# OBJECTIVE - I

**1.** A body of weight $w_1$ is suspended from the ceiling of a room through a chain of weight $w_2$. The ceiling pulls the chain by a force

(a) $w_1$ (b) $w_2$ (c*) $w_1 + w_2$ (d) $\frac{w_1 + w_2}{2}$

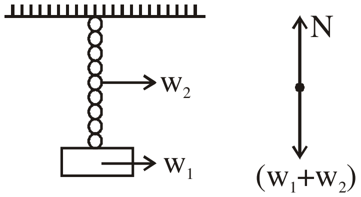
**Sol.** B

F.B.D. Net force zero

$(w_1 + w_2) - N = 0$

$N = w_1 + w_2$

The ceiling pulls the chain by a force $(w_1 + w_2)$.




**2.** When a horse pulls a cart , the force to move forward is the force exerted by

(a) the cart on the horse (b*) the ground on the horse

(c) the ground on the cart (d) the horse on the ground

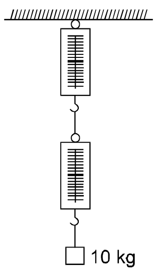
**Sol.** Horce pushes the earth. Earth acts reaction force on the horse.

**3.** A car accelerates on a horizontal road due to the forse exerted by

(a) the engin of the car (b) the driver of the car (c) the earth (d*) the road

**Sol.** **D**

**4.** A block of mass 10 kg is suspended through two loght spring balance as shown in figure (5-Q2)



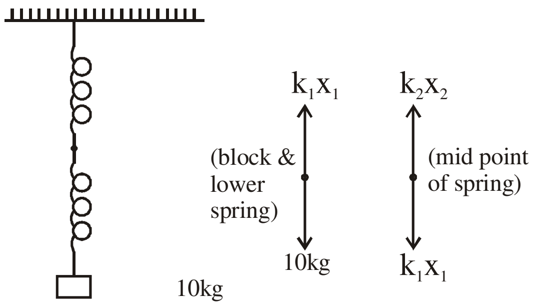

(a*) Both the sales will read 10 kg.

(b) Both the sales will read 5 kg.

(c) The upper sale will read 10 kg and the lower zero.

(d) The readings may be anything but their sum will be 10 kg.

**Sol.** A




$K_1x_1 = 10$ ....... (i)

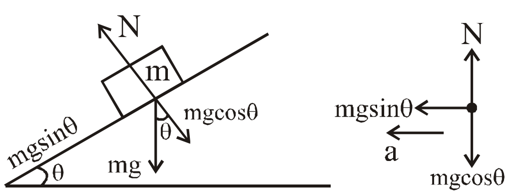
$K_2x_2 = K_1x_1$ ......... (ii)

$K_1x_1 = K_2x_2 = 10$ kg

**5.** A block of mass m is placed on a smooth inclined plane of inclination $\theta$ with the horizontal. The force exerted by the plane on the block has a magnitude

(a) mg (b) mg/cos $\theta$ (c*) mgcos $\theta$ (d) mgtan $\theta$

**Sol.** C




F.B.D.

N = mgcosq

Normal force exerted by the plane on the block has a magnitude is mg cosq.

**6.** A block of mass m is placed on a smooth wedge of inclination $\theta$ . The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block has a magnitude.

(a) mg (b*) mg/cos $\theta$ (c) mgcos $\theta$ (d) mgtan $\theta$

**Sol.** B

F.B.D. of small Block 'm'

Block at equilibrium w.r.t. to wedge.

mg sin q = ma cos q

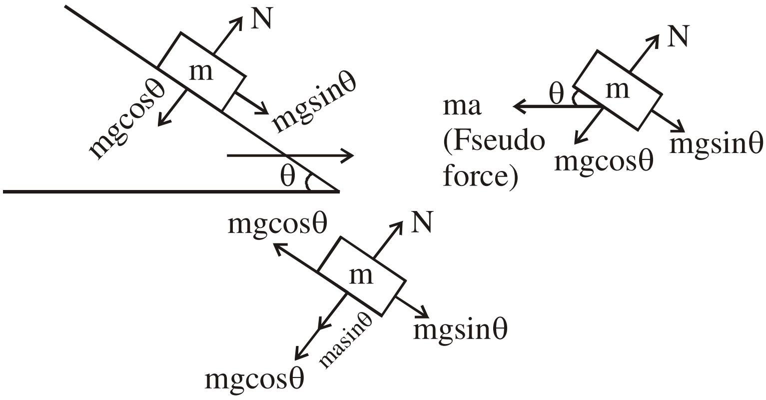
a = g tan q ......... (1)

N = mg cos q + ma sin q

from equation (1)

N = mg cos q + mg tan q sin q

$$N = mg\left(\frac{\sin^2\theta + \cos^2\theta}{\cos\theta}\right)$$




N = mg/cos q

The force exerted by the wedge on the block has a magnitude is mg/cos q.

**7.** Neglect the effect of rotation of the earth. Suppose the earth suddenly stops attracting objects placed near its surface. A person standing on the surface of the earth will

(a) fly up (b) slip along the surface

(c) fly along a tangent to the earth's surface (d*) remain standing

**Sol.** A

A person standing on the surface of the earth will remain standing because net force on the person is zero.

**8.** Three rigid rods are joined to form an equilateral triangle ABC of side 1m. Three particles carrying charges 20 $\mu$C each are attached to the vertices of the triangle. The whole system is at rest always in an inertial frame.The resultant force on the charged particle at A has the magnitude.

(A*) zero (B) 3.6 N (C) $3.6\sqrt{3}$ N (D) 7.2 N

**Sol.** $\overline{F}_{net} = m\overline{a}$

$\overline{a}$ = acceleration of charge of particle at A = 0

\ $\overline{F}_{net} = 0.$

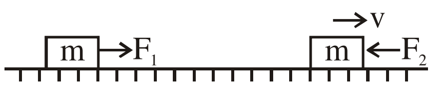
Since whole system is at rst then A is also at rest so resultant force on charge A is zero.

**9.** A force $F_1$ acts on a particle so as to accelerate it from rest to a velocity v. The force $F_1$ is then replaced by $F_2$ is then replaced by $F_2$ which decelerates it to rest.

(a) $F_1$ must be the equal to $F_2$ (b*) $F_1$ may be equal to $F_2$

(c) $F_1$ must be unequal to $F_2$ (d) None of these

**Sol.** B




$F_1$ provides $a_1$ $F_2$ provides $a_2$

$\vec{a}_1 = F_1/m$ $\vec{a}_2 = F_2/m$

v = u + at v = u + at'

$$v = 0 + \frac{F_1}{m}t \qquad 0 = \frac{F_1}{m}t - \frac{F_2}{m}t'$$

$F_1 t = F_2 t'$

$F_1$ may be equal to $F_2$.

**10.** Two objects A and B are thrown upward simultaneously with the same speed. The mass of A is greater than the mass of B .Suppose the air exerts a constant and equal force of resistance on the two bodies.

(a) The two bodies will reach the same height.

(b*) A will go higher than B.

(c) B will go higher than A.

(d) Any of the above three may happen depending on the speed with which the objects are thrown.

**Sol.** B

Let air exerts a constant Force = F (in downward direction)

acceleration of particle 'A' in downward direction due to air resistance force $a_1 = F/m_1$.

acceleration of particle 'B' in downward direction due to air resistance $a_2 = F/m_2$

Q $m_1 > m_2$

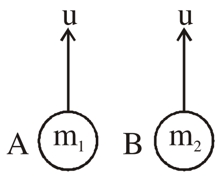
$a_1 < a_2$

$S = ut + 1/2\ at^2$

$H_A = ut - 1/2\ a_1 + 2$

& $H_B = ut - 1/2\ a_2 = 2$

$H_A > H_B$




**11.** A smooth wedge A is fitted in a chamber hanging from a fixed ceiling near the earth's surface. A block B placed at the top of the wedge takes a time T to slidedown the length. If the block is placed at the top of the wedge and the cables supporting the chamber start accelerating it upward with an acceleration of 'g', at the same instant, the block will.

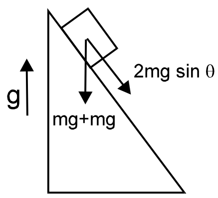
(A) take a time loger than T to slide down the wedge

(B*) take a time shorter than T to slide down the wedge

(C) remain at the top of the wedge

(D) jump off the wedge

**Sol.**




When chamber starts moving up by acceleration 'g', pseudo force mg acts downward on block.

Driving force is increased from mg sin q to 2 mg sin q hence acceleration is increased.

**12.** In an imaginary atmosphere, the air exerts a small force F on any particle in the direction of the particle's motion. A particle of mass m projected upward takes a time $t_1$ in reaching the maximum height and $t_2$ in the return journey to the original point. Then

(a) $t_1 < t_2$

(b*) $t_1 > t_2$

(c) $t_1 = t_2$

(d) the relation between $t_1$ and $t_2$ depends on the mass of the particle.

**Sol.** B

Acceleration due to air resistance force Þ F/m = a direction of air resistance force in the direction of motion.

In upward direction of motion $g_{eff} = (g - a)$

$$t_1 = \sqrt{\frac{2H}{g_{eff}}} = \sqrt{\frac{2H}{g-a}} \qquad .........\ (1)$$

In downward direction of motion $g_{eff} = (g + a)$

$$t_2 = \sqrt{\frac{2H}{g_{eff}}} = \sqrt{\frac{2H}{g+a}} \qquad .........\ (2)$$

equation (1) & (2) we say that $t_1 > t_2$.

**13.** A person standing on the floor of an elevator drops a coin. The coin reaches the floor of the elevator is stationary and in time $t_2$ if it is moving uniformly. Then

(a*) $t_1 = t_2$ (b) $t_1 > t_2$ (c) $t_1 > t_2$ (d) $t_1 < t_2$ or $t_1 > t_2$ depending

**Sol.** A

Elevator move in upward direction with uniformly mean acceleration of elecvator is zero.

in both case $g_{eff} = g^{-}$

$$t_1 = \sqrt{\frac{2H}{g}} \qquad \& \qquad t_2 = \sqrt{\frac{2H}{g}}$$

So $t_1 = t_2$.

**14.** A free $^{238}U$ nucleus kept in a train emits an alpha particle. When the train is stationary, a nucleus decays and a particle and the recoiling nucleus becomes x at time after the decay. If the decay takes place while the train is moving at a uniform velocity v, the distance between the alpha particle and the recoiling nucleus at a time t after the decay as ,measured by the passenger is

(a) x + vt (b) x –vt

(c*) x (d) depends on the direction of the train.

**Sol.** C

Train is moving at a uniform velocity V, w.r.t. train velocity alpha particle and recoiling nucleus is zero.

In the moving train, the distance between the alpha particle and recoiling nucleus at a time 't' after the decay as measured by the passenger is 'x'.

# OBJECTIVE - II

**1.** 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 around 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 angle.

**Sol.** BD
A reference frame attached to the earth cannot be an inertial frame because the earth is rotating about it axis & revolving around the sun.

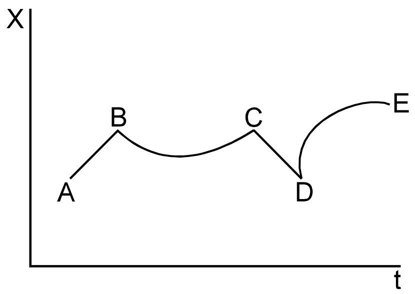
**2.** A particle stays at rest as seen in a frame. We can conclude that
(a) the frame is inertial.
(b) resultant force on the particle is zero.
(c*) the frame may be inertial but the resultant force on the particle is zero.
(d*) the frame may be noninertial but there is a nonzero resultant force.

**Sol.** CD
A particle stays at rest as seen in a frame. We can conclude that the frame may be inertial but the resultant force on the particle is zero or the frame may be non inertial but the resultant force on the particle is nonzero.

**3.** A particle is found to be at rest when seen from a frame $S_1$ and moving with a constant velocity when seen from another frame $S_2$. Markout the possible options.
(a*) Both the frames are inertial
(b*) Both the frames are noninertial.
(c) $S_1$ is inertial and $S_2$ is noninertial.
(d) $S_1$ is noninertial and $S_2$ is inertial.

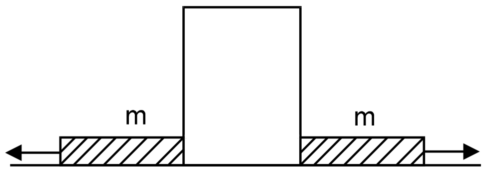
**Sol.** AB
Both the frame are inertial (One frame is ground & other frame is water)
Both the frame are non-inertial (Both the frame move different velocity & in on frame move with same velocity).

**4.** Figure (5-Q3) shows the displacement of a particle going along the X-axis as a function of time. The force acting on the particle is zero in the region.
(a*) AB (b) BC (c*) CD (d) DE




**Sol.** AC
Slope of x-t graph gives the velocity. Here AB & CD slope is constant. So we can say that velocity A to B & C to D is constant. That means the force acting on the particle is zero in AB & CD region.

**5.** Figure shows a heavy block kept on a frictionless surface and being pulled by two ropes of equal mass m. At t = 0, the force on the left rope is withdrawn but the force on the right and continues to act. Let $F_1$ and $F_2$ be the magnitudes of the forces by the right rope and the left rope on the block respectively.




(a*) $F_1 = F_2 = F$ for $t < 0$
(b) $F_1 = F_2 = F + mg$ for $t < 0$
(c) $F_1 = F$, $F_2 = F$ for $t > 0$
(d) $F_1 < F$, $F_2 = F$ for $t > 0$

**Sol.** A

Þ $t < 0$ at equilibrium condition

$F_1 = F_2 = F$ (Horizontal direction)

Þ $t < 0$

$F_2 = 0, \quad F_1 = F$

**6.** The force exerted by the floor of an elevator on the foot of a person standing there is more than the weight of the person if the elevator is

(A*) going up and speeding up (B) going up and speeding down

(C) going down and speeding up (D*) going down and speeding down

**Sol.** BC

It mean normal force exerted by the floor of the elevator on the person is greater that the weight of the person.

$N > mg$

going up Þ $g_{eff} = g + a$

and speeding up

$N = mg_{eff} = mg + ma \quad (N > mg)$

going down Þ $g_{eff} = g - a$

and speeding up

$N = mg - ma \quad (N < mg)$

going down Þ $g_{eff} = g - (-a) = g + a$

and speeding up

$N = mg + ma \quad (N > mg)$

going up Þ $g_{eff} = g - a$

and speeding up

$N = mg - ma \quad (N < mg)$

**7.** If the tension in the cable supporting an elevator is equal to the weight of elevator , the elevator may be

(a) going up with increasing speed. (b) going down with incresing speed.

(c*) going up with uniform speed. (d*) going down with uniform speed.

**Sol.** CD

Means acceleration of elevator is zero.

Elevator may be going up & going down with uniform speed.

**8.** A particle is observed from frames two $S_1$ and $S_2$ . The frame S2 moves with respect to $S_1$ with an acceleration a.Let $F_1$ and $F_2$ be the pseudo forces on the particle when seen from $S_1$ and $S_2$ respectively. Which of the following are not possible ?

(a) $F_1 = 0, F_2 \neq 0$ (b) $F_1 \neq 0, F_2 = 0$ (c) $F_1 \neq 0, F_2 \neq 0$ (d*) $F_1 = 0, F_2 = 0$

**Sol.** D

$a_{S_2S_1} = a$

Acceleration of the particle w.r.t. to $S_1 = F_1/m$

Acceleration of the particle w.r.t. to $S_2 = F_2/m$

If $F_1 = 0$ & $F_2 = 0$

We can conclude that $a_{S_2S_1} = 0$ is not possible.

**9.** A person says that he measured the acceleration of a particle to be nonzero while no force was acting on the particle.

(a) He is a liar.

(b) His clock might have been longer than the standrad.

(c) His meter scale might have been longer than the standrad.

(d*) He might have used noninertial frame.

**Sol.** Means person move with an acceleration is 'a'. W.r.t. to person pseudo force acting on the particle. So we can say that he might have used non inertial frame.