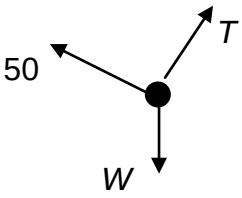
EDEXCEL MECHANICS M1 (6677) – JUNE 2004 **PROVISIONAL MARK SCHEME**

Question Number	Scheme	Marks
1	 (a) R ($\rightarrow$): $T\cos 60 = 50\cos 30$	M1 A1
	$T = \underline{86.6\text{ N}}$	A1 (3)
	(b) R($\uparrow$): $W = 50\sin 30 + T\cos 30$	M1 A1
	$= \underline{100\text{ N}}$	A1 (3)
	or R ($\|\|$ to BC): $W\cos 60 = 50$	M1 A1
	$W = \underline{100\text{ N}}$	A1 (3)

(a) *M1 for a valid equation in T only*
Treat use of tan 30/60 (e.g. tan 30 = T/50) as invalid equation unless there is a triangle of Forces

(b) *M1 for a valid equation involving W (and T if necessary)*

for first A1 in (i), allow for using their T (i.e. effectively f.t.)

Accept each answer as awrt.

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2	(a) '$v = u + at$': $9.5 = 5 + 1.5a \Rightarrow a = 3$	M1 A1
	Hence $v^2 = 5^2 + 2 \times 3 \times 24$	M1
	$= 169 \Rightarrow v = \underline{13 \text{ m s}^{-1}}$ (*)	A1 (4)
	(b) '$I = mv - mu$' : $-30 = 2(v - 13) \Rightarrow v = (-)\ 2 \text{ m s}^{-1}$	M1 A1
	In direction of *CA* (o.e.)	A1 (3)

(a) *2nd M1 for equation in v (and numbers) only*
Final A1 is cso

(b) *M1 for valid impulse = momentum change equn with 3 non-zero terms including '30' and '13'*
A1 for '30' and '13' with same sign
A1 for direction as 'CB' or anything convincing!

NB both A's in (b) are cao = cso!

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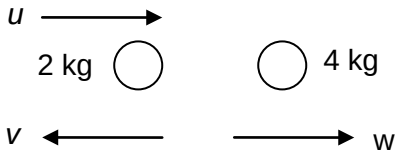
3	 CLM: $2u = -2v + 4w$	M1 A1
	Using $w = 3v$ ($\Rightarrow 2u = -2v + 12v$) and solve	M1
	$\Rightarrow v = \frac{1}{5}u$ (*)	A1 cso
		(4)
(b)	$10 = 2a \Rightarrow a = 5\ \text{m s}^{-2}$	B1
	$0 = \frac{1}{25}u^2 - 2 \times 5 \times 1.6$	M1 A1√
	$\rightarrow u = \underline{20\ \text{m s}^{-1}}$	M1 A1
		(5)

(a) *1st M1 for valid CLM equn*
*2nd M1 for correct equn for 'v' and 'w' and solving for v **or** w.*
Final A1 is cso (dropping u and reinserting loses last A1)

(b) *Allow B1 for $a = \pm 5$*
M1 for using '$v^2 = u^2 + 2as$' with v = 0 and with a value for a
*A1 **f.t.** on their a (provided this is not g), but signs must be correct*

***SC** For using u instead of u/5 ($\rightarrow u = 4$), allow M1 A0 M0.*

Energy: $\frac{1}{2} \times 2 \times (u/5)^2 = 10 \times 1.6$ M1 A1 A1

$\rightarrow u = 20$ dep M1 A1

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Question Number	Scheme	Marks
4	(a) M(D): $20g \times 1.5 + 10g \times 1 = R_B \times 3$	M1 A1
	$\Rightarrow \quad R_B = \underline{40g/3 \approx 131 \text{ or } 130 \text{ N}}$	M1 A1 (4)
	[NB For moments about another point, allow M1 A1 for moments equation dimensionally correct and with correct number of terms; second M1 is for complete method to find R_B.]	
	(b) R(↑): $R_D + 40g/3 = 20g + 10g$	M1 A1√
	$\Rightarrow \quad R_D = \underline{50g/3 \approx 163 \text{ or } 160 \text{ N}}$	A1 (3)
	or M(B): $20g \times 1.5 + 10g \times 2 = R_D \times 3$	M1 A1
	$\Rightarrow \quad R_D = \underline{50g/3 \approx 163 \text{ or } 160 \text{ N}}$	A1 (3)
	[NB For moments about another point, allow M1 for a complete method to find R_D, A1 for a correct equation for R_D.]	
	(c) $R_B = 0$	M1
	M(D): $20g \times x = 10g \times 1$	M1 A1
	$x = DF = \underline{0.5 \text{ m}}$	A1 (4)
	For weight/mass confusion, A0 A0 in (a) but allow f.t. in (b) (ans 50/3 = 16.7)	
	General rule of deducting max. 1 per question for > 3 s.f	
	(c) *2nd M1: must have correct no. of non=zero terms, and equation in x only* *If use value(s) of R's from (a) or (b): M0.*	

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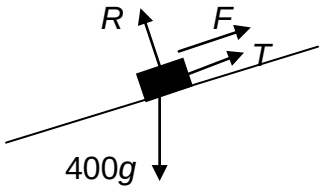
5	(a) 	
	$R = 400g\cos 15°$ (≈ 3786 N)	B1
	$F = 0.2R$ used	B1
	$T + 0.2R = 400g\sin 15°$	M1 A1
	$\downarrow$	
	$T \approx$ 257 or 260 N	M1 A1
		(6)
	(b) $400g\sin 15° - 0.2 \times 400g\cos 15° = 400a$	M1 A1
	$a = 0.643(\ldots)$	A1
	$50 = \frac{1}{2} \times 0.643 \times t^2$	M1 A1√
	$t =$ 12.5 or 12 s	A1
		(6)
	General rule again about > 3 sf	
	Weight/mass confusion: treat as MR [→ T = 26.3/26; a = 0.0656…; t = 39(.0)]	
	(b) *Allow a = 0.64*	
	(*Final M1 not dependent but requires an attempt to find an a which is not assumed to be g*)	

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Question Number	Scheme	Marks
6	(a) Direction of $\mathbf{v} = (7\mathbf{i} - 7.5\mathbf{j}) - (4\mathbf{i} - 6\mathbf{j}) = 3\mathbf{i} - 1.5\mathbf{j}$	M1 ↓
	$\tan\theta = \frac{1.5}{3} = 0.5 \Rightarrow \theta = 26.565\ldots$	M1 A1
	Bearing = <u>117</u> (accept awrt)	A1 (4)
	(b) $\mathbf{v} = (3\mathbf{i} - 1.5\mathbf{j}) \div \frac{3}{4} = 4\mathbf{i} - 2\mathbf{j}$	B1
	$\mathbf{s} = \underline{(4\mathbf{i} - 6\mathbf{j}) + t(4\mathbf{i} - 2\mathbf{j})}$	M1 A1√ (3)
	(c) At 1015 $\mathbf{s} = (4\mathbf{i} - 6\mathbf{j}) + \frac{5}{4}(4\mathbf{i} - 2\mathbf{j})$ $(= 9\mathbf{i} - 8.5\mathbf{j})$	M1 A1
	$\mathbf{m} = 0.25(p\mathbf{i} + q\mathbf{j})$	B1 ↓
	$\mathbf{s} = \mathbf{m} \Rightarrow \underline{p = 36,\ q = -34}$	M1 A1, A1 (6)
	(a) *Forming direction for **v** can be either way round.* *M1 for tan = 'i/j' **or** 'j/i'* *A1 for 26.6 or 63.4 (awrt) from a correct direction for **v*** *A1 cao*	
	(b) *Allow B1 for correct vector for **v** wherever seen (e.g. in (a))*	
	(c) *line 1: **or** $(7\mathbf{i} - 7.5\mathbf{j}) + \frac{1}{2}(4\mathbf{i} - 2\mathbf{j}) = \ldots..$* *1st M1 allow for a valid attempt with a value of t.* *2nd M1 using **s** = **m** and equating at least one coefficient*	

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Question Number	Scheme	Marks
7		
	(a) $F_1 = \frac{2}{7}$ x 4g (= 11.2) or $F_2 = \frac{2}{7}$ x 6g (= 16.8)	B1
	System: 40 – $\frac{2}{7}$ x 4g – $\frac{2}{7}$ x 6g = 10a (equn in a and not T)	M1 A1
	$\Rightarrow$ $\underline{a = 1.2 \text{ m s}^{-2}}$ (*)	A1
		(4)
	(b) P: $T - \frac{8}{7}g = 4 \times 1.2$ **or** Q: $40 - T - \frac{12}{7}g = 6 \times 1.2$	M1 A1
	$\Rightarrow$ $T = \underline{16 \text{ N}}$	A1
		(3)
	(c) Accelerations of P and Q are same	B1
		(1)
	(d) $v = 1.2 \times 7 = 8.4$	B1
	P: $(-)\frac{8}{7}g = 4a \Rightarrow a = (-)\frac{2}{7}g = 2.8$	M1 A1
	$\downarrow$	
	$0 = 8.4 - 2.8t \Rightarrow \underline{t = 3 \text{ s}}$ (*)	M1 A1
		(5)
	(e) Q: $40 - \frac{12}{7}g = 6a$ ($\Rightarrow a \approx 3.867$)	M1 A1
	$\downarrow$	
	$v = 8.4 + 3.867 \times 3 = \underline{20 \text{ m s}^{-1}}$	M1 A1
		(4)
	(a) *1st A1 requires values for the F's. (Allow M1 with just 'F''s)* (b) *Allow M1 A1 for one of these equations wherever seen (e.g. in (a))* (c) *extra statement about tensions being equal (with the correct ans): B0* (d) *allow verification* *No g: allow 1st M1 in each of parts (a), (b), (d), (e) as f.t. but other A's are cao*	