AS
Mathematics

7356/1 - Paper 1

Mark scheme

7356

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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 Assessment Writer.

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 or m marks and is for accuracy
B	mark is independent of M or 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
SCA	substantially correct approach
sf	significant figure(s)
dp	decimal place(s)

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.

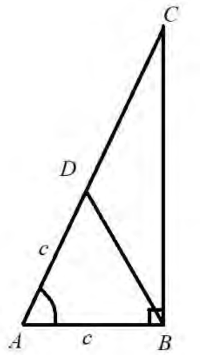
Q	Marking Instructions	AO	Marks	Typical Solution
1	Selects correct answer	AO1.1b	B1	(–1, 8)
	Total		**1**	

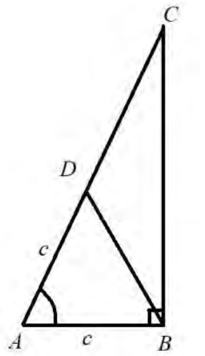
Q	Marking Instructions	AO	Marks	Typical Solution
2	Selects correct answer	AO1.1b	B1	$\frac{2}{3}$
	Total		**1**	

Q	Marking Instructions	AO	Marks	Typical Solution
3	Correctly identifies the two end points 90 and 270 Condone $\frac{\pi}{2}$ and $\frac{3\pi}{2}$	AO1.2	M1	$90° < x < 270°$
	Correctly uses inequalities May state (90, 270) – must be round brackets Again, condone $\frac{\pi}{2}$ and $\frac{3\pi}{2}$	AO2.5	A1	
	Total		**2**	

Q	Marking Instructions	AO	Marks	Typical Solution
4(a)	Expands $(1 - 3x)^4$ showing a 1, a $(\pm 3x)$ term and a $(\pm 3x)^2$ term	AO1.1a	M1	$1 + 4(-3x) + 6(-3x)^2$ $1 - 12x + 54x^2$
	Uses correct coefficients, 4 & 6 (PI by correct answer, ignore sign errors)	AO1.1b	A1	
	Obtains totally correct expansion Ignore extra terms	AO1.1b	A1	
(b)	Selects value to use for x and substitutes it in their expansion. Correct value, or solves $1 - 3x = 0.994$	AO2.2a	M1	Need $x = 0.002$ $1 - 12 \times 0.002 + 54 \times 0.002^2$
	Evaluates expression 0.976216 CAO for three terms or 0.976215 CAO for four or five terms used and shown	AO1.1b	A1	=0.976216
	Total		**5**	

Q	Marking Instructions	AO	Marks	Typical Solution
5	Forms an equation for gradient of CD = ¼ or –¼ of the form difference in y over difference in x (or vice versa = 4 or -4)	AO3.1a	M1	$\frac{d-2}{6-c} = \frac{1}{4}$ $4d - 8 = 6 - c$
	Obtains a correct equation for c & d	AO1.1b	A1	$c + 4d = 14$
	Forms an equation for the mid-point of CD lying on $y + 4x = 11$	AO3.1a	M1	$\frac{2+d}{2} + 4\left(\frac{c+6}{2}\right) = 11$
	Obtains correct equation for c & d (any correct form)	AO1.1b	A1	$4c + d = -4$
	Solves for c and d CAO	AO1.1b	A1	$c = -2 \quad d = 4$
	Total		**5**	

Q	Marking Instructions	AO	Marks	Typical Solution
6(a)	Uses area of ADB = area of CDB or area of ADB = ½ area of ABC Possibly by use of "½ab sinC" twice	AO3.1a	M1	 Area of ADB = Area of CDB
	Deduces that AC = 2 x AD = 2 x AB or equivalent	AO1.1b	A1	CD = AD = c AC = 2c
	Uses trigonometry involving sin and tan based on triangle with AC = 2 x AB	AO1.1a	M1	cos A = $\frac{c}{2c} = \frac{1}{2}$ so A = 60° tan A = √3
	Obtains correct conclusion (AG) Sets out a well-constructed mathematical argument. Use of 60° or equivalent must be justified	AO2.1	R1	sin A = $\frac{\sqrt{3}}{2}$ 2sin A = √3 = tan A
(b)(i)	Uses tan A = $\frac{\sin A}{\cos A}$ and multiplies Or Uses sketch of two graphs to show two intersections	AO1.1a	M1	$\frac{\sin A}{\cos A}$ = 2 sin A sin A = 2 sin A cos A
	Solves the equation to give A = 0° and 60° Or interprets intersections of graphs of the correct shape between 0° and 90° to be the solutions Special case 0° and 60° stated but not justified award B1. Stated and verified award B2	AO1.1b	A1	sin A(1 – 2cos A) = 0 sin A = 0 or cos A = ½ A = 0° and A = 60°
(b)(ii)	Selects A = 60°. (Can be earned with no other working shown)	AO3.2a	B1	We need A = 60°
	Total		**7**	

Q	Alternative marking Instructions	AO	Marks	Typical Solution
6(a)	Obtains area formula for ABD using sin A	AO3.1a	M1	 Area of ADB = $\frac{1}{2}c^2 \sin A$
	Obtains expression for BC using tan A	AO1.1a	M1	$\frac{BC}{c} = \tan A$ BC = c tan A
	Obtains correct expression for area of ABC	AO1.1b	A1	Area of ABC = $\frac{1}{2} c^2 \tan A$
	Simplifies to correct conclusion (AG) Sets out a well-constructed mathematical argument.	AO2.1	R1	$\frac{1}{2} c^2 \tan A = 2 \times \frac{1}{2}c^2 \sin A$ tan A = 2 sin A
(b)(i)	Uses tan A = $\frac{\sin A}{\cos A}$ and multiplies Or Uses sketch of two graphs to show two intersections	AO1.1a	M1	$\frac{\sin A}{\cos A} = 2 \sin A$ sin A = 2 sin A cos A
	Solves the equation to give A = 0° and 60° Or interprets intersections of graphs of the correct shape between 0° and 90° to be the solutions Special case 0° and 60° stated but not justified award B1. Stated and verified award B2	AO1.1b	A1	sin A(1 – 2cos A) = 0 sin A = 0 or cos A = ½ A = 0° and A = 60°
(b)(ii)	Selects A = 60°. (Can be earned with no other working shown)	AO3.2a	B1	We need A = 60°
	Total		**7**	

Q	Marking Instructions	AO	Marks	Typical solution
7	Investigates last digit of n. Allow M1 for investigation of $2k + 1$	AO3.1a	M1	Last digit of n determines last digit of n^4
	Deduces that only need to investigate numbers ending in 1, 3, 7, 9 Condone inclusion of 5 at this stage	AO2.2a	M1	All even numbers divide by 2, so are not prime Any number ending in 5 is a multiple of 5 so is not prime Primes > 5 end in 1, 3, 7 or 9
	Considers each in turn to show that n^4 will end in a 1	AO1.1a	M1	If n ends in 1, 1^4 is 1 so n^4 ends in a 1 If n ends in 3, 3^4 is 81 so n^4 ends in a 1 If n ends in 7, 7^4 is 2401 so n^4 ends in a 1 If n ends in 9, 9^4 is 6561 so n^4 ends in a 1
	Provides evidence that $1^4, 3^4, 7^4, 9^4$ all end in a 1	AO1.1b	A1	
	Constructs rigorous mathematical argument to show the required result Only award if they have a completely correct solution, which is clear, easy to follow and contains no slips. Must include clear statement that final digit of n determines final digit of n^4	AO2.1	R1	Statement proved by exhaustion
	Total		**5**	

Q	Marking Instructions	AO	Marks	Typical Solution
8(a)	Reads graph and uses $10^{\log P}$ or $10^{\log V}$ to get either P or V	AO3.4	M1	$\log_{10}P = 2.18$ $P = 151$
	Correctly obtains P and V AWRT 150 and AWRT 0.71	AO1.1b	A1	$\log_{10}V = -0.15$ $V = 0.708$
(b)	Calculates value of gradient to find d Condone use of log d = gradient Or uses a value of c plus a P/V pair to find d	AO3.4	M1	$\log_{10}P = \log_{10}c + d\log_{10}V$
	Obtains correct value for d AWRT -1.4 Not necessarily a decimal	AO1.1b	A1	Gradient = $d = -1.4$
	Calculates value of intercept to find $\log_{10} c$ Or uses a value of d plus a P/V pair to find c	AO3.4	M1	Intercept = $\log_{10} c$
	Calculates correct value for c AWRT 93	AO1.1b	A1	$c = 93.3$
(c)	Uses their values of c and d in the formula $P = cV^d$	AO1.1a	M1	$P = 93.3 \times 2^{-1.4}$
	Obtains P value, **including units** AWFW 30 to 40	AO3.2a	A1	$= 35.4$ kilopascals
	Total		**8**	

Q	Marking Instructions	AO	Marks	Typical Solution
9(a)	Shows how this particular value has been calculated As in typical solution **Or** (–6.51 – (–6)) ÷ (3.1 – 3)	AO1.1b	B1	(–6.51 – (–6)) ÷ 0.1
(b)	Calculates values for $(x + h)$ and $f(x + h)$ CAO	AO1.1b	B1	3.01, –6.0501
	Calculates value for gradient	AO1.1b	B1	–5.01
(c)	Infers suggested limit	AO2.2b	B1	– 5
(d)	Recalls and applies formula for gradient	AO1.2	M1	Gradient = $\frac{f(3+h)-f(3)}{h}$
	Substitutes correct expressions for $f(3 + h)$ and $f(3)$	AO1.1b	A1	$= \frac{(3+h)-(3+h)^2-(3-3^2)}{h}$
	Simplifies to obtain $-h - 5$	AO1.1b	A1	$= \frac{-h^2-5h}{h}$ $= -h - 5$
	Evaluates gradient at $x = 3$ and shows that it is the required value. Constructs rigorous mathematical argument to show the required result. Only award if they have a completely correct solution, using $h \to 0$ (not =0)	AO2.1	R1	As $h \to 0$, gradient $\to -5$ When $x = 3$ gradient = –5
	Total		**8**	

(d)	**Alternative** Recalls and applies formula for gradient	AO1.2	M1	Gradient = $\frac{f(x+h)-f(x)}{h}$ $= \frac{(x+h)-(x+h)^2-(x-x^2)}{h}$ $= \frac{-h^2-(2x-1)h}{h}$ $= -h-(2x-1)$ As $h \to 0$, gradient $\to -(2x-1)$ When x = 3 gradient = –5
	Substitutes correct expressions for $f(x+h)$ and $f(x)$	AO1.1b	A1	
	Simplifies to obtain $-h-(2x-1)$	AO1.1b	A1	
	Evaluates gradient at x = 3 and shows that it is the required value. Constructs rigorous mathematical argument to show the required result. Only award if they have a completely correct solution, which is clear, easy to follow and contains no slips.	AO2.1	R1	
	Total		**4**	

Q	Marking Instructions	AO	Marks	Typical Solution
10(a)	Verifies that $x = 1$ gives $y = 3$	AO1.1b	B1	$y = 2 \times 1^2 - 8 \times 1^{\frac{3}{2}} + 8 \times 1 + 1$ =3
	Expresses $x\sqrt{x}$ as $x^{\frac{3}{2}}$	AO1.1b	B1	$y = 2x^2 - 8x^{\frac{3}{2}} + 8x + 1$
	Attempts to differentiate (at least one term correct)	AO1.1a	M1	
	Correctly differentiates	AO1.1b	A1	$\frac{dy}{dx} = 4x - 12\sqrt{x} + 8$
	Explains $\frac{dy}{dx}$ = 0 for stationary or maximum point Must be explicitly seen	AO2.4	E1	For stationary point $4(\sqrt{x})^2 - 12\sqrt{x} + 8$=0
	Shows solution of $\frac{dy}{dx}$ = 0 to give $x = 1$ (and $x = 4$) (May be awarded for work seen in (b)) or correct verification of $x = 1$	AO1.1b	B1	$\sqrt{x} = 1 \text{ or } \sqrt{x} = 2$ $x = 1 \text{ or } x = 4$
	Differentiates again (May be awarded for work seen in (b))	AO1.1a	M1	$\frac{d^2y}{dx^2} = 4 - \frac{6}{\sqrt{x}}$
	Shows that $x = 1$ gives a negative value (in a correct second differential)	AO1.1b	A1	x = 1 gives $\frac{d^2y}{dx^2} = -2$ Negative so maximum when x = 1
	Concludes that maximum point is at $(1, 3)$. Constructs rigorous mathematical argument to show the required result. Failure to score E1 does not rule out award of this mark	AO2.1	R1	Maximum at $(1, 3)$
(b)	States coordinates	AO1.1b	B1	$(4, 1)$
	States minimum point	AO1.1b	B1	Minimum
	Total		**11**	

Notes:

A candidate who does not handle the $x\sqrt{x}$ term can score B1 B0 M1 A0 E1 B0 M1 A0 R0

Q	Marking Instructions	AO	Marks	Typical Solution
11	Circles correct answer	AO1.1b	B1	$a = 28$
	Total		**1**	

Q	Marking Instructions	AO	Marks	Typical Solution
12	Circles correct answer	AO2.2a	B1	$F - R = 3$
	Total		**1**	

Q	Marking Instructions	AO	Marks	Typical Solution
13(a)	Draws first stage of graph correctly.	AO3.3	B1	Line connecting (0, 0) to (4, 3).
	Draws second stage correctly Line moving down by 6 ms^{-1} in 5s	AO3.3	B1F	Line connecting (4, 3) to (9, -3).
	Deduces final stage correctly Horizontal line of length $33/v$ where v is the speed of the vehicle at the end of the second stage.	AO2.2a	B1F	Line connecting (9, -3) to (20, -3).
13(b)	Finds at least one non-rectangular area. As typical solution **Or** t between 0 & 6.5: Area of triangle = 3 x 6.5 ÷ 2 = 9.75 m (forward) t between 6.5 & 20: Area of trapezium = 0.5(13.5 + 11) x (-3) = -36.75 m (backwards)	AO1.1a	M1	t between 0 & 4: Area of triangle = 3 x 4 ÷ 2 = 6 m (forward) t between 4 & 6.5: Area of triangle = 3 x 2.5 ÷ 2 = 3.75 m (forward) t between 6.5 & 9: Area of triangle = 2.5 x -3 ÷ 2 = -3.75 m (backwards) t between 9 and 20: Area of rect. = -3 x 11 = -33 m (backwards)
	Subtracts *their areas* below axis from areas above axis. OE	AO1.1a	M1	Displacement from O is 9.75 – 36.75 = –27 m
	Calculates distance from P correctly. CAO. Units not required	AO3.2a	A1	Distance is 27m
	Total		**6**	

Q	Marking Instructions	AO	Marks	Typical Solution
14(a)	Forms two equations of motion for 1.8 and 1.2 kg mass, three terms, condone sign error. "Whole string" approach scores M0	AO3.4	M1	1.8 x 9.81 – T = 1.8 x a
	Obtains two correct equations	AO1.1b	A1	T – 1.2 x 9.81 = 1.2 x a
	Solves to find correct value for a $0.2g$ or AWRT 1.96	AO1.1b	A1	a = 1.96 m s^{-2}
	Uses $s = ut + ½\,at^2$ with *their* calculated a value	AO1.1a	M1	1.5 = ½ x 1.96 x t^2
	Calculates correct t value AWRT 1.24	AO1.1b	A1	t = 1.24 seconds
14(b)	Any valid assumption stated. Do not allow any comment already stated as an assumption in the question. Air resistance is permitted.	AO3.5b	E1	The string is long enough so that lighter mass does not reach the peg before the heavier mass hits the ground.
	Total		**6**	

Q	Marking Instructions	AO	Marks	Typical Solution
15(a)	States that the resistance is less for the second rider so the force required for equilibrium is also less, or mention of slipstreaming OE	AO2.4	E1	Jason experiences less air resistance than Laura.
15(b)(i)	Models situation by using given mass and total resistance force to form equation of motion PI	AO3.3	M1	As $F = ma$ then a = - 0.625 m s^{-2}
	Uses appropriate suvat formula. May include $u = 25$.	AO3.4	M1	u = 25 km/h = 6.944 m s^{-1} v = 0; use $v^2 = u^2 + 2as$ so that 0 = 6.944^2 + 2 x (-0.625) x s
	States correct value for s (AWFW 38.5 to 38.6) **Or** maximum $u = 7.07$ m s^{-1} or 25.5 km/h (AWRT) **Or** a needs to be < -0.603 (AWRT) **Or** Resistance needs to be >38.5 N (AWFW 38.4 to 38.6) **Or** v^2 is -1.8 (AWRT) when $s = 40$	AO1.1b	A1	s = 38.6 m
	Makes appropriate comparison to conclude that Laura stops in time. Not necessary to see 38.6 < 40, but comparison for other variables must be clear.	AO3.2a	E1	So Laura stops before reaching the accident
15(b)(ii)	States an assumption that, if incorrect, would **contradict** the conclusion in **(i).** (eg reaction time, diminishing resistive force as speed drops OE)	AO3.5a	E1F	Taking account of reaction time would mean she travelled a distance before starting to brake.
	Total		**6**	

Q	Marking Instructions	AO	Marks	Typical Solution
16(a)	Shows integral of v with respect to t Condone omission of dt	AO1.1a	M1	$\int 0.06(2+t-t^2)\ dt$
	Integrates with at least two correct terms (condone omission of constant at this stage) Any equivalent form.	AO1.1b	A1	$= 0.12t + 0.03t^2 - 0.02t^3 + c$
	Finds constant using $t = 0$ and displacement of 3. PI.	AO2.2a	M1	Using $t = 0$, $c = 3$
	Finds fully correct expression for r.	AO1.1b	A1	$r = 0.12t + 0.03t^2 - 0.02t^3 + 3$
16(b)	Models problem as only force acting is that due to gravity so that $v = 0$ at highest point. (PI)	AO3.3	M1	$a = -9.8$ m s^{-2} $v = 0$ m s^{-1}
	Uses appropriate suvat formula $v = u + at$ with $u = 3.43$ and g negative or $u = -3.43$ and g positive	AO1.1a	M1	$0 = 3.43 - 9.8t_{max}$ $\therefore t_{max} = 0.35$ s
	Finds $t_{max} = 0.35$ s (CAO) Condone addition of the 2 seconds to give $t = 2.35$ s or 2.4s	AO1.1b	A1	
	Total		**7**	

	TOTAL		**80**	