Pearson Edexcel

Mark Scheme (Results)

Summer 2025

Pearson Edexcel GCE
In Further Mathematics (8FM0)
Paper 25 Further Mechanics 1

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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. 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.

5. Where a candidate has made multiple responses and indicates which response they wish to submit, examiners should mark this response.
   If there are several attempts at a question which have not been crossed out, examiners should mark the final answer which is the answer that is the most complete.
6. Ignore wrong working or incorrect statements following a correct answer.

7. Mark schemes will firstly show the solution judged to be the most common response expected from candidates. Where appropriate, alternatives answers are provided in the notes. If examiners are not sure if an answer is acceptable, they will check the mark scheme to see if an alternative answer is given for the method used.

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)	Equation of motion	M1	3.4
	$\frac{20000}{U} - 1600 = 0$	A1	1.1b
	$U = 12.5$	A1	1.1b
		(3)	
1(b)	$\frac{20000}{8} = F$, the driving force	B1	3.3
	Equation of motion	M1	3.1b
	$F + 1000g\sin\alpha - 1600 = 1000a$	A1	1.1b
	$a = 1.1$	A1	1.1b
		(4)	
1(c)	E.g. Make the resistance dependent on the speed.	B1	3.5c
	Make the resistance variable (not constant)	**(1)**	
	B0: Anything which is not related to the model i.e. to the total resistance being constant. e.g. Model the road as rough, include friction, include air resistance, unevenness of the road, more accurate value of g, make air resistance dependent on the speed. **N.B.** If there is more than one answer, penalise incorrect extras once e.g. one correct, one incorrect is B0.		
			(8 marks)

Notes:		
1a	M1	Allow $F - 1600 = 0$ or $F = 1600$
	A1	Correct equation in U only.
	A1	Allow 13 **N.B**. A correct answer only, with no working, can score all 3 marks.
1b	B1	Seen or implied. Allow 20 instead of 20000. B0 if they use $\frac{20000}{8}$ as the resultant force not the driving force.
	M1	Correct no. of terms, condone sign errors and sin/cos confusion.
	A1	Correct equation.
	A1	cao
1c	B1	Accept 'make resistance non-constant' oe

Question	Scheme	Marks	AOs
2(a)	$u \rightarrow \quad \rightarrow 0$ $(P)\ m \quad 3m\ (Q)$ $v \leftarrow \quad \rightarrow w$		
	Use of CLM	M1	3.1a
	$-mv+3mw=mu$	A1	1.1b
	Use of NEL	M1	3.4
	$v+w=eu$	A1	1.1b
	Solve for v:	M1	1.1b
	$\frac{u(3e-1)}{4}$*	A1*	2.2a
		(6)	
2(b)	$1 \geqslant e > \frac{1}{3}$	B1	2.2a
		(1)	
2(c)	Use of impulse-momentum for P or Q	M1	3.1a
	P: $\pm m(v+u)$ **OR** Q: $\pm 3mw$	A1	1.1b
	$\frac{9mu}{8}$ or $1\frac{1}{8}mu$	A1	1.1b
		(3)	
			(10 marks)

Notes:		
2a		**N.B.** When checking for consistency between their equations, mark the CLM equation FIRST.
	M1	Use of CLM, with correct no. of terms, condone sign errors and consistent missing m's
	A1	Correct unsimplified equation. Allow v replaced by $-v$
	M1	Use of NEL with e on the correct side of the equation, condone sign errors.
	A1	Correct unsimplified equation consistent with CLM equation.
	M1	Solve for v (must be dimensionally correct but allow slips in algebra)
	A1*	Given answer correctly obtained, with no errors seen. Allow $\frac{u}{4}(3e-1)$ or $\frac{1}{4}u(3e-1)$ or $\frac{u}{4}(-1+3e)$ or $\frac{1}{4}u(-1+3e)$ or $\frac{u(-1+3e)}{4}$

		If they have v in the initial direction of P and obtain $v = \frac{u(1-3e)}{4}$, we need to see a clear explanation of why the signs are changed.
2b	B1	cao
2c	M1	Condone sign errors but must have correct terms (M0 if m omitted). M0 if m is used with w or $3m$ is used with v.
	A1	$\pm m(v+u)$ or $\pm 3mw$. **N.B.** v and w do not need to be substituted.
	A1	Accept $1.1mu$ or better. **N.B.** Must be of form kmu and must be positive.

Question	Scheme	Marks	AOs
3(a)	Use of conservation of energy principle: $\frac{1}{2}m\times 7^2 = mgh$	M1	3.4
	$\frac{1}{2}m\times 7^2 = mgd\sin\alpha$	A1	1.1b
	$d = 3.1$ or 3.13 (m)	A1	1.1b
		(3)	
3(b)	Resolve perpendicular to the plane: $R = mg\cos\alpha$	M1	3.1b
	Use of $F = \frac{2}{3}R$	M1	1.2
	$F = \frac{2}{5}mg$ or $\frac{6}{15}mg$ or $0.4mg$ (must be in terms of m and g)	A1	1.1b
		(3)	
3(c)	WD against friction = Fx or $F\left(\frac{h}{\sin\alpha}\right)$	B1	3.4
	Use of work-energy principle: $mgh - \frac{1}{2}m\times 7^2 = \frac{2}{5}mgx$	M1	3.1b
	$mgx\sin\alpha - \frac{1}{2}m\times 7^2 = \frac{2}{5}mgx$	A1	1.1b
	$x = 6.3$ or 6.25 (m)	A1	1.1b
		(4)	
			(10 marks)

Notes:

N.B. Only penalise overaccuracy in answer to (a) or fractional answers to (a) and (c) ONCE for the question.

Consistent use of $\sin\alpha = \frac{3}{5}$ and $\cos\alpha = \frac{4}{5}$ could be treated as a MR of $\tan\alpha = \frac{4}{3}$ for $\tan\alpha = \frac{3}{4}$, if there is no evidence to the contrary e.g. a correct triangle, and leads to (a) $d = 4.17$ or 4.2 (m) (b) $\frac{8mg}{15}$ (c) $x = 37.5$ or 38 (m). It can score MAX (a) M1A1A0 (b) M1M1A0 (c) B1M1A1A1

3a	M1	Correct no. of terms, dimensionally correct, condone sin/cos confusion and sign errors, allow consistent missing m's. **N.B.** h does not need to be substituted.
	A1	A correct equation in (m), d and α, seen or implied. **N.B.** Could be e.g. $2.5 = d\sin\alpha$ if they find h first.
	A1	Either answer. 25/8 is A0 as is 245/8g
3b	M1	Correct no. of terms, dimensionally correct, condone sin/cos confusion.

	M1	Use of $F = \frac{2}{3}R$
	A1	cao
3c	B1	Seen or implied, F does not need to be substituted but must be F not R.
	M1	Correct no. of terms, dimensionally correct, condone sin/cos confusion and sign errors, allow consistent missing m's. **N.B.** Allow if they clearly make a slip and use Rd instead of Fd for WD against friction. **N.B.** M0 if they use h from part (a) or any other numerical value for h.
	A1	Correct equation in (m), x and α, seen or implied. **N.B.** Could be e.g. $5 = x\sin\alpha$ if they find h first.
	A1	Either answer. 25/4 is A0

Question	Scheme	Marks	AOs
4(a)	Use of impulse-momentum	M1	3.4
	$9mu = m(4u-(-v))$ **OR** $9mu = m(4u-v)$	A1	1.1b
	$e = \frac{4u}{v}$ oe **OR** $e = \frac{4u}{-v}$ oe	A1	1.1b
	Use of NEL	M1	3.4
	$e = \frac{4}{5}$ oe	A1	1.1b
		(5)	
4(b)	Use of CLM	M1	3.1a
	$4mu - 2mu = mv_A + 2mv_B$	A1	1.1b
	Use of sum of kinetic energies to obtain equation.	M1	3.4
	$mu^2 = \frac{1}{2}mv_A^2 + \frac{1}{2}\times 2mv_B^2$	A1	1.1b
	Solve for v_A (must be 0 or a multiple of u) **N.B.** Allow slips with signs, brackets etc but must come from a substitution method of solution of their equations to give a quadratic. Allow if they only have one solution. **N.B.** They may use NEL as well to find $v_A = \frac{2u}{3}(1-5e)$ and $v_B = \frac{u}{3}(2+5e)$ in terms of e then sub. these into the energy equation to give a quadratic in e, then find e (= $\frac{1}{5}$ or $-\frac{1}{5}$, which is rejected) which is then used to find v_A.	**D**M1	1.1b
	$v_A = 0$ or $\frac{4}{3}u$ Need **both** unless they've used NEL and rejected $\frac{4}{3}u$ as it comes from $e = -\frac{1}{5}$. **N.B.** $\frac{4}{3}u$ is impossible but candidates do not need to show that it is impossible, since it would imply no further collision of A with the wall.	A1	1.1b
	No further collision of A with the wall, with a correct justification in both cases if they have the two possible values for v_A.	A1	2.4

			(7)	
				(12 marks)
Notes:				
		N.B. In part (a), the first two (M1A1) marks are for use of impulse-momentum to produce an equation in (m), u and v. The second two marks (A1M1) are for use of NEL to produce an equation in e, u and v.		
4a	M1	Correct no. of terms, condone sign errors. Allow consistent missing m's. **N.B.** Must be using $4u$.		
	A1	Correct impulse-momentum equation.		
	A1	Correct NEL equation. (Must be consistent with their other equation but v does **not** need to be substituted.		
	M1	Condone sign errors but M0 if ratio of speeds is inverted.		
	A1	cao		
4b	M1	Correct no. of terms, condone sign errors. Allow consistent missing m's. Treat an incorrect mass as an A error.		
	A1	Correct unsimplified equation. The $4mu$ and $2mu$ terms must have opposite signs but the signs on the other terms could be + or $-$.		
	M1	Correct no. of terms. Must be ADDING the kinetic energies. Allow consistent missing m's. Treat an incorrect mass as an A error.		
	A1	Correct unsimplified equation, v_A and v_B do not need to be substituted.		
	DM 1	Solve for speed of A, dependent on previous two M marks.		
	A1	cao		
	A1	**cso**		

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