9th advanced

WS-5

Thank

①

(1)

$m_f = 20$ kg/sec

$u_g = 10^3$ m/s

$F_{up} = m_f \frac{du_g}{dt}$

$= 20 \times 10^3$

$= 2 \times 10^4$ N

(2)

when $m = \frac{1}{100} m_f = \frac{1}{100} 20$

$V = u \ln \frac{m_0}{m}$

$V = 10^3 \ln \frac{m_0}{\frac{1}{100} m_0}$

$V = 10^3 \cancel{\log} \ln 100$

$= 10^3 \times (4.6) = 4.6 \times 10^3$ m/s

(2)

$m_0 = 6 \times 10^3$ kg

$\frac{m_{gas}}{t} = 200$ kg/s

$u_{gas} = 800$ m/s

$t = 5$ sec

$F = \frac{m_{fuel}\, du_{gas}}{dt}$

200

$\Rightarrow F = 200 \times 800$

$F = 16 \times 10^4$ N

After 5 sec.

Mass $= m_0 - M_{gas} \times t$

$= 6000 - 200 \times 5$

$= 6000 - 1000$

$= 5000$ kg

$\therefore a = \frac{F}{m}$

$= \frac{16 \times 10^4}{5000}$

$\Rightarrow 32$ m/s²

(3)

$M_{Rocket} = 20$ kg ; $m_{fuel} = 180$ kg

$u_{gas} = 1.6$ km/sec

$F_{upthrust} = m_{fuel} \times \frac{du_{gas}}{dt}$

$= 180 \times 1.6$

$= 18 \times 16$ N

$V = u \ln \frac{m_0}{m}$

$V = 1.6 \ln \frac{180}{20}$

$= 1.6 \ln 9$

$= 1.6 \ln 3^2$

$\Rightarrow 1.6 \times 2 \ln 3$

$\Rightarrow 3.2 \ln 3$

$\doteq 3.7$ km/sec

Break

(4)

$N_U = 900\,N = m(g+a)$

$N_L = 300\,N = m(g-a)$

$\Rightarrow \frac{N_U}{N_L} = \frac{900}{300} 3$

$\Rightarrow \frac{\cancel{m}(g+a)}{\cancel{m}(g-a)} = 3$

$\Rightarrow g+a = 3(g-a)$

$\Rightarrow g+a = 3g-3a$

$\Rightarrow 4a = 2g$

$\Rightarrow a = \frac{2g}{4} = \frac{2\times10}{4} = 5\,m/s^2.$

From

$N_U = m(g+a)$

$\Rightarrow 900 = m(10+5)$

$\Rightarrow \cancel{900}^{60} = m\times\cancel{15}$

$\Rightarrow m = 60\,kg$

(5)

when lift is moving up with an acceleration $a=$

$N_U = m(g+a)$

$= 60(10+2.45)$

$\%$ change in wt $= \frac{N_U - mg}{mg}\times100$

$= \frac{m(g+a)-mg}{mg}\times100$

$= \frac{\cancel{mg}+ma-\cancel{mg}}{mg}\times100$

$= \frac{ma}{mg} = \frac{a}{g}\times100$

$= \frac{2.45}{9.8}\times\cancel{100}^{25}$

$= 25\%$

(6)

when lift is moving down with an acceleration $a=\frac{g}{4}$

$T = m(g-a)$ ; $T = 9000\,N$

$\Rightarrow \cancel{9000}^{3000} = m(g-\frac{g}{4}) = \frac{\cancel{3}mg}{4}$

$\Rightarrow mg = 4\times3000$

when lift is moving up with an acceleration $a = \frac{g}{3}$

$T = m(g+a) = m(g+\frac{g}{3})$

$= \frac{4mg}{3} = \frac{4}{\cancel{3}}\times4\times\cancel{3}000$

$= 16000\,N.$

(7)

From $T = m(g-a)$

Given $T = \frac{3}{4}mg$

$\therefore \frac{3}{4}\cancel{m}g = \cancel{m}(g-a)$

$\Rightarrow \frac{3g}{4} = g-a$

$\Rightarrow a = g - \frac{3g}{4}$

$\Rightarrow a = \frac{g}{4}$

moving up
leration a =

(2)

(8)

Breaking strength

$N = m(g-a)$

Given $N = 80g$; $m=100$

$\Rightarrow 80g = 100(g-a)$

$\Rightarrow \cancel{80\times 10}^{9.8} = \cancel{100}(g-a)$

$\Rightarrow 4g = \cancel{9g - a}\ 5g - 5a$

$\Rightarrow \cancel{5a = 9.8 - g}$

$= \cancel{1.96}$

$5a = 5g - 4g$

$\Rightarrow a = \frac{g}{5} = \frac{9.8}{5} = 1.96\ m/s^2$

(9)

If $a_1 = \frac{g}{3}$

$w = m(g + a_1)$

$w = m(g + \frac{g}{3}) = \frac{4}{3}mg \rightarrow (1)$

If $a_2 = \frac{g}{2}$

$w' = m(g - a_2)$

$= m(g - \frac{g}{2})$

$w' = \frac{mg}{2} = \frac{1}{2}mg$

From (1) $mg = \frac{3w}{4}$

$\therefore w' = \frac{1}{2}\frac{3w}{4} = \frac{3w}{8}$.

(14)

$\frac{m_{fuel}}{t} = 50\ kg/s$

$u_{gas} = 2\ km/s = 2\times 10^3\ m/s$

$F_{up} = m\frac{du}{dt}$

$= 50\times 2\times 10^3$

$= 100\times 10^3\ N.$

$v = u \ln\frac{m_0}{m}$ ; $m = \frac{1}{10}m_0$

$= 2\ln\frac{\cancel{m_0}}{\frac{1}{10}\cancel{m_0}}$

$= 2\ln 10$

$= 4.6\ km/s$

$= 4.6\times 10^3\ m/s$

(15) ~~Given~~ (15)

Given $m = 10^3 kg$; $a = 1 m/s^2$

$T = m(g+a)$

$= 10^3(10+1)$

$= 11\times 10^3\ N.$

(16)

$m = 70\ kg$; $a = 3\ m/s^2$

$N = m(g+a)$

$= 70(10+3)$

$= 70\times 13 = 910N.$

(18), (19) (20)

Given $m = 75\ kg$ ; $a = 2\ m/s^2$

$N = m(g+a)$ (upward motion)

$= 75(10+2)$

$= 900\ N$

For downward moti. (5)

$N = m(g-a)$

$= 75(10-2)$

$= 75 \times 8$

$= 600\ N$

Given

For uniform motion $a = 0$

$N = mg$

$= 75 \times 10$

$= 750\ N$

L Task SAQ's

(1)

$M_R = 500\ kg$

$u_{gas} = 250\ m/s$

$a = 20\ m/s^2$

$F_{up} = m \frac{u_g}{t}$

$\Rightarrow M_R\, a = \frac{m_g}{t} u_g$

$\Rightarrow \cancel{750}\overset{3}{\cancel{0}} \times 20 = \frac{m_g}{t} \times \cancel{250}$

$\Rightarrow \frac{m}{t} = 60\ kg/s$

(2)

$M_R = 8000\ kg$

$u_g = 800\ m/s$

$F_{up} = \frac{m_g}{t} \times u_g$

$\Rightarrow M_R\, g = \frac{m_g}{t} \times u_g$

$\Rightarrow \overset{10}{\cancel{8000}} \times 10 = \frac{m}{t} \times \cancel{800}$

$\Rightarrow \frac{m}{t} = 10 \times 10 = 100\ kg/s$

(3)

Force on floor $= \omega_m + \omega_B$

$= m_m g + 40$

$= 75 \times 10 + 40$

$= 750 + 40 = 790\ N$

(4)

Given $a = 4\ m/s^2$ ; $m = 10\ kg$

$N = m(g+a)$

$= 10(10+4)$

$= 140\ N.$

(5)

Given weight $mg = 300\ N$

$N = 400\ N.$ $\Rightarrow m = \frac{300}{g} = 30\ kg$

For upward motion

$N = m(g+a)$

$\Rightarrow 400 = mg + ma$

$\Rightarrow 400 = 300 + 30\ a$

$\Rightarrow 100 = 30\ a$

$\Rightarrow a = 3.3\ m/s^2$

(6)

$a = 2.45\ m/s^2$; $N = 50N$

For upward motion

$N = m(g+a)$

$\Rightarrow 50 = m(9.8 + 2.45)$

$\Rightarrow 50 = m \times 12.25$

$\Rightarrow m = \frac{50}{12.25}\ kg$

True weight $= mg$

$= \frac{50}{12.25} \times 9.8 = 40N.$

(7)

Given $m = 80\ kg$

$u = 8\ m/s$; $v = 0$

$S = 20\ m$

From $v^2 - u^2 = 2aS$

$\Rightarrow 0^2 - 8^2 = 2 \times a \times 20$

$\Rightarrow -64 = 40a$

$\Rightarrow a = -\frac{64}{40}$

$\Rightarrow a = -1.6\ m/s^2$

Apparent weight $= m(g+a)$

$= 80(10 - 1.6)$

$= 80 \times 8.4$

$= 672\ N.$

(8)

Given $m = 2.5\ kg$ ; $a = 19.6\ m/s^2$

For downward motion

$N = m(g-a)$

$\Rightarrow N = 2.5(9.8 - 19.6)$

$= 2.5 \times 9.8$

$= 24.5\ N$

(9)

Given $m = 70\ kg$ ; $a = 4\ m/s^2$

For upward motion

$T = m(g+a)$

$= 70(10+4)$

$= 980\ N.$

Given $m = 80\,kg$

$u = 8\,m/s$; $v = 0$; $s = 16\,m$

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

$\Rightarrow 0^2 - 8^2 = 2a \times 16$

$\Rightarrow -64 = 32a$

$\Rightarrow a = \frac{-64}{32} = -2\,m/s^2$

For upward motion

$N = m(g+a)$

$= 80(9.8 - 2)$

$= 80 \times 7.8 = 624\,N$

(17), (18)

(15)

$m = 1500\,kg$

$a = \frac{v}{t} = \frac{-3.6}{12-10} = \frac{-3.6}{2}$

$a = -1.8\,m/s^2$

For upward motion

$N = m(g+a)$

$= 1500(9.8 - 1.8)$

$= 1500 \times 8$

$= 12000\,N.$

(16)

Area of graph

$s = \frac{1}{2} \times 8 \times 3.6 + \frac{1}{2} \times 12 \times 3.6$

$= \frac{1}{2}(8+12)3.6$

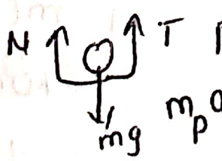
$= 36\,m$

(17)
(18)

Given $M_p = 100\,kg$ : $M_{cr} = 25\,kg$

$N = F = 450\,N$

Free body diagram for paints




$F = N + T - m_p g$

$m_p a = N + T - m_p g \rightarrow (1)$

For whole system


$2T - (m_p + m_{cr})g = (m_p + m_{cr})a$
$\rightarrow (2)$

By multiplying eqn (1) with 2

$2[N + T - m_p g] = 2m_p a$

$\Rightarrow 2N + 2T - 2m_p g = 2m_p a \rightarrow (3)$

By doing (2) − (3) we get

$\Rightarrow 2N + 2T - 2m_p g - 2T + (m_p + m_{cr})g$
$= 2m_p a - (m_p + m_{cr})a$

$\Rightarrow 2N - 2m_p g + (m_p + m_{cr})g = (M_p - m_{cr})a$

$\Rightarrow 2 \times 450 - 2 \times 100 \times 10 + (100+25) \times 10$
$= (100 - 25)a$

$\Rightarrow 900 - 750 = 75a$

$a = \frac{150}{75} = 2\,m/s^2$

(17), (18) continuation

From (1)

$$M_p a = N + T - M_p g$$

$$\Rightarrow M_p(a+g) = N + T$$

$$\Rightarrow 100(2+10) = 450 + T$$

$$\Rightarrow 1200 = 450 + T$$

$$\Rightarrow T = 750 \text{ N.}$$