AS MATHEMATICS 7356/1

Paper 1

Mark scheme

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256A7356/1/MS

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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

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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
ISW	ignore subsequent working
PI	possibly implied
sf	significant figure(s)
dp	decimal place(s)

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 fourth answer	1.2	B1	$\dfrac{\sin x}{\cos x}$
	Question 1 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
2	Circles first answer	1.1b	B1	-2
	Question 2 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
3	Substitutes $x = 2$ into $\mathrm{p}(x)$	1.1a	M1	$2(2)^3 - a(2)^2 + 6(2) + 2a = 0$
	Sets their $\mathrm{p}(2)$ equal to zero and solves to obtain a value for a PI by $a = 14$	1.1a	M1	$16 - 4a + 12 + 2a = 0$ $28 - 2a = 0$
	Obtains $a = 14$	1.1b	A1	$a = 14$
	Question 3 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
4	Obtains one correct value for 3θ or θ Condone missing or incorrect labelling	1.1a	M1	$\tan 3\theta = \dfrac{3}{2}$ $3\theta = 56.3°, 236.3°, 416.3°$ $\theta = 19°, 79°, 139°$
	Obtains AWRT 56, 236 and 416 and no others within the range Condone missing or incorrect labelling	1.1a	M1	
	Divides their solutions for 3θ by 3 to obtain solutions for θ FT their values for 3θ Must be at least 2 solutions for 3θ	1.1b	A1F	
	Question 4 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
5	Uses one or both of a and b as negative values with $a > b$	3.1a	M1	Let $a = 1$, $b = -1$ $\dfrac{1}{-1} = -1 < 1$ Therefore Jayven is wrong.
	Demonstrates a counter example and shows a clear comparison of a simplified fraction with 1 May be in words	2.1	R1	
	Question 5 Total		**2**	

Q	Marking instructions	AO	Marks	Typical solution
6(a)	Uses a law of logs correctly	1.1a	M1	$\log_2 x^2 - \log_2 y = 2\log_2 x - \log_2 y$
	Obtains $2p - q$ with no incorrect use of logs	1.1b	A1	$= 2p - q$
	Subtotal		**2**	

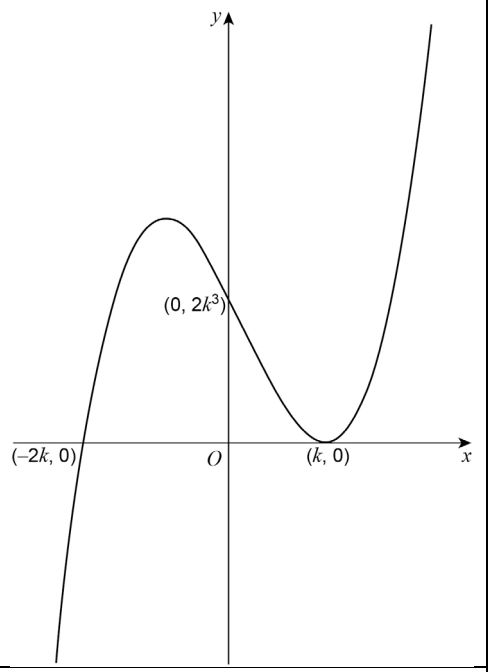
Q	Marking instructions	AO	Marks	Typical solution
6(b)	Rewrites $\sqrt{y}$ as $y^{\frac{1}{2}}$ PI by $\frac{1}{2}\log_2 y$ or $\frac{1}{2}q$	1.1b	B1	$\log_2 16 + \log_2 x^3 + \log_2 y^{\frac{1}{2}}$
	Uses logs correctly to obtain three terms	3.1a	M1	$= 4 + 3\log_2 x + \frac{1}{2}\log_2 y$
	Obtains $4 + 3p + \frac{1}{2}q$ with no incorrect use of logs seen	1.1b	A1	$= 4 + 3p + \frac{1}{2}q$
	Subtotal		**3**	

	Question 6 Total		**5**	

Q	Marking instructions	AO	Marks	Typical solution
7(a)	States 7	1.1b	B1	7
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
7(b)	Obtains $b <$ their radius from part **(a)** or $b >$ their negative radius from part **(a)**, condone non-strict inequality	2.2a	M1	$-7 < b < 7$
	Obtains $-7 < b < 7$ FT their radius from part **(a)**	2.2a	A1F	
	Subtotal		**2**	

	Question 7 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
8	Draws a correctly orientated cubic graph with two turning points	1.1a	M1	
	Draws a cubic graph cutting negative x-axis	1.1b	A1	
	Draws a cubic graph with two turning points that just touches the x-axis	2.2a	M1	
	Draws a correct graph with all points correctly labelled	1.1b	A1	
	Question 8 Total		**4**	

Q	Marking instructions	AO	Marks	Typical solution
9(a)	Expresses at least one term in x or x^2 correctly May be unsimplified Condone missing $-$ sign	1.1a	M1	$(1-5x)^7 = 1+ {}^7C_1(-5x) + {}^7C_2(-5x)^2$ $= 1-35x+525x^2$
	Obtains $-35x$ or $+525x^2$	1.1b	A1	
	Obtains $1-35x+525x^2$	1.1b	A1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
9(b)	Multiplies the coefficient of their x term by k Or Multiplies the coefficient of their x^2 term by 3 Condone one sign error	3.1a	M1	Coefficient of x^2: $-35\times k+525\times 3=1477$ $-35k+1575=1477$ $-35k=-98$ $k=\frac{14}{5}$
	Multiplies the coefficient of their x term by k and multiplies the coefficient of their x^2 term by 3 and equates the sum to 1477 Condone one sign error	1.1a	M1	
	Obtains $k=\frac{14}{5}$	1.1b	A1	
	Subtotal		**3**	

	Question 9 Total		**6**	

Q	Marking instructions	AO	Marks	Typical solution
10	Obtains gradient of tangent $=\frac{1}{9}$	1.1b	B1	Gradient of tangent $=\frac{1}{9}$
	Recalls gradient function $=3e^{3x}$	1.2	B1	Gradient of curve $=3e^{3x}$
	Equates their gradient function to their numerical tangent gradient	3.1a	M1	$3e^{3x}=\frac{1}{9}$
	Uses natural log correctly with their equation of the form $ke^{3x}=m$ to obtain an equation without e	1.1a	M1	$e^{3x}=\frac{1}{27}$ $3x=\ln\frac{1}{27}$
	Obtains $x=\ln\frac{1}{3}$ ACF ISW Accept AWRT -1.1	1.1b	A1	$x=\ln\frac{1}{3}$
	Question 10 Total		**5**	

Q	Marking instructions	AO	Marks	Typical solution
11(a)	Obtains x^3+2x^2-8x	1.1b	B1	x^3+2x^2-8x
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
11(b)	Integrates their answer to **(a)** with at least one term correct	1.1a	M1	$\int_{-4}^{2} x(x-2)(x+4)\,\mathrm{d}x$ $=\int_{-4}^{2} x^3+2x^2-8x\,\mathrm{d}x$ $=\left[\frac{x^4}{4}+\frac{2x^3}{3}-4x^2\right]_{-4}^{2}$ $=\left(\frac{(2)^4}{4}+\frac{2(2)^3}{3}-4(2)^2\right)$ $-\left(\frac{(-4)^4}{4}+\frac{2(-4)^3}{3}-4(-4)^2\right)$ $=\left(-\frac{20}{3}\right)-\left(-\frac{128}{3}\right)$ $=36$
	Completes integration correctly FT their answer to **(a)** provided it is a three-term cubic expression	1.1b	A1F	
	Substitutes limits explicitly into their integrated function and subtracts in the correct order	1.1a	M1	
	Completes reasoned argument to show that $\int_{-4}^{2} x(x-2)(x+4)\,\mathrm{d}x=36$ AG Must see a correct expression with all powers evaluated prior to obtaining 36	2.1	R1	
	Subtotal		**4**	

Q	Marking instructions	AO	Marks	Typical solution
11(c)(i)	Explains that part of the area is above and part is below the x-axis Or Explains that any part below the axis will give a negative value when using integration Do not accept comments that reference negative area	2.3	E1	The area is above and below the axis, so cannot be evaluated as a single integral
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
11(c)(ii)	Adds their $\pm\frac{128}{3}$ + their $\pm\frac{20}{3}$ to obtain an answer not equal to 36 OE could be in integral form	2.2a	M1	$\frac{128}{3}+\frac{20}{3}=\frac{148}{3}$
	Obtains $\frac{148}{3}$ OE CAO	1.1b	A1	
	Subtotal		**2**	

	Question 11 Total		**8**	

Q	Marking instructions	AO	Marks	Typical solution
12(a)	Writes 22	1.1b	B1	22
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
12(b)	Sets up correct factorial expressions as part of a division or multiplication	3.1a	M1	$\frac{40!}{18!22!} \div \frac{40!}{17!23!} = \frac{40!}{18!22!} \times \frac{17!23!}{40!}$
	Completes a reasoned argument to obtain $\frac{23}{18}$	1.1b	R1	$= \frac{17!23!}{18!22!}$ $= \frac{23}{18}$
	Subtotal		**2**	

	Question 12 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
13(a)	Explains that A is the number of points at the start of the level. Must be in context. Accept 'initial points' or 'maximum points'	3.2a	E1	The points available at the start of the level
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
13(b)	Takes natural log of both sides and correctly uses addition law of logs	1.1a	M1	$P = A\text{e}^{kt}$ $\ln P = \ln A\text{e}^{kt}$
	Completes reasoned argument to show given result	2.1	R1	$\ln P = \ln A + \ln \text{e}^{kt}$ $\ln P = \ln A + kt$
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
13(c)	States $k = -0.08$	2.2a	B1	Gradient $= k \Rightarrow k = -0.08$
	Equates $\ln A$ to 5.30	2.2a	M1	$\ln A = 5.30$
	Obtains $A =$ AWRT 200	1.1b	A1	$A = \text{e}^{5.30}$ $A = 200$
	Subtotal		**3**	

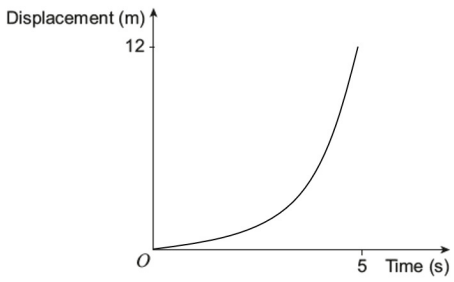
Q	Marking instructions	AO	Marks	Typical solution
13(d)	Substitutes their values of A and k appropriately into the model PI by $5.3 - 0.08t$	3.4	M1	$200\text{e}^{-0.08t} = 20$ $\text{e}^{-0.08t} = \frac{1}{10}$
	Obtains a correct equation in t	1.1b	A1	
	Obtains $t = 28$ or AWRT 29	1.1b	A1	$-0.08t = \ln\frac{1}{10}$ $t = 28.782$ $\therefore$ time is 29 seconds
	Subtotal		**3**	

	Question 13 Total		**9**	

Q	Marking instructions	AO	Marks	Typical solution
14	Circles second answer	1.1b	B1	2.5 m s^{-2}
	Question 14 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
15	Ticks first box	2.2a	R1	**F_1** and **F_2** are parallel forces.
	Question 15 Total		**1**	

Q	Marking instructions	AO	Marks	Typical solution
16(a)	Obtains 2.4 m s^{-1} ACF Condone missing units	1.1b	B1	2.4 m s^{-1}
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
16(b)	Draws a graph which is convex at the origin and reaches or passes through approximately (5,12)	3.5c	B1	
	Subtotal		**1**	

	Question 16 Total		**2**	

Q	Marking instructions	AO	Marks	Typical solution
17	Forms a three-term equation of motion Condone use of $g = 9.81$ or 10	3.3	M1	$R - mg = ma$ $R - 60(9.8) = 60(1.2)$ $R = 660$
	Obtains 660	1.1b	A1	
	Question 17 Total		**2**	

Q	Marking instructions	AO	Marks	Typical solution
18	Selects an appropriate equation of constant acceleration and substitutes $u = \pm 12$, $a = \pm 10$ $v = 0$ Condone use of $g = 9.8$ or 9.81	3.1b	M1	$u = 12$, $a = -10$ $v = 0$ Using $v^2 = u^2 + 2as$
	Substitutes consistent correct values to obtain s or h Condone $h + 1.8$ for s	1.1b	A1	$0^2 = 12^2 + 2(-10)s$ $s = 7.2$
	Obtains 9	3.2a	B1	$h = 7.2 + 1.8 = 9$
	Question 18 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
19	Obtains $p^2 + (-0.5)^2$ or $p^2 + 0.5^2$ ACF Condone any variable for p	1.1b	B1	Magnitude of given vector $= \sqrt{p^2 + (-0.5)^2}$ $\sqrt{p^2 + 0.25} = 1.3$
	Equates their expression for the magnitude of the given vector to 1.3 or the square of the magnitude of the given vector to 1.3^2 to obtain at least one value for p	3.1a	M1	$p^2 = 1.44$ $p = \pm 1.2$
	Deduces $p = \pm 1.2$	2.2a	R1	
	Question 19 Total		**3**	

Q	Marking instructions	AO	Marks	Typical solution
20(a)	States 1.8 m s^{-1} Condone missing units	3.4	B1	1.8 m s^{-1}
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
20(b)(i)	Differentiates to find expression for acceleration with at least one term correct	3.4	M1	$v = 1.8 + 3.8t - 0.25t^2$ $a = \frac{dv}{dt} = 3.8 - 0.5t$
	Obtains $3.8 - 0.5t$	1.1b	A1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
20(b)(ii)	Sets their expression for acceleration equal to 0	3.4	M1	Max v when $a = 0$ $3.8 - 0.5t = 0$ $t = 7.6$ max $v = 1.8 + 3.8(7.6) - 0.25(7.6)^2$ $= 16.24$ m s^{-1}
	Obtains $t = 7.6$	1.1b	A1	
	Substitutes their positive value for t into $v = 1.8 + 3.8t - 0.25t^2$	3.3	M1	
	Obtains AWRT 16.2 m s^{-1} CSO Condone missing units	1.1b	A1	
	Subtotal		**4**	

Q	Marking instructions	AO	Marks	Typical solution
20(c)	Compares their maximum speed and 12.4 and concludes appropriately that the values are not approximately equal and the model is not accurate FT their maximum speed Accept valid comments about the initial speed being unrealistic	3.5a	E1F	$16.2 > 12.4$ Model overestimates the speed significantly so not an accurate model
	Subtotal		**1**	

	Question 20 Total		**8**	

Q	Marking instructions	AO	Marks	Typical solution
21(a)	Forms a three-term equation modelling the motion of bucket *A* with at least one side correct	3.3	M1	For bucket *A* $3.5g - T = 3.5a$ For bucket *B* $T - 0.5g = 0.5a$ Eliminating T $3g = 4a$ $a = \frac{3g}{4}$ Substituting $T = \frac{7g}{8}$
	Forms a three-term equation modelling the motion of bucket *B* with at least one side correct	3.3	M1	
	Forms two fully correct equations	1.1b	A1	
	Eliminates either a or T to form a single equation	1.1a	M1	
	Obtains $a = \frac{3g}{4}$ OE in terms of g	1.1b	A1	
	Obtains $T = \frac{7g}{8}$ OE in terms of g	1.1b	A1	
	Subtotal		**6**	

Q	Marking instructions	AO	Marks	Typical solution
21(b)	Explains that the model is unrealistic as buckets have size	3.5b	E1	Assumes the buckets have no size but this is unrealistic as buckets have dimensions
	Subtotal		**1**	

	Question 21 Total		**7**	

	Question Paper Total		**80**	