Mark Scheme (Results)

Autumn 2020

Pearson Edexcel GCE Further Mathematics
AS Further Mechanics 2 Paper 8FM0_26

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- 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.
- 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/indicative content will not be exhaustive.

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)	$\frac{1}{2}a$	B1	1.1b
	Loaded lamina has a mass distribution which is symmetrical about the perpendicular bisector of *AD*	B1	2.4
		(2)	
(b)	Moments about *AD*	M1	3.1a
	$6ma + m.2a = 12m\bar{x}$	A1	1.1b
	$\bar{x} = \frac{2a}{3}$ *	A1*	2.2a
		(3)	
(c)	Moments about *AB*	M1	3.1a
	$kma + 12m.\frac{1}{2}a = (k+12)m\bar{y}$	A1	1.1.b
		A1	1.1b
	$\bar{y} = \frac{(k+6)a}{(k+12)}$ *	A1*	2.2a
		(4)	
(d)	Moments about *AD*	M1	3.1a
	$\bar{x}_1 = \frac{8a}{(k+12)}$	A1	1.1b
	Use of $\tan\alpha = \frac{\bar{y}}{\bar{x}_1}$	M1	1.1b
	$\frac{3}{2} = \frac{\frac{(k+6)a}{(k+12)}}{\frac{8a}{(k+12)}}$	A1	1.1b
	Solve for *k*	M1	1.1b
	$k = 6$	A1	1.1b
	SC: For use of $(\tan\alpha =)\frac{\text{their } \bar{y}}{\text{their } \bar{x}} = \frac{3}{2}$, M1A1M0A0M0A0		
		(6)	
			(15 marks)

Notes
(a) **B1:** cao **B1:** clear explanation
(b) **M1:** Correct no. of terms and dimensionally correct (allow cancelled *m*'s) **A1:** A correct equation **A1*:** Correctly obtained printed answer
(c) **M1:** Correct no. of terms and dimensionally correct (allow cancelled *m*'s) **A1:** Correct equation with one error **A1:** Correct equation **A1*:**Correctly obtained printed answer
(d) **M1:** Correct no. of terms and dimensionally correct (allow cancelled *m*'s) **A1:** Correct distance **M1:** Correct use of tan but allow reciprocal **A1:** Correct equation **M1:** Solve for *k* **A1:** cao

Question	Scheme	Marks	AOs
2(a)	$(a\sqrt{3})^2 + (3a - AP)^2 = AP^2$	M1	1.1b
	$AP = 2a$ *	A1*	1.1b
		(2)	
(b)	Equation of motion horizontally	M1	3.1b
	$T + T \times \frac{1}{2} = \frac{mU^2}{a}$	A1	1.1b
		A1	1.1b
	$T = \frac{2mU^2}{3a}$	A1	2.2a
		(4)	
(c)	Resolving vertically	M1	3.1b
	$R + T \times \frac{\sqrt{3}}{2} = mg$	A1	1.1b
	On the table => $R > 0$	M1	2.1
	$mg - \frac{2mU^2\sqrt{3}}{3a \times 2} > 0$	A1	1.1b
	$U^2 < ag\sqrt{3}$ *	A1*	2.2a
		(5)	
(d)	Bead would lift off the table	B1	2.4
		(1)	
(e)	Tension would vary along the string	B1	3.5b
		(1)	
			(13 marks)

Notes
(a) **M1:** Use of Pythagoras $3a^2 + 9a^2 - 6a \times AP + AP^2 = AP^2$ => $6a \times AP = 12a^2$ **A1:** $AP = 2a$. GIVEN ANSWER
(b) **M1:** Use of horizontal equation to solve the problem, with correct no. of terms etc **A1:** Equation with at most one error **A1:** Correct equation **A1:** Correct answer
(c) **M1:** Use of vertical resolution to solve the problem, with correct no. of terms etc **A1:** Correct equation **M1:** Use of $R > 0$ **A1:** Correct inequality **A1*:** Correctly obtained given answer
(d) **B1:** Clear comment
(e) **B1:** Clear explanation

Question	Scheme	Marks	AOs
3(a)	Use of initial condition to find p	M1	3.1b
	$t = 0$, $v = 0$, acceleration $= 3$ => $p = 3$	A1	1.1b
	Use $v = 4$, acceleration $= \frac{1}{2}$	M1	1.1b
	$q = -\frac{5}{8}$	A1	1.1b
	Use acceleration $= \frac{dv}{dt}$ and rearrange	M1	1.1b
	$8\frac{dv}{dt} = (24 - 5v)$ *	A1*	2.2a
		(6)	
(b)	Separate the variables and integrate	M1	3.1b
	$8\int \frac{dv}{(24-5v)} = \int dt$	A1	1.1b
	$-\frac{8}{5}\ln(24-5v) = t + C$	A1	1.1b
	Use $t = 0$, $v = 0$ to give $C = -\frac{8}{5}\ln 24$	M1	1.1b
	Substitute $v = 4$ and find and simplify T	M1	1.1b
	$T = \frac{8}{5}\ln 6$	A1	1.1b
		(6)	
			(12 marks)

Notes
(a) **M1:** Use initial conditions **A1**: cao **M1:** Use second condition **A1:** cao **M1:** Use appropriate derivative and rearrange **A1*:** Correct given answer
(b) **M1:** Separate the variables and integrate **A1:** Correct integration (C not required) **M1:** Use of limits or initial conditions to find C **M1:** Use $v = 4$ to find T **A1:** Correct answer (single log)

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