

January 2005

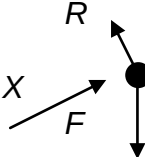
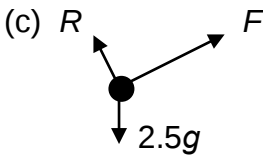
6677 Mechanics M1

Mark Scheme

Question Number	Scheme	Marks
1	3 $\longrightarrow$ 1.5 kg  2.5 $\longleftarrow$ $\longleftarrow$ 4  2.5 kg $\longrightarrow$ v (a) CLM: $1.5 \times 3 - 2.5 \times 4 = -1.5 \times 2.5 + 2.5 \times v$ $\Rightarrow v = \underline{-0.7 \text{ m s}^{-1}}$ so speed = $\underline{0.7 \text{ m s}^{-1}}$ (b) Direction of Q unchanged (c) Impulse = $1.5 (3 + 2.5)$ = $\underline{8.25, \text{Ns}}$	M1 A1 A1 (3) A1✓ (1) M1 A1, B1 (3)

Question Number	Scheme	Marks
2	(a) $R(\uparrow): T + 3T = 40g + 20g$ $T = 15g$, so tension at C is <u>45g or 441 N or 440 N</u> (b) $M(B) \quad 15g \times 3 + 45g \times d = 40g \times 1.5$ Solve: $d = \underline{1/3 \text{ or } 0.33 \text{ or } 0.333 \text{ m}}$	M1 A1 (2) M1 A2,1,0✓ ↓ M1 A1 (5)

Question Number	Scheme	Marks
3	(a) Distance = $\frac{1}{2} \times 4 \times 9 + 16 \times 9$ or $\frac{1}{2} (20 + 16) \times 9$	M1
	= <u>162 m</u>	A1 (2)
	(b) Distance over last 5 s = $\frac{1}{2}(9 + u) \times 5$	M1
	$162 + \frac{1}{2}(9 + u) \times 5 = 200$	M1 A1✓
	$\Rightarrow u = \underline{6.2 \text{ m s}^{-1}}$	A1 (4)
	(c) $6.2 = 9 + 5a$	M1 A1✓
	$a = (-) \underline{0.56 \text{ m s}^{-2}}$	A1 (3)

Question Number	Scheme	Marks
4	 (a) $R = 2.5g \cos 20$ $\approx \underline{23.0 \text{ or } 23 \text{ N}}$ (b) $X = 0.4 \times 23.0 + 2.5g \sin 20$ $\approx \underline{17.6 \text{ or } 18 \text{ N}}$  (c) In equilb. $F = 2.5g \sin 20 \approx 8.38 \text{ or } 8.4 \text{ N}$ $\mu R = 0.4 \times 2.5g \cos 20 \approx 9.21 \text{ or } 9.2 \text{ N}$ $8.4 < 9.2$ (using '$F < \mu R$' not $F = \mu R$) Since $F < \mu R$ remains in equilibrium	M1 A1 (2) M1 A2,1,0✓ A1 (4) B1 B1 M1 (cso) A1 (4)

Question Number	Scheme	Marks
5	(a) 's = ut + $\frac{1}{2}at^2$' for B: $0.4 = \frac{1}{2}a(0.5)^2$ $a = \underline{3.2 \text{ m s}^{-2}}$ (b) N2L for B: $0.8g - T = 0.8 \times 3.2$ $T = \underline{5.28 \text{ or } 5.3 \text{ N}}$ (c) A: $F = \mu \times 0.5g$ N2L for A: $T - F = 0.5a$ Sub and solve $\mu = \underline{0.75 \text{ or } 0.751}$ (d) Same acceleration for A and B.	M1 A1 A1 (3) M1 A1✓ ↓ M1 A1 (4) B1 M1 A1 ↓ M1 A1 (5) B1 (1)

Question Number	Scheme	Marks
6	(a) $16^2 = 20^2 - 2 \times a \times 24 \Rightarrow a = \underline{3 \text{ m s}^{-2}}$	M1 A1 (2)
	(b) $v^2 = 20^2 - 2 \times 3 \times 30$ $v = \underline{\sqrt{220} \text{ or } 14.8 \text{ m s}^{-1}}$	M1 A1√ A1 (3)
	(c) $0.3 = m \times 3 \Rightarrow m = 0.1 \text{ kg } (*)$	M1 A1 (2)
	(d) $0.1(w + \sqrt{220}) = 2.4$ $w = 9.17$	M1 A1√ A1 ↓
	$0 = 9.17 - 3 \times t$ $t \approx \underline{3.06 \text{ s}}$	M1 A1√ A1 (6)

Question Number	Scheme	Marks
7	(a) $\mathbf{v}_P = \{(29\mathbf{i} + 34\mathbf{j}) - (20\mathbf{i} + 10\mathbf{j})\}/3 = \underline{(3\mathbf{i} + 8\mathbf{j}) \text{ km h}^{-1}}$ (b) $\mathbf{p} = (20\mathbf{i} + 10\mathbf{j}) + (3\mathbf{i} + 8\mathbf{j})t$ $\mathbf{q} = (14\mathbf{i} - 6\mathbf{j}) + 12t\mathbf{j}$ (c) $\mathbf{q} - \mathbf{p} = (-6 - 3t)\mathbf{i} + (-16 + 4t)\mathbf{j}$ $d^2 = (-6 - 3t)^2 + (-16 + 4t)^2$ $= 36 + 36t + 9t^2 + 16t^2 - 128t + 256$ $= 25t^2 - 92t + 292 \quad (*)$ (d) $25t^2 - 92t + 292 = 225$ $25t^2 - 92t + 67 = 0$ $(t - 1)(25t - 67) = 0$ $t = 67/25 \text{ or } 2.68$ time ≈ 161 mins, or 2 hrs 41 mins, or 2.41 am, or 0241	M1 A1 (2) M1 A1✓ M1 A1 (4) M1 A1 ↓ M1 ↓ M1 A1 (cso) (5) M1 A1 ↓ M1 A1 A1 (5)