

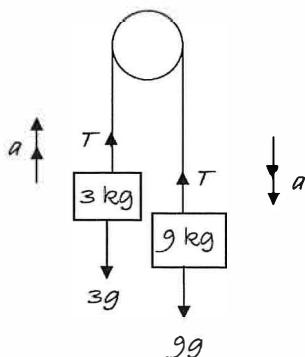
## Mechanics 7 – Connected Particles 2

### Section 1

1. (i)  $v = 11$       (ii)  $v = -2$       (iii)  $s = 7$       (iv)  $s = 22.5$   
 2. (i)  $a = -4.375$       (ii)  $a = 0$       (iii)  $u = 9.80$       (iv)  $u = 9$   
 3. (i)  $v = 1, s = 24$       (ii)  $a = -2.5, u = 2$

### Section 2

1.



Considering 3 kg mass:

$$T - 3g = 3a \quad \checkmark \quad (1)$$

Considering 9 kg mass:

$$9g - T = 9a \quad \checkmark \quad (2)$$

Adding:

$$6g = 12a \quad \checkmark$$

$$a = \frac{1}{2} \times 9.8 = 4.9$$

The acceleration of the system is  $4.9 \text{ ms}^{-2}$ .  $\checkmark$

$$(1) \text{ gives } T = 3g + 3a \quad \checkmark$$

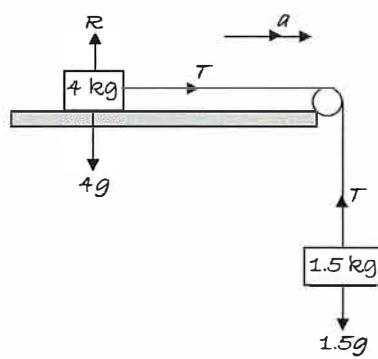
$$= 3(9.8 + 4.9)$$

$$= 44.1$$

The tension in the string is 44.1 N.  $\checkmark$

(6 marks)

2.



For the 4 kg mass:

$$T = 4a \quad \checkmark \quad (1)$$

For the 1.5 kg mass:

$$1.5g - T = 1.5a \quad \checkmark \quad (2)$$

Adding:

$$1.5g = 5.5a \quad \checkmark$$

$$a = \frac{1.5 \times 9.8}{5.5} = 2.67 \quad \checkmark$$

The acceleration of the system is  $2.67 \text{ ms}^{-2}$  (3 s.f.)  $\checkmark$

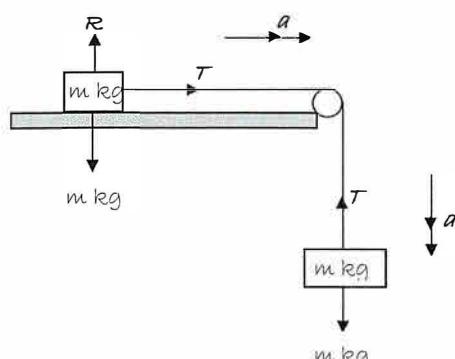
$$\text{Substituting into (1): } T = 4a \quad \checkmark$$

$$T = 4 \times \frac{1.5 \times 9.8}{5.5} = 10.7$$

The tension in the string is 10.7 N (3 s.f.)  $\checkmark$

(7 marks)

3.



For particle on table:  $T = ma \quad \checkmark \quad (1)$

For particle hanging:  $mg - T = ma \quad \checkmark \quad (2)$

$$(1) + (2) \Rightarrow mg = 2ma \Rightarrow a = \frac{g}{2} = 4.9 \text{ N} \quad \checkmark$$

$$s = ?, u = 0, v = ?, a = 4.9, t = 0.5 \quad \checkmark$$

$$s = ut + \frac{1}{2}at^2 \quad \checkmark \Rightarrow s = 0.613 \text{ m} \text{ (3 s.f.)} \quad \checkmark$$

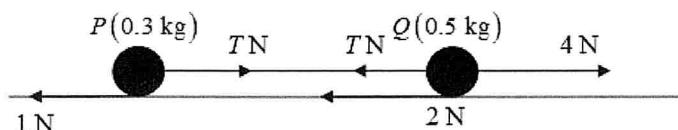
$$v = u + at \quad \checkmark \Rightarrow v = 2.45 \text{ ms}^{-1} \quad \checkmark$$

(9 marks)

Q4 (a)  Mark together	$(\downarrow) 0.4g - T = 0.4a$	M1 A1
	$(\uparrow) T - 0.3g = 0.3a$	M1 A1
	solving for $T$	<b>DM1</b>
	$T = 3.36 \text{ or } 3.4 \text{ or } 12g/35 \text{ (N)}$	A1 (6)
(b)	$0.4g - 0.3g = 0.7a$	<b>DM1</b>
	$a = 1.4 \text{ m s}^{-2}, g/7$	A1 (2)
(c)	$(\uparrow) v = u + at$	
	$v = 0.5 \times 1.4$	M1
	$= 0.7$	A1 ft on $a$
	$(\uparrow) s = ut + \frac{1}{2}at^2$	
	$s = 0.5 \times 1.4 \times 0.5^2$	M1
	$= 0.175$	A1 ft on $a$
	$(\downarrow) s = ut + \frac{1}{2}at^2$	
	$1.175 = -0.7t + 4.9t^2$	<b>DM1 A1 ft</b>
	$4.9t^2 - 0.7t - 1.175 = 0$	
	$t = \frac{0.7 \pm \sqrt{0.7^2 + 19.6 \times 1.175}}{9.8}$	<b>DM1 A1 cao</b>
	$= 0.5663 \dots \text{or } -\dots$	
	Ans 0.57 or 0.566 s	A1 cao (9)
		[17]

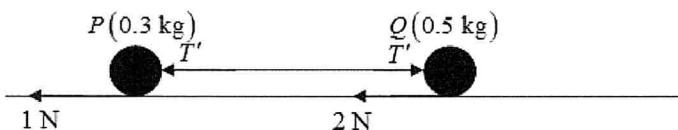
**Section 3**

(a)	For system, $\uparrow, T - 950g - 50g = 1000 \times -2$ $T = 7800 \text{ N}$	M1 A1 A1 <b>(3)</b>
(b)	For woman, $\uparrow, R - 50g = 50 \times -2$ $R = 390 \text{ N}$	M1 A1 A1 <b>(3)</b> <b>[6]</b>



(a) For system N2L	$4 - 3 = 0.8a$ $a = 1.25 \text{ (m s}^{-2}\text{)}, 1.3$	M1 A1 A1 <b>(3)</b>
(b)	$v = u + at \Rightarrow v = 0 + 1.25 \times 6 = 7.5 \text{ (m s}^{-1}\text{)}$	M1 A1 <b>(2)</b>
(c) For P N2L	$T - 1 = 0.3 \times 1.25$ $T = 1.375 \text{ (N)}$ 1.38, 1.4	ft their $a$ M1 A1 ft A1 <b>(3)</b>

OR For Q N2L  $4 - 2 - T = 0.5 \times 1.25$



(d) For system N2L	$-3 = 0.8a \Rightarrow a = -3.75$ $v^2 = u^2 + 2as \Rightarrow 0^2 = 7.5^2 - 2 \times 3.75s$ $s = 7.5 \text{ (m)}$	M1 A1 M1 A1 <b>(4)</b>
(e) For P N2L	$T' + 1 = 0.3 \times 3.75$ $T' = 0.125 \text{ (N)}, 0.13$	M1 A1 A1 <b>(3)</b> <b>[15]</b>