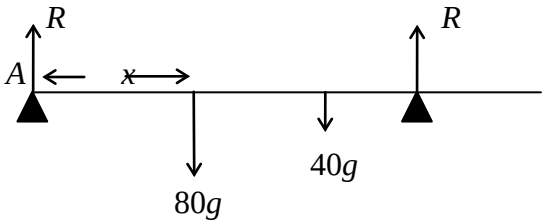
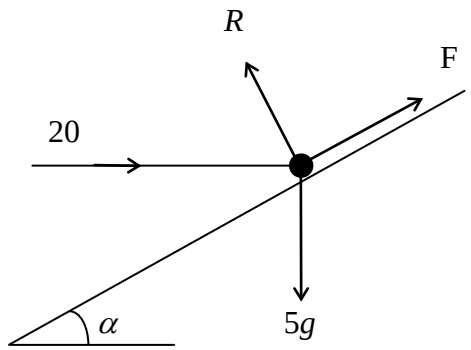
EDEXCEL MECHANICS M1 (6677) – JUNE 2003 PROVISIONAL MARK SCHEME

Question Number	Scheme	Marks
1. (*a*)		
	$R(\uparrow)$: $2R = 80g + 40g$	M1
	$R = 60g$ or 588 N	A1 (2)
(*b*)	M(*A*): $80g \times x + 40g \times 2 = 60g \times 3$	M1 A2 ft (–1 eeoo)
	$\Rightarrow x = 1\frac{1}{4}$ m	A1 (4)
		(6 marks)
2. (*a*)	$I = 0.12 \times 3 = 0.36$, Ns	B1, B1 (2)
(*b*)	$0.12 \times 3 = 0.12 \times 1.2 + 0.08v$	M1 A1
	$\Rightarrow v = 2.7$ m s^{-1}	A1 (3)
(*c*)	$I = 0.12 \times (3 - 1.2)$ or 0.08×2.7	M1
	$= 0.216$ Ns	A1 (2)
		(7 marks)
3. (*a*)	"$v^2 = u^2 + 2as$": $v^2 = 4^2 + 2 \times g \times 5$	M1 A1
	$v \approx 10.7$ m s^{-1} (accept 11 m s^{-1})	A1 (3)
(*b*)	"$v = u + at$": $-10.7 = 4 - gt$	M1 A1 ft
	$t = \dfrac{14.7}{g} = 1.5$ s	A1 (3)
(*c*)	Air resistance; 'spin'; height of diver; hit board again; horizontal component of velocity (any two)	B1 B1 (2)
		(8 marks)
4.		
	$R(\nwarrow)$: $R = 5g \cos \alpha + 20 \sin \alpha$	M1 A1
	$R(\nearrow)$: $F + 20 \cos \alpha = 5g \sin \alpha$	M1 A1
	Using $\cos \alpha = \frac{4}{5}$ or $\sin \alpha = \frac{3}{5}$	B1
	[$\Rightarrow R = 51.2$ N; $F = 13.4$ N]	
	Using $F = \mu R$	M1
	Solving: $\mu = 0.262$ (accept 0.26)	M1 A1 (8)
		(8 marks)

(ft = follow through mark; –1eeoo = minus one mark for each error or omission)

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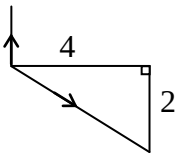
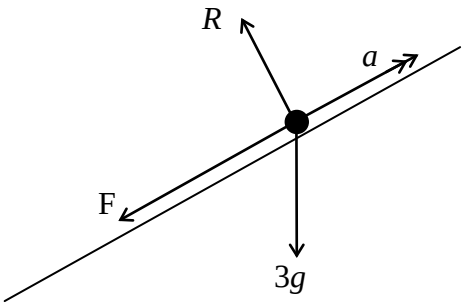
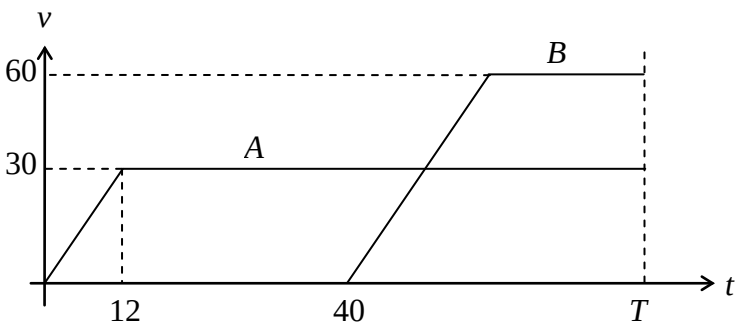
5. (*a*)	"$v = u + at$": $\mathbf{v} = (-2 + 2t)\mathbf{i} + (7 - 3t)\mathbf{j}$	M1 A1
	$\mathbf{v}$ parallel to $\mathbf{i}$ $\Rightarrow 7 - 3t = 0$ $\Rightarrow t = 2\frac{1}{3}$ s	M1 A1 (4)
(*b*)	$t = 3$, $\mathbf{v} = 4\mathbf{i} - 2\mathbf{j}$	M1
	$\lvert\mathbf{v}\rvert = \sqrt{20} \approx 4.47$ m s^{-1}	M1 A1 (3)
(*c*)	 Angle = (arctan $\frac{2}{4}$), + 90° = 116.6° (accept 117°)	M1, M1 A1 (3)
	[or 180° – (arctan $\frac{4}{2}$)]	[M1 M1 A1]
		(10 marks)
6. (*a*)	 $R(\nwarrow)$: $R = 3g\cos 30°$ (= 25.46 N)	M1 A1
	F = $0.4R \approx 10.2$ N (accept 10 N)	M1 A1 (4)
(*b*)	$R(\nearrow)$: $-F + 3g\sin 30° = 3a$	M1 A2 (–1 eeoo)
	$\Rightarrow a \approx 8.3$ m s^{-2}	M1 A1
	"$v^2 = u^2 + 2as$": $6^2 = 2 \times a \times s$	M1
	$\Rightarrow s \approx 2.17$ m (accept 2.2 m)	A1 (7)
		(11 marks)
7. (*a*)	 Shape for *A*	B1
	Shape for *B* with parallel slope	B1
	Figures	B1 (3)
(*b*)	Distance moved by $A = \frac{1}{2} \times 12 \times 30, + 30(T - 12)$	B1, M1 A1
	B accelerates for 24 s	B1
	Distance moved by $B = \frac{1}{2} \times 24 \times 60, + 60(T - 64)$	B1, M1 A1
	$\frac{1}{2} \times 12 \times 30, + 30(T - 12) = \frac{1}{2} \times 24 \times 60, + 60(T - 64)$	M1
	$\Rightarrow T = 98$ s	A1 (9)
		(12 marks)

(ft = follow through mark; –1 eeoo = minus one mark for each error or omission)

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Question Number	Scheme	Marks
8. (*a*)	Car + truck: $2000a = 2400 - 600 - 400$	M1 A1
	$a = 0.7$ m s^{-2}	A1 (3)
(*b*)	Car only: $T - 400 = 800 \times 0.7$	M1 A1 ft
	[*or* truck only: $2400 - T - 600 = 1200 \times 0.7$]	
	$T = 960$ N	A1 (3)
(*c*)	New acceleration of truck a' given by $1200\ a' = 2400 - 600$	M1
	$a' = 2400 - 600 = 1.5$ m s^{-1}	A1
	Time to reach 28 m s^{-1} $= \dfrac{28 - 20}{1.5} = 5.33$ s	M1 A1
	Time to reach 28 m s^{-1} if rope had not broken $= \dfrac{28 - 20}{0.7} = 11.43$ s	M1 A1
	Difference = 6.1 s $\approx$ 6 s (*)	A1 (7)
		(13 marks)

(ft = follow through mark; (*) indicates final line is given on the paper)