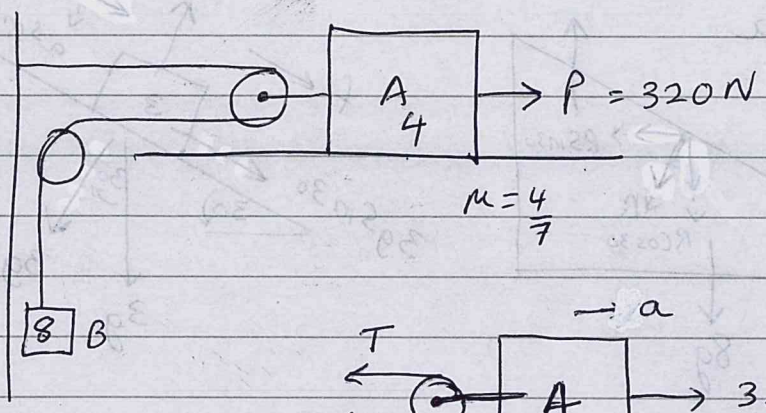
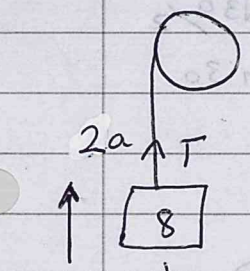
2014



$\mu R = \frac{4}{7}(4g)$



$320 - 2T - \frac{4}{7}(4g) = 4a$

(i) $T - 8g = 8(2a)$ ✓

$T - 8g = 16a$

$\frac{T-8g}{4} = 4a$

$320 - 2T - \frac{16g}{7} = 4a$

$320 - 2T - \frac{16g}{7} = \frac{T-8g}{4}$

$8960 - 56T - 64g = 7T - 56g$

$8960 - 8g = 63T$

$140.97N = T$

(ii) $T - 8g = 16a$

$T = 16a + 8g$

$320 - 2T - \frac{16g}{7} = 4a$

$320 - 2(16a + 8g) - \frac{16g}{7} = 4a$

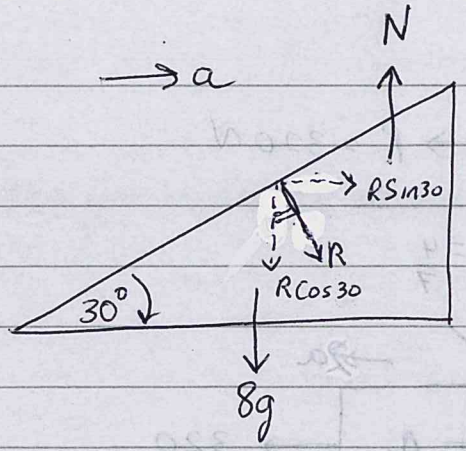
$2240 - 224a - 112g - 16g = 28a$

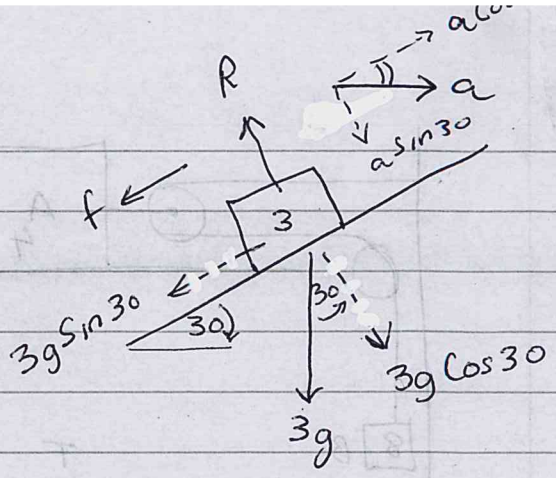
$2240 - 128g = 252a$

$3.91 = a$

2014

(4.)(b)





$R\sin 30 = 8a$

$R/2 = 8a$

$N - 8g = 0$

$3g\sin 30 = 3(f - a\cos 30)$

$3g/2 = 3f - 3\sqrt{3}a/2$

$3g\cos 30 - R = 3a\sin 30$

$\frac{3g\sqrt{3}}{2} - R = \frac{3a}{2}$

(1) $R = 16a$

(2) $3g = 6f - 3\sqrt{3}a$

(3) $3g\sqrt{3} - 2R = 3a$

$3g\sqrt{3} - 32a = 3a$

$3g\sqrt{3} = 35a \quad a = \frac{3g\sqrt{3}}{35}$, $6F = 3g + 3\sqrt{3}\left(\frac{3g\sqrt{3}}{35}\right)$

$6F = 3g + \frac{27g}{35}$, $f = \frac{132g}{210}$

$f = \frac{22g}{35}$

Wedge:

$u = 0$

$v =$

$a = \frac{3g\sqrt{3}}{35}$

$s = 3\sqrt{3}$

$t = ?$

$\frac{3\sqrt{3}}{100} = \frac{3g\sqrt{3}}{70}t^2$

$t = \sqrt{\frac{70(3\sqrt{3})}{3g\sqrt{3}\,100}} = \sqrt{\frac{7}{10g}}$

Particle:

$u = 0$

$v =$

$a = 22g/35$

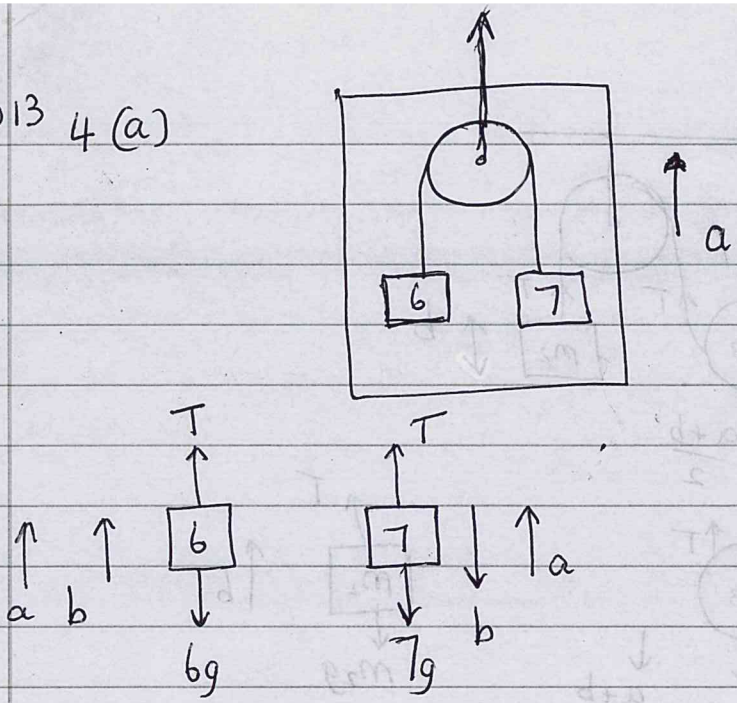
$s = x$

$t = \sqrt{\frac{7}{10g}}$

$x = \frac{1}{2}\left(\frac{22g}{35}\right)\left(\frac{7}{10g}\right)$

$x = \frac{77}{350} = \frac{11}{50} = 0.22m$

2013 4 (a)



$T - 6g = 6(a+b)$ $\quad 7g - T = 7(b-a)$

(i) if $a = 0$: $\quad T - 6g = 6b \quad 7g - T = 7b \quad$ (add)

$g = 13b \qquad b = 9/13 \;,\; T = 6b + 6g = 63.32\,N$

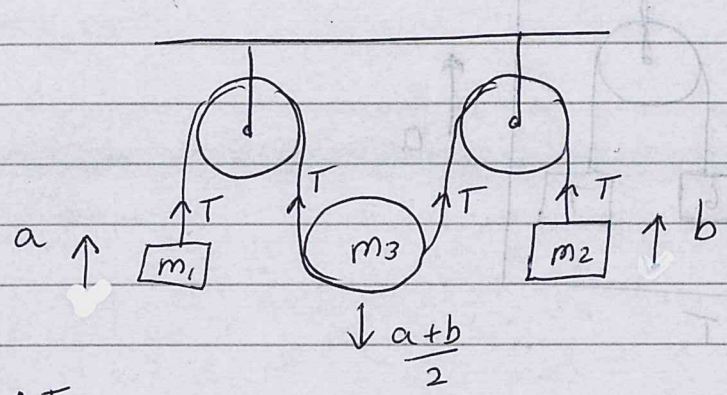
(ii) $a = 9/8$: $\quad T - 6g = \frac{6g}{8} + 6b \qquad 7g - T = 7 - \frac{7g}{8}$ (add)

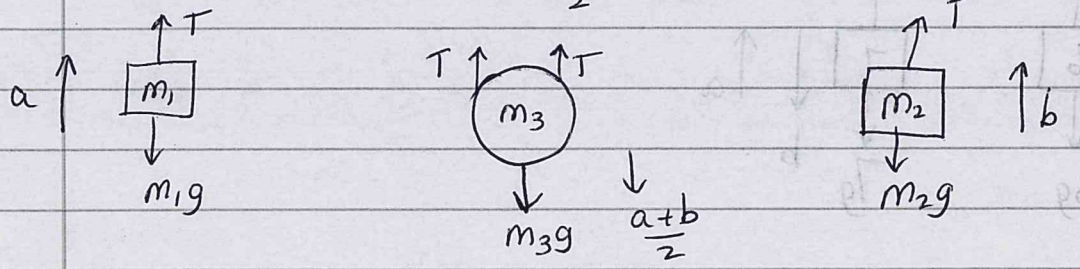
$g = \frac{\quad}{8} + 13b$

$\frac{9g}{8} = 13b \quad \Rightarrow b = \frac{9g}{104}$

$T = \frac{6g}{8} + 6g + 6\left(\frac{9g}{104}\right) = \frac{189g}{26} = 71.24\,N$

4
2013 (b)





$T - m_1 g = m_1 a$ $\quad m_3 g - 2T = m_3\left(\frac{a+b}{2}\right)$ $\quad T - m_2 g = m_2 b$

$a = \frac{T - m_1 g}{m_1}$ $\quad \frac{a+b}{2} = \frac{T - m_1 g}{2m_1} + \frac{T - m_2 g}{2m_2}$ $\quad b = \frac{T - m_2 g}{m_2}$

$$= \frac{m_2 T - m_1 m_2 g + m_1 T - m_1 m_2 g}{2 m_1 m_2}$$

$$m_3 g - 2T = \left(\frac{m_2 T - m_1 m_2 g + m_1 T - m_1 m_2 g}{2 m_1 m_2}\right) m_3$$

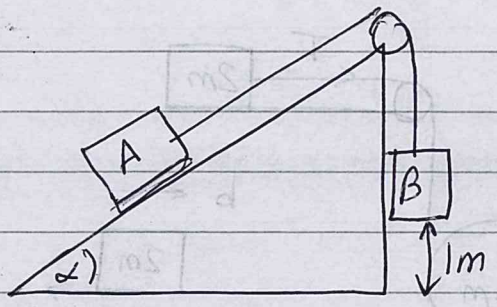
$$2 m_1 m_2 m_3 g - 4 m_1 m_2 T = m_2 m_3 T - 2 m_1 m_2 m_3 g + m_1 m_3 T$$

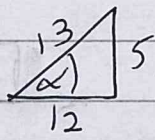
$$4 m_1 m_2 m_3 g = m_2 m_3 T + m_1 m_3 T + 4 m_1 m_2 T$$

$$\frac{4 m_1 m_2 m_3 g}{m_1 m_3 + m_2 m_3 + 4 m_1 m_2} = T$$

Q4

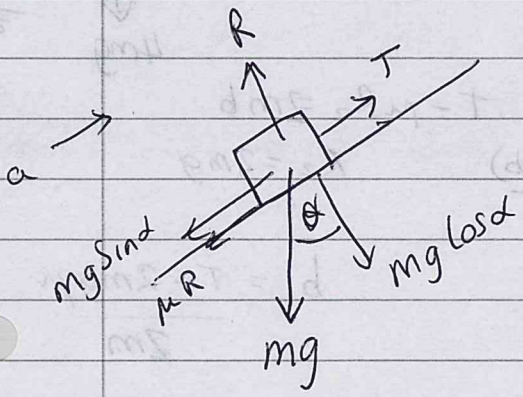
2012(a)

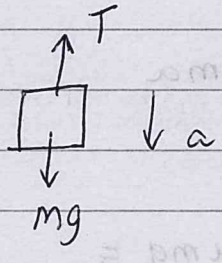




$\sin\alpha = \frac{5}{13}$

$\cos\alpha = \frac{12}{13}$





$T - mg\sin\alpha - \mu R = ma$ $\qquad mg - T = ma$

$R = mg\cos\alpha = \frac{12mg}{13}$ $\qquad$ add

$T - \frac{5mg}{13} - \frac{1}{2}\frac{12mg}{13} = ma$ $\qquad mg - \frac{5mg}{13} - \frac{6mg}{13} = 2ma$

$13g - 5g - 6g = 26a$

$\frac{2g}{26} = \frac{g}{13} = a$

B:

$u = 0$

$v =$

$a = g/13$ $\qquad v^2 = 0^2 + 2g/13$ $\qquad v = \sqrt{\frac{2g}{13}}$

$s = 1$

$t =$

A:

$u = \sqrt{2g/13}$

$v = 0$

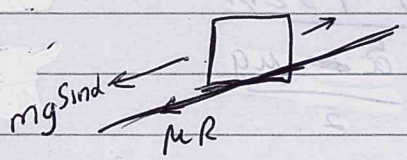
$a = \frac{11mg}{13}$

$s =$

$t =$

$s = \frac{0^2 - 2g/13}{22mg/13} = \frac{2g}{22g} = \frac{1}{11}\,m$

After B strikes ground, Tension = 0



$F = -(mg\sin\alpha + \mu R)$

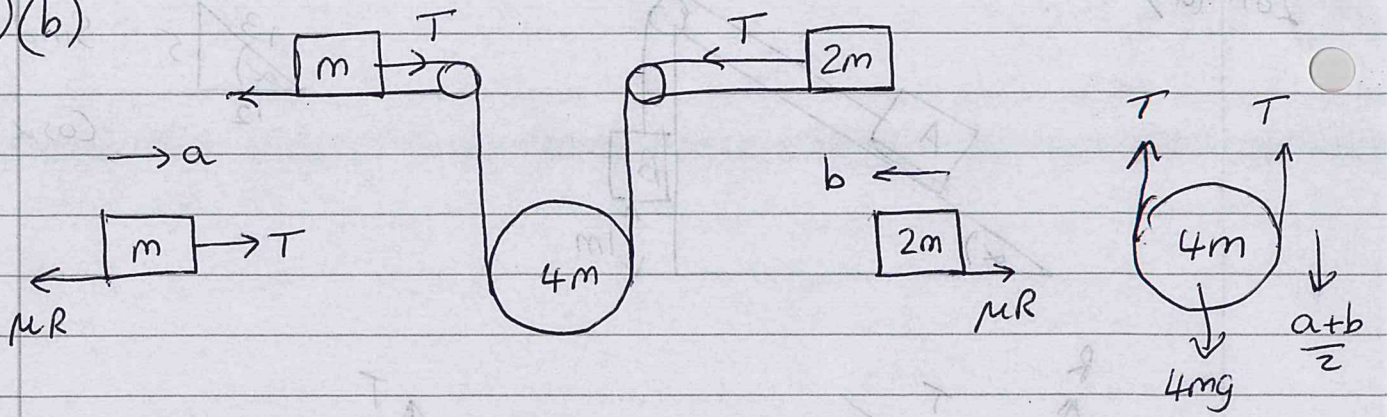
$F = -\left(\frac{5mg}{13} + \frac{6mg}{13}\right)$

$F = \frac{-11mg}{13}$

$a = \frac{11mg}{13}$

2012

(4.)(b)



$T - \mu R = ma$ $\quad R = mg$ $\quad 4mg - 2T = 4m\left(\frac{a+b}{2}\right)$ $\quad T - \mu R_2 = 2mb$ $\quad R_2 = 2mg$

$a = \frac{T - \mu mg}{m}$ $\quad b = \frac{T - 2mg\mu}{2m}$

$\frac{a+b}{2} = \frac{T-\mu mg}{2m} + \frac{T-2mg\mu}{4m} = \frac{2T-2\mu mg+T-2\mu mg}{4}$

$\frac{a+b}{2} = \frac{3T-4\mu mg}{4m}$

$4mg - 2T = 4m\left(\frac{3T-4\mu mg}{4m}\right)$

$4mg - 2T = 3T - 4\mu mg$

$4mg(1+\mu) = 5T \Rightarrow T = \frac{4mg(1+\mu)}{5}$

(ii) find b in terms of a

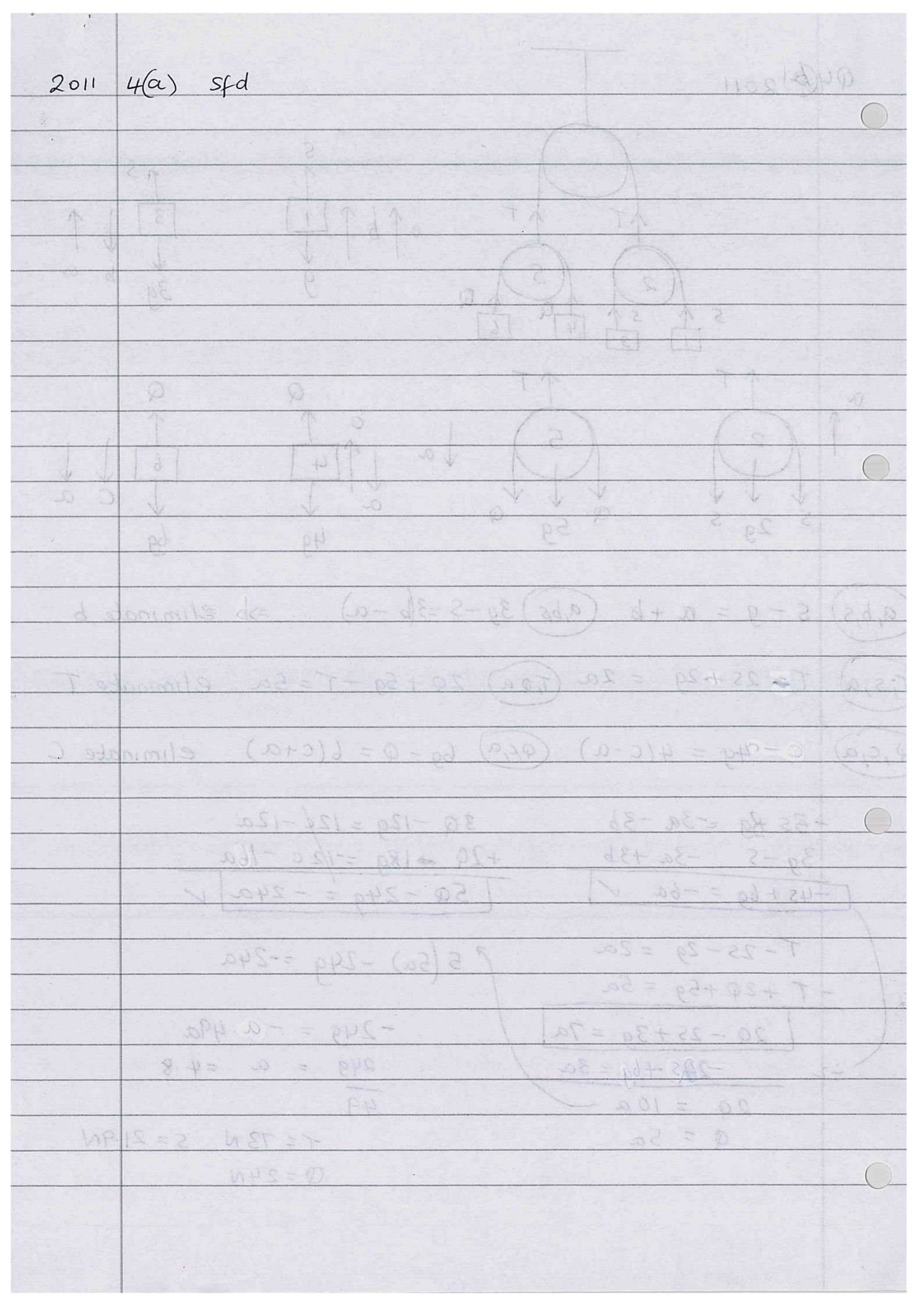
$a = \frac{4mg(1+\mu)}{5} - \frac{\mu mg}{m}$ $\quad b = \frac{4mg(1+\mu)}{5} - \frac{2\mu mg}{2m}$

$a = \frac{4g+4\mu g}{5} - \frac{5\mu g}{5}$ $\quad b = \frac{4g+4\mu g}{10} - \frac{5\mu g}{2}$

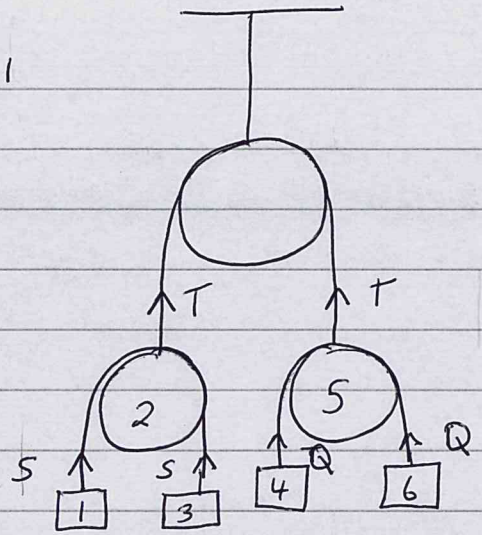
$a = \frac{4g-\mu g}{5}$ $\quad = \frac{2g+2\mu g - 5\mu g}{5}$

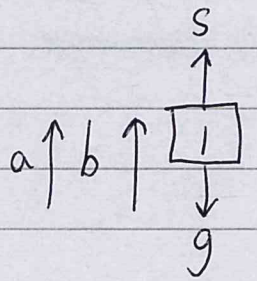
$b = 3a - \frac{10g}{5} = 3a - 2g.$ $\quad b = \frac{2g-3\mu g}{5}$

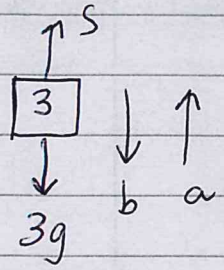
2011 4(a) sfd

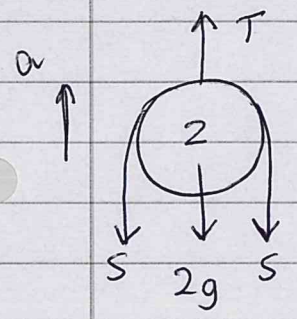


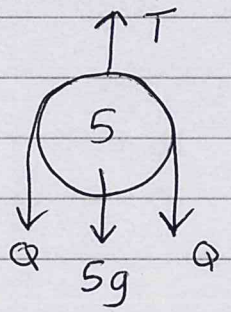
Q4(b) 2011

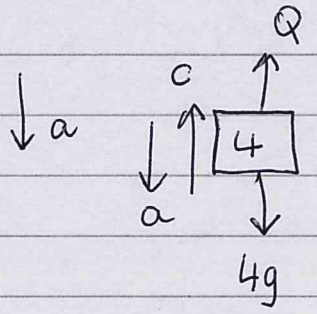


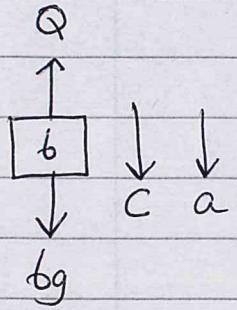












(a,b,s) $S - g = a + b$ (a,b,s) $3g - S = 3(b - a)$ $\Rightarrow$ eliminate b

(T,s,a) $T - 2S - 2g = 2a$ (T,Q a) $2Q + 5g - T = 5a$ eliminate T

(Q,c,a) $Q - 4g = 4(c - a)$ (Q,f,a) $6g - Q = 6(c + a)$ eliminate C

$-3S + 3g = -3a - 3b$

$3g - S = -3a + 3b$

$-4S + 6g = -6a$ ✓

$3Q - 12g = 12c - 12a$

$+2Q + 12g = -12c - 12a$

$5Q - 24g = -24a$ ✓

$T - 2S - 2g = 2a$

$-T + 2Q + 5g = 5a$

$2Q - 2S + 3g = 7a$

$\div 2$ $2S - 3g = 3a$

$2Q = 10a$

$Q = 5a$

$5(5a) - 24g = -24a$

$-24g = -49a$

$24g = a = 4.8$

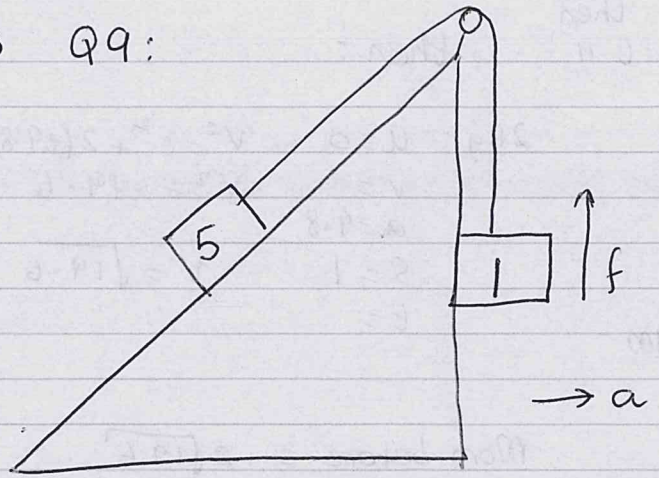
49

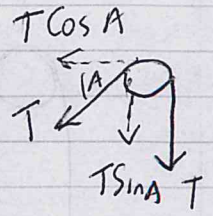
$T = 73\,N$ $S = 21.9N$

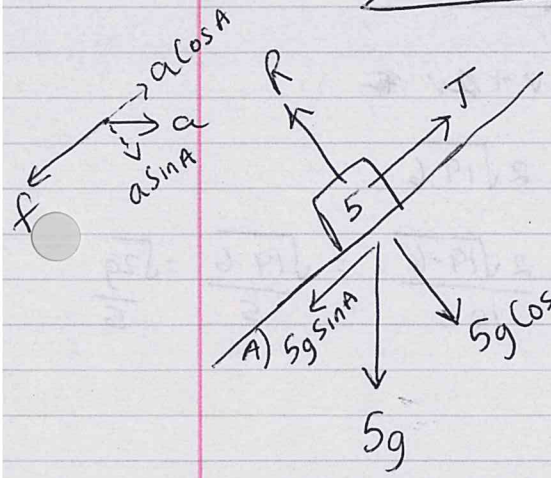
$Q = 24N$

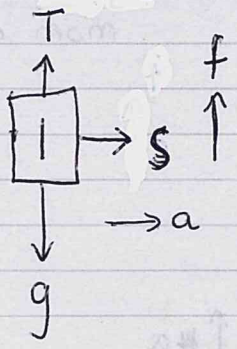
BOOK

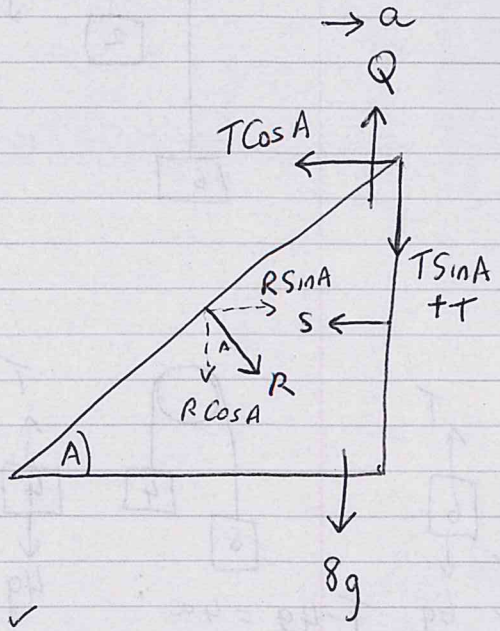
P 93 Q9:











$5g\cos A - R = 5a\sin A$

$T - 5g\sin A = 5(a\cos A - f)$

$\sin A = 3/5 \quad \cos A = 4/5$

$5g \cdot \frac{4}{5} - R = 5a \cdot \frac{3}{5}$

$\boxed{4g - R = 3a}$ ✓

$T - 5g \cdot \frac{3}{5} = 5(a \cdot \frac{4}{5} - f)$

$\boxed{T - 3g = 4a - 5f}$ ✓

$\boxed{T - g = f}$ ✓

$\boxed{S = 1a}$ ✓

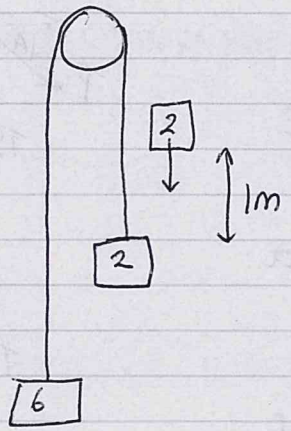
$RSinA - S - TCosA = 8a$

$Q - TSinA - T - 8g - RCosA =$

$\boxed{R \cdot \frac{3}{5} - S - T \cdot \frac{4}{5} = 8a}$ ✓

Book Pg 106 e.g 6.11 Q11 then

Q5:



then:

2kg: $u=0$, $v=$, $a=9.8$, $s=1$, $t=$

$v^2 = 0^2 + 2(9.8)(1)$

$v^2 = 19.6$

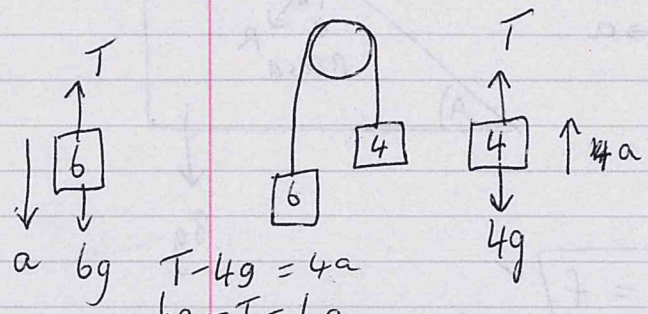
$v = \sqrt{19.6}$

Mom before $= 2\sqrt{19.6}$

mom after $= 6v + 4v$

$10v = 2\sqrt{19.6}$

$v = \frac{2\sqrt{19.6}}{10} = \frac{\sqrt{19.6}}{5} = \frac{\sqrt{2g}}{5}$



$T - 4g = 4a$

$6g - T = 6a$

$2g = 10a$

$\frac{g}{5} = a$

6kg:

$u = \frac{\sqrt{2g}}{5}$

$v = 0$

$a = -g/5$

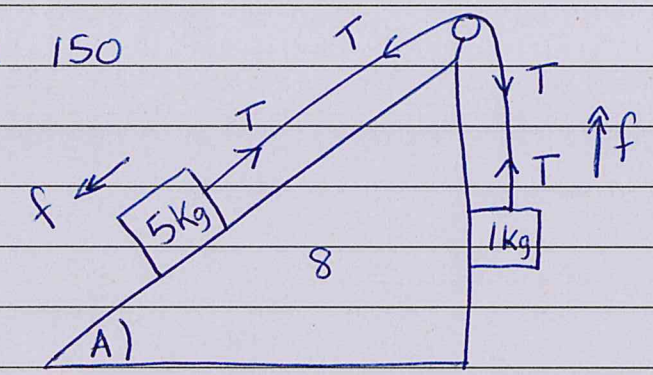
$s =$

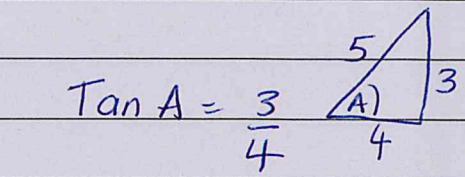
$t =$

$0^2 = \frac{2g}{25} - 2gs \Rightarrow s = \frac{1}{5} = 0.2m$

A Q4 type Q from Fundamental Applied Maths

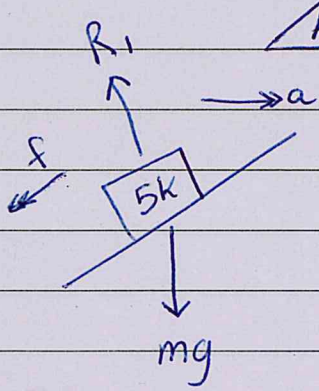
Q10 page 150

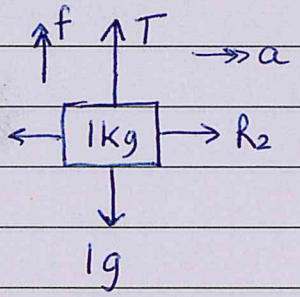


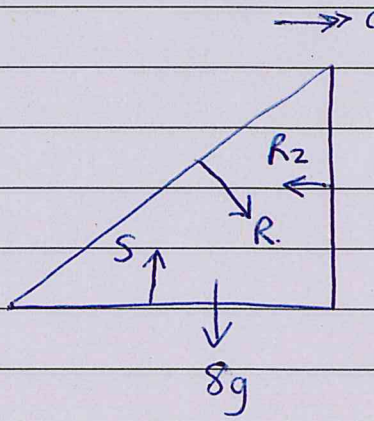


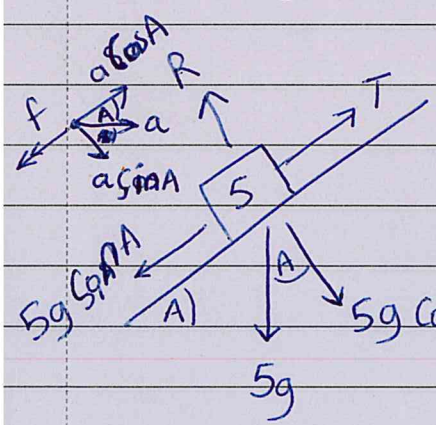
$\tan A = \frac{3}{4}$

$\sin A = \frac{3}{5}$, $\cos A = \frac{4}{5}$









① $5g\cos A - R = 5(a\sin A)$

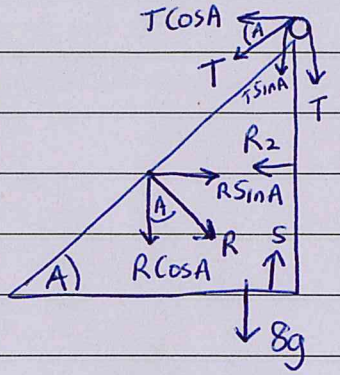
$4g - R = 3a$

② $5g\sin A - T = 5(f - a\cos A)$

$3g - T = 5(f - 4g/5)$

③ $T - 1g = 1f$

④ $R_2 = 1a$



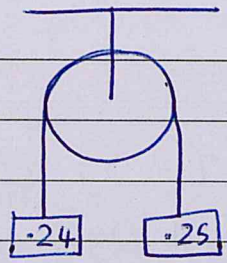
⑤ $R\sin A - T\cos A - R_2$

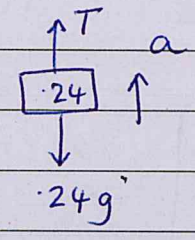
$\frac{3R}{5} - \frac{4T}{5} - R_2 = 8a$

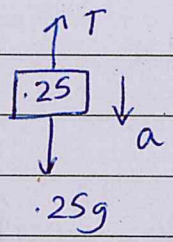
⑥ $S = T\sin A + T + 8g + R\cos A$

2010 Q4:

(i)







① $T - 0.24g = 0.24a$

② $-T + 0.25g = 0.25a$

$0.01g = 0.49a \qquad a = 0.2\ m/s^2$

From ① $T = 0.24(-2) + 0.24(9.8) = 2.4\ N = T$

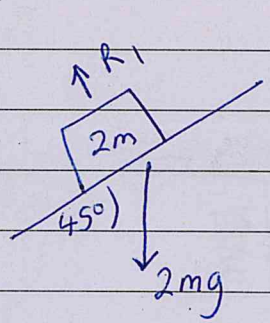
(ii) $u = 0$ $\quad v = ?$ $\quad a = 0.2$ $\quad s = 1.6$

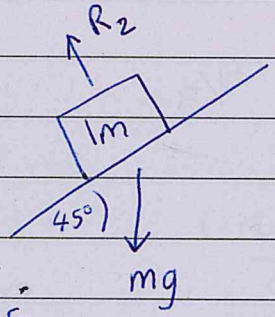
$v^2 = u^2 + 2as$

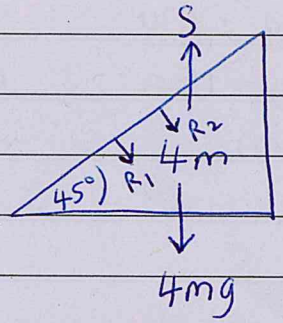
$v^2 = 0 + 2(0.2)(1.6) \qquad v^2 = \frac{16}{25}, \quad v = \frac{4}{5}$

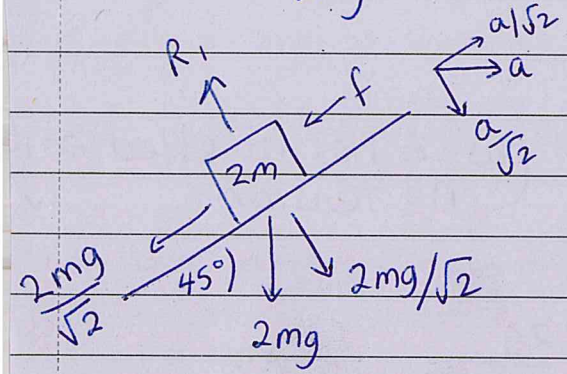
or $v = 0.8\ m/s$

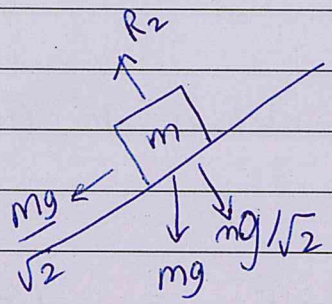
(b.)

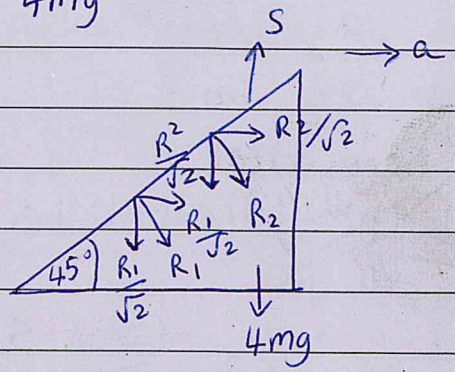












① $\frac{2mg}{\sqrt{2}} - R_1 = \frac{2ma}{\sqrt{2}}$

② $\frac{mg}{\sqrt{2}} - R_2 = \frac{ma}{\sqrt{2}}$

③ $\frac{R_1}{\sqrt{2}} + \frac{R_2}{\sqrt{2}} = 4ma$

① $\frac{2mg - 2ma}{\sqrt{2}} = R_1$

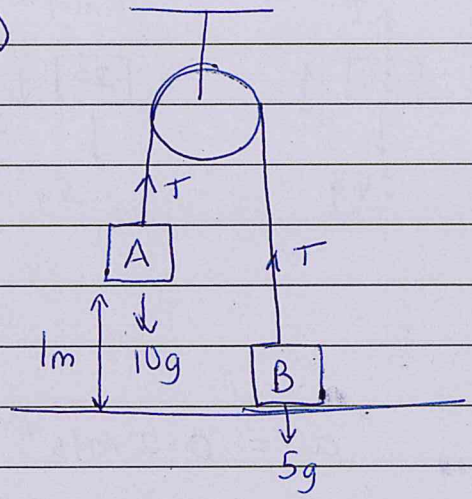
② $\frac{mg - ma}{\sqrt{2}} = R_2$

$\frac{2mg - 2ma}{2} + \frac{mg - ma}{2} = 4ma$

$2mg - 2ma + mg - ma = 8ma$

$\Rightarrow a = 3g/11$

2009 Q4 (a)



$T - 5g = 5a$

$-T + 10g = 10a$

When A hits ground B will have travelled 1m. It will have a certain velocity V. After this it is as if B has been tossed in air at speed V. We can then work out the greatest height and add it to 1m.

1st find V → need to find a = accel of system.

$T - 5g = 5a$

$-T + 10g = 10a$

$5g = 15a \qquad a = 9/3$

Find v (after 1m)

$u = 0$

$v = ?$

$a = 9/3$

$s = 1m$

$v^2 = 0^2 + \frac{2g(1)}{3} \Rightarrow v = \sqrt{\frac{2g}{3}}$

now treat as if just thrown into air (as A has no effect on it no tension ✓)

find greatest height

$u = \sqrt{\frac{2g}{3}}$

$v = 0$

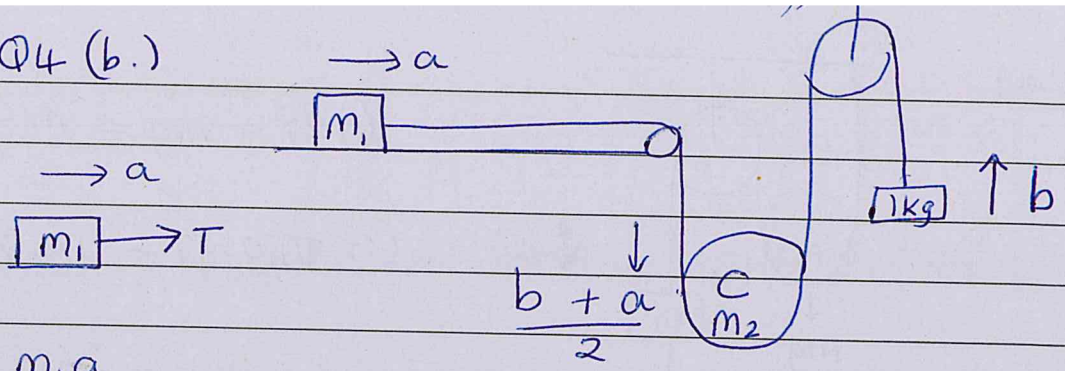
$a = -g$

$s = ?$

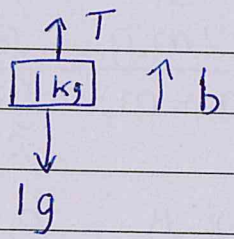
$s = \frac{v^2 - u^2}{2a} = \frac{0 - \frac{2g}{3}}{-2g} = \frac{1}{3}m$

So total height of B = $1m + \frac{1}{3}m = \frac{4}{3}m$

2009 Q4 (b.)

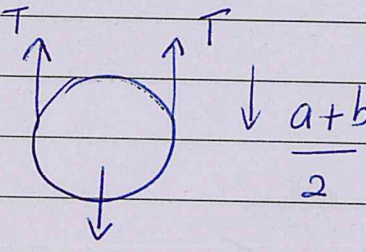


① $T = m_1 a$



② $T - 1g = 1b$

② $T = b + g$



③ $m_2 g - 2T = m_2 \left(\frac{a+b}{2}\right)$

③ $2m_2 g - 4T = m_2 (a+b)$

from ① $4T = 4m_1 a$

from ② $b = T - g$

from ③ $4T = 2m_2 g - m_2 a - m_2 b$

$4m_1 a = 2mg - m_2 a - m_2 (T - g)$

$4m_1 a = 2m_2 g - m_2 a - m_2 (m_1 a - g)$

$4m_1 a = 2m_2 g - m_2 a - m_1 m_2 a + m_2 g$

$4m_1 a = 3m_2 g - m_2 a - m_1 m_2 a$

$a(4m_1 + m_2 + m_1 m_2) = 3m_2 g$

④ $a = \frac{3m_2 g}{m_1 m_2 + m_2 + 4m_1}$

C will remain at rest if $b + a = 0$ or $b = -a$, $a = -b$

from ② $T = -a + g \Rightarrow a = g - T$, $a = g - m_1 a$

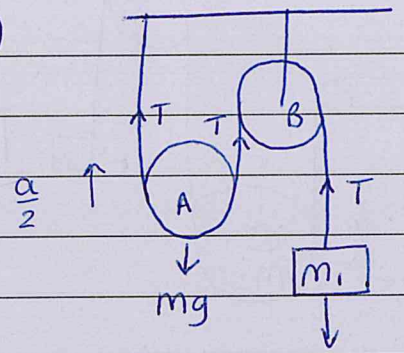
$a(m_1 + 1) = g \quad a = g / m_1 + 1$

from ④ $\frac{3m_2 g}{m_1 m_2 + m_2 + 4m_1} = \frac{g}{m_1 + 1}$

$3m_1 m_2 + 3m_2 = m_1 m_2 + m_2 + 4m_1 \Rightarrow 2m_1 m_2 + 2m_2 - 4m_1 = 0$

$2 + \frac{2m_2 - 4m_1}{m_1 m_2} = 0 \quad \frac{2m_1 - m_2}{m_1 m_2} = 1 \quad K = 1$

2008 Q4 (a)



① $2T - mg = m(a/2)$

② $m_1 g - T = m_1 a$

$2T - mg = m(a/2)$

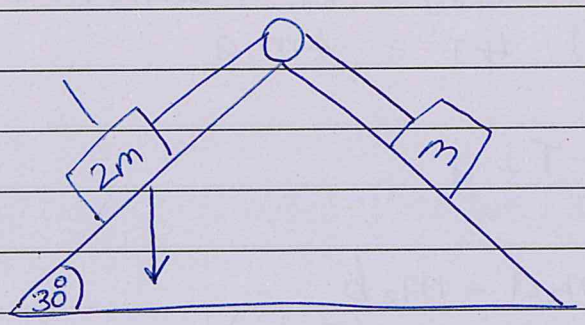
$-2T + 2m_1 g = 2m_1 a$

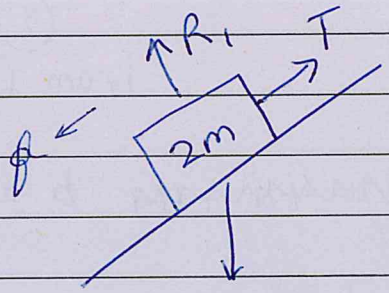
$g(2m_1 - m) = a(m + 4m_1)/2$

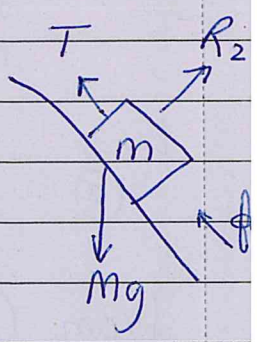
$\therefore \dfrac{2g(2m_1 - m)}{4m_1 + m} = a$ and accel of $A = \dfrac{a}{2}$

So accel of $A = \dfrac{g(2m_1 - m)}{4m_1 + m}$

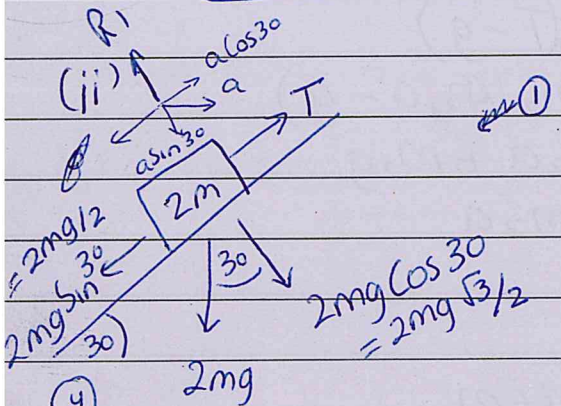
(b.)



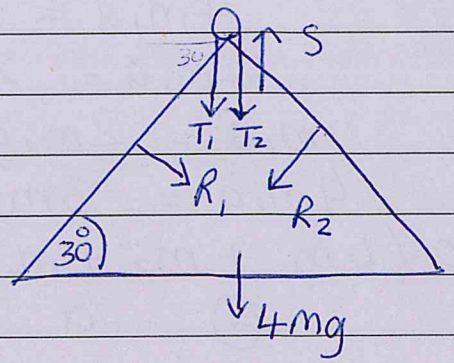




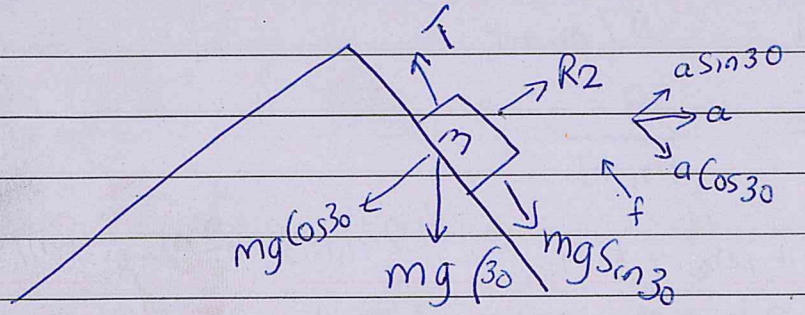
(ii)



①



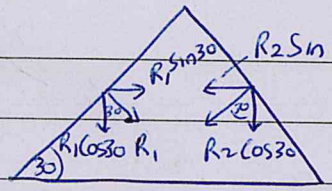
② $\dfrac{2mg\sqrt{3}}{2} - R_1 = \dfrac{2ma}{2}$ or $mg\sqrt{3} - R_1 = ma$ ② $R_1 = mg\sqrt{3} - ma$



$R_2 - mg\cos 30 = ma\sin 30$

$R_2 - \dfrac{mg\sqrt{3}}{2} = \dfrac{ma}{2}$

$R_2 = \dfrac{mg\sqrt{3} + ma}{2}$



$R_1 \sin 30 - R_2 \sin 30 = 4ma$

$\frac{R_1}{2} - \frac{R_2}{2} = 4ma \Rightarrow R_1 - R_2 = 8ma$

$mg\sqrt{3} - ma - \left(\frac{ma + mg\sqrt{3}}{2}\right) = 8ma$

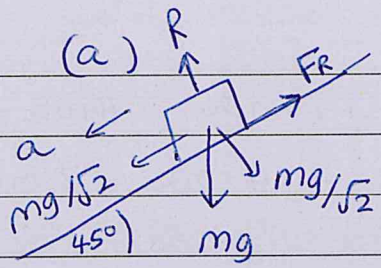
$2mg\sqrt{3} - 2ma - ma - mg\sqrt{3} = 16ma$

$mg\sqrt{3} = 16ma + 3ma$

$mg\sqrt{3} = 19ma$

$\frac{g\sqrt{3}}{19} = a$

2007 : Q4 (a)



(y)

(1) $R = \frac{mg}{\sqrt{2}}$

(2) $F_R = \mu R = \frac{3}{4} \times \frac{mg}{\sqrt{2}}$

(x)

(3) $\frac{mg}{\sqrt{2}} - F_R = ma$

$$\frac{mg}{\sqrt{2}} - \frac{3mg}{4\sqrt{2}} = ma \quad \Rightarrow \quad a = \frac{g}{4\sqrt{2}}$$

(x)

$u = 0$

$v =$

$a = g/4\sqrt{2}$

$s = 4$

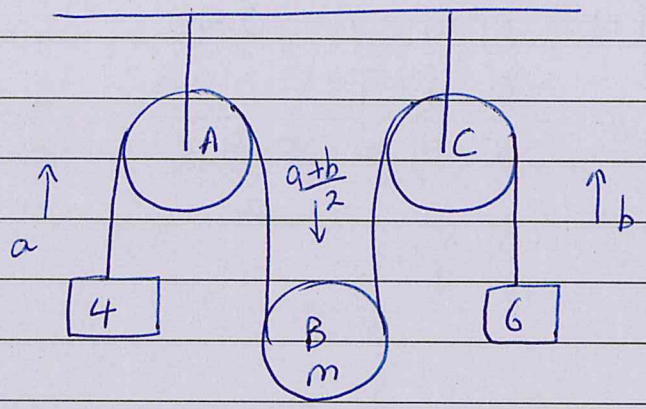
$t = ?$

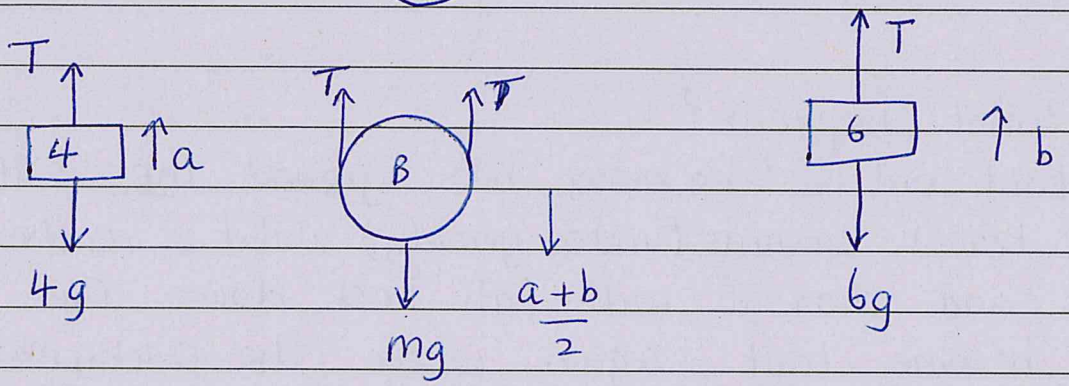
$$s = ut + \tfrac{1}{2}at^2$$

$$4 = 0 + \frac{g}{8\sqrt{2}}t^2 \quad \Rightarrow \quad t^2 = \frac{32\sqrt{2}}{g}$$

$$t = \sqrt{\frac{32\sqrt{2}}{g}}$$

2007 Q4(b.)





① $T - 4g = 4a$ ② $mg - 2T = \frac{ma+mb}{2}$ ③ $T - 6g = 6b$

$a = \frac{T-4g}{4}$ $b = \frac{T-6g}{6}$

$$mg - 2T = \frac{m\left(\frac{T-4g}{4} + \frac{T-6g}{6}\right)}{2}$$

$$2mg - 4T = m\left(\frac{3T-12g+2T-12g}{12}\right)$$

$$24mg - 48T = m(5T - 24g) = 5mT - 24mg$$

$$-48T - 5mT = -48mg$$

$$T(48+5m) = 48mg \qquad T = \frac{48mg}{5m+48}$$

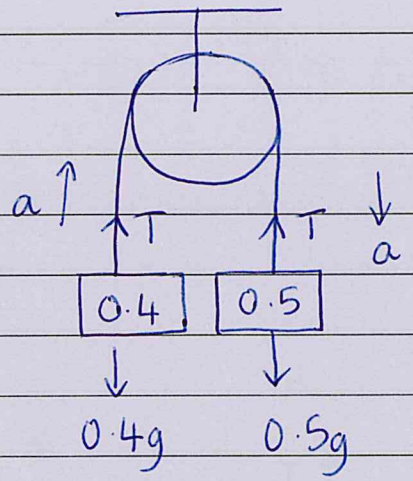
(iii) Need to show that $a+b = 0$ when $m = 9.6$

$$a+b = \frac{T-4g}{4} + \frac{T-6g}{6} = 5T - 24g$$

$$T = \frac{48(9.6)(9.8)}{5(9.6)+48} = 47.04 \qquad 5T - 24g = 0$$

2006:

(4) (a.)



(i) $0.5g - T = 0.5a$

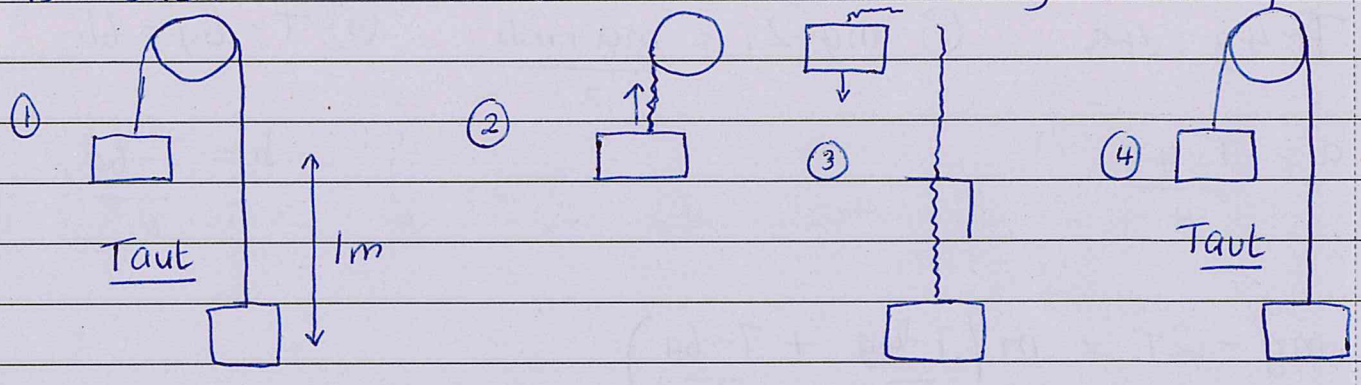
$-0.4g + T = 0.4a$

$0.1g = 0.9a$

$\frac{g}{9} = a$

(ii) Think! What happens?

String is taut until 5kg mass hits ground. Then 0.4kg mass will travel upwards (under gravity) until it reaches max height and then it will fall back down. The string will become taut again when the 0.4kg mass is back where it was when the 0.5kg hit the floor.



So 1st, find speed of .4kg mass after travelling 1m

$u = 0$

$v = ?$

$a = g/9$

$s = 1$

$t = ?$

$v^2 = 0^2 + \frac{2g}{9}$ $\quad v = \sqrt{\frac{2g}{9}}$

Then find t for 0.4kg to be at displacement 0 (discounting t=0) after being 'thrown' up at $u = \sqrt{2g/9}$

$u = \sqrt{2g/9}$

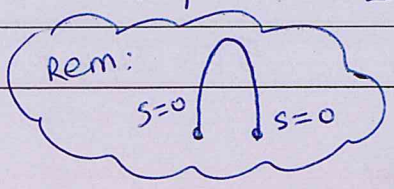
$v =$

$a = -g$

$s = 0$

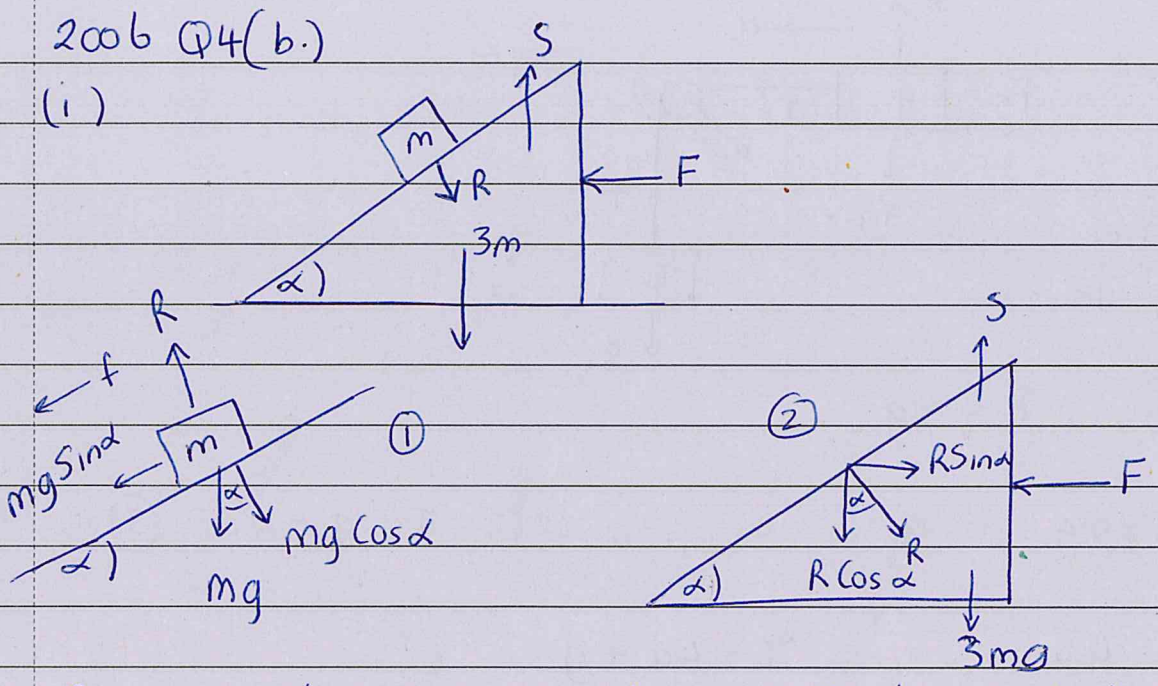
$t = ?$

$0 = \sqrt{\frac{2g}{9}}\,t - \frac{g}{2}t^2 \Rightarrow \frac{2}{g}\sqrt{\frac{2g}{9}} = t = 0.30s$



2006 Q4(b.)

(i)



Reaction between wedge and horizontal surface = S

$S = R\cos\alpha + 3mg$

but from ① :

$R = mg\cos\alpha$ (because no accel in this direction because no wedge acceleration)

$\therefore S = mg\cos\alpha\cos\alpha + 3mg = mg\cos^2\alpha + 3mg$

$= mg(\cos^2\alpha + 3)$

(iii) Need to find f

$u = 0$

$v = 4.9$ $\quad a = \frac{v-u}{t} = \frac{4.9-0}{1}$ $\quad a = 4.9\,m/s^2$

$a =$

$t = 1s$

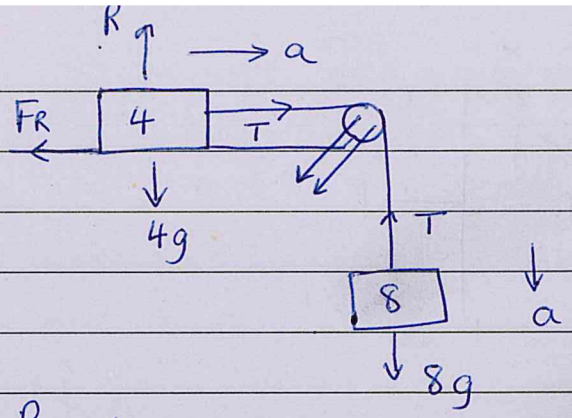
but from ① $\quad mg\sin\alpha = ma \quad a = g\sin\alpha$

So $4.9 = g\sin\alpha$

$\frac{4.9}{g} = \sin\alpha = \frac{4.9}{9.8} = \frac{1}{2} \Rightarrow \alpha = 30^\circ$

2005 4(a.)

(i)



$8g - T = 8a$

$T - F_R = 4a$

$F_R = \mu R$, $R = 4g$

$F_R = \frac{1}{4} \times 4g = g$ So from (2): $T - g = 4a$ (3)

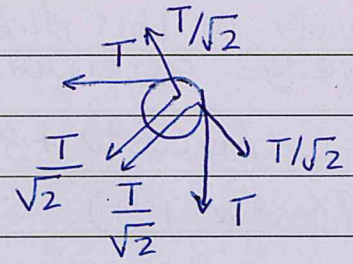
(3) $T - g = 4a$ $\quad T = 4a + g$

(1) $-T + 8g = 8a$ $\quad T = \frac{28g}{12} + \frac{12g}{12} = \frac{40g}{12} = \frac{10g}{3}$

$7g = 12a$

$\frac{7g}{12} = a$

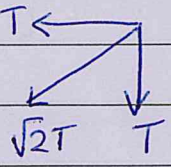
(ii)



Force exerted by string on pulley $= \frac{T}{\sqrt{2}} + \frac{T}{\sqrt{2}} = \frac{2T}{\sqrt{2}} = \sqrt{2}T$

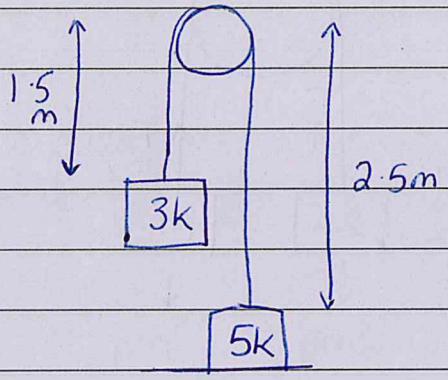
$\sqrt{2}T = \frac{\sqrt{2} \cdot 10g}{3}$ or $\frac{10\sqrt{2}\,g}{3}$

or Could just have done this:



2005

Q4 (b)



For 3kg mass → it is unaffected by 5kg until string becomes taut.

$u = 0$

$v = ?$ $\quad v^2 = 0 + 2(9.8)(1.5)$ or $v^2 = 3g \quad v = \sqrt{3g}$

$a = 9.8$ $\quad$ just before the string becomes taut

$s = 1.5$

'just' after string becomes taut both particles have a speed (a common speed)

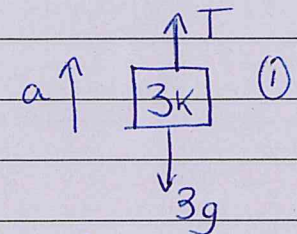
using P.C.M:

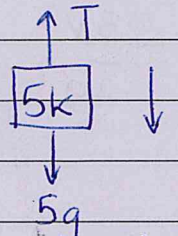
$$3\sqrt{3g} + 5(0) = (5+3).V$$

$$\therefore V = \frac{3\sqrt{3g}}{8}$$

(ii) Show 3kg mass will not reach the table

Work out its acceleration:





① $T - 3g = 3a$

② $5g - T = 5a$

$8a = 2g$

$a = \frac{g}{4}$ ←

How far down will it go before its vel.=0?

$u = \frac{3\sqrt{3g}}{8}$

$v = 0$

$a = g/4$

$s =$

$t =$

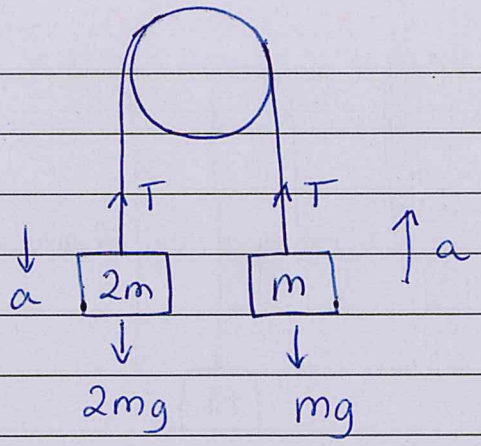
$$s = \frac{0^2 - \left(\frac{3\sqrt{3g}}{8}\right)^2}{2g/4} = \frac{27g}{64} = 0.84m$$

$\frac{2g}{4}$

So it won't hit ground before going upwds.

2004: Q4 (a.)

(i)



① $2mg - T = 2ma$

② $-mg + T = ma$

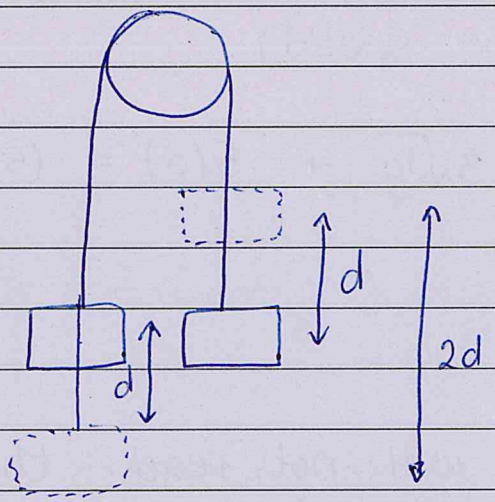
$mg = 3ma$

$\frac{g}{3} = a$

(ii) String breaks when speed = v.

Find distance travelled by one particle and double it since both will have travelled same distance

* string breaking IS IRRELEVENT!



$u = 0$

$v = v$

$a = g/3$

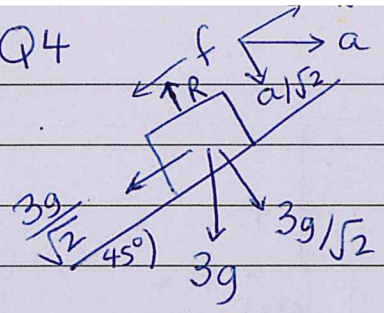
$s = d$

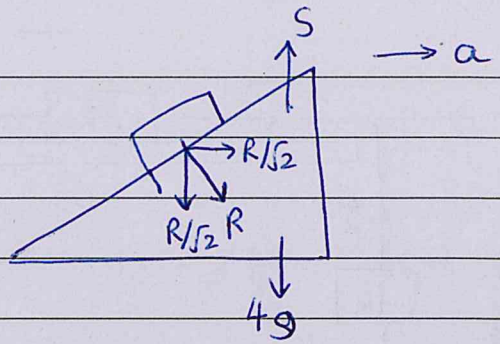
$d = \frac{v^2 - 0^2}{\frac{2g}{3}} = \frac{3v^2}{2g}$

$2d = \frac{3v^2}{g}$

2004: Q4

(b.)





(y)

$\frac{3g}{\sqrt{2}} - R = 3\left(\frac{f}{\sqrt{2}}\right)$

$\frac{R}{\sqrt{2}} = 4a$

$3g - R\sqrt{2} = 3a$ ①

③ $R = 4\sqrt{2}\,a$

(x) $\frac{3g}{\sqrt{2}} = 3\left(f - \frac{a}{\sqrt{2}}\right)$

$3g = 3\sqrt{2}f - 3a$ ② or $g = \sqrt{2}f - a$

Sub in for R into ①: $3g - 8a = 3a$ $\quad 3g = 11a$ $\quad a = \frac{3g}{11}$

Sub in for a into ②: $g = \sqrt{2}f - \frac{3g}{11}$

$\frac{11g + 3g}{11\sqrt{2}} = f = \frac{14g}{11\sqrt{2}}$

(iii) $u = 0$
$v =$
$a = 14g/11\sqrt{2}$
$s = 1m$
$t =$

find t for particle to travel 1m then find how far wedge would have travelled in this time.

$S = 1m = 0 + \frac{14g}{22\sqrt{2}}t^2 \Rightarrow t = \sqrt{\frac{22\sqrt{2}}{14g}}$

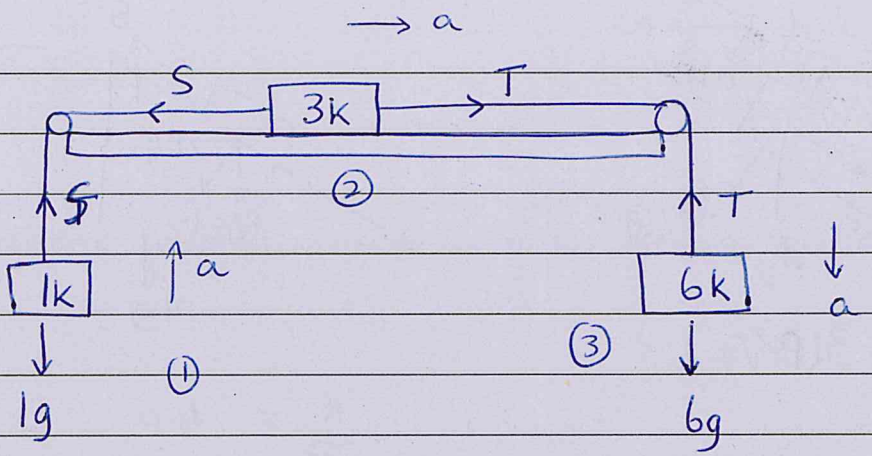
How far will wedge have travelled?

$u = 0$
$v =$
$a = 3g/11$
$s =$
$t = \sqrt{\frac{22\sqrt{2}}{14g}}$

$S = 0 + \frac{3g}{22} \cdot \frac{22\sqrt{2}}{14g} = \frac{3\sqrt{2}}{14}\,m$

2003

Q4 (a.)



① $S - g = a$

② $T - S = 3a$

$S = T - 3a$

$S = 6g - 6a - 3a$

$S = 6g - 9a$

③ $6g - T = 6a$

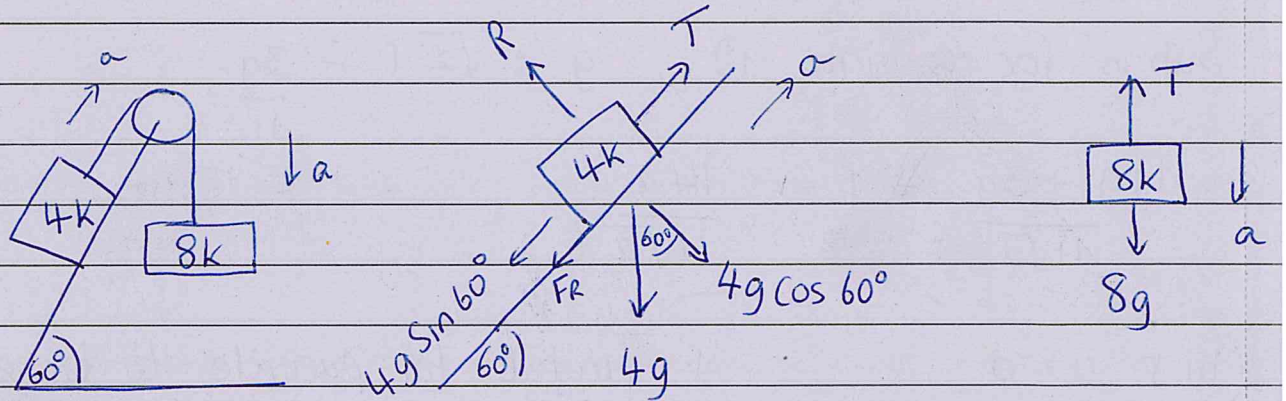
$T = 6g - 6a$

$6g - 9a - g = a$

$5g = 10a$

$\frac{g}{2} = a$

(b.)



(i)

$T - F_R - 4g \sin 60 = 4a$

$F_R = \mu R = \frac{1}{4} \times 2g = \frac{g}{2}$

$8g - T = 8a$

$R = 4g \cos 60$

$R = 4g \cdot \frac{1}{2} = 2g$

$T - \frac{g}{2} - 4g\frac{\sqrt{3}}{2} = 4a$

$2T - g - 4g\sqrt{3} = 8a$ but $8a = 8g - T$

$2T - g - 4g\sqrt{3} = 8g - T$

$3T = 8g + g + 4g\sqrt{3}$

$T = 52.03\ N$

2003 Q4 (b.)

(ii) need to find a:

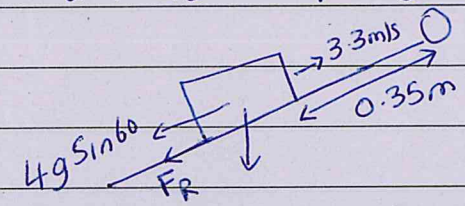
from (2.) $a = \frac{8g - T}{8} = 3.3\ m/s^2$

$u = 0$
$v =$
$a = 3.3$
$s = ?$
$t = 1$

$s = 0 + \frac{3.3(1)}{2} = 1.65m.$

(iii) String cut after 1s => find V when string is cut

$v = u + at \quad v = 0 + 3.3(1) = 3.3 m/s$



accel of block $= \frac{F}{m} = \frac{4g\sin 60 + F_R}{4} = \frac{4g\frac{\sqrt{3}}{2} + \frac{g}{2}}{4}$

$a = \frac{4g\sqrt{3} + g}{8} = 9.712\ m/s^2$

$u = 3.3$
$v = 0$
$a = -9.712$
$s = ?$
$t =$

$s = \frac{0^2 - 3.3^2}{-19.42} = 0.56m$

So since it will be travelling forward for more than 0.35m (2.00 - 1.65m) it will reach pulley.

* Could also just put 0.35 in for S and see if V is (+)

2002 Q4 (a)

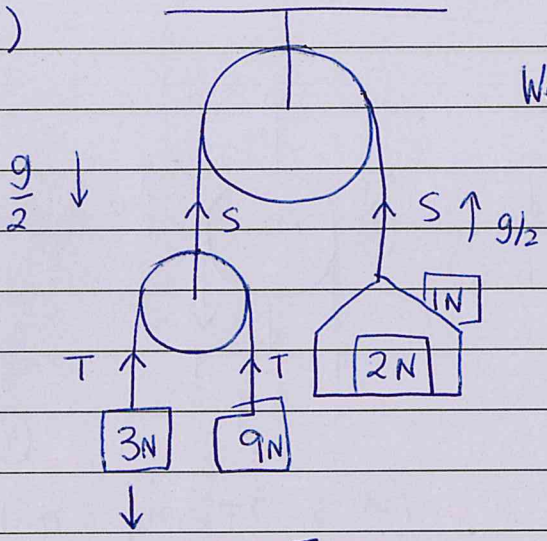
SHM

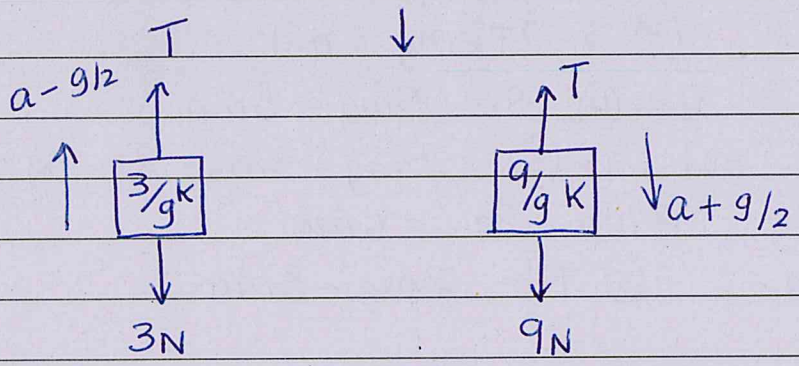
2002 Q4 (b.)

$F = m \times a$

Weight N = mass $\times g_F$

$\frac{W}{g}$ = mass





$9 - T = \frac{9}{g}(a + g/2)$

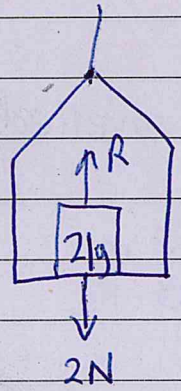
$T - 3 = \frac{3}{g}(a - g/2)$

$6 = \frac{12a}{g} + \frac{9}{2} - \frac{3}{2}$ $\qquad 6 = \frac{12a}{g} + 3$

$3 = \frac{12a}{g}$ $\qquad \frac{3g}{12} = a = \frac{g}{4}$

acceleration of $9_N = a + \frac{g}{2} = \frac{g}{4} + \frac{g}{2} = \frac{3g}{4}$

(ii)



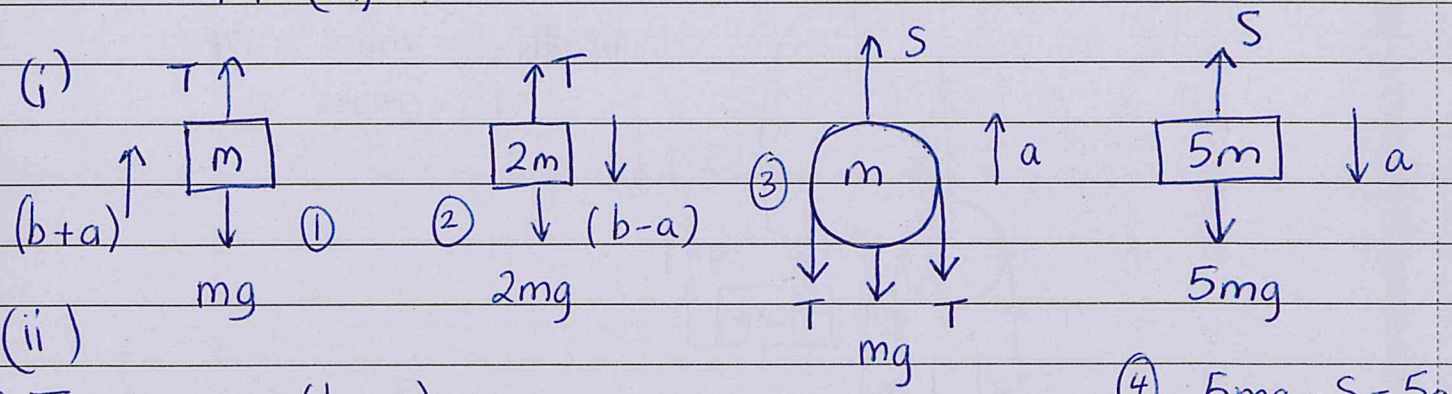
$F = m\ a$

$R - 2N = \left(\frac{2N}{g}\right)\left(\frac{g}{2}\right)$ $\qquad R - 2N = 1N$

$R = 3N$

2001 Q4 (a.)

(i)



(ii)

① $T - mg = m(b+a)$

② $2mg - T = 2m(b-a)$

③ $S - 2T - mg = ma$

④ $5mg - S = 5ma$

from ④ $S = 5mg - 5ma$

Sub into ③: $5mg - 5ma - 2T - mg = 6ma$

$4mg - 2T = 6ma$

⑤ $T = 2mg - 3ma$

Sub ⑤ into ①:

$2mg - 3ma - mg = mb + ma$

$2g - g - b = 4a$

⑥ $g - b = 4a$

$2g - 2b = 8a$

$2g - 5a = 8a$

$2g = 13a$

$\frac{2g}{13} = a$, $b = \frac{5a}{2} = \frac{5g}{13}$

Sub ⑤ into ②

$2mg - 2mg + 3ma = 2mb - 2ma$

$3a = 2b - 2a$

$5a = 2b$ ⑦

accel of m particle $= b + a = 7g/13$, of 2m : $b - a = 3g/13$

(iii) for 2m mass $u = 0$

find t to travel 1m $v =$

$a = 3g/13$

$s = 1m$

t

$s = 1 = 0 + \frac{3g}{26}t^2$

$\sqrt{\frac{26}{3g}} = t$

Then see how far 5m would have travelled

$u = 0$

$v =$

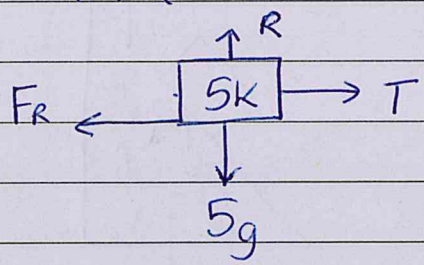
$a = 2g/13$

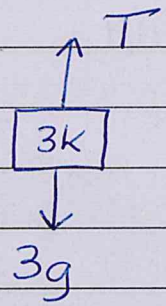
$s =$

$t = \sqrt{\frac{26}{3g}}$

$s = 0 + \frac{2g}{26}\left(\frac{26}{3g}\right) = \frac{2}{3}m$

2000 Q4 (a)





$T - F_R = 5a$

$F_R = \mu R = \frac{1}{5} \cdot 5g = g$

$3g - T = 3a$

so $T - g = 5a$ (1)

$-T + 3g = 3a$ (2)

$2g = 8a \Rightarrow a = \frac{g}{4}$

(3k)

$u = 0$

$v =$

$a = g/4$

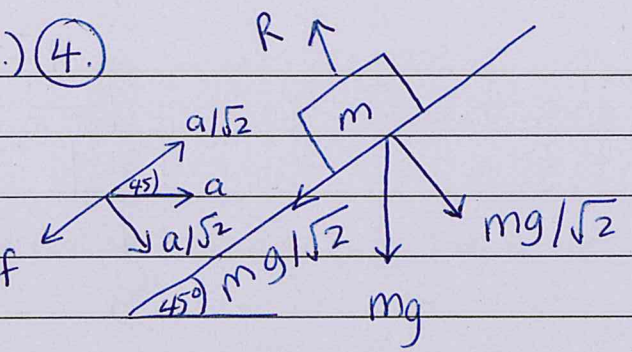
$s =$

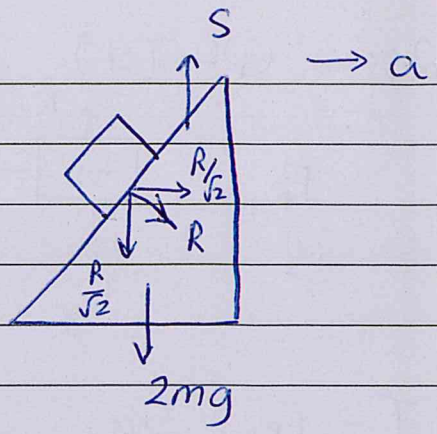
$t = 2$

$s = 0 + \frac{g}{8}(2)^2 = \frac{g}{2}$ m.

2000 (b.) (4.)

(i)





(ii)

(g)

$$\frac{mg}{\sqrt{2}} - R = \frac{ma}{\sqrt{2}} \quad \text{or} \quad \boxed{mg - R\sqrt{2} = ma} \quad (1)$$

$$\boxed{\begin{array}{l} \frac{R}{\sqrt{2}} = 2ma \quad (2) \\ R = 2\sqrt{2}ma \end{array}}$$

(x) $\frac{mg}{\sqrt{2}} = m\left(f - \frac{a}{\sqrt{2}}\right)$

$$mg = mf\sqrt{2} - ma$$

$$\boxed{g = f\sqrt{2} - a} \quad (3)$$

Sub (2) into (1) $\quad mg - 2\sqrt{2}ma \cdot \sqrt{2} = ma$

$g - 4a = a \qquad g = 5a$

$g/5 = a$

(iii) First find accel of mass rel. to wedge $= f$ from

(3) $f = \frac{g+a}{\sqrt{2}} = \frac{g + g/5}{\sqrt{2}} = \frac{6g}{5\sqrt{2}} = f.$

Then - when is speed of wedge $= 1$ m/s (find t)

$u = 0$

$v = 1 \qquad v = 1 = 0 + gt/5$

$a = g/5 \qquad \frac{5}{g} = t$

$t =$

Now what is speed of mass rel to wedge after $\frac{5}{g}$ s?

$u = 0$

$v = ?$ $\qquad v = 0 + \frac{6g}{5\sqrt{2}} \cdot \frac{5}{g} = \frac{6}{\sqrt{2}}$ OR $3\sqrt{2}$ m/s

$a = 6g/5\sqrt{2}$

$t = 5/g$