TEST

JEE Mains PYQs Laws of Motion (Physics Master Academy)

QUESTIONS

SECTIONS

1. Section A - 30 Questions

Section 1 : Section A - 30 Questions

SECTION INSTRUCTIONS

This section coantions 30 MCQS. 4 marks will be awarded for every correct answer and - 1 for every incorrect answer

1 The initial mass of a rocket is 1000kg. Calculate at what rate the fuel should be burnt so that the rocket is given an acceleration of $20ms^{-2}$. The gases come out at a relative speed of 500 ms^{-1} with respect to the rocket: (use g = $10m/s^2$)

- 6.0×10^2 kgs^{-1}
- 500 kgs^{-1}
- 10 kgs^{-1}
- 60 kgs^{-1}

Correct: +4 · Incorrect: -1

2 A force $\vec{F}$ = (40 $\hat{i}$ + 10 $\hat{j}$)N acts on a body of mass 5kg. IF the body starts from rest, its position vector r at time t = 0 will be

- $(100\hat{i} + 400\hat{j})$m
- $(100\hat{i} + 100\hat{j})$m
- $(400\hat{i} + 100\hat{j})$m
- $(400\hat{i} + 400\hat{j})$m

Correct: +4 · Incorrect: -1

3 A boy pushes a box of mass 2kg with a force $\vec{F}$ (20 $\hat{i}$ + 10 $\hat{j}$)N on a frictionless surface. If the box was initially at rest, then___m is displacement along the x axis after 10s.

- 100
- 250
- 500
- 300

Correct: +4 · Incorrect: -1

4 A spaceship sweeps stationary interplanetary dust. As a result, its mass increase at a rate $\frac{dM(t)}{dt} = b\,v^2(t)$, where v(t) is its instantaneous velocity. The instantaneous acceleration of the satellite is

- $-b\,v^3 t$
- $\frac{-b v^3}{M(t)}$
- $\frac{-2b v^3}{M(t)}$
- $\frac{-b v^3}{2M(t)}$

Correct: +4 · Incorrect: -1

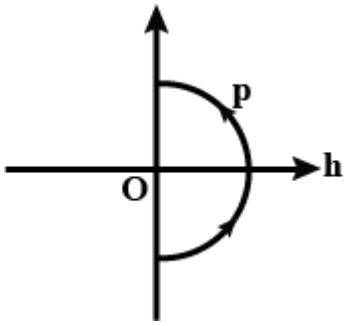
5 A ball is thrown upward with an initial velocity V_0 from the surface of the earth. The motion of the ball is affected by a drag force equal to $m\gamma v^2$ (where m is mass of the ball, v is the instantaneous velocity, γ is constant). Time taken by the ball to rise to its zenith is:

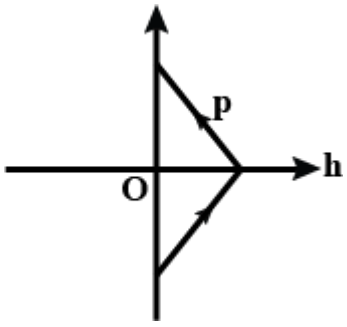
- $\frac{1}{\sqrt{\gamma g}} tan^{-1}\left(\sqrt{\frac{\gamma}{g}} V_0\right)$
- $\frac{1}{\sqrt{\gamma g}} sin^{-1}\left(\sqrt{\frac{\gamma}{g}} V_0\right)$
- $\frac{1}{\sqrt{\gamma g}} \ln\left(1+\sqrt{\frac{\gamma}{g}} V_0\right)$

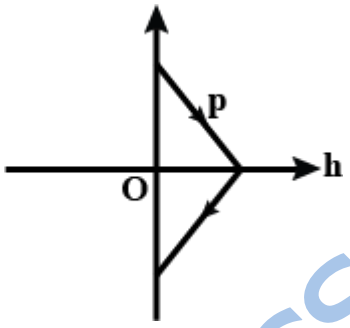
○ $\frac{1}{\sqrt{2\gamma g}} tan^{-1}\left(\sqrt{\frac{2\gamma}{g}} V_0\right)$

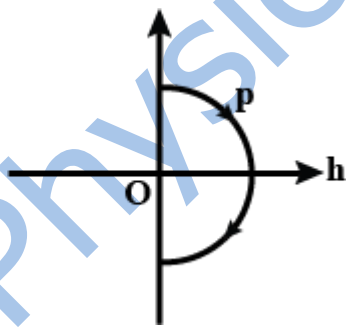
Correct: +4 · Incorrect: -1

6 A ball is thrown vertically up (taken as +z axis) from the ground. The correct momentum height (p-h) diagram is

○ 

○ 

○ 

○ 

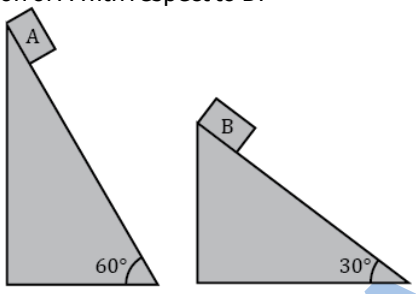
Correct: +4 · Incorrect: -1

7 A particle of mass m is acted upon by a force F given by the empirical 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:

- log v(t) against 1/t
- v(t) against t^2
- log v(t) against $1/t^2$
- log v(t) against t

Correct: +4 · Incorrect: -1

8 Two kxed frictionless inclined planes making an angle 30° and 60° with the vertical are shown in kgure. Two blocks A and B are placed on the two planes. What is the relative acceleration of A with respect to B?



- 4.9 ms^{-2} in horizontal direction
- 9.8 ms^{-2} in vertical direction
- zero
- 4.9 ms^{-2} in vertical direction

Correct: +4 · Incorrect: -1

9 A ball of mass 0.2k is thrown verticalluy upwards by applying a force by hand. If the hand moves 0.2m while applying the force and the ball goes upto 2m height further, knd the magnitude of the force (consider g = 10m/s^2)

- 4N
- 16N
- 20N
- 22N

Correct: +4 · Incorrect: -1

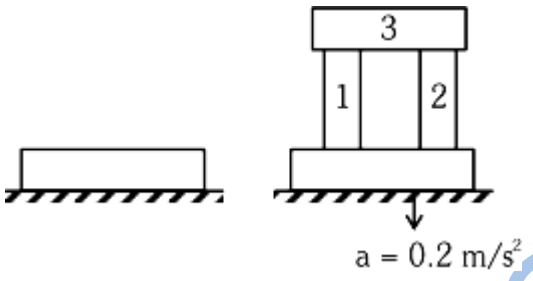
10 A player caught a cricket ball of mass 150g moving at a rate of 20m/s. IF the catching process is completed in 0.1s, the force of the blow exerted by the ball on the hand of the player is equal to

- 150N

- 3N
- 30N
- 300N

Correct: +4 · Incorrect: -1

11 A steel block of 10kg rests on a horizontal floor as shown. When three iron cylinders are placed on it as shown, the block and cylinder go down with an acceleration $0.2 m/s^2$. The normal reaction R_2 by the floor if mass of the iron cylinders are equal and of 20kg each is___N. (take $g = 10 m/s^2$ and $1/4_s = 0.2$)



- 716
- 686
- 714
- 684

Correct: +4 · Incorrect: -1

12 A person standing on a spring balance inside a stationary lift measures 60kg. The weight of that person if the lift descends with uniform downward acceleration of $1.8 m/s^2$ will be___N. ($g = 10 m/s^2$)

- 450
- 492
- 465
- 472

Correct: +4 · Incorrect: -1

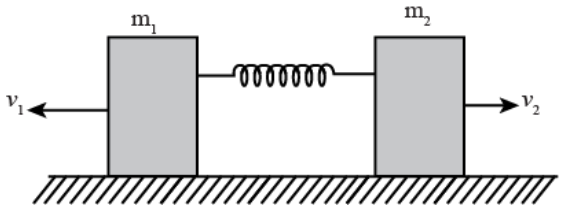
13 An elevator in a building can carry a maximum 10persons, with the average mass of each person being 68kg. The mass of the elevator is 920kg and it moves with a constant speed of 3m/s. The frictional force opposing the motion is 6000N, If the elevator is moving up with its full capacity, the power delivered by the motor to the elevator ($g = 10 m/s^2$) must be at least:

- 56300W

- 62300W
- 48000W
- 66000W

Correct: +4 · Incorrect: -1

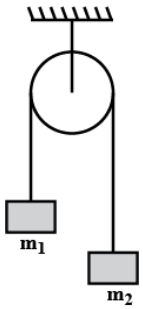
14 A spring is compressed between two blocks of masses m_1 and m_2 placed on a horizontal frictionless surface as shown in the kgure. When the blocks are released, they have initial velocity of v_1 and v_2 as shown. The blocks travel distances x_1 and x_2 respectively before coming to rest. The ratio (x_1/x_2) is



- $\frac{m_2}{m_1}$
- $\frac{m_1}{m_2}$
- $\sqrt{\frac{m_2}{m_1}}$
- $\sqrt{\frac{m_1}{m_2}}$

Correct: +4 · Incorrect: -1

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



- 5 m/s^2
- 9.8 m/s^2

- ○ 0.2 m/s^2
- ○ 4.8 m/s^2

Correct: +4 · Incorrect: -1

16 One end of a masless rope which passes over a massless pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is 360N. With what value of maximum safe acceleration (in ms^{-2}) can a man of 60kg climb on the rope?

- ○ 16
- ○ 6
- ○ 4
- ○ 8

Correct: +4 · Incorrect: -1

17 When a body slides down from rest along a smooth inclined plane making an angle of 30° with the horizontal , it takes time T. When the same body slides down from the rest along a rough inclined plane making the same angle and through the same distance, it takes time αT, where α is a constant greater than 1. The coefkcient of friction between the body and the rough plane is

$$\frac{1}{\sqrt{x}}\left(\frac{\alpha^2-1}{\alpha^2}\right)$$

where x =___.

- ○ 0
- ○ 1
- ○ 2
- ○ 3

Correct: +4 · Incorrect: -1

18 An insect is at the bottom of hemispherical ditch of radius 1m. It crawls up the ditch but starts slipping after it is at height h from the bottom. If the coefkcient of friction between the ground and the insect is 0.75, then h is ($g = 10\ ms^{-2}$)

- ○ 0.20m
- ○ 0.45m
- ○ 0.60m
- ○ 0.80m

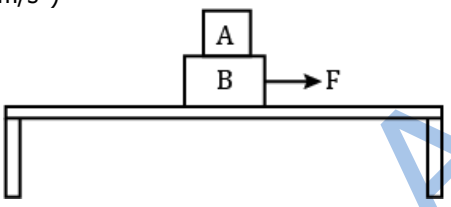
Correct: +4 · Incorrect: -1

19 A block starts moving up an inclined plane of the inclination 30° with an initial velocity of v_0. It comes back to its initial position with velocity $v_0/2$. The value of the coefkcient of kinetic friction between the block and the inclined plane is close to l/1000. The nearest integer to l is ____

- 346
- 343
- 340
- 342

Correct: +4 · Incorrect: -1

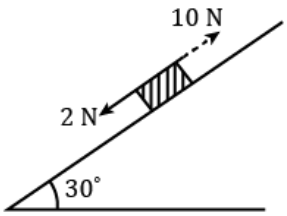
20 Two blocks A and B masses m_A = 1kg and m_B = 3kg are kept on the table as shown in kgure. The coefkcient of fraction between A and B is 0.2m and between B and the surface of the table is also 0.2. The maximum force F that can be applied on B horizontally so that the block A does not slide over the block B is (take g = 10m/s^2)



- 8N
- 16N
- 40N
- 12N

Correct: +4 · Incorrect: -1

21 A block kept on a rough inclined plane as shown in the kgure, remains at rest upto a maximum force 2N down the inclined plane. The maximum external force up the inclined plane that does not move the block is 10N. The coefkcient of static friction between the block and the plane is (take g = 10mn/s^2)



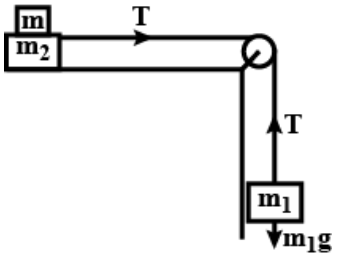
- $\frac{\sqrt{3}}{2}$
- $\frac{\sqrt{3}}{4}$

○ $\frac{1}{2}$

○ $\frac{1}{4}$

Correct: +4 · Incorrect: -1

22 Two masses m_1 = 5kg and m_2 = 10kg, connected by an inextensible string over a frictional pulley as moving as shown in kgure. The coefkcient of friction of horizontal surface is 0.15. The minimum weight m that should be put on top of m_2 to stop the motion is



○ 18.3kg

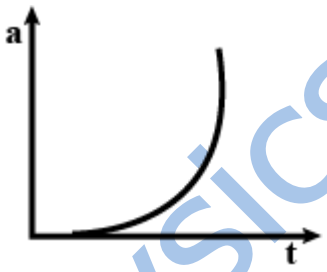
○ 27.3kg

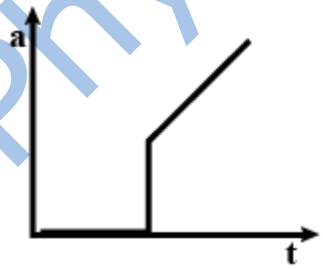
○ 43.3kg

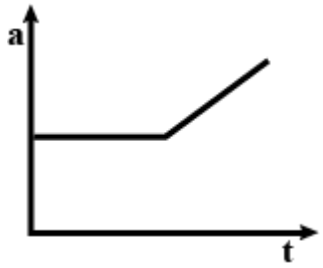
○ 10.3kg

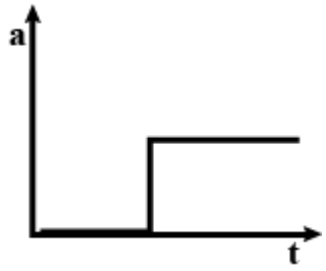
Correct: +4 · Incorrect: -1

23 A block is placed on a rough horizontal plane. A time dependent horizontal force F = kt acts on the block, where k is a positive constant. The acceleration – time graph of the block is

○ 

○ 





Correct: +4 · Incorrect: -1

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

- 1000m
- 800m
- 400m
- 100m

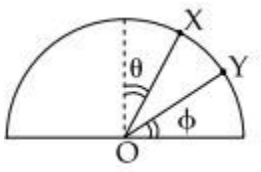
Correct: +4 · Incorrect: -1

25 A block of 200g mass moves with a uniform speed in a horizontal circular groove,, with vertical side walls of radius 20cm. If the block takes 40s to complete one round, the normal force by the side walls of the groove is

- 9.859×10^{-2}N
- 9.859×10^{-4}N
- 6.28×10^{-3}N
- 0.0314N

Correct: +4 · Incorrect: -1

26 A particle is released on a vertical smooth semicircular track from point X so that OX makes angle θ from the vertical (see kg). The normal reaction of the track on the particle vanishes at point Y where OY makes angle ϕ with the horizontal. Then



- ○ $\sin\phi = \cos\phi$
- ○ $\sin\phi = ½ \cos\theta$
- ○ $\sin\phi = 2/3 \cos\theta$
- ○ $\sin\phi = ¾ \cos\theta$

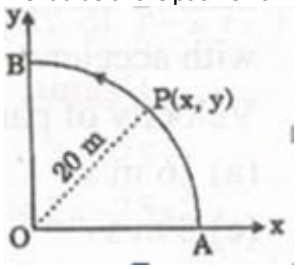
Correct: +4 · Incorrect: -1

27 A body of mass 'm' is tied to one end of a spring and whirled around in a horizontal plane with a constant angular velocity is doubled, the elongation in the spring is 5cm. The original length of the spring is

- ○ 15cm
- ○ 12cm
- ○ 16cm
- ○ 10cm

Correct: +4 · Incorrect: -1

28 The point P moves in counter clockwise direction on a circular path as shown in kgure. The movement of P is such that it sweeps cut a length $s = t^3 + 5$ where s is in metres and t is in seconds. The radius of the path is 20m. The acceleration of P when t = 2s is nearly



- ○ 13 m/s^2
- ○ 12 m/s^2
- ○ 7.2 m/s^2
- ○ 14 m/s^2

Correct: +4 · Incorrect: -1

29 Which of the following statements is false for a particle moving in a circle with a constant angular speed?

- ○ The acceleration vector points to the centre of the circle
- ○ The acceleration vector is tangent to the circle
- ○ The velocity vector is tangent to the circle
- ○ The velocity and acceleration vectors are perpendicular to each other

Correct: +4 · Incorrect: -1

30 The minimum velocity (n ms^{-1}) with which a car driver must traverse a flat curve of radius 150m and coefkcient of friction 0.6 to avoid skidding is

- ○ 60
- ○ 30
- ○ 15
- ○ 25

Correct: +4 · Incorrect: -1

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ANSWERS

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Section 1 : Section A - 30 Questions

1 60 kgs^{-1}

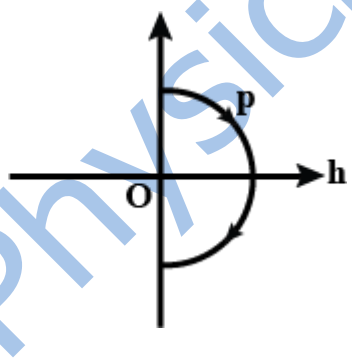
2 $(400\hat{i} + 100\hat{j})$m

3 500

4 $\frac{-bv^3}{M(t)}$

5 $\frac{1}{\sqrt{\gamma g}} tan^{-1}\left(\sqrt{\frac{\gamma}{g}} V_0\right)$

6



7 log v(t) against 1/t

8 4.9 ms^{-2} in vertical direction

9 22N

10 30N

11 684

12 492

13 66000W

14 $\frac{m_2}{m_1}$

15 0.2 m/s^2

16 4

17 3

18 0.20m

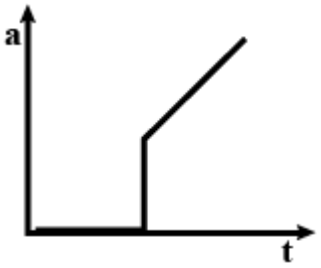
19 346

20 16N

21 $\frac{\sqrt{3}}{2}$

22 27.3kg

23



24 1000m

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26 $\sin\phi = 2/3\cos\theta$

27 15cm

28 $14\ m/s^2$

29 The acceleration vector is tangent to the circle

30 30