



Pearson  
Edexcel

## Mark Scheme (Results)

Autumn 2020

Pearson Edexcel GCE Further Mathematics  
AS Further Mechanics 1 Paper 8FM0\_25

## **Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at [www.edexcel.com](http://www.edexcel.com) or [www.btec.co.uk](http://www.btec.co.uk). Alternatively, you can get in touch with us using the details on our contact us page at [www.edexcel.com/contactus](http://www.edexcel.com/contactus).

## **Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

Autumn 2020

Publications Code 8FM0\_25\_2010\_MS

All the material in this publication is copyright

© Pearson Education Ltd 2020

## 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
  - $\square$  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

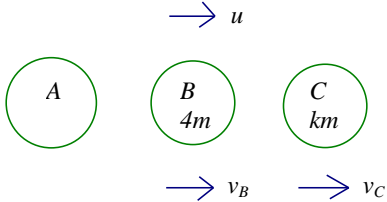
*(But note that specific mark schemes may sometimes override these general principles)*

- 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
<b>1a</b>				
	Use of CLM: $m \times \frac{I}{m} = 4mw$		M1	3.1a
	$I = 4mw$		A1	1.1b
			(2)	
<b>1b</b>	$e = \frac{w}{4w} = \frac{1}{4} *$		B1*	3.4
			(1)	
<b>1c</b>	KE Loss = $\frac{1}{2}m(4w)^2 - \frac{1}{2}4mw^2$		M1	3.4
	$= 6mw^2$		A1	1.1b
			(2)	
<b>(5 marks)</b>				
<b>Notes</b>				
<b>1a</b>	M1	Correct no. of terms, condone extra g s, sign errors (must be equation in $I$ , $m$ and $w$ only)		
	A1	Correct equation		
		Answer not given, so a correct answer with no clear error seen will score M1A1 An answer that relies on an impulse-momentum equation using $4m$ will score M0		
<b>1b</b>	B1*	Use of NLR to obtain <b>given answer</b>		
<b>1c</b>	M1	Allow negative loss		
	A1	cao		

Question	Scheme		Marks	AOs
<b>2a</b>	72 km h <sup>-1</sup> = 20 m s <sup>-1</sup>		B1	1.1b
			(1)	
<b>2b</b>	Use of $F = \frac{P}{v}$ and using the model		M1	3.4
	Equation of motion and using the model to form equation in $c$		M1	3.1b
	$\frac{50000}{20} - c \times 20^2 = 1000 \times 2.25 \quad \left( c = \frac{5}{8} \right)$		A1ft	1.1b
	Equation of motion and using the model		M1	3.1b
	$\frac{50000}{40} - c \times 40^2 = 1000a$		A1ft	1.1b
	Solve for $a$		M1	1.1b
	0.25 (m s <sup>-2</sup> )		A1	1.1b
			(7)	
<b>2c</b>	Equation of motion horizontally and using the model		M1	3.1b
	$\frac{50000}{W} - \frac{5}{8}W^2 = 0$ (max speed is $W$ m s <sup>-1</sup> )		A1ft	1.1b
	Solve for $W$ and convert to km h <sup>-1</sup> ( $W = 43.088\dots$ )		M1	1.1b
	$V = 155$ (nearest whole number)		A1	1.1b
			(4)	
<b>(12 marks)</b>				
<b>Notes</b>				
<b>2a</b>	B1	20 m s <sup>-1</sup> seen		
<b>2b</b>	M1	Follow through the 72 or their $v$ . Allow for 144 or their 144		
	M1	Correct no. of terms required		
	A1ft	Correct unsimplified equation ft on their 20		
	M1	Correct no. of terms required		
		Allow the second and third M marks if they have an equation in $F$ rather than $P$ .		
	A1ft	Correct equation ft on their 40 and their $c$		
	M1	Complete method to solve for $a$		
	A1	Cao $\left( \text{Accept } \frac{1}{4} \right)$		
<b>2c</b>	M1	Equation with correct no. of terms, correct structure and in terms of $W$ only.		

	A1ft	Correct equation, ft on their $c$ from part (b).
	M1	Complete method to solve for $V$ (including clear attempt to convert units)
	A1	Cao (The Q asks for a whole number)

Question	Scheme	Marks	AOs
<b>3a</b>	 <p>Use of CLM</p> $4mu = 4mv_B + kmv_C$ <p>Use of NLR</p> $\frac{1}{4}u = -v_B + v_C$ <p>Solve for <math>v_B</math></p> $v_B = \frac{u(16-k)}{4(k+4)} \quad \left( v_C = \frac{5u}{k+4} \right)$ <p>Use of <math>v_B \geq 0</math> and solve for <math>k</math></p> $(0 <) k \leq 16$ <p>Alternative for last 4 marks</p> <p>Solve for <math>v_B</math> in terms of <math>v_C</math> only</p> $v_B = \frac{(16-k)v_C}{20}$ <p>Use of <math>v_B \geq 0</math> and <math>v_C &gt; 0</math> to solve for <math>k</math></p> $(0 <) k \leq 16$ <p>(8)</p>		
<b>3b</b>	<p>Impulse-momentum equation</p> $-3mu = 4m(v_B - u) \quad \left( v_B = \frac{u}{4} \right) \text{ or } 3mu = kmv_C$ <p>Complete method to solve for <math>k</math></p> $k = 6$ <p>(4)</p>	M1 A1 M1 A1	3.1a 1.1b 1.1b 2.2a
<b>(12 marks)</b>			
<b>Notes</b>			

<b>3a</b>	M1	Correct no. of terms, condone extra $g$ s, sign errors
	A1	Correct equation
	M1	$e$ must be on correct side
	A1	Correct equation
	M1	Complete method to solve for $v_B$ (or a multiple of $v_B$ )
	A1	Correct expression for <i>their</i> $v_B$ or a multiple of <i>their</i> $v_B$
	M1	Use of appropriate inequality, allow strict inequality for method mark
	A1	Ca0 LHS not needed, but if there it must be correct.
<b>3b</b>	M1	Correct no. of terms, condone sign errors, but must be subtracting momentum terms
	A1	Correct equation
	M1	Eliminate and solve for $k$
	A1	$k = 6$

Question	Scheme		Marks	AOs
<b>4a</b>		$\frac{1}{2}mgH$	B1	1.1b
		$\frac{1}{2}m(8gH - v^2)$	B1	1.1b
		Apply the work-energy principle	M1	3.3
		$\frac{1}{2}mgH = \frac{1}{2}m(8gH - v^2) - mgH$	A1	1.1b
		$v = \sqrt{5gH}$	A1	1.1b
			(5)	
<b>4b</b>		Use NLR to find rebound speed: $\frac{1}{2}\sqrt{5gH}$	M1	3.4
		Apply the work-energy principle or <i>suvat</i> with $a = \frac{1}{2}g$	M1	3.3
		$\frac{1}{2}mgH = mgH - \frac{1}{2}m(v_1^2 - \frac{1}{4} \times 5gH)$ or $(v_1)^2 = \frac{5gH}{4} + 2 \times \frac{g}{2} \times H$	A1ft	1.1b
			A1	1.1b
		$v_1 = \frac{3}{2}\sqrt{gH}$	A1	2.2a
		(5)		
<b>4c</b>		Since $e < 1$ , ball loses energy in its collision with the ceiling.	B1	2.4
			(1)	
<b>(11 marks)</b>				
<b>Notes</b>				
<b>4a</b>	B1	Work done against resistance (allow -ve) Can be implied by use of $\frac{3}{2}mgH$ (work done against resistance + work done against weight)		
	B1	KE loss (allow -ve)		
	M1	Correct no. of terms, dimensionally correct. Condone sign errors.		
	A1	Correct unsimplified equation		
	A1	Correct answer (any equivalent but must be in terms of $g$ and $H$ ) Accept $2.2\sqrt{gH}$ or better		
<b>4b</b>	M1	Use of NLR		
	M1	Correct no. of terms, dimensionally correct		
	A1ft	Correct equation with at most one error ft on their answer to (a)		
		M1A1ft is available to a candidate who has not scored the first M1		

	A1	Correct equation (no ft)
	A1	Correct answer (any equivalent but must be in terms of $g$ and $H$ )
<b>4c</b>	B1	Clear explanation
		Need to identify that the loss of KE occurs in the impact with the ceiling. Do not insist on seeing $e < 1$ or equivalent. If they include incorrect additional statements then B0

Pearson Education Limited. Registered company number 872828  
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom