Dear student following is a Moderate level [○○●○○] test paper. Score of 15 Marks in 10 Minutes would be a satisfactory performance. Questions 1-8 (+3, –1). (All Questions have Single Options correct)

Q.1 Which of the following relations is NOT applicable to the rocket ?

(A) $\vec{F} = d\vec{p}/dt$ (B) $\vec{F} = M\vec{a}$

(C) $\vec{p} = M\vec{v}$ (D) $\vec{p} = \int \vec{F}\, dt$

Q.2 A gun of mass 1 kg fires a bullet of mass 1 g with a velocity of 1 ms^{-1}. The recoil velocity of the gun is :

(A) 1 ms^{-1} (B) 0.1 ms^{-1}

(C) 0.01 ms^{-1} (D) 0.001 ms^{-1}

Q.3 A body is at rest on the surface of the earth. Which of the following statements is correct. ?

(A) No force is acting on the body

(B) Only weight of the body acts on it.

(C) Net downward force is equal to the net upward force.

(D) None of the above statements is correct.

Q.4 A body of mass 200 g is moving with a velocity of 5ms^{-1} along the positive x-direction. At time t = 0, when the body is at x = 0, a constant force of 0.4 N directed along the negative x-direction is applied to the body for 10 s. What is the position (x) of the body at t = 2.5 s

(A) x = 1.0 m (B) x = 1.25 m

(C) x = 1.5 m (D) x = 1.75 m

Q.5 A rocket consume fuel at the rate of 100 kg s^{-1} . The exhaust gases are ejected at a speed of 5 × 10^4 ms^{-1} . What is the thrust experienced by the rocket ? Neglect the effect of gravity.

(A) 5 × 10^2 N (B) 5 × 10^4 N

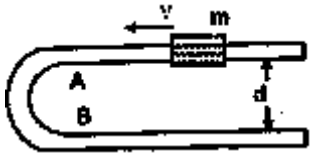
(C) 5 × 10^6 N (D) 5 × 10^8 N

Q.6 A block of mass m is projected up an inclined plane of inclination θ with an initial velocity u. If the coefficient of kinetic friction between the block and the plane is μ, the distance up to which the block will rise up the plane. before coming to rest, is given by

(A) $\frac{u^2\mu}{2g\sin\theta}$ (B) $\frac{u^2\mu}{2g\cos\theta}$

(C) $\frac{u^2}{4g\sin\theta}$ (D) $\frac{u^2}{4g\cos\theta}$

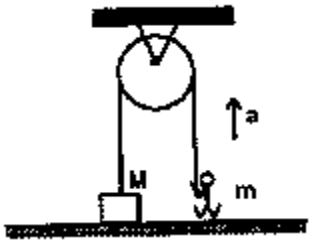
Q.7 A fixed U-Shaped smooth wire has semi-circular bending between A and B as shown in the figure. A bead of mass 'm' moving with uniform speed v through the semicircular bend at A and leaves at B. The average force exerted by the bead on the part AB of the wire is



(A) 0 (B) $\frac{4mv^2}{\pi d}$

(C) $\frac{2mv^2}{\pi d}$ (D) none of these

Q.8 In the figure the block of mass M is at rest on the floor. The acceleration with which a boy of mass m should climb along the rope of negligible mass so as to lift the block from the floor is



,

(A) = $\left(\frac{M}{m}-1\right)g$ (B) > $\left(\frac{M}{m}-1\right)$

(C) = $\frac{M}{m}g$ (D) > $\frac{M}{m}g$

PHYSICS IIT JEE (JUNE 5th WEEK CLASS TEST 3) (NLM) ANSWER KEY

Name : ..... **Roll No. :** .....

	A	B	C	D		A	B	C	D		A	B	C	D
1	○	○	○	○	4	○	○	○	○	7	○	○	○	○
2	○	○	○	○	5	○	○	○	○	8	○	○	○	○
3	○	○	○	○	6	○	○	○	○					

ANSWER KEY

Que.	1	2	3	4	5	6	7	8
Ans.	B	D	C	B	C	C	B	B

SOLUTIONS

Sol.1 (B)

Because F = Ma is applicable when mass does not vary. In case of the rocket, the mass continuously varies.

Sol.2 (D)

Recoil velocity

$$V = \frac{m\upsilon}{M} = \frac{0.001\text{kg} \times 1\text{ms}^{-1}}{1\text{kg}} = 0.001\ \text{ms}^{-1}.$$

Sol.3 (C)

The net force on the body is zero. Weight of the body is balanced the reaction of the ground.

Sol.4 (B)

Given $u = +5\ \text{ms}^{-1}$ along positive x-direction

$F = -0.4$ N along negative x-direction

$m = 200g = 0.2$ kg

The acceleration $a = \frac{F}{m} = \frac{-0.4}{0.2} = -2\ \text{ms}^{-2}$.

The negative sign shows that the motion is retarded. The position of the body at time t is given by $x = x_0 + ut + \frac{1}{2}at^2$

At t = 0, the body is at x = 0. Therefore, $x_0 = 0$

Hence $x = ut + \frac{1}{2}at^2$

Since the force acts during the time interval form t = 0 to t = 10 s, the motion is accelerated only between t = 0 and t = 10s. The position of the body at t = 2.5s given by

$$x = 5 \times 2.5 + \frac{1}{2} \times (-2) \times (2.5)^2 = 1.25\ \text{m}$$

Sol.5 (C)

Change of momentum of exhaust gases per second = mass of gases ejected per second × speed $= 100\ \text{kg s}^{-1} \times 5 \times 10^4\ \text{ms}^{-1} = 5 \times 10^6\ \text{kg ms}^{-2}$. From Newton's second law,

Force = change in momentum per second

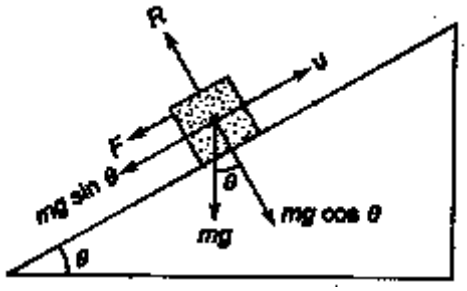
$= 5 \times 10^6$ N

The rocked exerts this force on the escaping gases and, in turn, will experience a thrust of 5×10^6 N.

Sol.6 (C)

Since the block is projected upwards, it rises after overcoming two forces : (i) the component mg sinθ of the weight mg and (ii) the force of friction F = mg sinθ, both acting downwards. Therefore, the total downward acceleration is

$$a = -g\sin\theta - g\sin\theta$$
$$= -2g\sin\theta$$

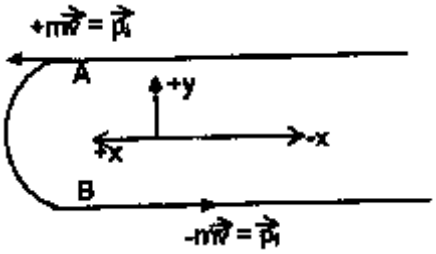


Let s be the distance moved up the plane before the block comes to rest. Then, from $\upsilon^2 - u^2 = 2as$, we have

$0 - u^2 = 2 \times (-2g\sin\theta) \times s$ or s

$$= \frac{u^2}{4g\sin\theta}$$

Sol.7 (B)



Choosing the positive X-Y axis as shown in the figure, the momentum of the bead at A is $\vec{P}_i = m\vec{v}$. The momentum of the bead at B is $\vec{P}_f = -m\vec{v}$

Therefore, the magnitude of the change in momentum between A and B is

$$\Delta\vec{P} = \vec{P}_f - \vec{P}_i = -2m\vec{v}$$

i.e. $\Delta P = 2mv$ along positive X-axis.

The time interval taken by the bead to reach form A to B is

$$\Delta t = \frac{\pi . d/2}{v} = \frac{\pi d}{2v}.$$

Therefore, the average force exerted by the bead on the wire is $F_{av} = \frac{\Delta p}{\Delta t}$

$$= \left(2mv / \frac{\pi d}{2v}\right) = \frac{4mv^2}{\pi d}$$

Sol.8 (B)

Equation of motion for M :

Since M is stationary,

$T - Mg = 0$

$\Rightarrow \quad T = mg$ .....(1)

Since the boy moves with an acceleration 'a', $T - mg = ma$

$\Rightarrow \quad T = m(g + a)$ .....(2)

Equating Eqs. (1) and (2), we obtain

$Mg = m(g + a)$

$\Rightarrow \quad a = \left(\frac{M}{m} - 1\right)g$

That means, if $a > \left(\frac{M}{m} - 1\right)g$, the block M can be lifted.