WS-3 9th integrated

Thashk

①

Given mass $m = 2\,kg$; $u = 0$

$t = 4\,sec$; $a = 1.5\,m/s^2$

According to Newton's IInd law $F = \frac{dp}{dt}$

$$\Rightarrow F \cdot dt = dp$$

$$\Rightarrow dp = F \cdot dt$$

$$\Rightarrow \quad = ma\,dt$$

$$= 2 \times 1.5 \times 4$$

$$= 12\,kg\,m/sec.$$

②

Mass $m = 0.4\,kg$

The body is initially at rest $u = 0$

time $t = 10\,sec$

After removal of force the body travels 200m

in 20 sec. $\therefore$ From $s = ut + \frac{1}{2}at^2$

$$\Rightarrow 200 = 0 \times 20 + \frac{1}{2}a(20)^2$$

$$\Rightarrow 200 = \frac{1}{2}a(20)^2$$

$$\Rightarrow a = \frac{200}{(20)^2} = \frac{200}{400} = \frac{1}{2}\,m/s^2$$

$\therefore$ Force $F = 0.4 \times \frac{1}{2} = 0.2\,N.$

(3)

Given mass $m = 2\,kg$

The body is moving towards north $u = 4\hat{j}\ m/s$

where $\hat{j}$ is unit vector along north.

Force $= 4(-\hat{i})\ N$ $-\hat{i} \to$ unit vector along west.

$\therefore\ ma = -4\hat{i}$

$\Rightarrow a = -\frac{4}{m}\hat{i} = -\frac{4}{2}\hat{i}$

$\Rightarrow a = -2\hat{i}\ m/s^2$

The distance travelled after '2' sec

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

$$\Rightarrow s = (4\hat{j})(2) + \frac{1}{2}(-2\hat{i})(2)^2$$

$$\Rightarrow s = 8\hat{j} - 4\hat{i}$$

$$|\vec{s}| = \sqrt{8^2 + (-4)^2} = \sqrt{64+16} = \sqrt{80} = 8.94\,m$$

(4)

Here mass of bullet $m = 4\times10^{-2}\ kg$

$u = 20\ m/s$; $v = 0$

time $= 0.05$ Sec $= 5\times10^{-2}$ sec.

According to Newton's II^{nd} law

$F = \frac{dp}{dt}$ [Here F is resistive force]

$\Rightarrow dp = -F.dt. = ma\,dt$

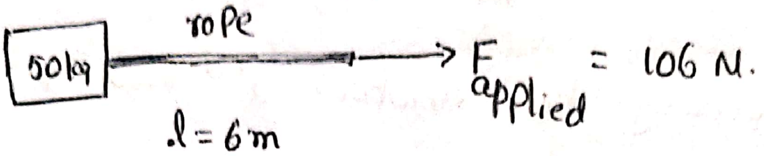
$= -\left[m\left(\frac{v-u}{dt}\right)\right]dt$

$= -m(v-u) = -4\times10^{-2}(0-20)$

$dp = +80\times10^{-2}$ kg m/sec

4

According to question, the ~~dia~~ we can draw



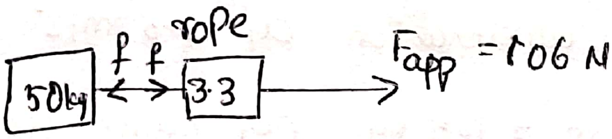
linear density of rope $\lambda = \frac{m}{l} = 0.55$ kg/m.

$\therefore$ mass of rope $m = \lambda l$

$= 0.55 \times 6$

$m = 3.3$ kg

$\therefore$ we can rearrange the diagram as shown below



let 'f' be the contact force which is the force acting on 50 kg.

Acceleration of the system $a = \frac{F_{app}}{\text{Total mass}}$

$$a = \frac{106}{50+3.3} = \frac{106}{53.3} \text{ m/s}^2$$

$\therefore$ The force acting on 50 kg mass is

$$f = M \times a$$

$$= 50 \times \frac{106}{53.3}$$

$$\simeq 100 \text{ N.}$$

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⑥

Given Force $F = 100\ N$

$m = 2\ kg$; time $t = 10\ s$.

According to newton's 2^{nd} law $F = \frac{dp}{dt}$

$\Rightarrow dp = F \cdot dt$

$= 100 \times 10$

$\Rightarrow dp = 1000\ NS$

⑦

Given $m_1 = 3\ kg$, let F be the force acting on it

so it's acceleration $a_1 = 0.5\ m/s^2$.

For $m_2 = 1.5\ kg$ For same force acceleration $a_2 = ?$

$\therefore$ $F = \text{constant}$

$\Rightarrow ma = \text{constant}$

$\Rightarrow m_1 a_1 = m_2 a_2$

$\Rightarrow \cancel{3} \times 0.5 = \cancel{1.5}\ a_2$

$\Rightarrow a_2 = 2 \times 0.5 = 1\ m/s^2$

⑧

Given $m_1 = 2\ kg \rightarrow a_1 = 1\ m/s^2$.

let m_2 be the mass of second body which is placed on I^{st} body

$\therefore$ combined mass $= m_1 + m_2$. $\rightarrow$ it's acceleration is a_2

Given $F = \text{same}$ (ie) $m_2 = 2\ kg$

$\Rightarrow m_1 a_1 = (m_1 + m_2)\ a_2$

$\Rightarrow 2 \times 1 = (2+2)\ a_2$

$\Rightarrow 2 = 4 a_2$

$\Rightarrow a_2 = \frac{2}{4} = \frac{1}{2} = 0.5\ m/s^2$

(9)

Given mass $m = 2kg$

After time = 2 sec the speed increases by 3 m/s

i.e) $dv = 3$ m/s.

According to Newton's 2nd law $F = \frac{dP}{dt}$

$$\Rightarrow F = \frac{m\,dv}{dt}$$

$$= 2 \times \frac{3}{2}$$

$$\Rightarrow F = 3\ \text{N}.$$

(10)

Given $F = 15N$

mass $m = 20$ kg ; Initially the body is at rest (i.e)

$u = 0$

∴ From Newton's 2nd law $F = ma$

$$\Rightarrow 15 = 20a$$

$$\Rightarrow a = \frac{15}{20} = \frac{3}{4}\ m/s^2$$

After 8 sec, the velocity of the body $V = u + at$

$$\Rightarrow V = 0 + \frac{3}{4} \times 8^2$$

$$\Rightarrow V = 0 + 6$$

$$\Rightarrow V = 6\ m/s$$

(18)

Given $m = 10$ kg ; $u = 0$

$F = 20$ N. , the final velocity of the body $v = 30$ m/s

(i) Final momentum = m × Final velocity

$= 10 \times 30$

$= 300$ Ns (or) 300 kg m/s

(ii) Initial momentum = m × Initial Velocity

$= 10 \times 0$

$= 0$

(iii) Acceleration of the body $F = ma$

$\Rightarrow a = \frac{F}{m} = \frac{20}{10} = 2\ m/s^2$

(19)

Given mass = 150 gm $= 150 \times 10^{-3}$ kg

Initial velocity $u = 20$ m/s ; Final velocity $v = -12$ m/s

Here 'v' is -ve because the ball in backing (ie) direction of motion is reversed.

Time of action $dt = \frac{1}{25}$ sec

According to Newton's 2nd law $F = \frac{dP}{dt} = m\frac{dv}{dt}$

$\Rightarrow F = m\left[\frac{v-u}{dt}\right] = 150 \times 10^{-3}\left[\frac{-12-20}{\frac{1}{25}}\right]$

$= 150 \times 25 \times 10^{-3}(-32)$

$= -120$ N [-ve sign shows $\vec{F}$ in opposing force]

(19)

let 'F' be the force

when $m_1 = 0.5$ kg $\rightarrow a_1 = 16\ m/s^2$

$m_2 = ?$ $\rightarrow a_2 = 4\ m/s^2$

Here Force on Ist body = Force on 2nd body

$\Rightarrow F_1 = F_2$

$\Rightarrow m_1 a_1 = m_2 a_2$

$\Rightarrow m_2 = \frac{m_1 a_1}{a_2} = \frac{0.5 \times \cancel{16}^{4}}{\cancel{4}} = 2$ kg.

when both m_1 & m_2 are tied together and same force is applied then their acceleration is a_3

$\therefore$ Force on combined mass $= [m_1 + m_2] a_3$

$\Rightarrow m_1 a_1 = (m_1 + m_2) a_3$

$\Rightarrow 0.5 \times 16 = [0.5 + 2] a_3$

$\Rightarrow \cancel{0.5} \times 16 = \cancel{2.5}^{5} a_3$

$\Rightarrow a_3 = \frac{16}{5} = 3.2\ m/s^2$

L Task   Jee main level

(1) Given Force $F = 15\,N$; Mass $= 15\ kg$; $dt = 8\ sec$.

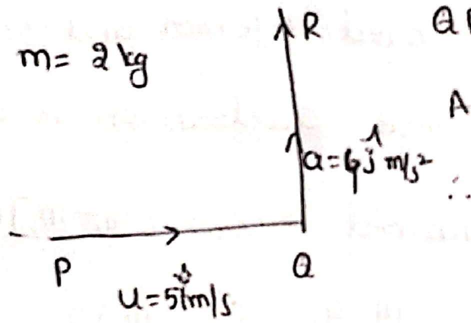
According to Newton's 2nd law $F = \frac{dP}{dt}$

$$\Rightarrow F = m\frac{dv}{dt}$$

$$\Rightarrow \cancel{15} = \cancel{15}\,\frac{dv}{8}$$

$$\Rightarrow dv = 8\ m/s$$

(2)



QR is the line Perpendicular to PQ.

A force of $F = 12\,N$ acts along QR.

$\therefore$ Acceleration a after '3' sec

$$\Rightarrow a = \frac{F}{m} = \frac{12}{2} = 6\ m/s^2$$

$\therefore$ velocity at the end of '3' sec

$$v = u + at$$

$$\Rightarrow v = 5\hat{i} + 6\hat{j}(3)$$

$$\Rightarrow v = 5\hat{i} + 12\hat{j}$$

$$\Rightarrow |\vec{v}| = \sqrt{5^2 + 13^2} = \sqrt{169} = 13\ m/s$$

(3) In this question they had given that the body has to move with same velocity 4 m/s after '2' sec (i.e.)

Velocity = constant $\Rightarrow$ acceleration = 0

Since Force = m × acceleration = m×0

= 0 N.

No force is required.

(4) Initially the body is at rest $u=0$

mass $m = 5$ tonnes

$= 5 \times 10^3$ kg

Force $F = 400$ N

Resistance to the motion $R = 60$ N per tonne

$\therefore$ For 5 tonnes $R = 60 \times 5$

$= 300$ N.

$\therefore$ Net force acting on a truck $= F - R$

$= 400 - 100$

$= 100$ N

According to Newton's 2nd law $F = ma$

$\Rightarrow 100 = m \times a$

$\Rightarrow a = \frac{100}{m} = \frac{100}{5 \times 10^3}$

$\Rightarrow a = \frac{1}{5} \times 10^{-1}$ m/s^2

$\therefore$ velocity at the end of 30 sec is

$v = u + at$

$\Rightarrow v = 0 + \frac{1}{5} \times 10^{-1} \times 30$

$\Rightarrow v = \frac{3}{5} = 0.6$ m/s.

(5) Force $F = 100$ N ; mass $m = 20$ kg

$\therefore$ From Newton's 2nd law $F = ma$

$\Rightarrow a = \frac{F}{m} = \frac{100}{20} = 5$ m/s^2

⑥

Here the velocity of the body is maintained constantly

so acceleration is zero.

$\therefore$ Force = m x acceleration

$= m \times 0$

Force $= 0 N$

⑦

Given mass = 1.5 kg

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

$\therefore$ Force $= m\ a$

$= 1.5 \times 2$

$= 3 N.$

⑧

Given mass $m = 20$ gm

Acceleration $a = 5\ cm/s^2$

$\therefore$ Force $= m\ a$

$= 20 \times 5$

$= 100$ gm cm/s^2 (or) 100 dyne.

we know that 1 dyne $= 10^{-5}$ Newton

$F = 100 \times 10^{-5} N$

$= 1 \times 10^{-3} N$

(9)

Given mass $m = 250$ gm

$= 250 \times 10^{-3}$ kg

Acceleration $a = 3 \ cm/s^2$

$= 3 \times 10^{-2} \ m/s^2$

$\therefore$ Force $F = ma$

$= 250 \times 10^{-3} \times 3 \times 10^{-2}$

$\Rightarrow 750 \times 10^{-5}$

$= 75 \times 10^{-4}$ N.

(10)

Here

Mass of block $M = 2$ kg.

Mass of water that striking the block is $\frac{dm}{dt} = 1$ kg/sec.

speed of water $u = 5$ m/s.

$\therefore$ According to Newton's 2nd law.

The force exerted by water on the block is

$$F = \frac{dp}{dt} \quad [\text{where } p = mu]$$

$$\Rightarrow M_{Block}\, a = u \frac{dm}{dt}$$

$$\Rightarrow 2a = 5 \times 1$$

$$\Rightarrow a = \frac{5}{2}$$

$$\Rightarrow a = 2.5 \ m/s^2$$

(11)

Velocity of the train $v = 10$ m/s.

The rate of mass of rain water added $= \frac{dm}{dt} = 5$ kg/s

$\therefore$ To maintain the velocity, the additional force required is $F = \frac{dp}{dt}$ where $p = mu$

$\Rightarrow F = \frac{d(mu)}{dt}$

$\Rightarrow F = u\frac{dm}{dt} = 10 \times 5 = 50$ N.

(18)

Given $m = 2$ kg ; initial velocity $u = 5$ m/s

Final velocity $v = 6$ m/s ; time $= 0.1$ sec.

(i)

Initial momentum $P_I = m \times$ initial velocity

$\Rightarrow P_I = 2 \times 5$

$\Rightarrow P_I = 10$ kg m/s

(ii)

Final momentum $P_F = m \times$ final velocity

$= 2 \times 6$

$= 12$ kg m/s

(19)

Given $F = 100$ dyne ; $m = 5$ gm ; $t = 10$ sec.

$\therefore$ According to Newton's 2nd law $F = \frac{dp}{dt}$

where $p = mu$ $\Rightarrow F = \frac{d}{dt}(mu) = m\frac{du}{dt}$

$\Rightarrow \cancel{F} \Rightarrow \cancel{100}^{20} = \cancel{5}\frac{du}{10}$

$\Rightarrow du = 20 \times 10 = 200$ cm/s

20

The rate at which gravel dropped $\frac{dm}{dt} = 0.5$ kg/sec

Velocity $v = 2$ m/sec

$\therefore$ According to Newton's 2nd law

$$F = \frac{dp}{dt} \quad \text{where } p = mv$$

$$\Rightarrow F = \frac{d}{dt}[mv]$$

$$= v\frac{dm}{dt}$$

$$= 2 \times 0.5$$

$$\Rightarrow F = 1N$$