Ex2A

(1) $T = \frac{30 \times 0.5}{2} = 7.5N$

(2) $40 = \frac{25 \times 0.1}{L}$ $\quad L = \frac{2.5}{40} = 0.0625\ m$

(3) $50 = \frac{30(1.5 - L)}{L}$

$50L = 45 - 30L$

$80L = 45$

$L = \frac{45}{80} = 0.5625\ m$

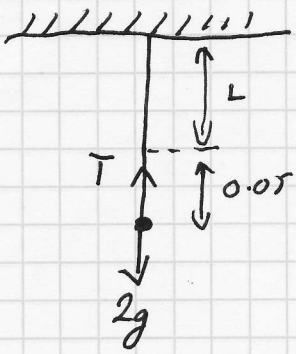
(4) $T = \frac{40 \times 0.1}{0.5} = 8N$

(5) $45 = \frac{A \times 0.25}{1}$

$A = 180N$

(6) $5 = \frac{4x}{2.5}$ $\quad x = 3.125m$

(7)



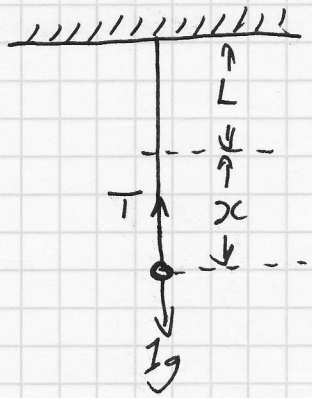
$T - 2g = 0$

$T = 2g$

$2g = \frac{50 \times 0.05}{L}$

$L = 0.128\ m \quad (12.8\ cm)$

(8)



$L + x = 1.4$

$T - g = 0$

$T = g$

Hookes Law $\quad g = \frac{20x}{L}$

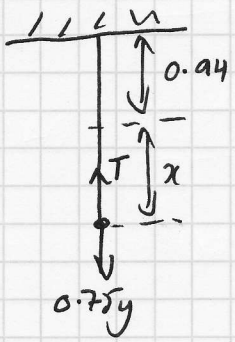
but $x = 1.4 - L$

$gL = 20(1.4 - L)$

$gL = 28 - 20L$

$L(g + 20) = 28$

$L = \frac{28}{g+20} = 0.94M$



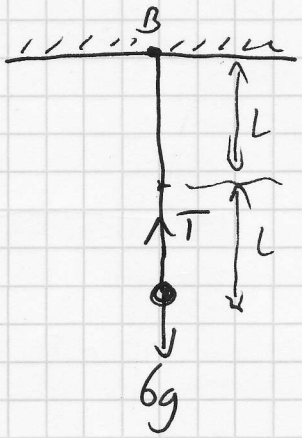
$T = 0.75g$

$0.75g = \frac{20x}{0.94}$

$x = 0.35\ m$

New length $= 1.29\ m$

(9)

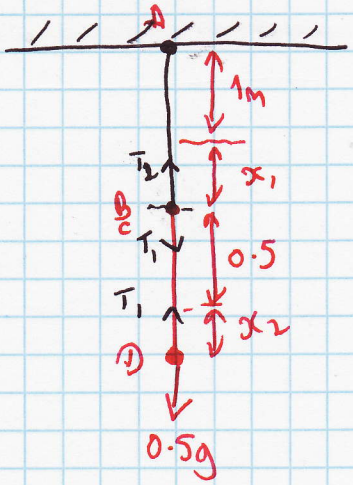


$T = 6g$

$6g = \frac{1.L}{L}$

$A = 6g = 58.8N$

(10)



IN equilib. $\therefore T_1 = T_2 = T = 0.5g$

for AB: ~~0.5g~~ $0.5g = \frac{15 \cdot x_2}{1}$

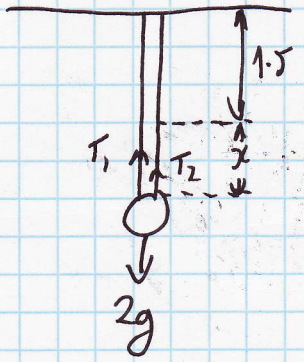
$x_1 = \frac{49}{150}$

for BC: $0.5g = \frac{15 \cdot x_2}{0.5}$

$x_2 = \frac{49}{360}$

$\therefore$ length of combined string $= 1 + 0.5 + \frac{49}{150} + \frac{49}{360} = 1.96\text{M}$

(11)



Same extension in equilibrium

$T_1 = \frac{8x}{1.5}$

$T_2 = \frac{6x}{1.5}$

$T_1 + T_2 = 2g$

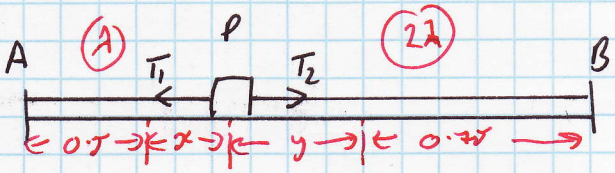
$\therefore \frac{8x}{1.5} + \frac{6x}{1.5} = 2g$

$14x = 29.4$

$x = 2.1$

$\therefore T_1 = 11.2\text{N}$ & $T_2 = 8.4\text{N}$

~~(12)~~



Surface is smooth $\therefore T_1 = T_2 = 10$

AP: $10 = \frac{Ax}{0.5}$ $\quad x = \frac{5}{A}$

BP: $10 = \frac{2Ay}{0.75}$ $\quad y = \frac{15}{4A}$

$x + y + 1.25 = 1.5$

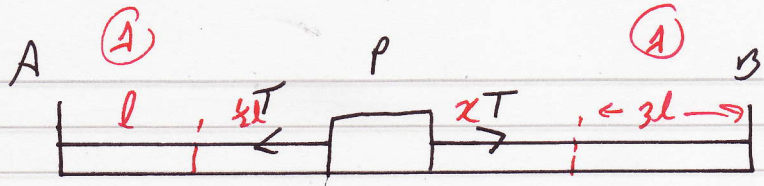
$x + y = 0.25$

$\therefore \frac{5}{A} + \frac{15}{4A} = 0.25$

$\times 4A \quad 20 + 15 = A$

$A = 35$

(13)



Tense string $\therefore$ equal T's

$$l + \tfrac{1}{2}l + x + 3l = AB$$

$$\frac{9}{2}l + x = AB \quad -(1)$$

Hooke's Law: (AP) $T = \frac{\lambda \frac{1}{2}l}{l}$

$$\lambda = 2T$$

(BP) $T = \frac{\lambda x}{3l}$ but $T = \frac{\lambda}{2}$

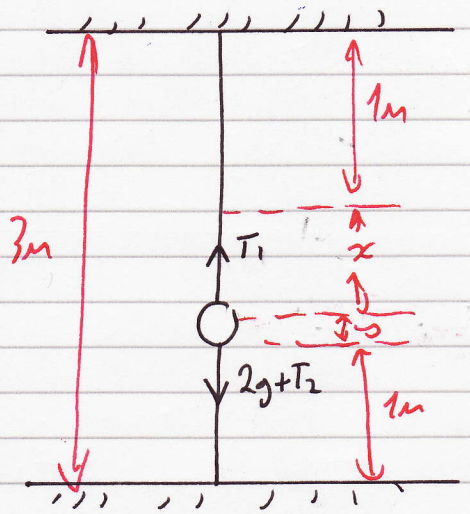
$$\frac{\lambda}{2} = \frac{\lambda x}{3l}$$

$$x = \frac{3l}{2}$$

in (1) $\frac{9}{2}l + \frac{3}{2}l = AB$

$$AB = 6l$$

(14)



$$x + y + 2 = 3$$

$$x + y = 1 \quad -(1)$$

$$T_1 - 2g - T_2 = 0$$

$$T_1 - T_2 = 2g \quad -(2)$$

$$T_1 = \frac{20x}{1} \qquad T_1 = 20x \quad -(3)$$

$$T_2 = \frac{20y}{1} \qquad T_2 = 20y \quad -(4)$$

in (2)

$$20x - 20y = 2g$$

$$10x - 10y = g$$

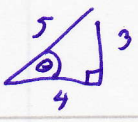
$$10x - 10(1-x) = g$$

$$10x - 10 + 10x = g$$

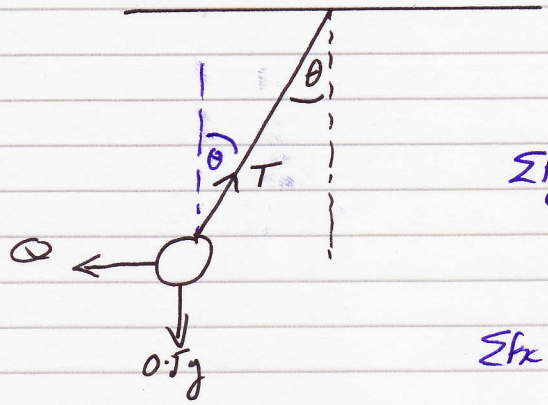
$$20x = 10 + g$$

$$x = 0.99$$

$\therefore$ $y = 0.01$ $\quad T_1 = 19.8N$ $\quad T_2 = 0.2N$



(15)



$\sin\theta = \frac{3}{5}$

Σf_y: $T\cos\theta - 0.5g = 0$

$T = \frac{0.5g}{\cos\theta} = 6.125\,N$

Σf_x: $Q - T\sin\theta = 0$

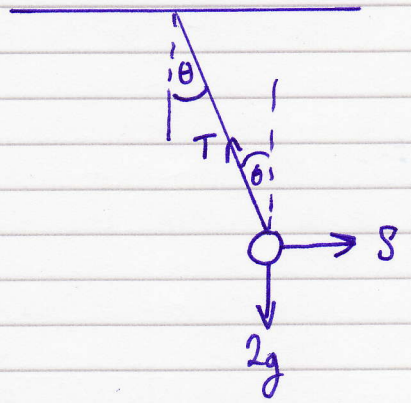
$Q = 6.125 \times \frac{3}{5} = 3.68\,N$

Now $T = \frac{\lambda x}{\ell}$

$6.125 = \frac{\lambda \cdot 0.06}{0.6}$

$\lambda = 61.3\,N$

(16)



Σf_y: $T\cos\theta - 2g = 0$ —①

Σf_x: $S - T\sin\theta = 0$ —②

HL: $T = \frac{60 \times 0.2}{0.5} = 24\,N$

from ① $T\cos\theta = 2g$

in ① $24\cos\theta = 2g$

$\cos\theta = \frac{2g}{24}$

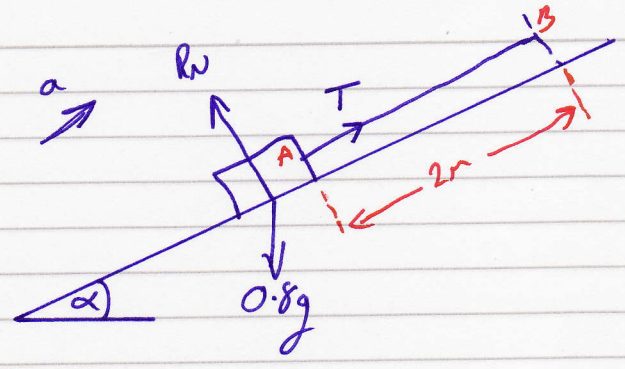
$\theta = 35.2°$

in ② $S = T\sin\theta$

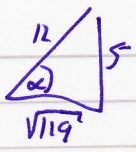
$= 24 \sin 35.2$

$= 13.9\,N$

(18)



$\sin\alpha = \frac{5}{12}$



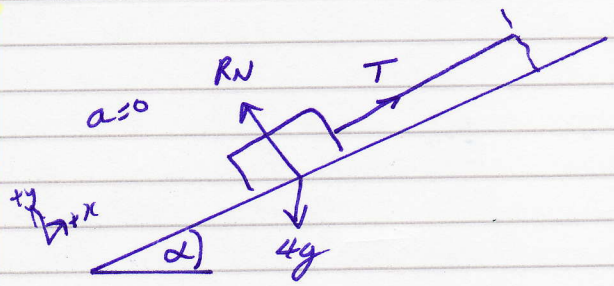
$$T = \frac{14.7 \times 0.5}{1.5} = 4.9\,N$$

N2L: $T - 0.8g\sin\alpha = 0.8a$

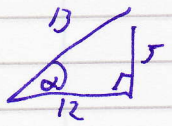
$4.9 - 0.8g \cdot \frac{5}{12} = 0.8a$

$$a = 2.04\ ms^{-2}$$

(17)



$\sin\alpha = \frac{5}{13}$



In equilib $\therefore \Sigma F_x = 0$ $\quad T - 4g\sin\alpha = 0$

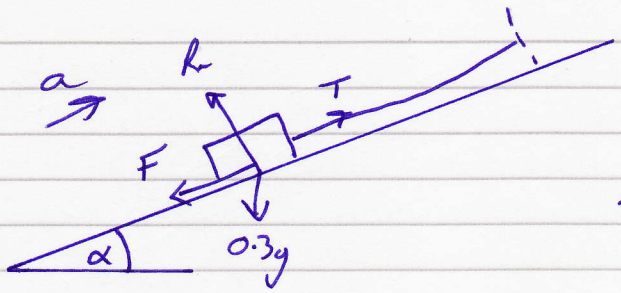
$$T = 4g \cdot \frac{5}{13} = 15.1\,N$$

HL: $T = \frac{\lambda x}{l}$

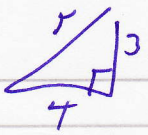
$15.1 = \frac{20x}{0.8}$

$$x = 0.603\ m$$

(19)



$\sin\alpha = \frac{3}{5}$



$\mu = 0.25$

$A = 4.9$, $l = 0.5$, $x = 0.5$

HL: $T = \frac{4.9 \times 0.5}{0.5} = 4.9N$

ΣF_y: $R_n - 0.3g\cos\alpha = 0$

$R_n = 0.3g \times \frac{4}{5} = 2.352$

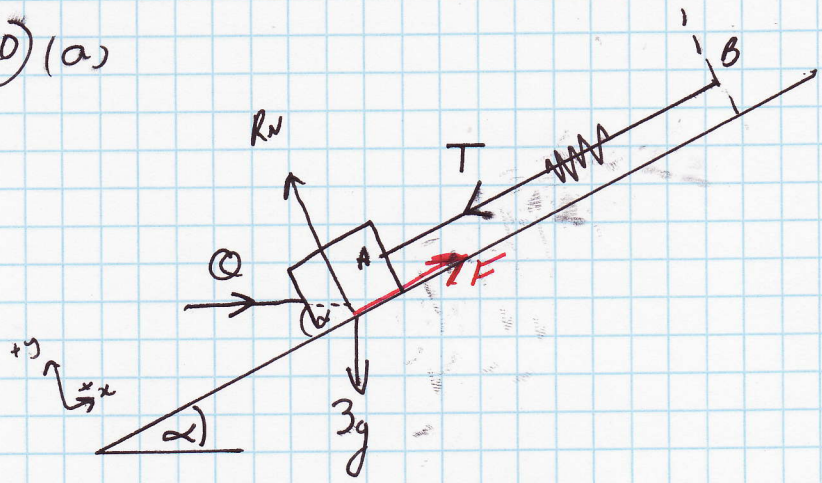
$F = \mu R_n = 0.25 \times 2.352 = 0.588N$

N2L: $T - F - 0.3g\sin\alpha = 0.3a$

$4.9 - 0.588 - \left(0.3 \times 9.8 \times \frac{3}{5}\right) = 0.3a$

$a = 8.49\ ms^{-2}$

(20) (a)



$\sin\alpha = \frac{3}{5}$

Spring AB: $\lambda = 90$, $x = 0.1$, $l = 0.5$

Thrust $T = \frac{90 \times 0.1}{0.5} = 18N$

(a) Smooth Plane ΣF_x: $Q\cos\alpha - T - 3g\sin\alpha = 0$

$$\frac{4}{5}Q = 18 + 3g \cdot \frac{3}{5}$$

$$Q = 44.55N$$

(b) Rough plane. Thrust remains the same, $Q = 35$

$$\Sigma F_x \quad 35\cos\alpha - 18 - 3g\sin\alpha + F = 0$$

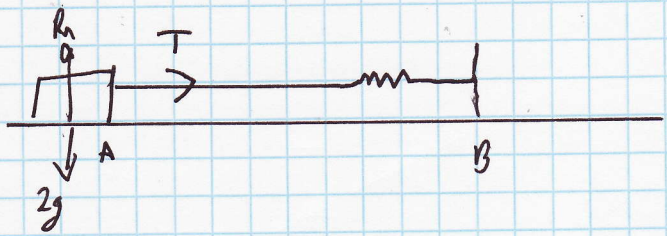
$$F = -35 \cdot \frac{4}{5} + 18 + 3g \cdot \frac{3}{5} = 7.64N$$

Now $R_N - Q\sin\alpha - 3g\cos\alpha = 0$

$$R_N = 35 \cdot \frac{3}{5} + 3 \cdot 9.8 \cdot \frac{4}{5} = 42.52 \quad 44.52$$

Then $\mu = \frac{F}{R_N} = \frac{7.64}{44.52} = 0.172$

(21)



(a) $\lambda = 60$, $l = 0.5$, $x = 0.2$

Tension $T = \frac{60 \times 0.2}{0.5} = 24$

$F = ma$

$24 = 2 \times a$

$a = 12 ms^{-2}$

(b) $\lambda = 60$, $l = 0.5$, $x = 0.2$

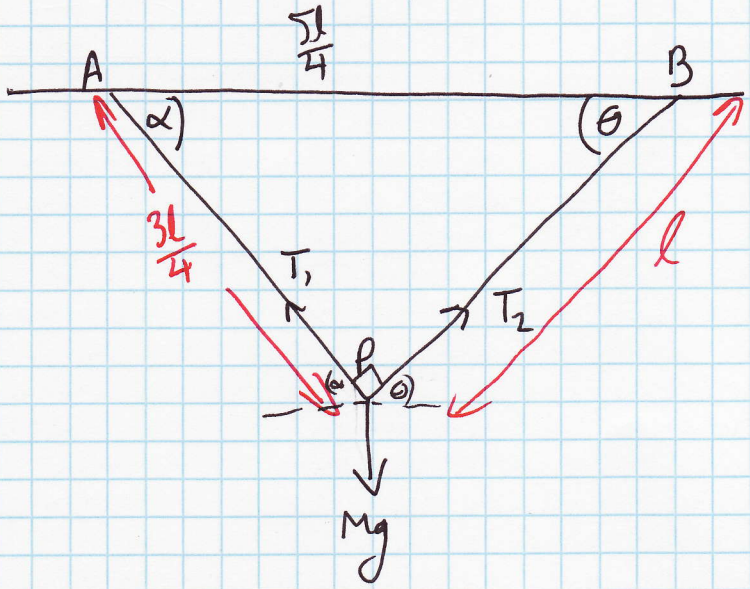
Thrust, $T = \frac{60 \times 0.2}{0.5} = 24$

$F = ma$

$24 = 2a$

$a = 12 ms^{-2}$

(22)



Check if right angled: $AP^2 + BP^2 = AB^2$?

$$\left(\frac{3l}{4}\right)^2 + l^2 = \left(\frac{5l}{4}\right)^2$$

$$\frac{9l^2}{16} + \frac{16l^2}{16} = \frac{25l^2}{16}$$

$$\frac{25l^2}{16} = \frac{25l^2}{16}$$

$\therefore A\hat{P}B$ is right angle

Resolving: ΣF_y: $T_1 \sin\alpha + T_2 \sin\theta - Mg = 0$ — (1)

ΣF_x: $T_2 \cos\theta - T_1 \cos\alpha = 0$ — (2)

but $\cos\alpha = \frac{3l}{4} \div \frac{5l}{4} = \frac{3l}{4} \times \frac{4}{5l} = \frac{3}{5}$, $\sin\alpha = \frac{4}{5}$

$\cos\theta = l \div \frac{5l}{4} = l \times \frac{4}{5l} = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$

$\therefore$ in (2) $T_2 \cdot \frac{4}{5} = T_1 \cdot \frac{3}{5}$

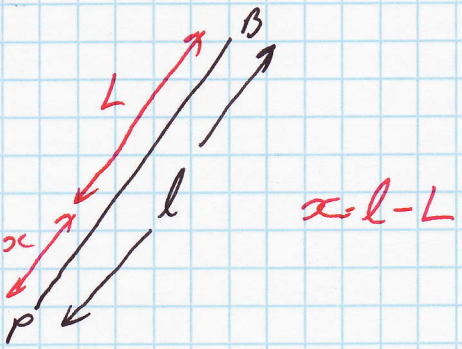
$$T_1 = \frac{4}{3} T_2$$

in (1) $\frac{4}{3} T_2 \cdot \frac{4}{5} + T_2 \cdot \frac{3}{5} = Mg$

$$\frac{5}{3} T_2 = Mg$$

$$T_2 = \frac{3Mg}{5}$$

(22) Cont'd Now Hookes Law: $T_2 = \frac{\lambda x}{L}$



$$\frac{3mg}{5} = \frac{\lambda(l-L)}{L}$$

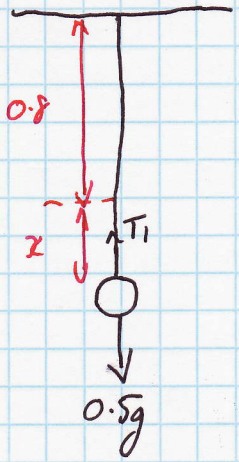
$$3Lmg = 5\lambda L - 5\lambda L$$

$$5\lambda L + 3Lmg = 5\lambda l$$

$$L(5\lambda + 3mg) = 5\lambda l$$

$$L = \frac{5\lambda l}{5\lambda + 3mg}$$ As required.

(23)

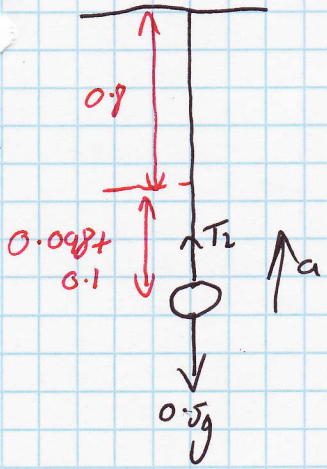


$T_1 - 0.5g = 0$

$T_1 = 4.9$ N

HL: $4.9 = \frac{40x}{0.8}$

$x = 0.098$ m



$T_2 = \frac{40 \times 0.198}{0.8} = 9.9$N

$T_2 - 0.5g = 0.5a$

$9.9 - 4.9 = 0.5a$

$a = 10 ms^{-2}$