Newton's laws : connected particles

Ex 3 C, P52

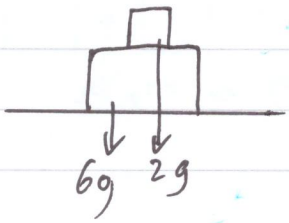
(1) /

(2) $F = T = mg$, so $T = 0.2 \times 9.8 = 1.96\ N$

(3) /

(4) $T_1 = 5 \times 9.8 = 49\ N$, $T_2 = 5 \times 9.8 + 2 \times 9.8$
$= 68.6\ N$

(5)



R between cubes $= 2g = 19.6\ N$
R " " & table $= 8 \times 9.8$
$= 78.4\ N$

(6) (a) $F = (m_1 + m_2)a$

(b) $F - T = m_1 a$

(c) $T = m_2 a$

(7) (a) Resolve ↓ : $F_{net} = ma \Rightarrow m_1 g - T = m_1 a$

(b) Resolve ↑ : $T - m_2 g = m_2 a$

Could Extend question by adding, to find a : So $m_1 g - m_2 g = m_1 a +$

$\Rightarrow a = \dfrac{(m_1 - m_2)g}{m_1 + m_2}$

(8) (a) $F_{Net} = ma$

Resolve $\rightarrow$: $T = m_1 a$

(b) Resolve $\downarrow$: $m_2 g - T = m_2 a$

(9) (a) $F_{Net} = ma$

Resolve $\downarrow$: $m_1 g - T = m_1 a$

(b) Resolve $\rightarrow$: $T_1 - T_2 = m_2 a$

(c) Resolve $\uparrow$: $T_2 - m_3 g = m_3 a$

(10) (a) $F_{Net} = ma$

Resolve $\uparrow$: $T - (m+M)g = (m+M)a$

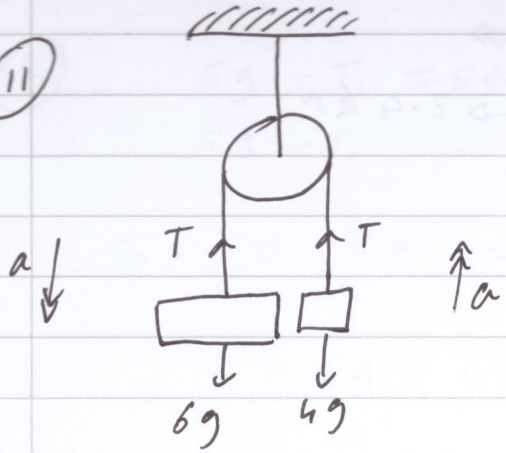
(b) So There are two Reaction forces? one due to Tension in cable & one due to cut of lift?

But I Thought That mg was R !?

$T - R - mg = ma$ ✓

(c) $R - mg = ma$

(11)



Resolve ↓

$6g - T = 6a$

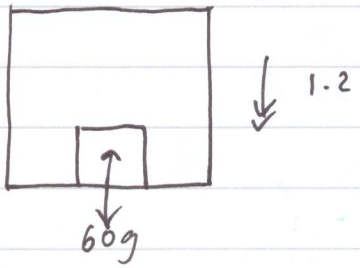
$T - 4g = 4a$

& $2g = 10a$

$\Rightarrow a = \frac{1}{5}g = 1.96 \text{ m/s}^2$

$\Rightarrow T = 4a + 4g = 47.04 \text{ N}$

(12)



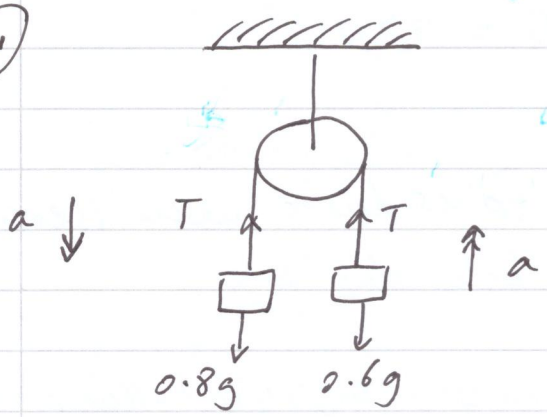
Resolve ↓

$60g - R = 60 \times 1.2$

$\Rightarrow R = 516 \text{ N}$

(13) $R - 60g = 60 \times 1.2 \Rightarrow R = 660 \text{ N}$

(14)



Resolve ↓

$0.8g - T = 0.8a$ (*)

$T - 0.6g = 0.6a$

So $0.2g = 1.4a$

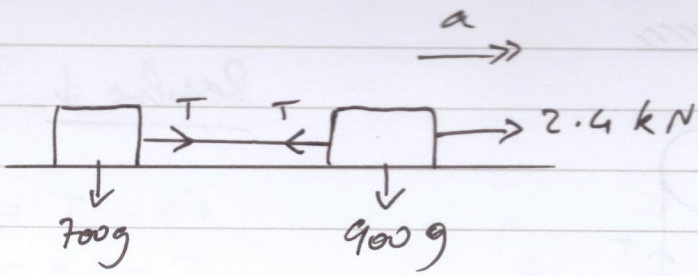
$\Rightarrow a = 1.4 \text{ m/s}^2$

(b) ~~$F = ma$~~

By (*) $T = 0.8(g - 1.4) = 6.72$

So force on Pulley $= 2T = 13.44 \text{ N}$.

(15)



$F_{net} = ma$

Resolve $\rightarrow$: $\quad 24000 - T = 900a$

& $\quad T = 700a$

So $\quad 24000 - 700a = 900a$

$\Rightarrow a = 1.5\ m/s^2$

$\Rightarrow T = 1050\ N$

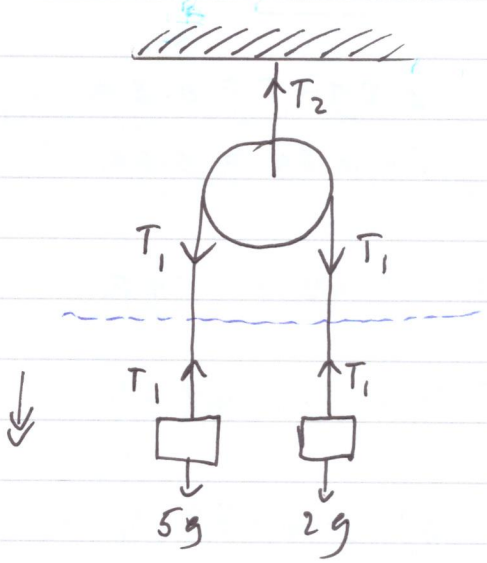
(16) (a) $\quad 5g - T_1 = 5a$

$T_1 - 2g = 2a$

So

$3g = 7a \quad \Rightarrow a = \frac{3}{7}g = 4.2\ m/s^2$

$\Rightarrow T_1 = 28\ N$



Forces due to masses is everything below blue line

Forces / TENSION in Pulley is everything above blue line.

So two forces T_1 pulling down

$\Rightarrow T_2 - 2T_1 = m(0)$, since $a = 0$ for pulley

$\Rightarrow T_2 = 56\ N.$

(b) $5g - T_1 = 5a$

$5g - T_1 = 5a$

So $0 = 5a \Rightarrow a = 0 m/s^2$

$\therefore T_1 = 5g = 49N$

Pulley is Stationary $\Rightarrow a = 0$

$\therefore T_2 - 2T_1 = m(0) \Rightarrow T_2 = 98N$

(c) Resolve ↓ : $0.9g - T_1 = 0.9a$

$T_1 - 0.5g = 0.5a$

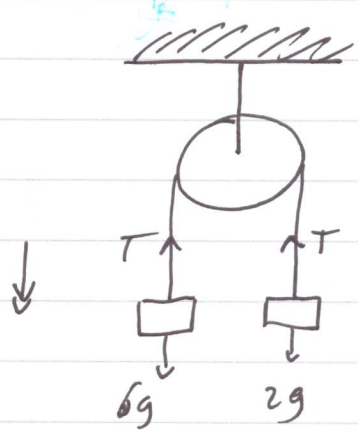
So $0.4g = 1.4a \Rightarrow a = 2.8 m/s^2$

So $T_1 = 6.3N$

& $T_2 - 2T_1 = m(0)$ since Pulley is Stationary

$\therefore T_2 = 2T_1 = 12.6N$

(17)



Resolve ↓

$6g - T = 6a$

$T - 2g = 2a$

So $4g = 8a \Rightarrow a = 4.9 m/s^2$

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

$= 0 + \frac{1}{2}(4.9) \times 4 = 9.8m$

(18) (a) Resolve ↓

$$7g - T_1 = 7a$$
$$T_1 - T_2 = 10a$$
$$T_2 - 4g = 4a$$

So $T_1 = 10a + T_2$ hence

$$7g - 10a - T_2 = 7a$$
$$\Rightarrow \quad 7g - T_2 = 17a$$
$$\& \quad T_2 - 4g = 4a$$

So $3g = 21a \Rightarrow a = 1.4\ m/s^2$

$\therefore T_1 = \ldots$, $T_2 = \ldots$

(b) Resolve ↓ :

$$2g - T_1 = 2a$$
$$T_1 - T_2 = 4a$$
$$T_2 - g = a$$

So $T_1 = 4a + T_2$ hence

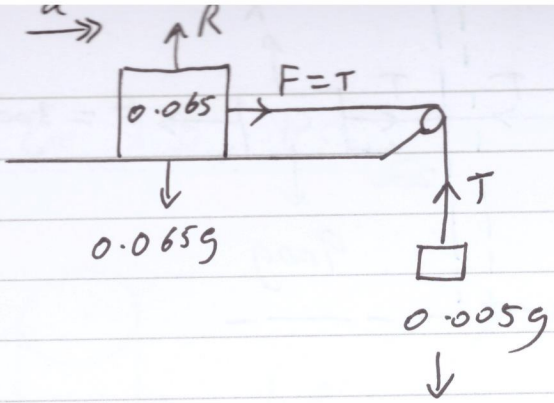
$$2g - 4a - T_2 = 2a$$
$$\Rightarrow \quad 2g - T_2 = 6a$$
$$\& \quad T_2 - g = a$$

So $g = 7a \Rightarrow a = 1.4\ m/s^2$

$\therefore T_1 = \ldots$, $T_2 = \ldots$

Does not make sense. 5g can't pull 65g

(19)



$F_{Net} = ma$

So

Resolve ↓: $0.005g - T = 0.005a$

Resolve →: $T = 0.065a$

(a) So $0.005g - 0.065a = 0.005a$

$\Rightarrow \frac{0.005g}{0.07} = a = 0.7 \, m/s^2$

(b) $T = 0.065(0.7) = 0.0455N$

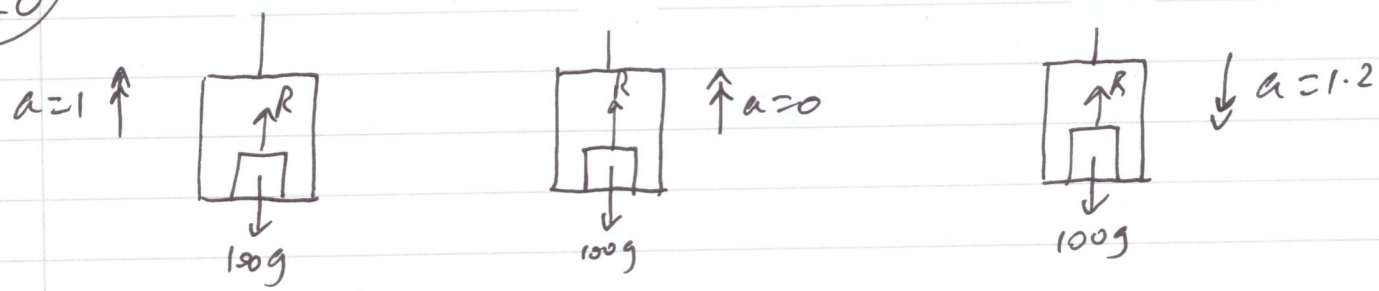
(c)

S	U	V	A	T
?	0	✓	2	

So $S = ut + \frac{1}{2}at^2 \Rightarrow S = 0 + \frac{1}{2}(0.7).4$

$= 1.4m$

(20)

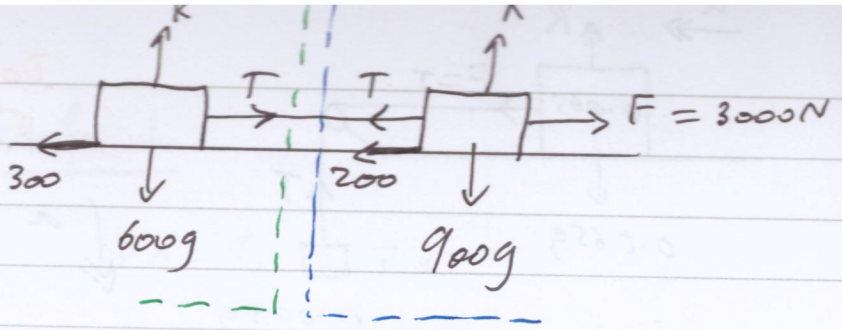


Resolve ↑: (a) $R - 100g = 100a$; (b) $R - 100g = 0$

$\Rightarrow R = 1080N$; $\Rightarrow R = 980N$

(c) $R - 100g = +100(-1.2) \Rightarrow R = 860N$

(21)



Resolve →:

$$F - T - 200 = 900a$$

So $$T = 3000 - 200 - 900a \quad (1)$$

&

$$T - 300 = 600a$$

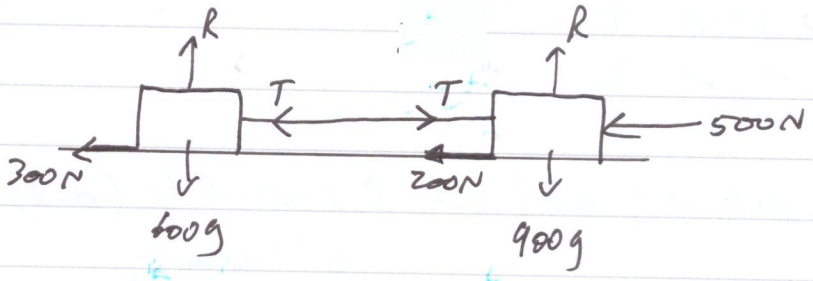
$$\Rightarrow T = 300 + 600a \quad (2)$$

(a) $\therefore (2) = (1)$: $$2800 - 900a = 300 + 600a$$

$$\Rightarrow \frac{2500}{1500} = a = 1\tfrac{2}{3}\ m/s^2$$

$$\therefore T = 300 + 600\left(1\tfrac{2}{3}\right) = 1300N$$

(b)



Resolve ←: car: $$-T + 200 + 500 = 900a$$

trailer: $$T + 300 = 600a$$

So $$600a - 300 = 700 - 900a$$

$$\Rightarrow 1500a = 1000, \quad \therefore a = \frac{2}{3}\ m/s^2$$

& T = compression or Thrust to the car $= 600\left(\frac{2}{3}\right) - 300$

$$= 100N$$