12. A boy sitting on the top most berth in the compartment of a train which is just going to stop on railway station, drops and apple aiming at the open hand of his brother

situated vertically below his hands at a distance of about 2m. The apple will fail

A. in the hand of his brother

B. slightly away from the hand of his brother in the direction of motion of the train

C. slightly away from the hand of his brother opposite to the direction of motion of the train

D. None of the above

Answer: B

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13. A particle of mass 10 kg is moving in a straight line. If its displacement, x with time tis given by $x = \left(t^3 - 2t - 10\right)m$ then the force acting on it at the end of 4 seconds is

A. 24N

B. 240N

C. 300N

D. 1200N

Answer: B

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14. Three forces start acting simultaneously on a particle moving with velocity, $\overrightarrow{v}$. These forces are represented in magnitude and direction by the three sides of a triangle ABC. The particle will now move with velocity

A. less than $\vec{v}$

B. greater than $\vec{v}$

C. $\left|\vec{v}\right|$ in the direction of the largest forec

BC

D. $\vec{v}$, remaining unchanged

Answer: D

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And Impulse

1. A particle of mass m is moving with a uniform velocity v_1. It is given an impulse such that its velocity becomes v_2. The impulse is equal to

A. $m\left(\overrightarrow{v}_2 - \overrightarrow{v}_1\right)$

B. $m\left(\overrightarrow{v}_1 - \overrightarrow{v}_2\right)$

C. $1.5m \times \left(\overrightarrow{v}_2 - \overrightarrow{v}_1\right)$

D. $0.5m\left(\overrightarrow{v}_2 - \overrightarrow{v}_1\right)$

Answer: A

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2. A hammer weighing 3 kg strikes the head of a nail with a speed of $2ms^{-1}$ drives it by 1 cm into the wall. The impulse imparted to the wall is

A. 6Ns

B. 3Ns

C. 2Ns

D. 12Ns

Answer: A

3. A ball is thrown up at an angle with the horizontal. Then the total change of momentum by the instant it returns to ground is

A. acceleration due to gravity $\times$ total time of flight

B. weight of the ball $\times$ half the time of flight

C. weight of the ball $\times$ total time of flight

D. weight of the ball $\times$ horizontal range

Answer: C

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4. A machine gun has a mass 5 kg. It fires 50 gram bullets at the rate of 30 bullets per minute at a speed of $400 \ \mathrm{m\,s^{-1}}$. What force is required to keep the gun in positon ?

A. 10 N

B. 5 N

C. 15 N

D. 30 N

Answer: A

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5. A force time graph for the motion of a body is shown in Fig. Change in linear momentum between 0 and 8s is

A. zero

B. 4 N-s

C. 8 Ns

D. None of these

Answer: A

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6. An object at rest in space suddenly explodes into three parts of same mass. The momentum of the two parts are $2p\hat{i}$ and $p\hat{j}$. The momentum of the third part

A. will have a magnitude $p\sqrt{3}$

B. will have a magnitude $p\sqrt{5}$

C. will have a magnitude p

D. will have a magnitude 2p.

Answer: B

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7. A 50 kg ice skater, initially at rest, throws a 0.15 kg snowball with a speed of 35 m/s. What is the approximate recoil speed of the skater?

A. 0.10 m/s

B. 0.20 m/s

C. 0.70 m/s

D. 1.4 m/s

Answer: A

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8. A bag of sand of mass m is suspended by a rope. A bullet of mass $\frac{m}{20}$ is fired at it with a velocity vand gets embedded into it. The velocity of the bag finally is

A. $\frac{v}{20} \times 21$

B. $\frac{20v}{21}$

C. $\frac{v}{20}$

D. $\frac{v}{21}$

Answer: A

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9. A ball of mass m falls vertically to the ground from a height h_1 and rebound to a

height h_2. The change in momentum of the ball on striking the ground is.

A. $m\sqrt{2}g(h_1 + h_2)$

B. $m\sqrt{2g(m_1 + m_2)}\Big)$

C. $mg(h_1 - h_2)$

D. $m\left(\sqrt{2gh_1} - \sqrt{2gh_2}\right)$

Answer: D

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10. A ball of mass 10 g moving perpendicular to the plane of the wall strikes it and rebounds in the same line with the same velocity. If the impulse experienced by the wall is 0.54 Ns, the velocity of the ball is

A. $27ms^{-1}$

B. $3.7ms^{-1}$

C. $54ms^{-1}$

D. $37ms^{-1}$

Answer: A

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11. The rate of mass of the gas emitted from the rear of a rocket is initially $0.1kg/s$. If the speed of the gas relative to the rocket is $50m/s$ and the mass of the rocket is $2kg$, then the acceleration of the rocket in m/s^2 is

A. 5

B. 5.2

C. 2.5

D. 25

Answer: C

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12. The linear momentum p of a body moving in one dimension varies with time according to the equation $p = a + bt^2$, where a and b are positive constants. The net force acting on the body is

A. proportional to t^2

B. a constant

C. proportional to t

D. inversely proportional to t

Answer: C

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13. A balloon has $8g$ of air A small hole is pierced into it The air escapes at a unifrom rate of $7cm/s$ If the ballon shrinks in $5.6s$ then the average force acting on the ballon is.

A. $10^{-4}N$

B. $10^{-2}dy \neq$

C. 56 dyne

D. $10^{-6}N$

Answer: A

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14. An object of mass 3m splits into three equal fragments. Two fragments have

velocities $v\hat{j}$ and $v\hat{i}$. The velocity of the third fragment is

A. $v\left(\hat{j}-\hat{i}\right)$

B. $v\left(\hat{i}-\hat{j}\right)$

C. $v\left(\hat{i}+\hat{j}\right)$

D. $\frac{v\left(\hat{i}+\hat{j}\right)}{\sqrt{2}}$

Answer: D

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15. A shell at rest at the origin explodes into three fragments of masses 1 kg, 2 kg and m kg. Thel kg and 2 kg pieces fly off with speeds of 12 m/s along X-axis and 16 m/s along y-axis respectively. If the m kg piece flies off with a speed of 40 m/s, the total mass of the shell must be

A. 3.8 kg

B. 4kg

C. 4.5 kg

D. 5 kg

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 3 Equilibrium Of Forces Motion Of Connected Bodies And Pulley

1. A rope of length 4 m having mass 1.5 kg/m lying on a horizontal frictionless surface is pulled at one end by a force of 12N. What is

the tension in the rope at a point 1.6 m from the other end?

A. 5N

B. 4.8N

C. 7.2N

D. 6N

Answer: B

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2. 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, the force exerted by the rope on the block is

A. $\frac{Pm}{M+m}$

B. $\frac{Pm}{M-m}$

C. P

D. $\frac{PM}{M+m}$

Answer: D

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3. Two mass m and 2m are attached with each other by a rope passing over a frictionless and massless pulley. If the pulley is accelerated upwards with an acceleration 'a', what is the value of tension?

A. $\frac{g+a}{3}$

B. $\frac{g-a}{3}$

C. $\frac{4m(g+a)}{3}$

D. $\frac{m(g-a)}{3}$

Answer: C

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4. A lift is moving down with acceleration a. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively

A. g.g

B. g-a,g-a

C. g-a,g

D. a,g

Answer: C

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5. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49N, when the lift is stationary. If the lift moves downward with an

acceleration of $5m/2^2$, the reading of the spring balance will be

A. 24N

B. 74N

C. 15N

D. 49N

Answer: A

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6. A triangular block of mass M with angle 30 , 60 , 90 rests with its 30 – 90 side on a horizontal smooth fixed table. A cubical block of mass m rests on the 60 – 30 sideofthe triangular block. What horizontal acceleration a must M have relative to the stationary table so that m remains stationary with respect to the triangular block [M = 9 kg, m = 1 kg]

A. g

B. $\frac{g}{\sqrt{2}}$

C. $\frac{g}{\sqrt{3}}$

D. $\frac{g}{\sqrt{5}}$

Answer: C

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7. A uniform chain of length / and mass mis hanging vertically from its ends A and B which are close together. At a given instant the end B is released. What is the tension at A when B has fallen a distance x $(x < l)$?

A. $\frac{mg}{2}\left[1+\frac{3x}{l}\right]$

B. $mg\left[1+\frac{2x}{l}\right]$

C. $\frac{mg}{2}\left[1+\frac{x}{l}\right]$

D. $\frac{mg}{2}\left[1+\frac{4x}{l}\right]$

Answer: A

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8. Two blocks of masses 2 kg and 1 kg are placed on a smooth horizontal table in contact with each other. A horizontal force of

3 newton is applied on the first so that the block moves with a constant acceleration. The force between the blocks would be

A. 3 newton

B. 2 newton

C. 1 newton

D. zero

Answer: C

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9. Block A is moving with acceleration A along a frictionless horizontal surface. When a second block, B is placed on top of Block A the acceleration of the combined blocks drops to 1/5 the original value. What is the ratio of the mass of A to the mass of B?

A. $5:1$

B. $1:4$

C. $3:1$

D. $2:1$

Answer: B

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10. Two blocks of masses 2 kg and 4 kg are attached by an inextensible light string as shown in the figure. If a force of 120 N pulls the blocks vertically upward, the tension in the string is (take $g = 10ms^{-2}$)

A. 20 N

B. 15 N

C. 35 N

D. 40 N

Answer: D

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11. A block is kept on a frictionless inclined surface with angle of inclination 'α'. The incline is given an acceleration 'a' to keep the

block stationary. Then 'a' is equal to

A. $g \cos ec\alpha$

B. $g / \tan \alpha$

C. gtanalpha`

D. g

Answer: C

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12. Three blocks with masses til, 2 ou and 3 in are connected by strings as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of mass 2m? (g is the acceleration due to gravity)

A. 2 mg

B. 3 mg

C. 6 mg

D. zero

Answer: D

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Exercise 1 Concept Builder Topicwise Topic 4 Friction

1. A conveyor belt is moving at a constant speed of $2m/s$. A box is gently dropped on it. The coefficient of friction between them is

$\mu = 0.5$. The distance that the box will move relative to belt before coming to rest on it taking $g = 10ms^{-2}$ is:

A. 1.2 m

B. 0.6 m

C. zero

D. 0.4 m

Answer: D

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2. A plank with a box on it at one end is gradually raised about he other end. As the angle of inclination with the horizontal reaches 30° the box starts to slip and slides 4.0 m down the plank in 4.0s. The coefficients of static and kinetic friction between the box 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

Answer: A

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3. A body of mass 2kg is placed on a horizontal surface having kinetic friction 0.4 and static friction 0.5 . If the force applied on the body is $2.5N$, then the frictional force acting on the body will be

A. 8 N

B. 10 N

C. 20 N

D. 2.5 N

Answer: D

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4. 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 10N, the mass of the block (in kg) is

A. 1.6

B. 4.0

C. 2.0

D. 2.5

Answer: C

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5. A body starts from rest on a long inclined plane of slope 45° . The coefficient of friction between the body and the plane varies as $\mu = 0.3x$, where x is the distance travelled down the plane. The body will have maximum speed (for $g = 10m/s^2$) when x =

A. 9.8 m

B. 27m

C. 12 m

D. 3.33m

Answer: D

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6. 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. 20 N

B. 50 N

C. 100 N

D. 2N

Answer: D

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7. A 100 N force acts horizontally on a block of 10 kg placed on a horizontal rough surface of coefficient of friction $\mu = 0.5$. If the acceleration due to gravity (g) is taken as

$10ms^{-2}$, the acceleration of the block (in ms^{-2}) is

A. 2.5

B. 10

C. 5

D. 7.5

Answer: C

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8. A block of mass 0.1 is held against a wall applying a horizontal force of 5N on 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. 4.9N

D. 0.49N

Answer: B

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9. A block of mass is placed on a surface with a vertical cross section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is:

A. $\frac{1}{6}m$

B. $\frac{2}{3}m$

C. $\frac{1}{3}m$

D. $\frac{1}{2}m$

Answer: A

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10. Starting from rest , a body slides down at 45° inclined plane in twice the time it takes to slide down the same distance in the absence of friction. The coefficient of friction between the body and the inclined plane is

A. 0.33

B. 0.25

C. 0.75

D. 0.80

Answer: C

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Exercise 1 Concept Builder Topicwise Topic 5 Circular Motion And Banking Of Road

1. A cane filled with water is revolved in a vertical circle of radius 4 m and water just does not fall down. The time period of revolution will be –

A. 1 sec

B. 10 sec

C. 8 sec

D. 4 sec

Answer: D

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2. The string of pendulum of length l is displaced through 90° from the vertical and released. Then the minimum strength of the string in order to withstand the tension, as the pendulum passes through the mean position is

A. 3 mg

B. 4mg

C. 5 mg

D. 6 mg

Answer: A

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3. A body of mass 0.4 kg is whirled in a vertical circle making 2 rev/sec. If the radius of the circle is 1.2 m, then tension in the string when the body is at the top of the circle, is

A. 41.56N

B. 89.86N

C. 109.86

D. 115.86N

Answer: A

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4. A body of mass m is tied to one end of a spring and whirled round in a horizontal circle with a constant angular velocity .The elongation is 1 cm . If the angular velocity is

doubled , the elongation in the spring is 5 cm.

what is the original length of the spring ?

A. 15 cm,

B. 12 cm

C. 16 cm

D. 10 cm

Answer: A

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5. A particle of mass m rotates with a uniform angular speed ω. It is viewed from a frame rotating about the Z-axis with a uniform angular speed ω_0. The centrifugal force on the particler is

A. $m\omega^2 r$

B. $m\omega_0^2 r$

C. $m\left(\frac{\omega+\omega_0}{2}\right)a$

D. zero

Answer: B

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6. the coefficient of friction between the rubber tyres and the roadway is 0.25 . Find the maximum speed with which a car can be driven round a curve of radius 20 m without skidding

A. 5m/s

B. 7m/s

C. 10 m/s

D. 14 m/s

Answer: B

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7. A bucket tied at the end of a $1.6m$ long string is whirled in a verticle circle with constant speed. What should be the minimum speed so that the water from the bucket does not spill, when the bucket is at the highest position $\left(Takeg = 10m / s^2\right)$

A. 4m/sec

B. 6.25 m/sec

C. 16 m/sec

D. None of the above

Answer: A

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Exercise 2 Concept Applicator

1. A body of mass 4 kg moving on a horizontal surface with an initial velocity of $6ms^{-1}$ comes to rest after 3 seconds. If one wants to keep the body moving on the same surface with the velocity of $6ms^{-1}$ the force required is

A. zero

B. 4N

C. 8N

D. 16N

Answer: C

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2. A block of mass m is connected to another block of mass M by a spring (massless) of spring constant k. The block are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is unstretched. Then a constant force F starts acting on the block of mass M to pull it. Find the force of the block of mass M.

A. $\frac{MF}{(m+M)}$

B. $\frac{mF}{M}$

C. $\frac{(M+m)F}{m}$

D. $\frac{mF}{(m+M)}$

Answer: D

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3. A plate of mass M is placed on a horizontal of frictionless surface (see figure), and a body of mass m is placed on this plate. The

coefficient of dynamic friction between this body and the plate is μ. If a force $2\mu mg$ is applied to the body of mass m along the horizontal, the acceleration of the plate will be

A. $\frac{\mu m}{M}g$

B. $\frac{\mu m}{(M+m)}g$

C. $\frac{2\mu m}{M}g$

D. $\frac{2\mu m}{(M+m)}g$

Answer: A

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4. An overweight acrobat, weighing in at 115 kg, wants to perform a single hand stand. He tries to cheat by resting one foot against a smooth frictionless vertical wall. The horizontal force there is 130 N. What is the magnitude of the force exerted by the floor on his hand? Answer in N.

A. 1134

B. 1257

C. 997

D. 1119

Answer: A

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5. A ball of mass 400 gm is dropped from a height of 5 m. A boy on the ground hits the ball vertically upwards with a bat with an average force of 100 newton so that it attains a vertical velocity of 20 m/s. The time for which

the ball remains in contact with the bat is $(g = 10m/s^2)$

A. 0.12 s

B. 0.08s

C. 0.04 s

D. 12s

Answer: A

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6. A man weighing $80kg$ is standing on a trolley weighting $320kg$. The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley along the rails at speed $1m/s$ (w.r.t. to trolley) then after $4s$ his displacement relative to the ground will be :

A. 5 metres

B. 4.8 metres

C. 3.2 metres

D. 3.0 metres

Answer: C

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7. A bullet is fired from a gun. The force on the bullet is given by $F = 600 - 2 \times 10^5$ t, where F is in newtons and t in seconds. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet?

A. 1.8 N-s

B. Zero

C. 9 N-s

D. 0.9 N-s

Answer: D

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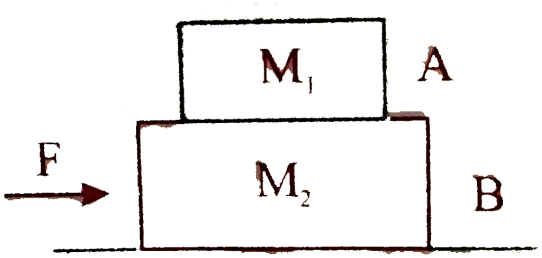
8. A block the of mass $4kg$ is placed on another block of mass $5kg$ and the block B rests on a smooth horizontal table for sliding the block A on B a horizontal force $12N$ is

required to be applied force on it How much maximum horizontal force can be applied on 'B' s that both A and B move together? Also find out the accleration proudced by this force



A. 30 N

B. 25 N

C. 27 N

D. 48 N

Answer: C

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9. A rocket of mass 5000 kg is to be projected vertically upward. The gases are exhausted vertically downwards with velocity $1000ms^{-1}$ with respect to the rocket. What is the minimum rate of burning the fuel so as to just lift the rocket upwards against gravitational attraction ?

A. $49kgs^{-1}$

B. $147kgs^{-1}$

C. $98kgs^{-1}$

D. $196kgs^{-1}$

Answer: A

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10. A particle of mass m is acted upon by a force F given by the emprical law $F = \frac{R}{t^2}v(t)$

If this law is to be tested experimentally by

observing the motion starting from rest, the best way is to plot :

A. log v(t) against $\frac{1}{t}$

B. v(t) against t^2

C. log v(t) agninst $\frac{1}{t^2}$

D. lov v(t) against t

Answer: A

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11. An insect crawls up a hemispherical surface very slowly. The coefficient of friction between the insect and the surface is 1/3. If the line joining the centre of the hemispherical surface to the insect makes an angle a with the vertical, the maximum possible value of α so that the insect does not slip is given by

A. $\cot\alpha = 3$

B. $\sec\alpha = 3$

C. $\cos ec\alpha 3$

D. $\cos \alpha = 3$

Answer: A

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12. A trailer of mass 1000 kg is towed by means of a rope attached to a car moving at a steady speed along a level road. The tension in the rope is 400 N. The car starts to accelerate steadily. If the tension in the rope is now

1650N, with what acceleration is the trailer moving?

A. $1.75ms^{-2}$

B. $0.75ms^{-2}$

C. $2.5ms^{-2}$

D. $1.25ms^{-2}$

Answer: D

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13. A particle moves in a circle with a uniform speed. When it goes from a point A to a diametrically opposite point B, the momentum of the particle changes by $\overrightarrow{P}_A - \overrightarrow{P}_B = 2$ kg m/s $\left(\hat{j}\right)$ and the centripetal force acting on it changes by $\overrightarrow{F}_A - \overrightarrow{F}_B = 8N\left(\hat{i}\right)$ where $\hat{i}, \hat{j}$ are unit vectors along X and Y axes respectively. The angular velocity of the particle is

A. dependent on its mass

B. 4 rad/sec

C. $\frac{2}{\pi}$ rad/sec

D. 16π rad/sec

Answer: B

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14. A ball of mass $0.5kg$ moving with a velocity of $2m/s$ strikes a wall normally and bounces back with the same speed . If the time of contact between the ball and the wall is 1

millisecond , the average force exerted by the wall on the ball is

A. 2000 newton

B. 1000 newton

C. 5000 newton

D. 125 newton

Answer: A

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15. A small ball of mass m starts at a point A with speed v_0. and moves along a frictionless track AB as shown. The track BC has coefficient of friction μ. The ball comes to stop at Cafter travelling a distance L which is:

A. $\frac{2h}{\mu} + \frac{v_o^2}{2\mu g}$

B. $\frac{h}{\mu} + \frac{v_o^2}{2\mu g}$

C. $\frac{h}{2\mu} + \frac{v_o^2}{\mu g}$

D. $\frac{h}{2\mu} + \frac{v_o^2}{2\mu g}$

Answer: B

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16. A box of mass 8 kg is placed on a rough inclined plane of inclination 45°. Its downward motion c can be prevented by applying an upward pull F and it can be made to slide upwards by applying a force 2F. The coefficient of friction between the box and the inclined plane is

A. $\frac{1}{2}$

B. $\frac{1}{\sqrt{2}}$

C. $\frac{1}{2\sqrt{2}}$

D. $\frac{1}{3}$

Answer: D

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17. A rocket has a mass of 100 kg . 90% of this is fuel. It ejects fuel vapours at the rate of $1kg/\sec$ with a velocity of 500 $m/\sec$ relative

to the rocket. It is supposed that the rocket is outside the gravitational field. The initial upthrust on the rocket when it just starts moving upwards is

A. zero

B. 500 newton

C. 1000 newton

D. 2000 newton

Answer: B

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18. A 40 kg slab rests on frictionless floor as shown in fig. A 10 kg block rests on the top of the slab. The static coefficient of friction between the block and slab is 0.60 while the kinetic friction is 0.40. The 10 kg block is acted upon by a horizontal force of 100 N. If $g = 9.8m/s^2$, the resulting acceleration of the slab will be:

A. $0.98m/s^2$

B. $1.47m/s^2$

C. $1.52m/s^2$

D. $6.1m/s^2$

Answer: A

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19. A small body of mass m slides down from the top of a hemisphere of radius r. The surface of block and hemisphere are frictionless. The height at which the body lose

contact with the surface of the sphere is

A. (3/2)r

B. (2/3)r

C. $\left(\frac{1}{2}\right)gr^2$

D. $v^2 / 2g$

Answer: B

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20. A spring is compressed between two toy carts of mass m_1 and m_2. When the toy carts are released, the springs exert equal and opposite average forces for the same time on each toy cart. If v_1 and v_2 are the velocities of the toy carts and there is no friction between the toy carts and the ground, then :

A. $v_1 / v_2 = m_1 / m_2$

B. $v_1 / v_2 - m_2 / m_1$

C. $v_1 / v_2 = \ - m_2 / m_1$

D. $v_1 / v_2 = -m_1 / m_2$

Answer: C

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21. A heavy box is to be dragged along a rough horizontal floor. To do so, person A pushes it at an angle 30° from the horizontal and requires a minimum force F_A, while person B pulls the box at angle 60° from the horizontal and needs minimum force F_B. If the coefficient

of friction between the box and the floor is $\frac{\sqrt{3}}{5}$, the ratio is $\frac{F_A}{F_B}$

A. $\sqrt{3}$

B. $\frac{5}{\sqrt{3}}$

C. $\sqrt{\frac{3}{2}}$

D. $\frac{2}{\sqrt{3}}$

Answer: D

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22. An open topped rail road car of mass M has an initial velocity v_0 along a straight horizontal frictionless track. It suddenly starts raising at timet = 0. The rain drops fall vertically with velocity u and add a mass m kg/sec of water. The velocity of car after t second will be (assuming that it is not completely filled with water)

A. $v_0 + m\frac{u}{M}$

B. $\frac{Mv_0}{M+mt}$

C. $\frac{Mv_0+ut}{M+ut}$

D. $v_0 + \frac{mut}{M + ut}$

Answer: B

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23. A 0.5 kg ball moving with speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed and at the same angle. If the ball is in contact with the wall for 0.25 seconds, the average force

acting on the wall is

A. 24 N

B. 12 N

C. 96 N

D. 48 N

Answer: A

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24. A 0.1 kg block suspended from a massless string is moved first vertically up with an acceleration of $5ms^{-2}$ and then moved vertically down with an acceleration of $5ms^{-2}$. If T_1 and T_2 are the respective tensions in the two cases, then

A. $T_2 > T_1$

B. $T_1 - T_2 = 1N,$ if $g = 10ms^{-2}$

C. $T_1 - T_2 = 1kgf$

D. $T_1 - T_2 = 9.8N$, if $g = 9.8ms^{-2}$

Answer: B

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25. A projectile of mass M is fired so that the horizontal range is 4 km. At the highest point the projectile explodes in two parts of masses M/4 and 3M/4 respectively and the heavier part starts falling down vertically with zero initial speed. The horizontal range (distance from point of firing) of the lighter part is:

A. 16 km

B. 1 km

C. 10 km

D. 2 km

Answer: C

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26. A rifle man, who together with his rifle has a mass of $100kg,$ stands on a smooth surface and fires 10 shots horizontally. Each bullet. has

a mass $10g$ and a muzzle velocity of $800m/s$,

a. What velocity does the rifle man acquire at the end of 10 shots?

b. If the shots are fired in $10s$, what will he the average force exerted on him?

c. Compare his kinetic energy with that of 10 bullets

A. $8ms^{-1}$

B. $0.8ms^{-1}$

C. $0.08ms^{-1}$

D. $-0.8ms^{-1}$

Answer: B

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27. A block of 7 kg is placed on a rough horizontal surface and is pulled through a variable force F (in N) = 5t, where t is time in second, at an angle of 37° with the horizontal as shown in figure. The coefficient of static friction of the block with the surface is one. If the force starts acting at t = 0s, the time at which the block starts to slide is t_0 sec. Find

the value of $t_0/2$ in sec. ($g = 10m/s^2$ and $\cos 37^\circ = \frac{4}{5}$)

A. 3

B. 4

C. 5

D. 6

Answer: C

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28. A motor cyclist moving with a velocity of 72 km/hour on a flat road takes a turn on the road at a point where the radius of curvature of the road is 20 meters . The acceleration due to gravity is $10m/\sec^2$. In order to avoid skidding, he must not bend with respect to the vertical plane by an angle greater than

A. $\tan = \tan^{-1} 6$

B. $\theta = \tan^{-1} 2$

C. $\theta = \tan^{-1} 25.92$

D. $\theta = \tan^{-1} 4$

Answer: B

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29. A blocky of mass m rests on a horizotal 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. Find the magnitude of F and the direction in which it has be applies.

A. $\theta = \tan^{-1}(\mu), F = \frac{\mu W}{\sqrt{1+\mu^2}}$

B. $\theta = \tan^{-1}\left(\frac{1}{\mu}\right), F = \frac{\mu W}{\sqrt{1+\mu^2}}$

C. $\theta = 0, F = \mu W$

D. $\theta = \tan^{-1}\left(\frac{\mu}{1+\mu}\right), F = \frac{\mu W}{1+\mu}$

Answer: A

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30. Fig. shows a uniform rod of length 30 cm having a mass of 3.0 kg. The strings shown in the figure are pulled by constant forces of 20 N and 32 N. All the surfaces are smooth and

the strings and pulleys are light. The force exerted by 20 cm part of the rod on the 10 cm part is

A. 20 N

B. 24 N

C. 32 N

D. 52 N

Answer: B

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