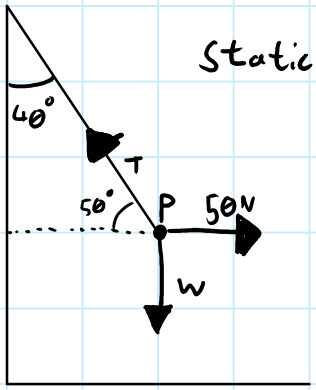
Specimen MA - M1

1)



Static Particle

Horizontal forces in equilibrium

a) $T\cos(50°) = 50N$

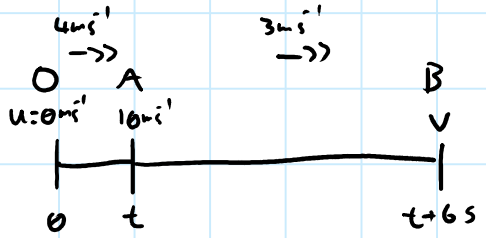
$T = 77.8N$

b) Vertical forces in equilibrium

$T\sin(50°) = W$

$W = 59.6N$

2)



A → B

a)

S	X	
U	$10 ms^{-1}$	$V = U + at$
V	—	$V = 10 + 3 \times 6$
A	$3 ms^{-2}$	$= 28 ms^{-1}$
T	6s	

b)

S	—	$s = ut + \frac{1}{2}at^2$
U	$10 ms^{-1}$	
V	X	$s = (10 \times 6) + \frac{1}{2}(3 \times 6^2)$
A	$3 ms^{-1}$	$= 60 + 54$
T	6s	$= 114 m$

O → A

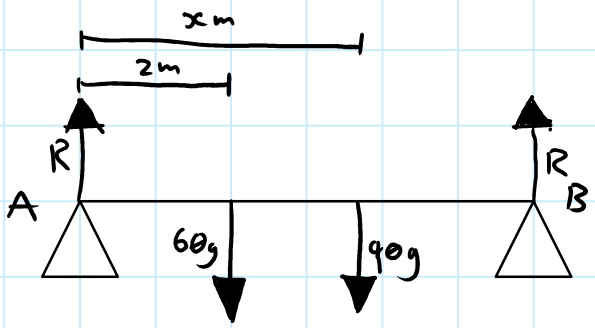
S	—	$v^2 = u^2 + 2as$
U	0	$10^2 = 0^2 + (2 \times 4)s$
V	$10 ms^{-1}$	$100 = 8s$
A	$4 ms^{-1}$	$s = 12.5 m$
T	X	

$OB = OA + AB$

$\therefore OB = 12.5 + 114$

$= 126.5$

3)



AB = 6m

a) Forces in equilibrium Static object

$2R = 60g + 90g$

$R = \frac{1}{2}\,1470$

$R = 735\,N$

b) moments $\circlearrowleft$ = moments $\circlearrowright$

moments in equilibrium

$6 \times (735) = 2 \times 60g + x \times 90g$

$4410 = 120g + 90xg$

$450 = 120 + 90x$

$\frac{330}{90} = x$

$x = \frac{11}{3}$

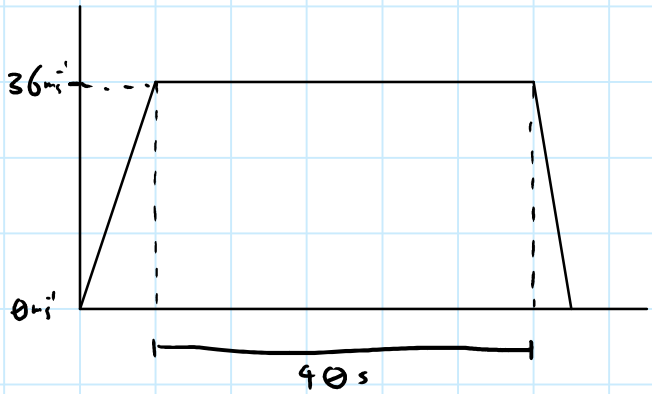
c)

i) Plank is rigid and therefore doesn't bend. Plank stays in a straight line when under force.

ii) The weight of the woman acts from C and only C.

4)

a)



b)

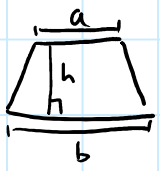
accelerating

S	x	$v = u + at$
U	$0 ms^{-1}$	$36 = 0 + 2t$
V	$36 ms^{-1}$	$t = 18s$
A	$2 ms^{-2}$	
T	—	

decelerating

S	x	$v = u + at$
U	$36 ms^{-1}$	$0 = 36 + -3t$
V	$0 ms^{-1}$	$t = 12s$
A	$-3 ms^{-2}$	
T	—	

Area of speed-time graph is the distance travelled.
Speed-time graph is a trapezium, therefore find area of the trapezium



$\text{area} = \frac{1}{2}(a+b)h$

$a = 90s$ $\quad h = 36 ms^{-1}$

$b = 90 + 18 + 12$

$= 120s$

$\therefore \text{distance} = \frac{1}{2}(90 + 120) \times 36$

$= 3780 m$

c) This question is asking you to describe how your graph from (a) differs from **figure 3**
Any of the following:

- There is no period of constant velocity for T_2
- T_2 accelerates then instantly decelerates
- T_2 has a higher maximum speed ✓

d) $\overrightarrow{AB}$ is 3780m

Area of a speed-time graph is distance travelled.
Figure 3 is a triangle of base 150s and height of V_{max}

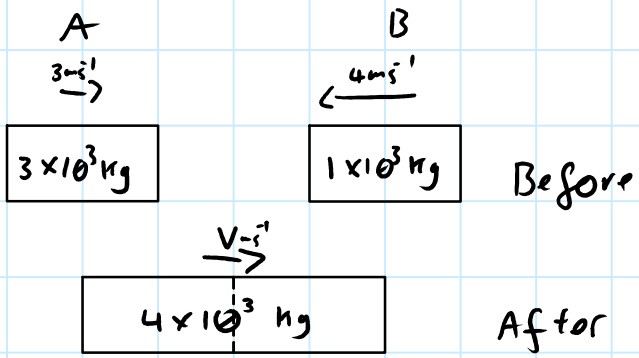
$3780 = \frac{1}{2}(150s) \times V_{max}$

$\frac{7560}{150} = 50.4\ ms^{-1}$

✓ $50.4_{ms^{-1}} > 36\ ms^{-1}$

5)

a)



a) Conservation of momentum

$3 \times 3000 + -4 \times 1000 = V \times 4000$

$\frac{5000}{4000} = V$

$V = 1.25 \text{ ms}^{-1}$

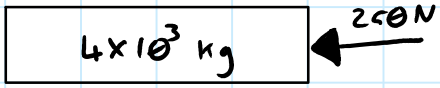
b) $I = \Delta P$

$(1.25 \times 1000) - -(4 \times 1000) = 5250 \text{ Ns}$

c) The Trucks are particles

5)

d)



$F = ma$

$\frac{-250}{4 \times 10^3} = \frac{-1}{16}\ ms^{-2}$

s ___

u $1.25\ ms^{-1}$ $\quad v^2 = u^2 + 2as$

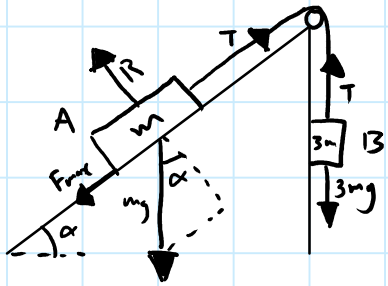
v $0\ ms^{-1}$ $\quad 0 = \frac{25}{16} + \frac{-2}{16}s$

a $-\frac{1}{16}\ ms^{-2}$ $\quad 0 = 25 - 2s$

t x $\quad s = 12.5m$

6)

a)



Forces on B

$$T - 3mg = 3m \times \left(-\tfrac{1}{2}g\right)$$

$$T - 3mg = -\tfrac{3}{2}mg$$

$$T = \tfrac{3}{2}mg$$

b) Forces on A

$(\nwarrow)$ $R - mg\cos(\alpha) = 0$

$\therefore R = \tfrac{4}{5}mg$

$(\nearrow)$ $T - \mu R - mg\sin(\alpha) = m \times \left(\tfrac{1}{2}g\right)$

$$\tfrac{3}{2}mg - \tfrac{4}{5}\mu mg - \tfrac{3}{5}mg = \tfrac{1}{2}mg$$

$$\tfrac{3}{2} - \tfrac{4}{5}\mu - \tfrac{3}{5} = \tfrac{1}{2}$$

$$1 = \tfrac{3}{5} + \tfrac{4}{5}\mu$$

$$\mu = \tfrac{1}{2}$$

7)

A: $s_0 = 0$ $\quad$ B: $s_0 = 300i$

$v = 20i$ $\quad$ $v = 10i + 10j$

a) $r = 0 + 20ti$ $\quad$ $s = 300i + (10i + 10j)t$

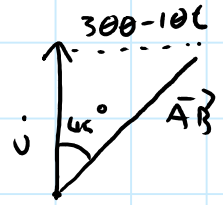
$r = 20ti$ $\quad$ $= (300 + 10t)i + (10t)j$

b) $\overrightarrow{AB} = s - r$

$= [(300 + 10t) - (20t)]i + (10t - 0)j$

$= (300 - 10t)i + 10tj$

c) when angle between $\overrightarrow{AB}$ & j is 45°



$\tan(45°) = \dfrac{300 - 10t}{10t}$

$1 = \dfrac{30 - t}{t}$

$2t = 30$

$t = 15$

8)

d) $|\vec{AB}| = 300$

$$\sqrt{(300-10t)^2+(10t)^2} = 300$$

$$(300-10t)^2+(10t)^2 = 90{,}000$$

$$90{,}000 - 6000t + 100t^2 + 100t^2 = 90{,}000$$

$$200t^2 - 6000t = 0$$

$$t^2 - 30t = 0$$

$$t(t-30) = 0$$

$t = 0$ initial case $\therefore$ ignore

$t = 30_s$