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

Q.1 When a train stops suddenly, passengers in the running train feel an instant jerk in the forward direction because
(A) The back of seat suddenly pushes the passengers forward
(B) Inertia of rest stops the train and takes the body forward
(C) Upper part of the body continues to be in the state of motion whereas the lower part of the body in contact with seat remains at rest.
(D) Nothing can be said due to insufficient data

Q.2 An object will continue moving uniformly until
(A) The resultant force acting on it begins to decrease
(B) The resultant force on it is zero
(C) The resultant force is at right angle to its rotation
(D) The resultant force on it is increased continuously

Q.3 The ratio of the weight of a man in a stationary lift and when it is moving downward with uniform acceleration 'a' is 3 : 2 The value 'a' is (g-Acceleration due to gravity of the earth)
(A) 3/2g (B) g/3 (C) 2/3g (D) g

Q.4 Newton's third law of motion leads to the law of conservation of
(A) Angular momentum (B) Energy
(C) Mass (D) Momentum

Q.5 A person standing in a stationary lift drops a coin from a certain height h. It takes t second to reach the floor of the lift. If the lift is rising up with a uniform acceleration a, time taken by the coin dropped from the same height h to reach the floor will be

(A) t (B) $t\sqrt{\frac{a}{g}}$

(C) $t\left(1+\frac{a}{g}\right)^{-1/2}$ (D) $t\left(1-\frac{a}{g}\right)^{-1/2}$

Q.6 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 newton and t is 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) 9 Ns (B) Zero (C) 0.9 Ns (D) 1.8 Ns

Q.7 Two skaters A and B of mass 50 and 70 kg, respectively, stand facing each other, 6 meters apart on horizontal smooth surface. They pull a rope stretched between them. How far has each moved when they meet ?
(A) Both have moved 3 m.
(B) A moves 4 m and B moves 2 m.
(C) A moves 2.5 m and B moves 3.5 m.
(D) A moves 3.5 m and B moves 2.5 m.

Q.8 A ball of mass m is moving towards a batsman at a speed υ. The batsman strikes the ball and deflects it by an angle θ without changing its speed. The impulse imparted to the ball is given by
(A) $m\upsilon\cos(\theta)$ (B) $m\upsilon\sin(\theta)$
(C) $2m\upsilon\cos(\theta/2)$ (D) $2m\upsilon\sin(\theta/2)$

Q.9 A block, released from rest from the top of a smooth inclined plane of angle of inclination q1, reaches the bottom in time t_1. The same block, released from rest from the top of another smooth inclined plane of angle of inclination θ_2, reaches the bottom in time t_2. If the two inclined planes have the same height, the relation between t_1 and t_2 is

(A) $\frac{t_2}{t_1}=\left(\frac{\sin\theta_1}{\sin\theta_2}\right)^{1/2}$ (B) $\frac{t_2}{t_1}=\frac{\sin^2\theta_1}{\sin^2\theta_2}$

(C) $\frac{t_2}{t_1}=\frac{\sin\theta_1}{\sin\theta_2}$ (D) $\frac{t_2}{t_1}=1$

Q.10 Match the column

Column I	**Column II**
(a) Rate of change of momentum	(p) Inertial frame
(b) Change of momentum	(q) Force
(c) A reference frame moving with a constant velocity	(r) Non-inertial frame
(d) A rotating reference frame	(s) Impulse

(A) a-q, b-s, c-p, d-r (B) a-p, b-s, c-q, d-r

(C) a-s, b-p, c-q, d-r (D) a-p, b-s, c-q, d-r

PHYSICS IIT JEE (JUNE 5th WEEK CLASS TEST 2) (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	○	○	○	○	9	○	○	○	○
										10	○	○	○	○

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	C	B	B	D	C	C	D	C	C	A

SOLUTIONS

Sol.1 (C)

Sol.2 (B)

Sol.3 (B)

$$\frac{mg}{m(g-a)} = \frac{3}{2} \Rightarrow a = \frac{g}{3}$$

Sol.4 (D)

Sol.5 (C)

As the lift is rising up with a uniform acceleration a, therefore, effective acceleration of the coin is g'= + a)

$$\therefore \quad t' = \sqrt{\frac{2s}{g'}} = \sqrt{\frac{2h}{g+a}} \text{ and } t = \sqrt{\frac{2h}{g}}$$

$$\frac{t'}{t} = \sqrt{\frac{g}{g+a}} = \left(1+\frac{a}{g}\right)^{-1/2}$$

$$t' = t\left(1+\frac{a}{g}\right)^{-1/2}$$

Sol.6 (C)

As $F = 600 - 2 \times 10^5 t$,

$\therefore$ At $t = 0$, $F = 600$ newton

As $F = 0$, on leaving the barret,

$\therefore \quad 0 = 600 - 2 \times 10^5 t$

$$t = \frac{600}{2\times 10^5} = 3 \times 10^{-3} s$$

This is the time spent by the bullet in the barrel.

$$\text{Average force} = \frac{600+0}{2} = 300 \text{ newton.}$$

$\therefore$ Average impulse imparted $= F \times t$

$= 300 \times 3 \times 10^{-3} = 0.9$ Ns

Sol.7 (D)

Let m_A and B_B be the masses of skaters A and B and a_A and a_B their respective acceleration, when they pull at each other. From Newton's third law, action and reaction forces are equal in magnitude, i.e.

$$m_A a_A = m_B a_B \text{ or } m_A \frac{\upsilon_A}{t} = m_B \frac{\upsilon_B}{t}$$

or $\quad m_A \upsilon_A = m_B \upsilon_B$ or $m_A^2 \upsilon_A^2 = m_B^2 \upsilon_B^2 \quad ...(1)$

Where υ_A and υ_B are their respective speed and t is the time taken for them to meet. Let s_A and s_B be the distance travelled by them when they meet, we have,

$2a_A s_A = \upsilon_A^2$ and $2a_B s_B = \upsilon_B^2$

Using these equation in Eq. (i), nothing that

$m_A a_A = m_B a_B$, we get $\frac{s_A}{s_B} = \frac{m_B}{m_A} = \frac{70}{50} = \frac{7}{5}$.

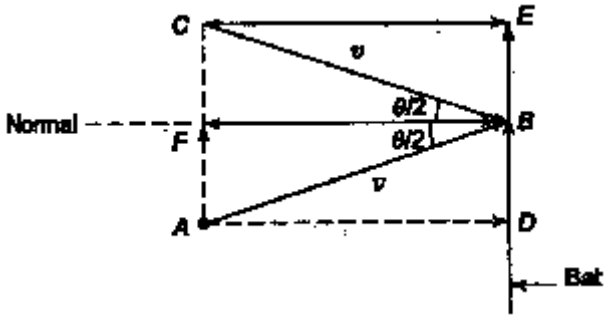
Since

$s_A + s_B = 6m$; $s_A = 3.5$ and $s_B = 2.5$ m. Hence,

Sol.8 (C)

The ball moving along AB with velocity v strikes the bat at point B and is deflected along BC with the same speed υ. vector AB can be resolved into two rectangular components AD = $\upsilon \cos(\theta/2)$ and AF = $\upsilon \sin(\theta/2)$. Now AF = DB and AD = FB (see fig.) Similarly, vector BC can be resolved into rectangular components BE = $\upsilon \sin(\theta/2)$ and BF = $\upsilon \cos(\theta/2)$. Since velocity components DB and BE along the bat are equal in magnitude and are along the same direction, the change in momentum along the bat

$= m\upsilon \sin(\theta/2) - m\upsilon \sin(\theta/2) = 0$, but the normal component FB and BE are in opposite directions, each having magnitude $\upsilon \cos(\theta/2)$.



Now

Impulse = change in momentum along BF

$$= m\upsilon\cos\left(\frac{\theta}{2}\right) - \left\{-m\upsilon\cos\left(\frac{\theta}{2}\right)\right\}$$

$$= 2m\upsilon\cos\left(\frac{\theta}{2}\right)$$

Sol.9 (C)

Let h be the height of each inclined plane. Then, the distance along the plane are

$s_1 = \frac{h}{\sin\theta_1}$ and $s_2 = \frac{h}{\sin\theta_2}$ respectively. The accelerations of the block are $a_1 = g \sin \theta_1$ and $a_2 = g \sin \theta_2$ respectively. Now, since the block is released from rest, the velocity of the block when it reaches the bottom of the planes is $\upsilon_1^2 = 2a_1s_1$ and $\upsilon_2^2 = 2a_2s_2$ respectively. But $\upsilon_1 = a_1t_1$ and $\upsilon_2 = a_2t_2$ or $a_1^2t_1^2 = 2a_1s_1$ and $a_2^2t_2^2 = 2a_2s_2$. These equations give

$$\frac{t_2^2}{t_1^2} = \frac{a_1}{a_2}\cdot\frac{s_2}{s_1}$$

$$= \frac{g\sin\theta_1}{g\sin\theta_2}\cdot\frac{h}{\sin\theta_2}\cdot\frac{\sin\theta_1}{h}$$

$$= \frac{\sin^2\theta_1}{\sin^2\theta_2}$$

Sol.10 (A)

a-q, b-s, c-p, d-r.