Mark Scheme (Results)

January 2014

Pearson Edexcel International Advanced Level

Mechanics 1 (WME01/01)

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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 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.

General Notes From Chief Examiner

- 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)	$12MU - 2MU = 5MV$ $2U = V$	M1 A1 A1 (3)
(b)	$I = 2M\left(V - -U\right)$ OR $I = 3M\left(-V - -4U\right)$ $= 6MU$	M1 A1 A1 (3) **6**
Notes		
1. (a)	M1 for attempt at CLM equation, with correct no. of terms, dimensionally correct. Allow consistent extra g's and cancelled *M*'s and sign errors. First A1 for a correct equation. Second A1 for $2U$ ($-2U$ A0) N.B. Allow *U*'s to be dropped or omitted in the equation if *U* is inserted in answer at the end. (Full marks can be scored). However, if *U* is not inserted then M0.	
(b)	M1 for attempt at impulse = difference in momenta, for either particle, (must be considering *one* particle) (M0 if g's are included or if mass omitted or if equation is dimensionally incorrect) Allow $\pm 2M(V - U)$ or $\pm 3M(-V - 4U)$ where *V* is their speed which does *not* need to be substituted. First A1 for $\pm 2M(2U - -U)$ or $\pm 3M(-2U - -4U)$ A1 for $6MU$ cao ($-6MU$ is A0) Allow change of sign at end to obtain magnitude.	

Question Number	**Scheme**	**Marks**
2. (a)	$v = \sqrt{2^2 + (-3)^2} = \sqrt{13} = 3.61 \text{ ms}^{-1}$	M1 A1 (2)
(b)	$\mathbf{a} + 4(2\mathbf{i} - 3\mathbf{j}) = (\mathbf{i} - 4\mathbf{j})$ $\mathbf{a} = (-7\mathbf{i} + 8\mathbf{j})\text{m}$	M1 A1 DM1 A1 (4) **6**
Notes		
2. (a)	M1 for $\sqrt{}$ (sum of squares of cpt.s) allow $\sqrt{(2^2+3^2)}$ A1 for $\sqrt{13}$, 3.6 or better	
(b)	First M1 for $\mathbf{a} \pm 4(2\mathbf{i} - 3\mathbf{j}) = (\mathbf{i} - 4\mathbf{j})$ oe A1 for $\mathbf{a} + 4(2\mathbf{i} - 3\mathbf{j}) = (\mathbf{i} - 4\mathbf{j})$ oe Second DM1, dependent, for solving for a A1 for $(-7\mathbf{i} + 8\mathbf{j})$ A0 for $\begin{pmatrix} -7\mathbf{i} \\ 8\mathbf{j} \end{pmatrix}$ or $(-7\mathbf{i}, 8\mathbf{j})$	

Question Number	**Scheme**	**Marks**
3.	*M(X),* $25g(14 - x) + 100g.\ 12 = 2009 \times 6$ $x = 12.8,\ 13$ (m)	M1 A1 A1 DM1 A1 **5**
	Notes	
3.	First M1 for producing an equation in a relevant unknown length *only*. Usual rules, correct no. of terms, dim correct. (If more than one equation is used, rules apply to *each* equation) First A2 for a correct equation; -1 each error (omission of *g*'s counts as one error) Second DM1, dependent, for solving for AG. Third A1 for 12.8, 13 oe. S.C. If they use *M* in their equation(s) and never find it or just assume a value for it e.g. 100, can score max M1A0A0M0A0	

Question Number	Scheme	Marks
4.	Use of $F = \mu R$; $\cos\alpha = \frac{4}{5}$ or $\sin\alpha = \frac{3}{5}$ $kmg\cos\alpha - mg\sin\alpha = F$ $mg\cos\alpha - kmg\sin\alpha = R$ equation in k and μ only $k = \frac{3+4\mu}{4+3\mu}$	B1 ; B1 M1 A1 A1 M1 A1 A1 DM1 DM1 A1 **11**

Notes

4.

First B1 for use of $F = \mu R$ i.e. seen on the diagram or in an equation.
Second B1 for $\cos\alpha = 0.8$ or $\sin\alpha = 0.6$ seen.
First M1 for resolving parallel to the plane (usual rules)
First A2 for a correct equation; -1 each error (omission of both g's is 1 error)
Second M1 for resolving perpendicular to the plane (usual rules)
Second A2 for a correct equation; -1 each error (omission of both g's is 1 error)
N.B. In each equation, if they write cos 4/5 or sin 3/5 (or both) treat as 1 A error but allow recovery if they actually use the correct trig. ratios.
Third DM1, dependent on first two M marks, for producing an equation in *k* and *μ only*.
Fourth DM1, dependent on third M1, for solving for k, in terms of μ only.
Fifth A1 for $k = \frac{3+4\mu}{4+3\mu}$ oe
N.B. The first two M1A2 marks can be for two resolutions in any two directions.

Question Number	**Scheme**	**Marks**
5.	$48 = 3u + \frac{1}{2}9a$ $248 = 8u + \frac{1}{2}64a$ $a = 6 \text{ ms}^{-1}$ $u = 7 \text{ ms}^{-1}$	M1 A1 M1 A1 A1 M1 A1 **7**

Notes

5.

First M1 for producing an equation in *u and a only.*
First A1 for a correct equation
Second M1 for producing an equation in *u and a only.*
(M0 for $200 = 5u + 0.5a.\ 5^2$)
Second A1 for a correct equation
Third M1 independent for solving *simultaneous* equations, in *u* and *a* only, for either *u* or *a*
Third A1 for $a = 6$
Fourth A1 for $u = 7$

Alternative using speed *v* at $t = 3$:
First M1 for attempt at: $48 = 3v - 0.5a.3^2$
First A1 for a correct equation
Second M1 attempt at : $200 = 5v + 0.5a.\ 5^2$
Second A1 for a correct equation
Third M1 independent for solving *simultaneous* equations, in *u* and *a* only, for either *u* or *a*
Third A1 for $a = 6$
Fourth A1 for $u = 7$

Alternative, using average speed = *actual speed* at half-time
$v = 48/3$ *at t = 1.5 (must be used/stated)* M1 A1
$v = 200/5$ *at t = 5.5 (must be used/stated)* M1 A1
$a = (40 - 16)/(5.5 - 1.5) = 6$ DM1 A1
$u = 16 - (6 \times 1.5) = 7$ A1

Question Number	Scheme	Marks
6. (a)	$0.75 = \frac{1}{2}a(0.5)^2$ $a = 6$ $0.5g\sin\theta - T = 0.5a$ $T = 0.92\ N$	M1 A1 A1 M1 A1 A1 (6)
(b)	$R = 0.1g$ $T - \mu R = 0.1a$ $0.92 - \mu 0.1g = 0.1\times 6$ $\mu = 0.327$ or 0.33	B1 M1 A1 M1 A1 (5) **11**

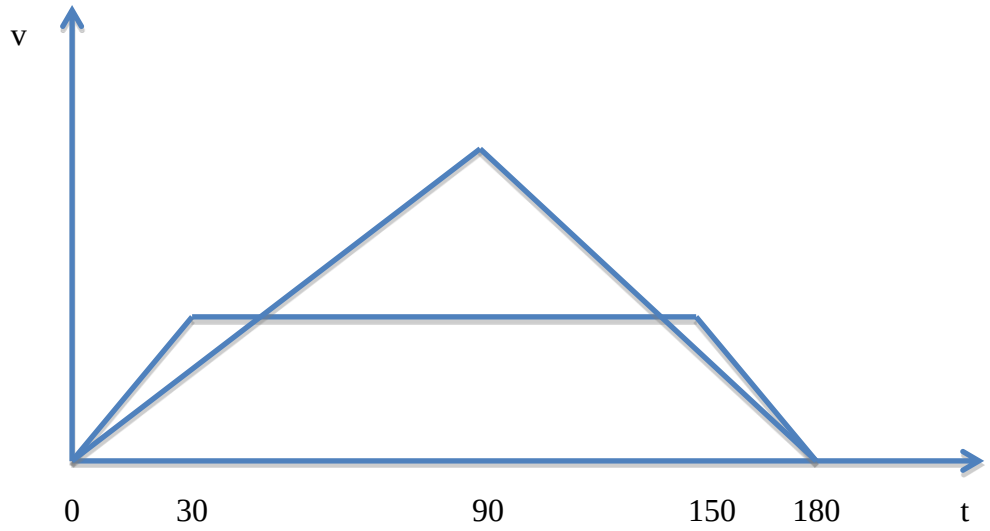
Notes

6. (a)	First M1 for use of $s = ut + 1/2at^2$ (or use of 2 *suvat* formulae AND eliminating v) with $u = 0$, to give equation in a *only*. First A1 for a correct equation Second A1 for $a = 6$ Second M1 for resolving parallel to the plane, up or down, for Q *only*. Third A1 for a correct equation (a does not need to be substituted) Fourth A1 for $T = 0.92$ (N)
(b)	B1 for $R = 0.1$g First M1 for resolving horizontally for P only First A1 for a correct equation (neither T, R nor a need to be substituted) Second M1 for substituting for T, R and a and solving for μ. Second A1 for $\mu = 0.327$ or 0.33 (16/49 A0) <u>Alternative:</u> B1 for $R = 0.1$g First M1 for a 'whole system' equation: $0.5g\sin\theta - \mu R = 0.6a$ First A1 for a correct equation (neither R nor a need to be substituted) Second M1 for substituting for R and a and solving for μ. Second A1 for $\mu = 0.327$ or 0.33

Question Number	Scheme	Marks
7. (a)	$\tan\theta = \frac{9}{13}$ $\theta = 34.7°$	M1 A1 A1 (3)
(b)	$a(2\mathbf{i}-\mathbf{j})+b(\mathbf{i}+3\mathbf{j})=(9\mathbf{i}+13\mathbf{j})$ $2a+b=9$ $-a+3b=13$ $a=2,\ b=5$ $\mathbf{P}=(4\mathbf{i}-2\mathbf{j})\text{N};\ \mathbf{Q}=(5\mathbf{i}+15\mathbf{j})\text{N}$	M1 A2 M1 M1 A1 A1 A1 A1 (9) **12**

Notes

7. (a)	M1 for $\tan\theta$ = 9/13 or 13/9 First A1 for a correct equation (allowing for a correct adjustment to their angle in the subsequent working) Second A1 for θ = 35° or better or 325° or better
(b)	First M1 for **P** + **Q** = 9**i** + 13**j** or **P** + **Q** = **F** (can occur anywhere) First A2; Treat as B1 for $a(2\mathbf{i}-\mathbf{j})$ seen or implied; B1 for $b(\mathbf{i}+3\mathbf{j})$ seen or implied. If they use the same *a* and *b*, they lose one of the B marks. Second M1 for equating their **i**- cpts *and* their **j**- cpts to produce two equations in two unknowns Third independent M1 for eliminating one unknown from 2 simultaneous equations Third A1 for *a* = 2 oe Fourth A1 for *b* = 5 oe Fifth A1 for $\mathbf{P}=(4\mathbf{i}-2\mathbf{j})$ (N) Sixth A1 for $\mathbf{Q}=(5\mathbf{i}+15\mathbf{j})$ (N) N.B. Can score all the marks if they 'spot' the answers.

Question Number	Scheme	Marks
8. (a)		B1 trapezium B1 triangle & overlap B1 figs (3)
(b)	$\frac{1}{2}(90+60).20=1500$ $1500=\frac{1}{2}a.90^2$ $a=\frac{10}{27}$ ms^{-1} or decimal	M1 A1 M1 A1 **ft** A1 (5)
(c)	$\frac{10t}{27}=20$ $t=54$ s $t=126$ s	M1 A1 A1 A1 **ft** (4)
(d)	$\frac{10}{27}\times 90\left(=\frac{100}{3}\right)$ $\frac{100}{3}\times 6-\frac{1}{2}.\frac{10}{27}.6^2\left(=\frac{580}{3}\right)$ $d=\frac{580}{3}-(20\times 6)$ $=\frac{220}{3}$m or decimal	M1 DM1 A1 DM1 A1 (5) **17**

Notes	
8. (a)	First B1 for isosceles (approx.) trapezium, from the origin, finishing on the *t*-axis. Second B1 for isosceles (approx.) triangle, from the origin, finishing on the *t*-axis at the same point *and overlapping twice.* Third B1 for 30, 90, 150, 180 placed correctly. Allow delineators
(b)	First M1 for complete method to find distance (or half the distance) between the stations First A1 for a correct expression (may not be evaluated) Second M1 for a complete method to find *a* (M0 if they use *s* = the full distance in any *suvat* equation) Second A1 ft on their distance Third A1 10/27 oe, 0.37 or better
(c)	First M1 for (their *a*) x *t* = 20 (or their *v* max for *A*) First A1 for a correct equation Second A1 for 54 (t_1) (54.1 A0) Third A1 ft for (180 – t_1), provided $30 < t_1 < 90$
(d)	First M1 for finding max speed of *B* e.g. their *a* x 90 (ans 100/3) (may have been found in (b) but must be seen in (d) Second M1 for a complete method (must have found a max *V*) to find distance moved by *B* between *t* = 90 and *t* = 96 (or between 84 and 90) First A1 for a correct expression Third DM1, dependent on first and second M marks, for a complete method to find the required distance Second A1 for 220/3 m oe, 73 m or better