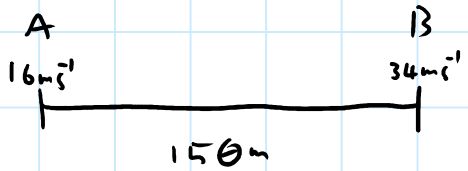
Mock MA - M1

1)



S	150m
U	$16ms^{-1}$
V	$34ms^{-1}$
A	—
T	—

a)

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

$1156 = 256 + 300a$

$900 = 300a$

$a = 3ms^{-2}$

b)

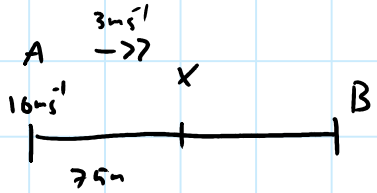
$s = \left(\frac{u+v}{2}\right)t$

$150 = \left(\frac{16+34}{2}\right)t$

$150 = 25t$

$t = 6s$

c)



S	75m
U	16ms⁻¹
V	—
A	3ms⁻¹
T	X

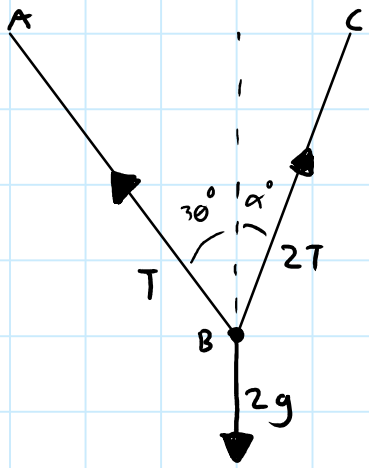
$v^2 = u^2 + 2as$

$v^2 = 256 + 45$

$v = \sqrt{706}$

$v = 26.6$ 3sf

2)



a) Horizontal forces in equilibrium

$$T\sin(30) = 2T\sin(\alpha)$$

$$\frac{T}{2T} \times \frac{1}{2} = \sin(\alpha)$$

$$\sin^{-1}\left(\tfrac{1}{4}\right) = 14.5^\circ \text{ (3sf)}$$

b) Verticle forces in equilibrium

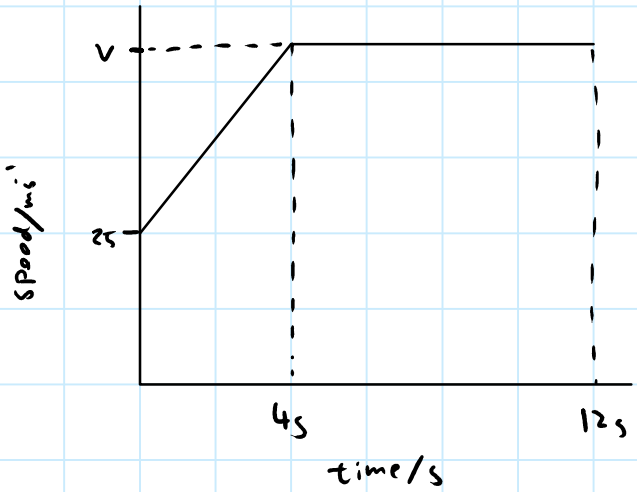
$$2T\cos(14.5) + T\cos(30) = 2g$$

$$2.8T = 2g$$

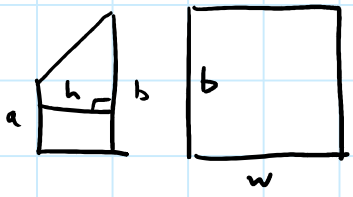
$$T = 6.99 \text{ N}$$

3)

c)



Area under a speed-time graph is equal to distance travelled
This speed-time graph is a trapezium and a rectangle.



$a = 25$, $b = v$, $h = 4$, $w = 12 - 4 = 8$

$600\,m = \frac{1}{2}(a+b)h + bw$

$600 = (25+v)\frac{4}{2} + 8v$

$600 = 50 + 10v$

$55\,ms^{-1} = v$

3)

c) $a = \frac{\Delta v}{\Delta t}$

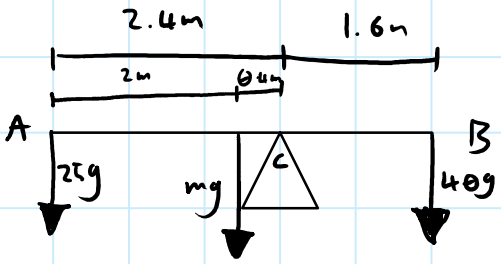
$a = \frac{55-25}{4-0}$

$a = \frac{30}{4}$

$a = 7.5\ ms^{-2}$

4)

a)



moments ↺ = moments (↻)

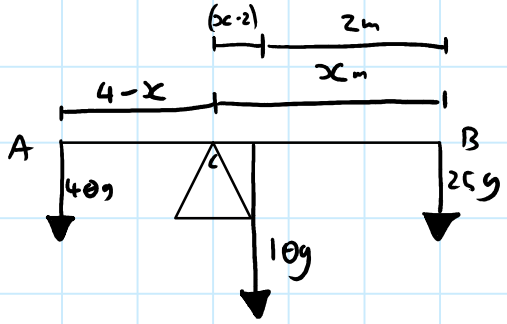
$(25g \times 2.4) + (mg \times 0.4) = (40g \times 1.6)$ Remove g as a common factor

$60 + 0.4m = 64$

$0.4m = 4$

$m = 10\ kg$

b)



moments ↺ = moments ↻

$40g(4-x) = 10g(x-2) + 25g(x)$ Remove g as a common factor

$160 - 40x = 10x - 20 + 25x$

$180 = 75x$

$x = 2.4\ m$

4)

c)

i) Plank assumed to be uniform so weight acts in centre of plank (AX = BX = AB/2)

ii) Plank assumed to be a rod as it is assumed rigid, doesn't bend under force & therefore remains straight

iii) Their weights act exactly on the ends of the planks

5)

a)

S	1.6m	
U	0ms^{-1}	$V^2 = u^2 + 2as$
V	—	$V^2 = 0 + 31.36$
A	9.8ms^{-2}	$V = 5.6 ms^{-1}$
T	X	

b)

78kg	↓5.6ms^{-1}	Conservation of momentum
6kg	0ms^{-1}	$(5.6 \times 78) + (0 \times 6) = V \times (78+6)$

$V = 5.2 ms^{-1}$

c)

S	X
U	5.2ms^{-1}
V	0ms^{-1}
A	—
T	0.06

$v = u + at$

$0 = 5.2 + 0.06a$

$a = -\frac{260}{3}$

$F(\downarrow) - F(\uparrow) = ma$

$(78+6)g - F = (78+6) \times -\frac{260}{3}$

$F = 823.2 + 7280$

$F = 8103.2\ N$

5) d)

s	—
u	5.2 ms^{-1}
v	0 ms^{-1}
a	x
t	0.06

$s = \left(\frac{u+v}{2}\right)t$

$s = \frac{5.2}{2} \times 0.06$

$s = 0.156\text{ m}$

$s = 0.16\text{ m}$ (2 sf)

6)

A: $s_0 = -5i + 10j$ B: $s_0 = 3i + 4j$

$v = 2i + 2j$ $v = -2i + 5j$

a) $r_A = (-5+2t)i + (10+2t)j$ $r_B = (3-2t)i + (4+5t)j$

$(-5+2t)i + (10+2t)j = (3-2t)i + (4+5t)j$

same i value: same j value

$-5+2t = 3-2t$ $10+2t = 4+5t$

$4t = 8$ $6 = 3t$

$t = 2$ $t = 2$

At time t = 2, they have same displacement from O, therefore they are in the same place at the same time, i.e. they collide.

b) A: $s_0 = -5i + 10j$

$v = i + j$

new $r_A = (5+t)i + (10+t)j$

$\overrightarrow{AB} = r_B - r_A$

$= (3-2t)i + (4+5t)j - (-5+t)i + (10+t)j$

$= (8-3t)i + (-6+4t)j$

6)

c) 1400 is $t = 2$

$|\vec{AB}|$ where $t = 2$ distance, not displacement

$\sqrt{(8-6)^2 + (-6+8)^2} = \sqrt{8}$

$= 2.83$ km (3sf)

d) time where i component of AB is 0

$8 - 3t = 0$

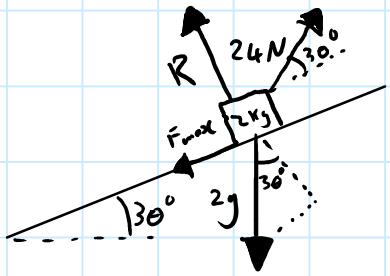
$t = \frac{8}{3}$

2 and $\frac{2}{3}$ hours afternoon

1440 hours

7)

a)



$\mu = 0.4$

$F(\uparrow)$ $R + 24\sin(30°) = 2g\cos(30°)$

$R + 12 = g\sqrt{3}$

$R = g\sqrt{3} - 12$

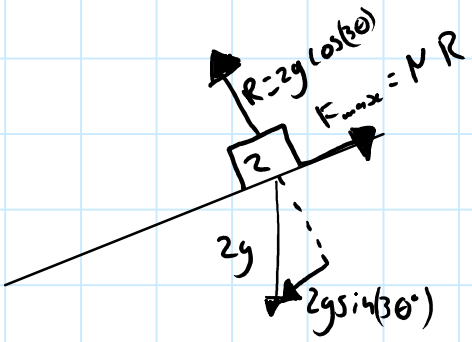
$F(\rightarrow)$ $24\cos(30°) - 2g\sin(30°) - F_{max} = ma$

$20.8 - 9.8 - 2.0 = 2a$

$8.99 = 2a$

$a = 4.5$ (2sf)

b)



$2g\sin(30°) = 9.8\ N$

$0.4\,(2g\cos(30°)) = 6.8\ N$

$9.8 > 6.8$ $\therefore$ motion down plane

7)

c) $F(\swarrow) - F(\nearrow) = ma$

$9.8 - 6.8 = 2a$

$3.01 = 2a$

$a = 1.5 \text{ m s}^{-2}$ (2sf)