8/10/21

ODM CONNECT HW

EXERCISES (FORCE & LAWS OF MOTION)

Q5. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400m in 20s. Find its acceleration. Find the force acting on it if its mass is 7 tonnes (Hint: 1 tonne = 1000kg)

Ans) Given;

$s = 400$ meters, $t = 20$ secs, $u = 0$

From the equations of motion $= s = ut + \frac{1}{2}at^2$

$\Rightarrow 400 = 0 + \frac{1}{2} \times a \times (20)^2$

$\Rightarrow 400 = \frac{1}{2} \times a \times 20 \times 20$

$\Rightarrow \frac{400 \times 2}{400} = a$

$\Rightarrow 2 = a$

So, $a = 2 m/s^2$

Now, $m = 7$ tonnes $= 7 \times 1000$ Kg $= 7000$ kg, $a = 2 m/s^2$

$F = ma = 7000 \times 2 = 14000$ N

Q6. Given;

$u = 20 m/s$, $v = 0$, $s = 50m$

$\Rightarrow v^2 - u^2 = 2as$

$\Rightarrow -20^2 = 2a \times 50$

$\Rightarrow -20^2 = 100a$

$\Rightarrow \frac{-400}{100} = a$

$\Rightarrow -4 = a$

$F = ma = 1kg \times -4 m/s^2 = -4N.$

(97).

(a) Force exerted by the engine, $F_1 = 40000\,N$

Force exerted from the track (frictional)

$= F_2 = 5000\,N$

Net accelerating force, $F_1 - F_2 = 40000 - 5000 =$

$35000\,N$

$\therefore$ 35000N

(b) Acceleration of the train $= \frac{\text{Force}}{\text{Mass}} =$

$= \frac{35000}{18000} = 1.94\ m/s^2$.

(98).

Mass of the automobile vehicle, $m = 1500\,kg$

Final velocity, $v = 0$ (finally the automobile stops)

Acceleration $= a = -1.7\ m/s^2$

$F = ma = 1500 \times (-1.7) = -2550\,N$.

Hence, the force between the automobile and the road is $-2550\,N$, in the direction opposite to the motion of the automobile

(912).

The logic is that Action and Reaction always act on different bodies, so they cannot cancel each other. When we push a massive truck, the force of friction between ~~the~~ its tyres and the road is very large and so the truck does not move

Q13. Mass of the hockey ball = $m = 200g = 0.2kg$

Hockey ball travels with velocity $v_1 = 10m/s$

Initial momentum $= mv_1$

Hockey ball travels in the opposite direction with velocity, $v_2 = -5m/s$

Final momentum $= mv_2$

$\therefore$ Change in momentum $= mv_1 - mv_2 = 0.2[10 - (-5)]$

$= 0.2(15) = 3kgm/s$

Q14.

Given,

mass $= 10g = \frac{10}{1000} = 0.01kg$

$u = 150m/s$, $v = 0$, $t = 0.03s$

$$a = \frac{v-u}{t} = \frac{0-150}{0.03} = \frac{-150}{\frac{3}{100}} = \frac{-150}{3} \times 100 = -5000$$

Now,

$v^2 - u^2 = 2as$

$\Rightarrow 0^2 - (150)^2 = 2 \times 5000 \times s$

$\Rightarrow -150 \times -150 = -10000s$

$\Rightarrow \frac{-150 \times -150}{-10000} = s$

$\Rightarrow \frac{22500}{10000} = 2.25$

Force, $F = ma$

$= 0.01 \times 5000 = 50N.$

$\therefore$ Magnitude of force $= 50N$

(11). Mass of the object, $m_1 = 1kg$
velocity of the object before collision, $v_1 = 10 m/s$
Mass of the stationary wooden block, $m_2 = 5kg$
Velocity of the wooden block before collision
$v_2 = 0 m/s$
∴ Total momentum before collision $= 1 \times 10$
$= 10 kgm/s$

According to the law of conservation of Momentum
Total Momentum before collision = Total momentum after the collision.

$\Rightarrow m_1 v_1 + m_2 v_2 = (m_1 + m_2) v$
$\Rightarrow 1(10) + 5(0) = (1+5) v$
$\Rightarrow v = 10/6$
$\Rightarrow 5/3 m/s$