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# Mark Scheme (Results)

## January 2013

## GCE Mechanics – M3 (6679/01)

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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.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Unless indicated in the mark scheme a correct answer with no working should gain full marks for that part of the question.

# 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.

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.

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
- * or AG: 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 incorrect 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. The maximum mark allocation for each question/part question(item) is set out in the marking grid and you should allocate a score of '0' or '1' for each mark, or "trait", as shown:

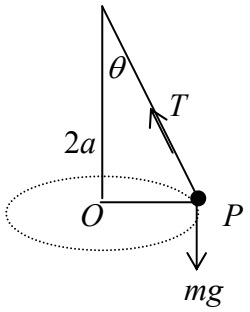
| | 0 | 1 |
|---|---|---|
| aM | | ● |
| aA | ● | |
| bM1 | | ● |
| bA1 | ● | |
| bB | ● | |
| bM2 | | ● |
| bA2 | | ● |

# January 2013
# 6679 M3
# Mark Scheme

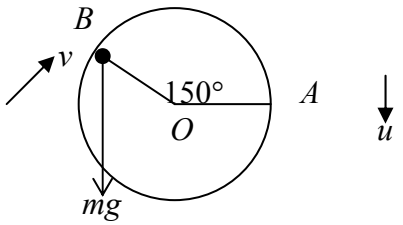
| Question Number | Scheme | Marks |
|---|---|---|
| **1.** | $v\dfrac{\mathrm{d}v}{\mathrm{d}x}=9x$ | M1 |
| | $\dfrac{1}{2}v^2=9x \quad (+c)$ | A1 |
| | $v^2=9x^2+c$ | M1dep |
| | $x=2 \;\; v=6 \quad 36=9\times4+c\Rightarrow c=0$ | |
| | $v^2=9x^2$ | A1 |

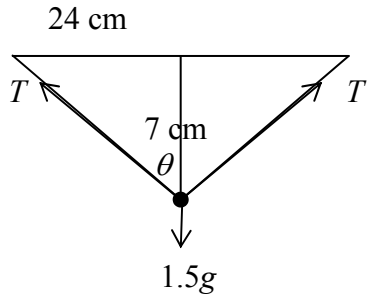
| Question Number | Scheme | Marks |
|---|---|---|
| **2 (a)** | Mass: $\frac{2}{3}\pi r^3$ $\quad$ $\frac{1}{3}k\pi r^3$ $\quad\|\|\quad$ | |
| | $2$ $\quad$ $k$ $\quad\|\|\quad$ $2+k$ | B1 |
| | Dist from $O$: $-\frac{3}{8}r$ $\quad$ $\frac{1}{4}kr$ $\quad\|\|\quad$ $\bar{x}$ | B1 |
| | $-\frac{3}{4}r+\frac{k^2r}{4}=\bar{x}(2+k)$ | M1A1ft |
| | $\bar{x}=\frac{(k^2-3)r}{4(k+2)}$ * | A1 |
| **(b)** | | |
| | $\tan\theta=\frac{(k^2-3)r}{4(k+2)}\div r$ | M1A1 |
| | $\frac{(k^2-3)}{4(k+2)}=\frac{11}{14}$ | |
| | $14k^2-42=44k+88$ | |
| | $7k^2-22k-65=0$ | |
| | $(7k+13)(k-5)=0$ | |
| | $k=5$ | M1depA1 |

| Question Number | Scheme | Marks |
|---|---|---|
| **3** | | |
| **(a)** | $0.6a = -\dfrac{12}{(t+2)^2}$ | M1 |
| | $0.6\int \mathrm{d}v = -\int \dfrac{12}{(t+2)^2}\,\mathrm{d}t$ | |
| | $0.6v = \dfrac{12}{(t+2)} \quad (+c)$ | M1depA1 |
| | $t=0 \quad v=15 \qquad 0.6\times 15 = 6 + c \;\Rightarrow\; c=3$ | M1dep |
| | $0.6v = \dfrac{12}{(t+2)} + 3 \qquad v = \dfrac{20}{(t+2)} + 5 = 5\left(\dfrac{4}{t+2}+1\right)$ * | A1 |
| **(b)** | $\dfrac{\mathrm{d}x}{\mathrm{d}t} = 5\left(\dfrac{4}{t+2}+1\right)$ | M1 |
| | $x = \int 5\left(\dfrac{4}{t+2}+1\right)\mathrm{d}t$ | |
| | $x = 5\left(4\ln(t+2)+t\right) \quad (+c')$ | M1depA1 |
| | $t=0,\ x=0 \quad c' = -20\ln 2$ | |
| | $t=5 \quad x = 5\left(4\ln 7 + 5\right) - 20\ln 2$<br>$= 50.05... = 50.1$ or better<br>or $20\ln\left(\dfrac{7}{2}\right) + 25$ | M1dep<br><br>A1 |

| Question Number | Scheme | Marks |
|---|---|---|
| **4** |  | |
| **(a)** | $\mathrm{R}(\uparrow) \qquad T\cos\theta = mg$ | M1 |
| | $T \times \dfrac{2a}{(2a+x)} = mg$ | A1 |
| | Hooke's Law: $\quad T = \dfrac{6mgx}{2a} = \dfrac{3mgx}{a}$ | M1A1 |
| | $\dfrac{3mgx}{a} \times \dfrac{2a}{(2a+x)} = mg$ | M1dep |
| | $6x = 2a + x$ | |
| | $x = \dfrac{2}{5}a \quad *$ | A1 |
| **(b)** | $T\sin\theta = \dfrac{mv^2}{r}$ | M1A1 |
| | $3mg \times \dfrac{2}{5}\sin\theta = \dfrac{mv^2}{\left(\dfrac{12a}{5}\right)\sin\theta}$ | M1dep |
| | $v^2 = \dfrac{6}{5}g \times \dfrac{12a}{5}\sin^2\theta$ | |
| | $\sin^2\theta = 1 - \left(\dfrac{4a^2}{\left(\dfrac{12a}{5}\right)^2}\right) = \dfrac{11}{36}$ | |
| | $v^2 = \dfrac{72ag}{25} \times \dfrac{11}{36} = \dfrac{22ag}{25}$ | M1depA1 |

| Question Number | Scheme | Marks |
|---|---|---|
| **5** | | |
| **(a)** | $x = a\sin\omega t$<br>$0.125 = 0.25\sin 0.1\omega$<br>$\sin 0.1\omega = \frac{1}{2}$<br>$0.1\omega = \frac{\pi}{6}$<br>$\omega = \frac{\pi}{0.6} = \frac{10\pi}{6}$<br>Period $= \frac{2\pi}{\omega} = \frac{6}{5} \quad (=1.2)$ | M1A1<br><br><br><br>M1depA1<br>A1<br>(B1 on e-pen) |
| **(b)** | $x = 0.25\sin\frac{5}{3}\pi t$<br>$t = 2 \quad x = 0.25\sin\left(2\times\frac{5}{3}\pi\right)$<br>$x = -0.2165...$<br>Dist from $B = 0.25 + x = 0.033$ m | <br>M1<br>A1<br>A1 ft |
| **(c)** | Max accel $= a\omega^2 = 0.25\times\left(\frac{5\pi}{3}\right)^2 = 6.853... = 6.85$ | M1A1 |
| **(d)** | Max speed $a\omega = 0.25\times\left(\frac{5\pi}{3}\right) = 1.308... = 1.31$ | M1A1 |

| Question Number | Scheme | Marks |
|---|---|---|
| **6** |  | |
| **(a)** | At $B$ $\quad mg\cos 60\ (+R) = \dfrac{mv^2}{a}$ | M1A1 |
| | $\dfrac{1}{2}g = \dfrac{v^2}{a} \qquad v = \sqrt{\dfrac{ag}{2}}$ * | A1 |
| **(b)** | Energy $A$ to $B$: $\quad \dfrac{1}{2}mu^2 - \dfrac{1}{2}m\left(\dfrac{ag}{2}\right) = mga\sin 30$ | M1A1A1 |
| | $u^2 = \dfrac{ag}{2} + 2ag \times \dfrac{1}{2}$ | |
| | $u = \sqrt{\dfrac{3ag}{2}}$ | A1 |
| **(c)** | Horiz speed = $\sqrt{\dfrac{ag}{2}}\cos 60 \quad \left(= \dfrac{1}{2}\sqrt{\dfrac{ag}{2}}\right)$ | M1A1 |
| | Initial vert speed = $(-)\sqrt{\dfrac{ag}{2}}\sin 60 \quad \left(= (-)\dfrac{1}{2}\sqrt{\dfrac{3ag}{2}}\right)$ | M1 |
| | $v^2 = \dfrac{1}{4} \times \dfrac{3ag}{2} + 2g \times \dfrac{a}{2}$ | M1A1 |
| | $v^2 = \dfrac{11ag}{8}$ | |
| | $\tan\theta = \dfrac{\text{vert}}{\text{horiz}} = \sqrt{\dfrac{11ag}{8} \times \dfrac{8}{ag}} = \sqrt{11}$ | M1 |
| | $\theta = 73.22... = 73$ | A1 |

| Question Number | Scheme | Marks |
|---|---|---|
| **7 (a)** | $T = \dfrac{\lambda x}{l} \Rightarrow 240 = \dfrac{\lambda \times 18}{30}$ | M1A1 |
| | $\lambda = 400$ | A1 |
| **(b)** |  | |
| | Extension = 10 cm or 20 cm (used in (b) or (c)) | B1 |
| | $T = \dfrac{400 \times 10}{15} = \left(\dfrac{800}{3}\right)$ | M1A1ft |
| | $\text{R}(\uparrow) \quad 2T\cos\theta - 1.5g = (\pm)1.5a$ | M1A1 |
| | $\dfrac{1600}{3} \times \dfrac{7}{25} - 1.5 \times 9.8 = (\pm)1.5a$ | |
| | $a = 89.75...$ $a = 90$ m s$^{-2}$ or 89.8 (positive) | A1 |
| **(c)** | $\text{E.P.E.} = \dfrac{1}{2} \times 400 \times \dfrac{0.2^2}{0.3}$ | B1ft (any correct EPE) |
| | $1.5g \times 0.07 + \dfrac{1}{2} \times 1.5v^2 = 200 \times \dfrac{0.2^2}{0.3} - \dfrac{200 \times 0.18^2}{0.3}$ | M1A1A1 |
| | $v^2 = \dfrac{1}{0.75}\left(200 \times \dfrac{0.2^2}{0.3} - \dfrac{200 \times 0.18^2}{0.3} - 1.5g \times 0.07\right)$ | M1dep |
| | $v = 2.32... = 2.3$ m s$^{-1}$ | A1 |

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