AS
MATHEMATICS
7356/1
Paper 1

Mark scheme

June 2023

Version: Final 1.1

2 3 6 A 7 3 5 6 / 1 / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Mark scheme instructions to examiners

General

The mark scheme for each question shows:
- the marks available for each part of the question
- the total marks available for the question
- marking instructions that indicate when marks should be awarded or withheld including the principle on which each mark is awarded. Information is included to help the examiner make his or her judgement and to delineate what is creditworthy from that not worthy of credit
- a typical solution. This response is one we expect to see frequently. However credit must be given on the basis of the marking instructions.

If a student uses a method which is not explicitly covered by the marking instructions the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

Key to mark types

M	mark is for method
R	mark is for reasoning
A	mark is dependent on M marks and is for accuracy
B	mark is independent of M marks and is for method and accuracy
E	mark is for explanation
F	follow through from previous incorrect result

Key to mark scheme abbreviations

CAO	correct answer only
CSO	correct solution only
ft	follow through from previous incorrect result
'their'	indicates that credit can be given from previous incorrect result
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
NMS	no method shown
PI	possibly implied
sf	significant figure(s)
dp	decimal place(s)
ISW	Ignore Subsequent Workings

AS/A-level Maths/Further Maths assessment objectives

AO		Description
AO1	AO1.1a	Select routine procedures
	AO1.1b	Correctly carry out routine procedures
	AO1.2	Accurately recall facts, terminology and definitions
AO2	AO2.1	Construct rigorous mathematical arguments (including proofs)
	AO2.2a	Make deductions
	AO2.2b	Make inferences
	AO2.3	Assess the validity of mathematical arguments
	AO2.4	Explain their reasoning
	AO2.5	Use mathematical language and notation correctly
AO3	AO3.1a	Translate problems in mathematical contexts into mathematical processes
	AO3.1b	Translate problems in non-mathematical contexts into mathematical processes
	AO3.2a	Interpret solutions to problems in their original context
	AO3.2b	Where appropriate, evaluate the accuracy and limitations of solutions to problems
	AO3.3	Translate situations in context into mathematical models
	AO3.4	Use mathematical models
	AO3.5a	Evaluate the outcomes of modelling in context
	AO3.5b	Recognise the limitations of models
	AO3.5c	Where appropriate, explain how to refine models

Examiners should consistently apply the following general marking principles:

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to students showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the student to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Work erased or crossed out

Erased or crossed out work that is still legible and has not been replaced should be marked. Erased or crossed out work that has been replaced can be ignored.

Choice

When a choice of answers and/or methods is given and the student has not clearly indicated which answer they want to be marked, mark positively, awarding marks for all of the student's best attempts. Withhold marks for final accuracy and conclusions if there are conflicting complete answers or when an incorrect solution (or part thereof) is referred to in the final answer.

Q	Marking instructions	AO	Marks	Typical solution
1	Circles correct answer	1.1b	B1	–0.1
	Question 1 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
2	Circles correct answer	1.1b	B1	$\dfrac{125}{8x^3}$
	Question 2 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
3	Obtains 15 as the binomial coefficient of the $(ax)^2$ term. Can be unsimplified.	1.1b	B1	15 $\dfrac{20}{3} = 15a^2$ $a = \pm\dfrac{2}{3}$
	Forms an equation in a^2 for the coefficient of x^2 using their '15'	1.1a	M1	
	Obtains their correct ± pair of values for a FT their '15' ACF	1.1b	A1F	
	Question 3 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
4(a)	Uses a trig identity, either $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$ or $\sin^2\theta + \cos^2\theta = 1$ correctly to obtain an equation in a single trig function.	1.1a	M1	$5\cos^2\theta = 4\sin^2\theta$ $\dfrac{5}{4} = \dfrac{\sin^2\theta}{\cos^2\theta} = \tan^2\theta$ $\tan\theta = \pm\dfrac{\sqrt{5}}{2}$
	Obtains $\tan^2\theta = \dfrac{5}{4}$ or $\sin^2\theta = \dfrac{5}{9}$ or $\cos^2\theta = \dfrac{4}{9}$ PI by one correct value for tan θ sin θ or cos θ	1.1b	A1	
	Obtains tan $\theta = \pm\dfrac{\sqrt{5}}{2}$ OE Must be in exact form	1.1b	A1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
4(b)	Obtains at least two correct solutions in the range based on the value of their tan θ , sin θ *or* cos θ OE	1.1a	M1	θ = 48.2, 131.8. 228.2, 311.8
	Obtains all 4 correct solutions and no further ones AWRT 48, 132. 228, 312	1.1b	A1	
	Subtotal		**2**	

	Question 4 Total		**5**	

Q	Marking instructions	AO	Marks	Typical solution
5(a)	Expresses $x\sqrt{x}$ in index form. PI by correct answer ACF	1.1a	M1	$y = x^{\frac{3}{2}}$ $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{3}{2}x^{\frac{1}{2}}$
	Obtains the correct derivative. ACF ISW	1.1b	A1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
5(b)	Rearranges the equation of the line to isolate the term in y or x PI by gradient = 3	1.1a	M1	$6x - 2y + 5 = 0$ $2y = 6x + 5$ Gradient = 3 $\frac{3}{2}x^{\frac{1}{2}} = 3$ $x = 4$ From line $2y = 6 \times 4 + 5$ $y = 14.5$ $14.5 = 4 \times 2 + k$ $k = 6.5$
	Obtains gradient of line = 3	1.1b	A1	
	Equates their gradient of line to their expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$	3.1a	M1	
	Solves their equation correctly using their $\frac{\mathrm{d}y}{\mathrm{d}x}$ to obtain their x value of the contact point	1.1a	M1	
	Deduces k = 6.5	.2.2a	A1	
	Subtotal		**5**	

	Question 5 Total		**7**	

Q	Marking instructions	AO	Marks	Typical solution
6(a)	Obtains $a = 2$	1.1b	B1	$y = 2(x^2 - 10x + 21)$ $y = 2(x^2 - 10x + 25 - 4)$ $y = 2((x - 5)^2 - 4)$ $y = 2(x - 5)^2 - 8$
	Obtains $b = 5$	1.1b	B1	
	Obtains $c = -8$	1.1b	B1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
6(b)	Obtains correct coordinates of their minimum point. FT their b and c Condone missing brackets.	1.1b	B1F	(5, –8)
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
6(c)	Uses a stretch scale factor of $\frac{1}{2}$ FT $\pm$ their $\frac{-4}{c}$,do not FT $c = \pm 4$ PI by correct answer	3.1a	M1	$\text{scale factor} = \frac{-4}{-8} = \frac{1}{2}$ $y = 2(x - 5)^2 - 8$ $y = \frac{1}{2}\left[2(x-5)^2 - 8\right]$ $y = (x-5)^2 - 4$ $y = x^2 - 10x + 21$
	Deduces their correct equation using their vertical stretch factor. ACF FT their c , do not FT $c = \pm 4$ ISW	2.2a	A1F	
	Subtotal		**2**	

	Question 6 Total		**6**	

Q	Marking instructions	AO	Marks	Typical solution
7(a)	Expands $(x + h)^4$, with correct powers of x and h.	1.1a	M1	$(x+ h)^4$
	Obtains fully correct expansion.	1.1b	A1	$= x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
7(b)	Forms an expression for $\dfrac{\text{difference in } y}{\text{difference in } x}$ in terms of x and h ACF FT their expression from part (a)	1.1b	B1F	$\dfrac{x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4 - x^4}{h}$
	Subtotal		**1**	

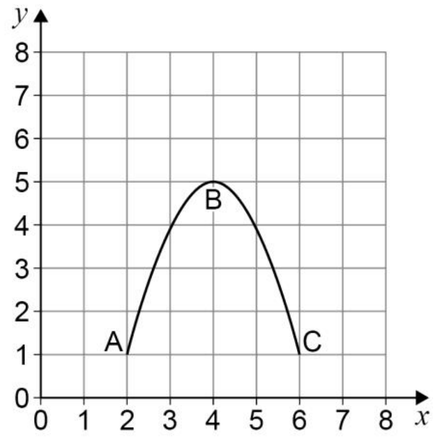
Q	Marking instructions	AO	Marks	Typical solution
7(c)	Explains or shows that the answer to part (b) can be (expanded and) simplified. FT their parts (a) and (b) where working is shown.	1.1b	E1F	The expression from part (b) can be simplified by cancelling h We then apply the limit as h tends to 0 to obtain the gradient.
	Explains that the gradient is found by letting h tend to 0 or Uses the limit as $h \to 0$	1.1b	E1	
	Subtotal		**2**	

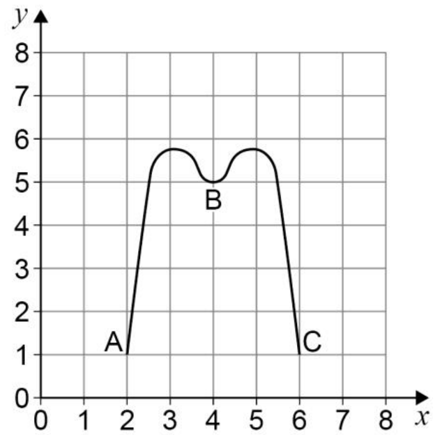
	Question 7 Total		**5**	

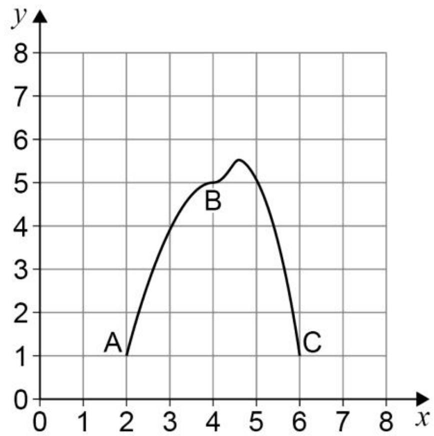
Q	Marking instructions	AO	Marks	Typical solution
8(a)	Integrates with one term correct	1.1a	M1	$\int_1^a \left(6-\frac{12}{\sqrt{x}}\right)dx = \left[6x-24\sqrt{x}\right]_1^a$
	Obtains fully correct integral	1.1b	A1	$= 6a-24\sqrt{a}-6+24$
	Substitutes limits and obtains the given answer. AG	2.1	R1	$= 6a-24\sqrt{a}+18$
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
8(b)	Explains or recognises that area is linked to integration	2.4	M1	Equal areas, positive and negative, so integral 1 to a = 0 $6a - 24\sqrt{a} + 18 = 0$ $a - 4\sqrt{a} + 3 = 0$ We need $a = 9$
	Equates the answer to part (a) to 0 or Finds intersection point with the x axis and evaluates an integral between 1 and their x value. NB Correct x value is 4	3.1a	M1	
	Solves $6a - 24\sqrt{a} + 18 = 0$ to obtain a value for a or $\sqrt{a}$ or Equates their **area** of R_1 to their integrated expression in term of a for R_2 Must have used a positive value for the area of R_1 NB Correct expression for R_2 is $6a - 24\sqrt{a} + 24$	1.1a	M1	
	Completes a reasoned argument with no errors to deduce a =9	2.2a	R1	
	Subtotal		**4**	

	Question 8 Total		**7**	

Q	Marking instructions	AO	Marks	Typical solution
9(a)	Draws a graph through the given points with a maximum at (4, 5)	1.1b	B1	
	Subtotal		1	

Q	Marking instructions	AO	Marks	Typical solution
9(b)	Draws a graph through the given points with a minimum at (4, 5)	2.2b	B1	
	Subtotal		1	

Q	Marking instructions	AO	Marks	Typical solution
9(c)	Draws a graph through the given points with a stationary point at (4, 5) that is neither a maximum nor a minimum.	2.2b	B1	
	Subtotal		1	

	Question 9 Total		3	

Q	Marking instructions	AO	Marks	Typical solution
10(a)	States that Kaya is correct and/or Charlie is wrong	2.3	E1	Charlie is wrong. Over the same time, the value goes down by the same proportion. Two thirds of £18 000 is £12 000 so two thirds of £12 000 is £8 000
	Shows where the value £8000 has come from. Ignore missing or incorrect £ sign.	3.3	B1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
10(b)	Uses 18 000 for value of A	3.1b	B1	$12\,000 = 18\,000\,e^{-2k}$ $k = \frac{1}{2}\ln 1.5 = 0.203$ $10\,000 = 18\,000\,e^{-kt}$ $t = 2.9$
	Substitutes 12 000 and 2 into model	3.4	M1	
	Solves to find correct value of k, exact or AWRT 0.203	1.1b	A1	
	Uses model with $V = 10\,000$ and their value of k	3.4	M1	
	Obtains the correct value of t AWRT 2.9 Condone $t = 3$	1.1b	A1	
	Subtotal		**5**	

Q	Marking instructions	AO	Marks	Typical solution
10(c)	Gives a reason in context why the model will not be suitable. For example: • Car will be worthless by then. • Car will have been scrapped after 30 years. • Model gives an unrealistic value of £41. • Scrap value will be worth more than model suggests.	3.5b	E1	The car will probably have been scrapped by then.
	Subtotal		**1**	

	Question 10 Total		**8**	

Q	Marking instructions	AO	Marks	Typical solution
11(a)	Obtains correct centre.	1.1b	B1	$x^2 - 10x + 25 + y^2 = 31$ $(x - 5)^2 + y^2 = 31$ Centre is (5, 0) and radius $\sqrt{31}$
	Obtains correct radius. AWRT 5.6	1.1b	B1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
11(b)(i)	Shows that origin is inside circle	2.1	R1	Distance from centre to origin is 5 and $5 < \sqrt{31}$ so vertex at origin is inside circle
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
11(b)(ii)	Selects an appropriate method to find the y coordinate of at least one other vertex. Condone one slip in the formation of the equation for the y coordinate.	3.1a	M1	$\tan 30^\circ = \dfrac{y}{8}$ so $y = 8\tan 30^\circ$ The other vertices are $(8, \pm\dfrac{8}{\sqrt{3}})$ Distance from centre to other vertices is $\sqrt{(3^2 + \dfrac{64}{3})} = \sqrt{(\dfrac{91}{3})}$ $< \sqrt{31}$ Both vertices are inside circle Complete triangle is inside circle
	Uses distance formula for distance from their centre to at least one vertex. or Find at least one y value on the circle when $x = 8$ NB Correct vales are $y = \pm\sqrt{22}$	3.1a	M1	
	Compares $\sqrt{(\dfrac{91}{3})}$ with $\sqrt{31}$ AWRT 5.5 and 5.6 or Compares $\dfrac{8}{\sqrt{3}}$ with $\sqrt{22}$ AWRT 4.6 and 4.7 **and** Deduces that one other vertex is inside circle.	2.2a	A1	
	Completes proof that triangle is completely inside circle, either by proof for the third vertex or by reference to symmetry.	2.1	R1	
	Subtotal		**4**	

	Question 11 Total		**7**	

Q	Marking instructions	AO	Marks	Typical solution
12	Circles correct answer	1.1b	B1	0.5
	Question 12 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
13	Circles correct answer	1.1b	B1	18
	Question 13 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
14(a)	Selects an appropriate equation of constant acceleration. and states $u = 0$, $t = 4$ and $a = g$ PI by correct substitution	1.1a	M1	$s = ut + \frac{1}{2}at^2$ $u = 0$, $t = 4$ and $a = g$ $0.8h = \frac{1}{2}g \times 4^2$ $0.8h = 8g$ $h = 10g$
	Substitutes $s = 0.8h$	1.1a	M1	
	Completes reasoned argument to obtain given answer	2.1	R1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
14(b)	Explains that h will be less	3.5a	E1	Air resistance will cause h to be lower
	Subtotal		**1**	

	Question 14 Total		**4**	

Q	Marking instructions	AO	Marks	Typical solution
15(a)	Uses gradient for $0 \le t < 4$ to show given acceleration value. AG	1.1b	B1	$a = \dfrac{10 - -4}{4} = 3.5$
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
15(b)	Selects a suitable method for calculating the displacement by working out an appropriate area. or Uses a constant acceleration equation and substitutes appropriate values.	3.1a	M1	$100 = 16 + 7s$ $s = 12$ m Since displacement = area When $t = 9$ $s = 12 + (9 – 4)10 = 62$ m
	Obtains a displacement of 12 when $t = 4$ or Obtains a displacement of $\dfrac{-16}{7}$ when $t = \dfrac{8}{7}$ Allow area of triangle = $\dfrac{16}{7}$ or Obtains a displacement of $\dfrac{100}{7}$ from $t = \dfrac{8}{7}$ to $t = 4$ or Obtains a displacement of $\dfrac{450}{7}$ from $t = \dfrac{8}{7}$ to $t = 9$ OE	1.1b	A1	
	Completes reasoned argument with fully correct working to show the given displacement. Do not award if decimal values are repeatedly used throughout to only one decimal place. AG	2.1	R1	
	Subtotal		**3**	

	Question 15 Total		**4**	

Q	Marking instructions	AO	Marks	Typical solution
16(a)	Differentiates to find expression for acceleration with at least one term correct. PI by -0.08 or 0.08	3.4	M1	a = 0.16 – 0.12t
	Obtains a fully correct expression for acceleration. PI by -0.08	1.1b	A1	
	Finds their acceleration of the boat when t = 2 FT their expression for a Must have differentiated at least one term. Correct units must be stated.	3.2a	A1F	a = –0.08 ms^{-2}
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
16(b)	Integrates v with at least one term correct. PI by 1.96	3.1b	M1	$s = \int v \, \mathrm{d}t$ $= \int 0.9 + 0.16t - 0.06t^2 \, \mathrm{d}t$
	Obtains a fully correct integral. Condone omission of constant PI by 1.96	1.1b	A1	$s = 0.9t + 0.08t^2 - 0.02t^3 + c$
	Substitutes t = 0 and t = 2 into their expression for s Must have integrated at least one term. PI by 1.96	1.1a	M1	s = 0 when t = 0 so c = 0 $s = 0.9(2) + 0.08(4) - 0.02(8)$
	Obtains displacement = 1.96 m Condone omission of units	1.1b	A1	Displacement = 1.96 m
	Subtotal		**4**	

	Question 16 Total		**7**	

Q	Marking instructions	AO	Marks	Typical solution
17(a)	Finds correct magnitude of force. Condone omission of units	1.1b	B1	$\sqrt{12^2+9^2}=15$ N
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
17(b)(i)	Forms correct expression for $\overrightarrow{AB}$ Condone omission of units	1.1b	B1	$\overrightarrow{AB}=\begin{bmatrix}k-3\\k-8\end{bmatrix}$ metres
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
17(b)(ii)	Deduces $\overrightarrow{AB}$ is a scalar multiple of $\begin{bmatrix}12\\9\end{bmatrix}$	2.2a	M1	Since direction of movement is in direction of force then $\overrightarrow{AB}$ is a scalar multiple of $\begin{bmatrix}12\\9\end{bmatrix}$ $\begin{bmatrix}k-3\\k-8\end{bmatrix}=\begin{bmatrix}12\lambda\\9\lambda\end{bmatrix}$ $9(k-3)=12(k-8)$ $9k-27=12k-96$ $k=23$
	Deduces $k = 23$ FT their answer to part (b)(i)	2.2a	A1F	
	Subtotal		**2**	

	Question 17 Total		**4**	

Q	Marking instructions	AO	Marks	Typical solution
18(a)	Uses $F = ma$ to form at least one equation modelling the van, car or both combined with at least three terms.	3.3	M1	$D - R - T = 2780 \times 0.6$ $T - 0.6R = 1620 \times 0.6$ Eliminating R $0.6D - 1.6T = 28.8$ $T = \frac{0.6}{1.6}(D - 48)$ $k = \frac{3}{8}$
	Obtains a fully correct equation. Other examples: $D - R - T = 1668$ $T - 0.6R = 972$ $D - 1.6R = 2640$ NB T may have been replaced by $kD - 18$ at any point.	1.1b	A1	
	Forms a second fully correct equation.	3.3	B1	
	Eliminates R to form an equation with D and T	3.4	M1	
	Obtains $k = \frac{3}{8}$ OE	1.1b	A1	
	Subtotal		**5**	

Q	Marking instructions	AO	Marks	Typical solution
18(b)	Describes any valid assumption. For example: • Tow bar has negligible mass. • The car is directly behind the van. • The masses include drivers. • Tow bar is rigid. • Tow bar is inextensible. • Do not accept any reference to resistances, tension being constant, tow bar breaks.	3.5b	B1	Tow bar is horizontal
	Subtotal		**1**	

	Question 18 Total		**6**	

	Question Paper Total		**80**	