Chapter 4 Forces Notes Answers

Check Your Understanding 1

1. Ans

(a) since acceleration = 0

$kx - mg = 0$

$100x - 1(9.81) = 0 \rightarrow x = 0.098\,\text{m}$

(b) since accelerating upwards,

$kx - mg = ma$

$100(x) - 1(9.81) = 1(1) \rightarrow x = 0.108\ \text{m}$

2. By Principle of Flotation, $Upthrust = Weight\ of\ solid$

$$\rho_{liquid}\left(\frac{4}{5}V_{solid}\right)g = \rho_{solid}V_{solid}g$$

$$\rightarrow \rho_{liquid} = \frac{5}{4}\rho_{solid} = 5.0\ \text{g cm}^{-3}$$

3. Tension in bottom spring = weight of 1kg

$kx_1 = 1(9.81) \rightarrow x_1 = 0.0981\ \text{m}$

for middle ball to be in eq,, tension in top spring = weight of 1 kg + tension in bottom spring

$kx_2 = kx_1 + mg = 2(9.81) \rightarrow x_2 = 0.1962\ \text{m}$

total extension = $x_1 + x_2 = 0.294\ \text{m}$

4. When submerged: weight = tension + upthrust where tension is apparent weight.

Upthrust = weight - tension = $0.200(9.81) - 0.190(9.81) = 0.0981\ \text{N}$

Since $U = \rho Vg \rightarrow V = \frac{U}{\rho g} = \frac{0.0981}{1000(9.81)} = 1.0 \times 10^{-5}\ \text{m}^{-3}$

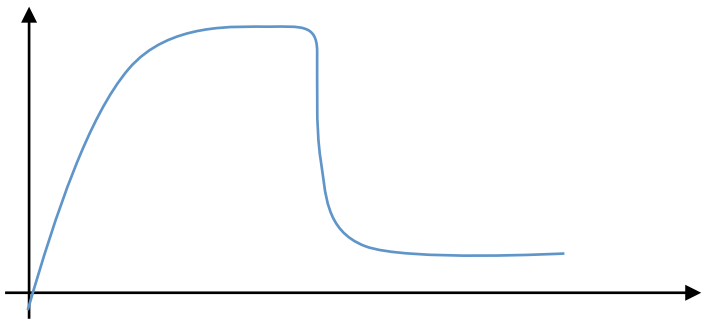
5. Ans

(a) at terminal speed, drag = weight = 598 N

(b) $598 = kv^2 \rightarrow k = \frac{598}{90^2} = 0.074\ \text{N s}^2\ \text{m}^{-2}$

(c) He will experience a decrease in velocity at a decreasing rate, until a new lower terminal velocity is reached.

(d)



Check Your Understanding 2

1. (a) $Fd\sin 0 = 0$

   (b) $Fd\sin 90 = 4$ Nm clockwise

   (c) $Fd\sin\theta = 2(1)\sin 150 = 1$ Nm anticlockwise

   (d) $Fd\sin\theta = 2(2)\sin 60 = 3.46$ Nm clockwise

2. (a) $Fd = 2(0.5) = 1.0$ Nm clockwise

   (b) $Fd_{\perp} = 2(0.5\cos 60) = 0.5$ Nm clockwise

3. considering vertical translational equilibrium,

   $2T_Y = mg \rightarrow 2T\cos 70 = 10 \rightarrow T = 14.6$ N

4. taking pivot about centre,

   $100(0.4) = F(0.5) \rightarrow F = 80\,\text{N}$

   considering vertical equilibrium,

   $R = 100 + F + mg = 100 + 80 + 10 = 190$ N

5. considering vertical translation equilibrium,

   $T_{QR}\cos 40 = 20 \rightarrow T_{QR} = 26.1$ N

   considering horizontal translational equilibrium,

   $T_{QR}\sin 40 = T_{PQ} = 16.8$ N

6. (a) Taking P as pivot, $10(0.5) = F(1)\sin 30 \rightarrow F = 10$ N

   (b) let force by hinge be R.

   $R_Y = mg - F_y = 10 - 10\sin 30 = 5$ N

   $R_X = 10\cos 30$

   $R = \sqrt{R_X{}^2 + R_Y{}^2} = \sqrt{8.66^2 + 5^2} = 10$ N