

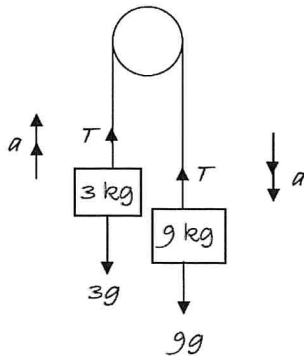
Mechanics 8 – Connected Particles 2

Section 1

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

Section 2

1.



Considering 3 kg mass: $T - 3g = 3a$ ✓ (1)

Considering 9 kg mass: $9g - T = 9a$ ✓ (2)

Adding: $6g = 12a$ ✓

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

The acceleration of the system is 4.9 ms^{-2} . ✓

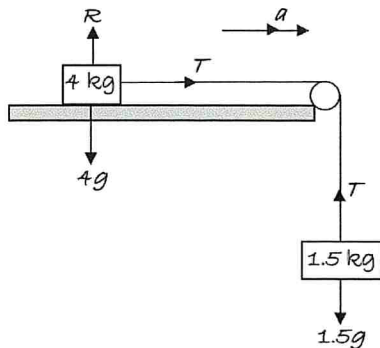
(1) gives $T = 3g + 3a$ ✓

$$= 3(9.8 + 4.9)$$

$$= 44.1$$

The tension in the string is 44.1 N . ✓ (6 marks)

2.



For the 4 kg mass: $T = 4a$ ✓ (1)

For the 1.5 kg mass: $1.5g - T = 1.5a$ ✓ (2)

Adding: $1.5g = 5.5a$ ✓

$$a = \frac{1.5 \times 9.8}{5.5} = 2.67 \text{ ✓}$$

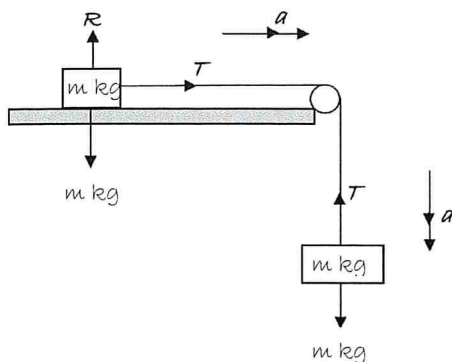
The acceleration of the system is 2.67 ms^{-2} (3 s.f.) ✓

Substituting into (1): $T = 4a$ ✓

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

The tension in the string is 10.7 N (3 s.f.) ✓ (7 marks)

3.



For particle on table: $T = ma$ ✓ (1)

For particle hanging: $mg - T = ma$ ✓ (2)

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

$$s = ?, u = 0, v = ?, a = 4.9, t = 0.5 \text{ ✓}$$

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

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

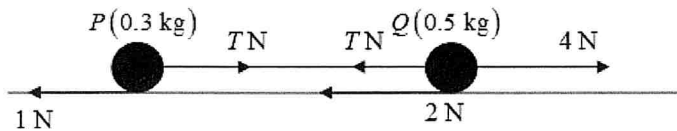
(9 marks)

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

(Total 39 marks)

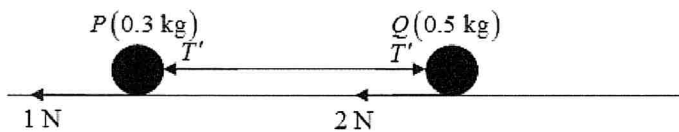
Section 3

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



(a)	For system N2L $4 - 3 = 0.8a$ $a = 1.25 \text{ (m s}^{-2}\text{)}, 1.3$	M1 A1 A1 (3)
(b)	$v = u + at \Rightarrow v = 0 + 1.25 \times 6 = 7.5 \text{ (m s}^{-1}\text{)}$	M1 A1 (2)
(c)	For P N2L $T - 1 = 0.3 \times 1.25$ $T = 1.375 \text{ (N)} 1.38, 1.4$	fit their a M1 A1ft A1 (3)

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 (4)
(e)	For P N2L $T' + 1 = 0.3 \times 3.75$ $T' = 0.125 \text{ (N)}, 0.13$	M1 A1 A1 (3) [15]