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Mark Scheme (Results)
January 2011

GCE

GCE Mechanics M1 (6677) Paper 1

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General Instructions for Marking

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
   - M marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - A marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - B marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.
3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - * The answer is printed on the paper
   - $\lfloor$ The second mark is dependent on gaining the first mark

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January 2011
Mechanics M1 6677
Mark Scheme

Question Number	Scheme	Marks
1. (a)	Conservation of momentum: $4m - 6 = m + 9$ $m = 5$	M1 A1 A1 (3)
(b)	Impulse = change in momentum $= 3\times 3 - (3\times -2) = 15$	M1 A1 (2) [5]

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Question Number	Scheme	Marks
2. (a)	$-6.45 = u - 9.8 \times 0.75$ $0.9 = u$ **	M1 A1 A1 (3)
(b)	$0 = 0.81 - 2 \times 9.8 \times s$ $s = 0.041$ or 0.0413	M1 A1 (2)
(c)	$h = -0.9 \times 0.75 + 4.9 \times 0.75^2$ $h = 2.1$ or 2.08	M1 A1 A1 (3) [8]

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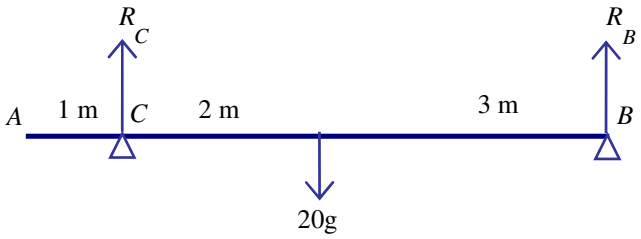
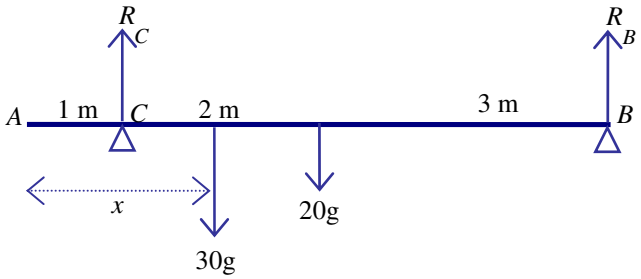
Question Number	Scheme	Marks
3. (a)	 Taking moments about B: $5 \times R_C = 20g \times 3$ $R_C = 12g$ or $60g/5$ or 118 or 120 Resolving vertically: $R_C + R_B = 20g$ $R_B = 8g$ or 78.4 or 78	M1 A1 A1 M1 A1 (5)
(b)	 Resolving vertically: $50g = R + R$ Taking moments about B: $5 \times 25g = 3 \times 20g + (6 - x) \times 30g$ $30x = 115$ $x = 3.8$ or better or 23/6 oe	B1 M1 A1 A1 A1 (5) [10]

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Question Number	Scheme	Marks
4. (a)	$\text{speed} = \sqrt{2^2 + (-5)^2}$ $= \sqrt{29} = 5.4$ or better	M1 A1 (2)
(b)	$\left(\left(7\mathrm{i} + 10\mathrm{j}\right) - \left(2\mathrm{i} - 5\mathrm{j}\right)\right)/5$ $= \left(5\mathbf{i} + 15\mathbf{j}\right)/5 = \mathbf{i} + 3\mathbf{j}$ $\mathbf{F} = m\mathbf{a} = 2\left(\mathbf{i} + 3\mathbf{j}\right) = 2\mathbf{i} + 6\mathbf{j}$	M1 A1 A1 DM1 A1ft (5)
(c)	$\mathbf{v} = \mathbf{u} + \mathbf{a}t = \left(2\mathbf{i} - 5\mathbf{j}\right) + \left(\mathbf{i} + 3\mathbf{j}\right)t$ $\left(-5 + 3t\right)\mathrm{j}$ Parallel to $\mathrm{i} \Rightarrow -5 + 3\mathrm{t} = 0$ $t = 5/3$	M1 A1 M1 A1 (4) [11]

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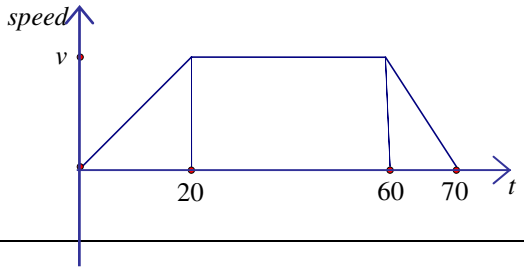
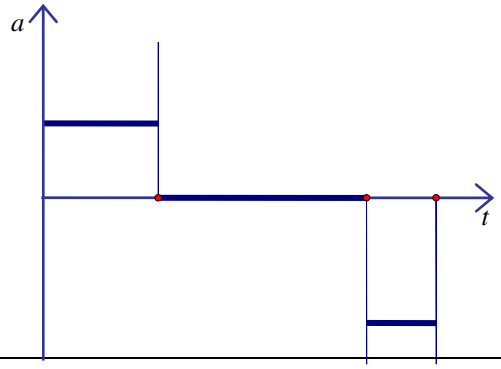
Question Number	Scheme	Marks
5. (a) (i)		
	1st section correct	B1
	2nd & 3rd sections correct	B1
	Numbers and v marked correctly on the axes.	DB1
(ii)		
	1st section correct	B1
	2nd section correct	B1
	3rd section correct and no "extras" on the sketch	B1
		(6)
(b)	$\frac{70+40}{2}\times v = 880$	M1 A1
	$v = 880\times\frac{2}{110} = 16$	DM1 A1
		(4)
		[10]

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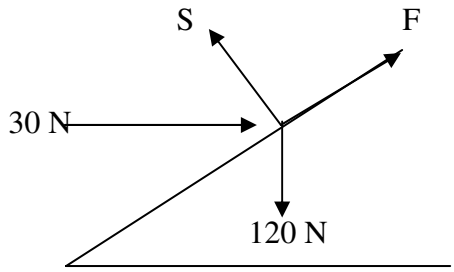
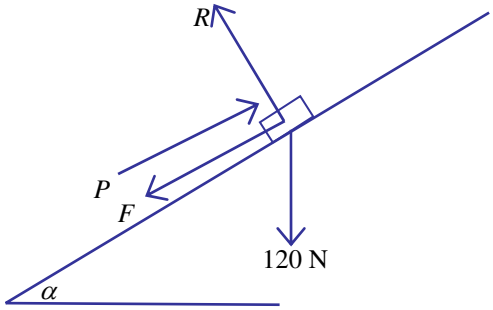
Question Number	Scheme	Marks
6. (a)	 Resolving perpendicular to the plane: $S = 120\cos\alpha + 30\sin\alpha$ $= 114$ *	M1 A1 A1 A1 (4)
(b)	 Resolving perpendicular to the plane: $R = 120\cos\alpha$ $= 96$ $F_{\max} = \frac{1}{2}R$ Resolving parallel to the plane: In equilibrium: $P_{\max} = F_{\max} + 120\sin\alpha$ $= 48 + 72 = 120$	M1 A1 A1 M1 M1 A(2,1,0) A1 (8)
(c)	$30 + F = 120\sin\alpha$ **OR** $30 - F = 120\sin\alpha$ So $F = 42\text{N}$ acting up the plane.	M1 A1 A1 (3) [15]

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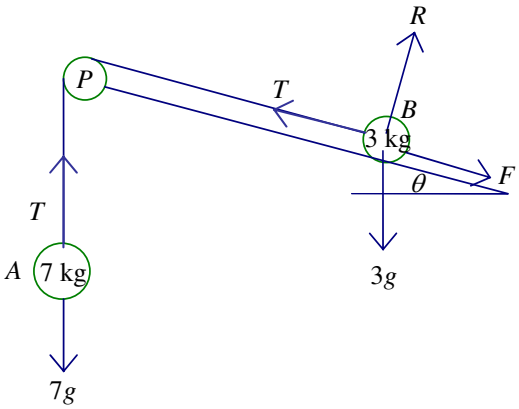
Question Number	Scheme	Marks
7. (a)	 $\tan\theta = \frac{5}{12}$ $\sin\theta = \frac{5}{13}$ $\cos\theta = \frac{12}{13}$	
	For A: $7g - T = 7a$	M1 A1
	For B: parallel to plane $T - F - 3g\sin\theta = 3a$	M1 A1
	perpendicular to plane $R = 3g\cos\theta$	M1 A1
	$F = \mu R = 3g\cos\theta = 2g\cos\theta$	M1
	Eliminating T, $7g - F - 3g\sin\theta = 10a$	DM1
	Equation in g and a: $7g - 2g\times\frac{12}{13} - 3g\frac{5}{13} = 7g - \frac{39}{13}g = 4g = 10a$	DM1
	$a = \frac{2g}{5}$ *oe* or 3.9 or 3.92	A1
		(10)
(b)	After 1 m,	
	$v^2 = u^2 + 2as$, $v^2 = 0 + 2\times\frac{2g}{5}\times 1$	M1
	$v = 2.8$	A1
		(2)
(c)	$-(F + 3g\ \sin\theta) = 3a$	M1
	$\frac{2}{3}\times 3g\times\frac{12}{13} + 3g\times\frac{5}{13} = 3g = -3a,\ a = -g$	A1
	$v = u + at,\ 0 = 2.8 - 9.8t,$	DM1
	$t = \frac{2}{7}$ oe, 0.29. 0.286	A1
		(4) [16]

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