Mark Scheme (Results)

Summer 2025

Pearson Edexcel GCE
AS Mathematics (8MA0)
Paper 22 Mechanics

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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.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 40.

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.

General Principles for Mechanics Marking

(But note that specific mark schemes may sometimes override these general principles)

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

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

- Omission of mass from a resolution is a 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. However, premature approximation should be penalised every time it occurs.
- Marks must be entered in the same order as they appear on the mark scheme.

- 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

- Mechanics Abbreviations
  M(A) Taking moments about A
  N2L Newton's Second Law (Equation of Motion)
  NEL Newton's Experimental Law (Newton's Law of Impact)
  HL Hooke's Law
  SHM Simple harmonic motion
  PCLM Principle of conservation of linear momentum
  RHS, LHS Right hand side, left hand side

Question	Scheme	Marks	AOs
1(a)	Use **total** distance = 400 to set up an equation in T only (oe e.g. $400-12.5-37.5=350$, $350\div 5=70$, $70+20=90$) by using area under graph and/or using *suvat* on each section. Must be a complete method, including use of $(T-20)$	M1	3.4
	$\frac{1}{2}(T+(T-20))\times 5=400$ **OR** $\frac{1}{2}\times 5\times 5+(T-20)\times 5+\frac{1}{2}\times 15\times 5=400$ **OR** $\frac{1}{2}\times 5\times 5+\frac{1}{2}\times(T-5+(T-20))\times 5=400$ **OR** $\frac{1}{2}\times(T-15+(T-20))\times 5+\frac{1}{2}\times 15\times 5=400$ **OR e.g.** $\frac{1}{2}\times 1\times 5^2+(T-20)\times 5+(5\times 15-\frac{1}{2}\times\frac{1}{3}\times 15^2)=400$ (*suvat*)	A1	1.1b
	$T=90$	A1	1.1b
		(3)	
(b)	e.g. The change from constant acceleration to constant speed (zero acceleration) will not be instantaneous. The change from constant speed to constant deceleration will not be instantaneous. The runner is unlikely to maintain constant speed. The runner is unlikely to maintain constant acceleration or deceleration The timing(s) may not be exact. Air or wind resistance on the runner. The runner is unlikely to run in a straight line (obstacles in the road) Any physical limitation of the runner or the terrain e.g. smoothness of the road i.e. bumps in the road. The runner may run more than 400 m. Traffic on the road.	B1	3.5b
		(1)	
			(Total 4 marks)

Notes:	
(a)	
M1:	Must cover the total distance. If using areas, must be using a correct formula for a triangle and/or a trapezium e.g. if ½ is missing then M0.
A1:	Correct unsimplified equation in T (allow T replaced by e.g. t throughout)
A1:	Cao, allow $t = 90$
(b)	
B1:	Any appropriate limitation of the model. B0 if incorrect extra answer(s) are included: e.g. the road not being straight, friction from the road, the road not being horizontal, the road not being flat

Question	Scheme	Marks	AOs
2(a)	Resultant force = $(-3\mathbf{i}+4\mathbf{j})\,(\mathrm{N})$	B1	1.1b
		(1)	
(b)	$(-3\mathbf{i}+4\mathbf{j})=0.25\mathbf{a}$ **OR** $\lvert\mathbf{R}\rvert=0.25\lvert\mathbf{a}\rvert$	M1	3.1a
	$\lvert\mathbf{a}\rvert=4\sqrt{(-3)^2+(4)^2}$ **OR** $\lvert\mathbf{R}\rvert=\sqrt{(-3)^2+(4)^2}$	M1	1.1b
	$\lvert\mathbf{a}\rvert=20\,(\mathrm{m\,s^{-2}})$	A1	1.1b
		(3)	
(c)	$\mathbf{F}_3=(3\mathbf{i}-4\mathbf{j})\,(\mathrm{N})$	B1**ft**	2.2a
		(1)	
			(Total 5 marks)

Notes: N.B. only penalise answers given as column vectors once in this question

(a)

B1: cao. Ignore if they find the magnitude.

(b)

M1: Use of $\mathbf{R}=0.25\mathbf{a}$ or in scalar form. Need to have used the mass correctly

M1: Use of Pythagoras on their **a** or their **R**

A1: Correct only and must come from a **correct R**.
A0 if they get 20 and then say $\lvert\mathbf{a}\rvert=\sqrt{20}$

(c)

B1ft: − (their answer to (a)) **OR** cao if they don't use answer to (a).

Question	Scheme	Marks	AOs
3(a)	Equation of motion for Q	M1	3.3
	$3g - T = 3a$ or $T - 3g = 3a$	A1	1.1b
		(2)	
(b)	For P: $T = 2a$ or $-T = 2a$ For system: $3g = 5a$ or $-3g = 5a$	B1	1.1b
	Solve for a	M1	3.4
	Acceleration $= \frac{3}{5}g = 5.9\left(\text{m s}^{-2}\right)$ or $5.88\left(\text{m s}^{-2}\right)$	A1	1.1b
		(3)	
(c)	Form an equation in v only e.g. $v^2 = 2\times(\text{their } a)\times 0.4$	M1	3.1b
	Speed $= 2.2\left(\text{m s}^{-1}\right)$ or $2.17\left(\text{m s}^{-1}\right)$	A1	1.1b
		(2)	
(d)	Form an equation in K only e.g. $K = \frac{1.2 - 0.4}{\textit{their } 2.2}$	M1	3.1b
	$K = 0.37$ or $K = 0.369$	A1	1.1b
		(2)	
(e)	Acceleration will be less, with a reason.	B1	3.5c
		(1)	
(f)	e.g. Consider the dimensions or shape of the packages or not modelling the packages as particles Consider resistance in the pulley Consider the weight or mass of the pulley Consider the weight or mass or dimensions of the rope Consider elasticity of the rope B0 use a more accurate value for g make the model 3D **N.B. Ignore** mention of resistance or friction from the table and/or air resistance.	B1	3.5c
		(1)	
			Total 11 marks

Notes:	
(a)	
M1:	Equation of motion for Q. Dimensionally correct. All relevant terms and no extras. Condone sign errors. Must appear in (a) Consistent inclusion of m : $3mg - T = 3ma$, can score M1A0
A1:	Correct equation, must appear in (a).
(b)	
B1:	Equation of motion for P, consistent with their equation for Q, or for whole system. Inclusion of m here is B0.
M1:	Obtain equation in a and solve **N.B.** If not using a valid attempt at a system equation with mass 5, they must be solving two equations in T and a which are dimensionally correct i.e. force = mass $\times$ a
A1:	Answer to 2 sf or 3 sf only. Must be positive.
(c)	
M1:	Complete method using *suvat* to form an equation in v or v^2 using their a, even if negative. **N.B**. Must have found a value for a.
A1:	Answer to 2 sf or 3 sf
(d)	
M1:	Complete method to form an equation in K only
A1:	Answer to 2 sf or 3 sf
(e)	
B1:	Correct conclusion with a reason. B0 if no reason given.
(f)	
B1:	Must relate to an aspect of the model. B0 if any incorrect extras included.

Question	Scheme	Marks	AOs
	N.B. In this question you must show all stages of your working. Solutions relying entirely on calculator technology are not acceptable.		
4(a)	Differentiate s with respect to t	M1	1.1b
	$(v=)6t^2-24t+18$	A1	1.1b
	Equate their v to 0 and solve for t	M1	1.1b
	$t=1$ or $t=3$	A1	1.1b
		(4)	
(b)	Finds values of s for $t=4$ and their two values of t, in the interval $0\leqslant t\leqslant 4$ Their t values must have come from solving $v = 0$, a 3 term quadratic. ($s_1=8,\ s_3=0,\ s_4=8$ are the actual values) Could be seen or implied by at least 2 correct s values for their t values. Could see: $f(1), f(3), f(4)$ where $f(t)=\int 6t^2-24t+18\ \mathrm{d}t$ but must see this integrated before the substitution. **N.B.** M0 if one of their two values is not in the interval $0\leqslant t\leqslant 4$ Ignore any extra values of s found.	M1	1.1b
	Total distance $=\left(s_1\left(-s_0\right)\right)+\left(s_1-s_3\right)+\left(s_4-s_3\right)$ oe Could see: $\left[f(t)\right]_0^1-\left[f(t)\right]_1^3+\left[f(t)\right]_3^4$ evaluated **OR** e.g. $=\left(s_1\left(-s_0\right)\right)+\left(s_1-s_2\right)+\left(s_2-s_3\right)+\left(s_4-s_3\right)$	M1	2.1
	= 24 (m)	A1	1.1b
		(3)	
(c)	Attempt to find the value of t for the maximum speed e.g. by using the symmetry of the function **N.B.** this can be implied by use of $t = 2$ to find MAX v. **OR** by differentiating v with respect to t , equating to 0 and solving for t **OR** by completing the square: $v=6(t-2)^2-6$	M1	2.1
	$t=2$, seen or implied	A1	1.1b
	$v=6\left(\mathrm{m\,s^{-1}}\right)$ Must be positive.	A1	1.1b

	N.B. $t = 2$, $v = 6$ only, with no working, scores M1A1A1 $t = 2$ only with no working, is M1A1A0 $v = 6$ only with no working can score M1A1A1 $(2, -6)$ only scores M0.		
		(3)	
			Total 10 marks

Notes:

(a)

M1: Differentiate, with at least 2 powers decreasing by 1

A1: Correct expression

M1: Solve a 3 term quadratic = 0, obtained by differentiating s.
N.B. Must see some working for this as a calculator solution is not permitted.

A1: cao

(b)

M1: Clear attempt to find the relevant s values, ignoring any extras..
Condone if they integrate their v and obtain an incorrect expression for s.

M1: Correct use of their s values to find the required distance.

A1: Correct only

(c)

M1: Any complete method to obtain t
$(a = 12t - 24 = 0 \rightarrow t = 2)$

A1: Seen or implied e.g. in $6(t-2)^2 - 6$

A1: Correct only.

N.B. The first 2 marks can be scored if they are using $v = t^2 - 4t + 3$

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