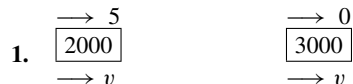


## Worked Solutions

### Mechanics M1 Paper A

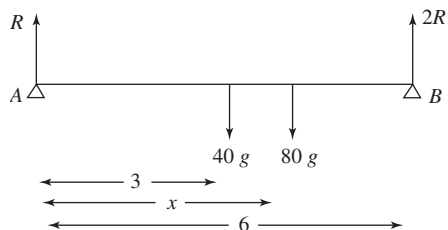


(a) CLM:  $2000 \times 5 = 2000v + 3000v$   
 $v = 2 \text{ ms}^{-1}$

(b)  $I = mv - mu = 3000 \times 2$   
 $I = 6000 \text{ Ns}$

(c)  $I = mv - mu$   
 $R \times 1.6 = 5000 \times 2$   
 $R = 6250 \text{ N}$

2.



(a)  $R(\uparrow): R + 2R = 40g + 80g$   
 $R = 392 \text{ N}$  (2)

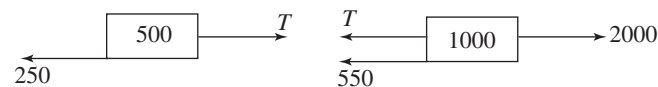
(b)  $M(A): 40g \times 3 + 80gx = 2 \times 392 \times 6$   
 $x = 4.5 \text{ m}$  (4)

3. (a)  $d = \frac{1}{2} \times 5 \times 1.5 + 20 \times 1.5 + \frac{1}{2} \times 10 \times 1.5$   
 $d = 41.3 \text{ m}$  (3)

(b)  $a = \frac{0 - 1.5}{10}$   
 deceleration  $= 0.15 \text{ ms}^{-2}$  (2)

(c)  $R = 30 \times 0.15 = 4.5 \text{ N}$  (2)

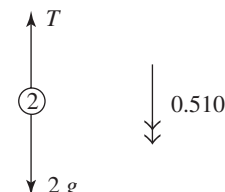
4.



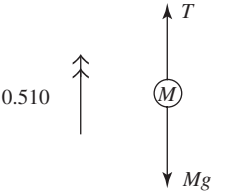
(a) Whole system:  
 $2000 - 550 - 250 = (1000 + 500)a$   
 $a = 0.8 \text{ ms}^{-2}$  (6)

(b) Caravan:  
 $T - 250 = 500 \times 0.8$   
 $T = 650 \text{ N}$  (3)

5. (a)  $s = ut + \frac{1}{2}at^2$   
 $0.5 = 0 + \frac{1}{2} \times a \times 1.4^2$   
 $a = 0.510 \text{ ms}^{-2}$  (3)

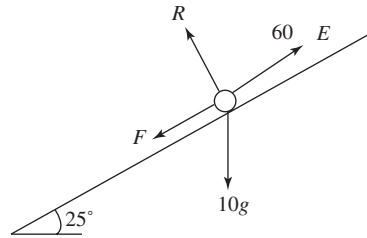
(b) 2 kg: 

$R(\uparrow): 2g - T = 2 \times 0.510$   
 $T = 18.6 \text{ N}$  (3)

(c) M: 

$R(\uparrow): 18.6 - Mg = M \times 0.510$   
 $M = 1.80 \text{ kg}$  (4)

6.



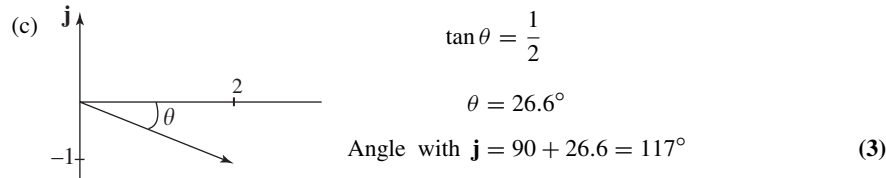
(a)  $R(\perp)$ :  $R = 10g \cos 25 = 88.8 \text{ N}$  (3)

(b)  $R(\parallel)$ :  $F = 60 - 10g \sin 25 = 18.6$   
 $\mu = \frac{F}{R} = \frac{18.6}{88.8} = 0.209$  (5)

(c) Block : Particle (2)  
 Rope : Light inextensible string (2)

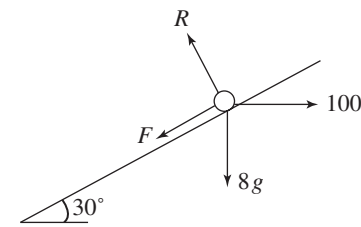
7. (a)  $F = \begin{pmatrix} 4 \\ 5 \end{pmatrix} + \begin{pmatrix} 2 \\ -8 \end{pmatrix} = \begin{pmatrix} 6 \\ -3 \end{pmatrix} = (6\mathbf{i} - 3\mathbf{j}) \text{ N}$  (1)

(b)  $\begin{pmatrix} 6 \\ -3 \end{pmatrix} = 3a$   
 $a = \begin{pmatrix} 2 \\ -1 \end{pmatrix} = (2\mathbf{i} - \mathbf{j}) \text{ ms}^{-2}$  (2)

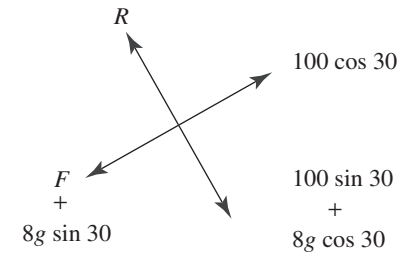


(d)  $v = u + at$   
 $v = \begin{pmatrix} 3 \\ -2 \end{pmatrix} + \begin{pmatrix} 2 \\ -1 \end{pmatrix} \times 3 = \begin{pmatrix} 9 \\ -5 \end{pmatrix} = (9\mathbf{i} - 5\mathbf{j}) \text{ ms}^{-1}$  (5)

8. (a)



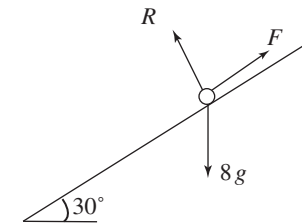
(b) Resolving all forces  $\parallel$  and  $\perp$  to the plane: (2)



$R(\perp)$ :  $R = 100 \sin 30 + 8g \cos 30$   $R = 118 \text{ N}$

(c)  $R(\parallel)$ :  $F = 100 \cos 30 - 8g \sin 30 = 47.4$   
 $\mu = \frac{F}{R} = \frac{47.4}{118} = 0.402$  (5)

(d)



$R(\perp)$ :  $R = 8g \cos 30 = 67.9$

$F = 0.402 \times 67.9 = 27.3$

$R(\parallel)$ :  $8g \sin 30 - 27.3 = 8a$   
 $a = 1.49 \text{ ms}^{-2}$  (4)