Mark Scheme (Results)

Summer 2013

GCE Mechanics 1 (6677/01)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

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
- ⌐ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme

General Rules for Marking Mechanics

- Usual rules for M marks: correct no. of terms; dim correct; all terms that need resolving (i.e. multiplied by cos or sin) are resolved.

- Omission or extra g in a resolution is accuracy error not method error.

- Omission of mass from a resolution is method error.

- Omission of a length from a moments equation is a method error.

- Omission of units or incorrect units is not (usually) counted as an accuracy error.

- DM indicates a dependent method mark i.e. one that can only be awarded if a previous specified method mark has been awarded.

- Any numerical answer which comes from use of g = 9.8 should be given to 2 or 3 SF.

- Use of g = 9.81 should be penalised once per (complete) question.

- N.B. Over-accuracy or under-accuracy of correct answers should only be penalised *ONCE* per complete question.

- In all cases, if the candidate clearly labels their working under a particular part of a question i.e. (a) or (b) or (c),……then that working can only score marks for that part of the question.

- Accept column vectors in all cases.

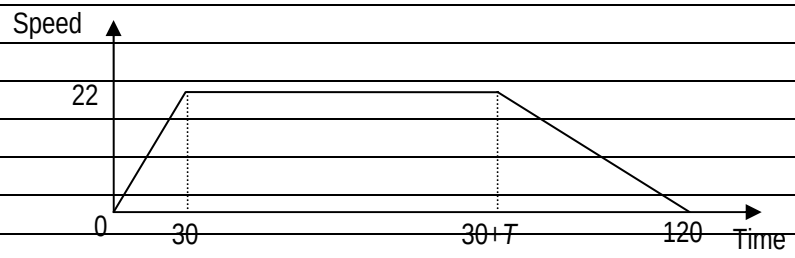
- Misreads – if a misread does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, bearing in mind that after a misread, the subsequent A marks affected are treated as A ft.

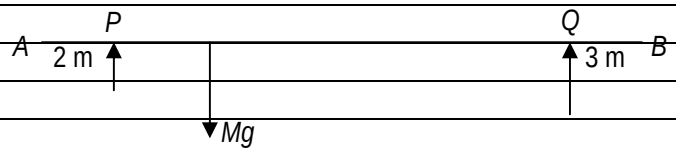
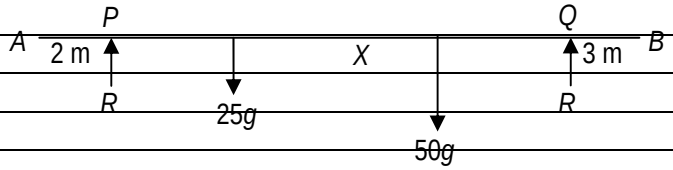
Question Number	Scheme	Marks
1.		
(a)	For P, $-I = 3(1-4)$	M1 A1
	$I = 9$ Ns	A1
		(3)
(b)	For Q, $9 = m(1.5--3)$	M1 A1
	$m = 2$	A1
	OR	
	$12-3m = 3+1.5m$	M1 A1
	$m = 2$	A1
		(3)
		[6]
Notes for Question 1		
Q1(a)	M1 for attempt at Impulse = difference in momenta <u>for particle *P*</u>, (must be considering *one* particle i.e. have *same mass* in both terms) (M0 if g is included or if mass omitted). First A1 for $\pm 3(1-4)$ Second A1 for 9 (Must be positive). Allow change of sign at end to obtain magnitude. **<u>N.B.</u>** For M1 they may use CLM to find a value for m first and then use it when considering the change in momentum of Q to find the impulse.	
Q1(b)	**EITHER** M1 for attempt at: their Impulse from (a) = difference in momenta <u>for particle *Q*</u>, (must be considering *one* particle) (M0 if g is included or if mass omitted). First A1 for $9 = m(1.5--3)$ oe. Second A1 for $m = 2$. **OR** M1 for attempt at CLM equation, with correct no. of terms, dimensionally correct. Allow consistent extra g's and sign errors. First A1 for a correct equation i.e. $12-3m = 3+1.5m$ oe. Second A1 for $m = 2$.	

Question Number	Scheme	Marks
2.		
(a)	For system, $(\uparrow),\ T - 950g - 50g = 1000 \times -2$	M1 A1
	$T = 7800$ N	A1
		(3)
(b)	For woman, $(\uparrow),\quad R - 50g = 50 \times -2$	M1 A1
	$R = 390$ N	A1
		(3)
		[6]
	Notes for Question 2	
Q2(a)	(In both parts, use the *mass* to decide which part of the system is being considered and M marks can only be scored if an equation contains only forces acting on that part of the system) M1 is for a complete method for finding T i.e. for an equation in T *only*, dimensionally correct, with the correct number of terms. First A1 for a correct equation. Second A1 for 7800 (N).	
Q2(b)	M1 is for a complete method for finding R i.e. for an equation in R *only*, dimensionally correct, with the correct number of terms. First A1 for a correct equation. Second A1 for 390 (N). N.B. Equation for lift *only* is: $T - 950g - R = 950 \times (-2)$	

Question Number	Scheme	Marks
3.	$T\cos\alpha - F = 2g\cos 60^o$	M1 A1
	$T\sin\alpha + R = 2g\cos 30^o$	M1 A1
	$F = \frac{1}{3}R$	B1
	eliminating F and R	**DM**1
	$T = g(1+\frac{1}{\sqrt{3}})$, 1.6g (or better), 15.5, 15 (N)	**DM**1 A1
		(8)
		[8]
Notes for Question 3		
Q3	First M1 for resolving parallel to the plane with correct no. of terms and both T and $2g$ terms resolved. First A1 for a correct equation. (use of α instead of 30^o or 60^o or vice versa is an A error not M error; similarly if they use sin(3/5) or cos(4/5) when resolving, this can score M1A0) Second M1 for resolving perpendicular to the plane with correct no. of terms and both T and $2g$ terms resolved. Second A1 for a correct equation (use of α instead of 30^o or 60^o or vice versa is an A error not M error; similarly if they use sin(3/5) or cos(4/5) when resolving, this can score M1A0) B1 for $F = 1/3\ R$ seen or implied. Third M1, dependent on first two M marks and appropriate angles used when resolving in *both* equations, for eliminating *F and R.* Fourth M1 dependent on third M1, for solving for T Third A1 for 15(N) or 15.5 (N). N.B. The first two M marks can be for two resolutions in any directions. Use of tan α = 4/3 leads to an answer of 17.83…and can score max 7/8.	

Question Number	Scheme	Marks
4.		
(a)	$240 = \frac{1}{2}(u+34)10$	M1 A1
	$u = 14$	A1
		(3)
(b)	$34 = 14 + 10a \Rightarrow a = 2$	M1 A1
	$120 = 14t + \frac{1}{2} \times 2 \times t^2$	M1 A1
	$t^2 + 14t - 120 = 0$	
	Solving, $t = -20$ or 6	**DM**1
	$t = 6$	A1
	OR	
	$34 = 14 + 10a \Rightarrow a = 2$	M1 A1
	$v^2 = 14^2 + 2 \times 2 \times 120 \Rightarrow v = 26$	
	AND $26 = 14 + 2t$	M1 A1
	$t = 6$	**DM**1 A1
		(6)
		[9]
Notes for Question 4		
Q4(a)	First M1 for a complete method to produce an equation in u only. First A1 for a correct equation. ($u^2 - 48u + 476 = 0$ oe is possible). Second A1 for $u = 14$.	
Q4(b)	**EITHER** First M1 for an equation in a only. (M0 if $v = 34$ when $s = 120$ is used) First A1 for $a = 2$. (This may have been found in part (a)) Second M1 for a 3-term quadratic equation in t only, allow sign errors (must have found a value of a. (M0 if $v = 34$ when $s = 120$ is used) Second A1 for a correct equaton. Third M1 dependent on previous M1 for solving for t. Third A1 for $t = 6$ **OR** First M1 for an equation in a only. First A1 for $a = 2$. (This may have been found in part (a)) Second M1 for a complete method to obtain an equation in t only, allow sign errors. (must have found a value of a) Second A1 for a correct equaton. Third M1 dependent on previous M1 for solving for t. Third A1 for $t = 6$	

Question Number	Scheme	Marks
5.		
(a)	 Shape	B1
	Figures	B1
		(2)
(b)	$\frac{(120+T)22}{2}=2145$	M1 A1
	$T=75$	A1
		(3)
(c)	$\frac{(t+t-30)22}{2}=990$	M1 A1
	$t=60$	A1
	Answer $=60-10=50$	A1
		(4)
(d)	$990=0.5a50^2$	M1
	$a=0.79, 0.792, 99/125$ oe	A1
		(2)
		[11]
Notes for Question 5		
Q5(a)	First B1 for a trapezium starting at the origin and ending on the *t*-axis. Second B1 for the figures marked (allow missing 0 and a delineator oe for *T*) (allow if they have used $T=75$ correctly on their graph)	
Q5(b)	First M1 for producing an equation in their *T only* by equating the area of the trapezium to 2145, with the correct no. of terms. If using a single trapezium, we need to see evidence of using ½ the sum of the two parallel sides or if using triangle(s), need to see ½ base x height. Second A1 cao for a correct equation in *T* (This is not f.t. on their *T*) Third A1 for $T=75$. N.B. Use of a single *suvat* equation for the whole motion of the car e.g. $s=t(u+v)/2$ is M0	
Q5(c)	First M1 for producing an equation in *t only* (they may use $(t-30)$ oe as their variable) by equating the area of the trapezium to 990, with the correct no. of terms. If using a trapezium, we need to see evidence of using ½ the sum of the two parallel sides or if using triangle(s), need to see ½ base x height. First A1 for a correct equation. Second A1 for $t=60$ (Allow 30 + 30). Third A1 for answer of 50. N.B. Use of a single *suvat* equation for the whole motion of the car e.g. $s=t(u+v)/2$ is M0. Use of the motion of the motorcycle is M0 (insufficient information). Use of $v=22$ for the motorcycle is M0.	
Q5(d)	First M1 for an equation in *a* only. First A1 for $a=0.79, 0.792, 99/125$ oe N.B. Use of $v=22$ for the motorcycle is M0.	

Question Number	Scheme	Marks
6.		
(a)		
	$\mathrm{M}(P),\quad 50g\times 2 = Mg\times(x-2)$	M1 A1
	$\mathrm{M}(Q),\quad 50g\times 3 = Mg\times(12-x)$	M1 A1
(i)	$M = 25$ (kg)	**DM**1 A1
(ii)	$x = 6$ (m)	**DM**1 A1
		(8)
(b)		
	$(\uparrow) R + R = 25g + 50g$	M1 A1 **ft**
	$\mathrm{M}(A),\quad 2R + 12R = 25g\times 6 + 50g\times AX$	M1 A1 **ft**
	$AX = 7.5$ (m)	**DM**1 A1
		(6)
		[14]

Notes for Question 6		
Q6(a)	First M1 for moments about P equation with usual rules (or moments about a different point AND vertical resolution and R then eliminated) (M0 if non-zero reaction at Q) Second M1 for moments about Q equation with usual rules (or moments about a different point AND vertical resolution) (M0 if non-zero reaction at P) Second A1 for a correct equation in M and same unknown. Third M1, dependent on first and second M marks, for solving for M Third A1 for 25 (kg) Fourth M1, dependent on first and second M marks, for solving for x Fourth A1 for 6 (m) N.B. No marks available if rod is assumed to be uniform but can score max 5/6 in part (b), provided they have found values for M and x to f.t. on. If they have just invented values for M and x in part (a), they can score the M marks in part (b) but not the A marks.	
Q6(b)	First M1 for vertical resolution or a moments equation, with usual rules. First A1 **ft** on their M and x from part (a), for a correct equation. (must have *equal reactions* in vertical resolution to earn this mark) Second M1 for a moments equation with usual rules. Second A1 **ft** on their M and x from part (a), for a correct equation in R and same unknown length. Third M1, dependent on first and second M marks, for solving for AX *(not their unknown length)* with $AX \leq 15$ Third A1 for $AX = 7.5$ (m) N.B. If a single equation is used (see below), equating the sum of the moments of the child and the weight about P to the sum of the moments of the child and the weight about Q, this can score M2 A2 **ft** on their M and x from part (a), provided the equation is in one unknown. Any method error, loses both M marks. e.g. $25g.4 + 50g(x - 2) = 25g.6 + 50g(12 - x)$ oe.	

Question Number	Scheme	Marks
7.		
(a)	$t = 0$ gives $\mathbf{v} = \mathbf{i} - 3\mathbf{j}$	B1
	speed $= \sqrt{1^2 + (-3)^2}$	M1
	$= \sqrt{10} = 3.2$ or better	A1
		(3)
(b)	$t = 2$ gives $\mathbf{v} = (-3\mathbf{i} + 3\mathbf{j})$	M1
	Bearing is 315°	A1
		(2)
(c)(i)	$1 - 2t = 0 \Rightarrow t = 0.5$	M1 A1
(ii)	$-(3t - 3) = -3(1 - 2t)$	M1 A1
	Solving for t	**DM**1
	t = 2/3, 0.67 or better	A1
		(6)
		[11]
Notes for Question 7		
Q7(a)	B1 for **i** – 3**j.** M1 for √ (sum of squares of cpt.s) A1 for √10, 3.2 or better	
Q7(b)	M1 for clear attempt to sub $t = 2$ into given expression. A1 for 315.	
Q7(c)	**(i)** First M1 for $1 - 2t = 0$. First A1 for $t = 0.5$. N.B. If they offer two solutions, by equating both the **i** and **j** components to zero, give M0. **(ii)** First M1 for $\frac{1-2t}{3t-3} = \pm(\frac{-1}{-3})$ o.e. (Must be an equation in t *only*) First A1 for a correct equation (the + sign) Second M1, dependent on first M1, for solving for t. Second A1 for 2/3, 0.67 or better.	

Question Number	Scheme	Marks
8.		
(a)	For A, $T = 2ma$	B1
	For B, $3mg - T = 3ma$	M1 A1
	$3mg = 5ma$	**DM**1
	$\frac{3g}{5} = a$ (5.9 or 5.88 m s^{-2})	A1
		(5)
(b)	$T = 6mg/5$; $12m$; $11.8m$	B1
		(1)
(c)	$F = \sqrt{T^2 + T^2}$	M1 A1 **ft**
	$F = \frac{6mg\sqrt{2}}{5}$;$1.7mg$ (or better);$16.6m$;$17m$	A1
	Direction clearly marked on a diagram, with an arrow, and 45^o (oe) marked	B1
		(4)
		[10]
Notes for Question 8		
Q8(a)	B1 for $T = 2ma$ First M1 for resolving vertically (up or down) for B, with correct no. of terms. (allow omission of m, provided 3 is there) First A1 for a correct equation. Second M1, dependent on first M1, for eliminating T, to give an equation in a only. Second A1 for 0.6g, 5.88 or 5.9. N.B. 'Whole system' equation: $3mg = 5ma$ earns first 4 marks but any error loses all 4.	
Q8(b)	B1 for $\frac{6mg}{5}$, $11.8m$, $12m$	
Q8(c)	M1 $\sqrt{(T^2 + T^2)}$ or $\frac{T}{\sin 45^o}$ or $\frac{T}{\cos 45^o}$ or $2T\cos 45^o$ or $2T\sin 45^o$ (allow if m omitted) (M0 for $T \sin 45^o$) First A1 ft on their T. Second A1 cao for $\frac{6mg\sqrt{2}}{5}$ oe, $1.7mg$ (or better),$16.6m$,$17m$ B1 for the direction clearly shown on a diagram with an arrow and 45^o marked.	

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