OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL AS MATHEMATICS

(9660)

Mark scheme

Pure statistics and mechanics Unit 1

Specimen

Principal Examiners have prepared these mark schemes for specimen papers. These mark schemes have not, therefore, been through the normal process of standardising that would take place for live papers.

Key to mark scheme abbreviations

M	Mark is for method
m	Mark is dependent on one or more M marks and is for method
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
√ **or ft**	Follow through from previous incorrect result
CAO	Correct answer only
CSO	Correct solution only
AWFW	Anything which falls within
AWRT	Anything which rounds to
ACF	Any correct form
AG	Answer given
SC	Special case
oe	Or equivalent
A2, 1	2 or 1 (or 0) accuracy marks
–*x* EE	Deduct *x* marks for each error
NMS	No method shown
PI	Possibly implied
SCA	Substantially correct approach
sf	Significant figure(s)
dp	Decimal place(s)

No method shown

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

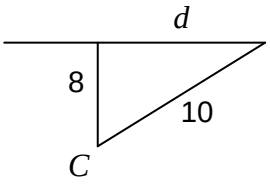
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn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

Where a question asks the candidate 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**.

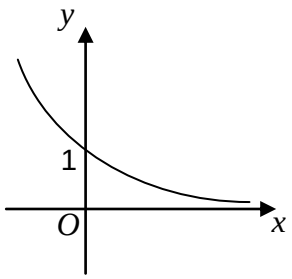
Otherwise we require evidence of a correct method for any marks to be awarded.

Q	Answer	Marks	Comments
1(a)	Arc = $r\theta$	M1	arc = $r\theta$ seen or used. PI by correct θ
	$4 = 50 \Rightarrow \theta = \frac{4}{5} = 0.8$	A1	$(\theta =) \frac{4}{5}$ oe
1(b)	Area of sector = $\frac{1}{2} r^2 \theta$	M1	Area = $\frac{1}{2} r^2 \theta$ seen or used within **(b)**. PI
	$= \frac{1}{2} \times 5^2 \times 0.8 = 10$ (cm^2)	A1ft	ft on 12.5 × their exact value for θ in part (a) provided $5 \leq$ their area $\leq 2\theta$
	Total	**4**	

Q	Answer	Marks	Comments
2(a)	$(x - 3)^2 + (y + 8)^2$	B1	Accept $(y - -8)^2$
	$= 100$	B1	condone RHS = 10^2 or $k = 10^2$
2(b)	$y = 0 \Rightarrow$ 'their' $(x - a)^2 + b^2 = k$	M1	**Alternative** 
	$(x - 3)^2 = 36$ or $x^2 - 6x - 27 (= 0)$ (PI)	A1	
	$\Rightarrow x = -3, 9$	A1	$(d^2 =) 10^2 - 8^2$ M1 $d^2 = 36$ A1 or $d = 6$ $\Rightarrow x = -3, 9$ A1
2(c)	Line CA has gradient $-\frac{2}{5}$	M1	
	CA has equation $(y + 8) = -\frac{2}{5}(x - 3)$	A1	Any form of correct equation eg $y = -\frac{2}{5}x + c$, $c = -\frac{34}{5}$
	$2x + 5y + 34 = 0$	A1cso	integer coefficients - all terms on 1 side
	Total	**8**	

Q	Answer	Marks	Comments
3(a)	Area = $\frac{1}{2} \times 10 \times AC \sin 150°$	M1	
	$40 = 2.5AC$ so $AC = 16$ (m)	A1	AG Be convinced
3(b)	$\{BC^2 =\} 10^2 + 16^2 - 2 \times 10 \times 16 \times \cos 150°$	M1	RHS of cosine rule used
	$= 100 + 256 + 277.128…$	m1	Correct order of evaluation
	$BC = \sqrt{633.128...} = 25.162… = 25.16$m	A1	AWRT 25.16
3(c)	$\frac{10}{\sin C} = \frac{BC}{\sin 150°}$ (or $\frac{BC}{\sin 150°} = \frac{AC}{\sin B}$)	M1	A correct equation using sine rule or cosine rule or area formula for either B or C Substitution of BC or AC not required for this M
	$\sin C = \frac{10 \sin 150°}{\text{their } 25.16}$ (= 0.1987…) (or $\sin B = \frac{10 \sin 150°}{\text{their } 25.16}$ (= 0.317… or 0.318))	m1	Correct rearrangement to either $\sin C$ or $\cos C$ or $\sin B$ or $\cos B$ equal to numerical expression ft on their numerical value for BC. PI by correct C or (by correct B if M scored)
	Smallest angle, (C =) 11.5° to 1dp	A1	Accept a value 11.4 to 11.5 inclusive
	Total	**8**	

Q	Answer	Marks	Comments
4(a)	$\tan x = -3$ $\Rightarrow x = \tan^{-1}(-3)$ (= –71.56…)°	M1	PI eg by 71(.56..) or –71(.56..) seen
	$x = 108°, 288°$	A1, A1	Condone more accurate answers. (108.4349…, 288.4349…) [Ignore answers outside interval; If more than 2 answers inside interval –1 from A marks for each extra to a min of 0]
4(b)(i)	$7\sin^2\theta + \sin\theta\cos\theta = 6(\cos^2\theta + \sin^2\theta)$	M1	$\cos^2\theta + \sin^2\theta = 1$ used, oe
	$7\sin^2\theta - 6\sin^2\theta + \sin\theta\cos\theta - 6\cos^2\theta = 0$ $\Rightarrow \sin^2\theta + \sin\theta\cos\theta - 6\cos^2\theta = 0$ $\Rightarrow \frac{\sin^2\theta}{\cos^2\theta} + \frac{\sin\theta}{\cos\theta} - 6 = 0$	M1	$\frac{\sin\theta}{\cos\theta} = \tan\theta$ used
	$\Rightarrow \tan^2\theta + \tan\theta - 6 = 0$	A1	CSO AG
4(b)(ii)	$(\tan\theta + 3)(\tan\theta - 2) = 0$	M1	Factorise or other valid method to solve quadratic
	$\tan\theta = -3$ or $\tan\theta = 2$	A1	Need both
	$\theta = 108°, 288°, \theta = 63°, 243°$	B2ft, 1ft	**Only** ft on (a) for their two +'ve $\tan^{-1}(-3)$ vals. [B1 if 3 correct (ft)] Condone more accurate answers. (108.4349…, 288.4349…; 63.4349…, 243.4349…) [Ignore answers outside interval; If more than 2 answers for each inside interval, –1 for each extra from Bs to a min of 0]
	Total	**10**	

Q	Answer	Marks	Comments
5(a)		B1	Correct shaped graph in 1st two quadrants only and indication of correct behaviour of curve for large positive and negative values. of x. Ignore any scaling on axes.
		B1	y-intercept indicated as 1 on diagram or stated as intercept = 1 or as coords (0, 1)
5(b)	$\frac{1}{2^x} = \frac{5}{4} \Rightarrow 2^{-x} = \frac{5}{4}$ (or $2^x = \frac{4}{5}$ or $2^{2-x} = 5$)	M1	Correct 'rearrangement' to eg $2^x = \frac{4}{5}$ or $2^{-x} = \frac{5}{4}$ or $0.5^x = 1.25$ PI or $\log 1 - \log 2^x = \log(\frac{5}{4})$ or better
	$\log 2^{-x} = \log 1.25 \Rightarrow -x\log 2 = \log 1.25$ [$\log 2^x = \log 0.8 \Rightarrow x\log 2 = \log 0.8$] [$\log 2^{2-x} = \log 5 \Rightarrow (2-x)\log 2 = \log 5$] [$2^x = 0.8$, $x = \log_2 0.8$], [$0.5^x = 1.25$, $x = \log_{0.5} 1.25$]	M1	Takes logs of both sides of eqn of form either $2x = k$ or $2^{-x} = k$ oe and uses 3rd law of logs or log to base 2 (or base $\frac{1}{2}$) correctly
	$x = -0.321928\ldots$ so $x = -0.322$ (to 3sf)	A1	Condone > 3sf [Logs must be seen to be used otherwise **max** of M1M0A0]

Q	Answer	Marks	Comments
5(c)	$\log_a b^2 + 3\log_a y = 3 + 2\log_a\left(\frac{y}{a}\right)$ $\log_a b^2 + 3\log_a y = 3 + 2[\log_a y - \log_a a]$	M1	A log law used correctly; condone missing base a
	$\log_a b^2 + \log_a y = 3 - 2\log_a a$ $\log_a b^2 y = 3 - 2\log_a a$	M1	A different log law used correctly condone missing base a.
	$\log_a b^2 y = 3 - 2(1)$ or $[\log_a b^2 y + \log_a a^2 = 3]$	M1	Either a further different log law used correctly condone missing base a or $\log_a a = 1$ stated / used
	$\Rightarrow \log_a b^2 y = 1 \Rightarrow b^2 y = a$	m1	$\log_a Z = k \Rightarrow Z = a^k$ used or a correct method to eliminate logs (dep on no misapplication of any log law OE in the whole solution) Rearrangements which require only two of the above Ms to eliminate logs correctly: award the remaining M with the m mark.
	$\Rightarrow y = ab^{-2}$	A1	ACF of RHS
	Total	**10**	

Q	Answer	Marks	Comments
6(a)	**No MR or MC in this question**		**Accept percentage equivalents in (a)**
	P(0) = **0.18**	B1	CAO; can be implied from working or **correct answer**
	$P(H = 3) = \binom{30}{3}(p)^3(1-p)^{27}$	M1	Correct expression using p = **0.18**, 0.47, 0.25 **or** 0.10 Can be implied by **correct answer** Ignore extra terms
	= **0.111** to **0.112**	A1	AWFW (0.11151)
6(b)	P(≥ 2) = **0.35**	B1	CAO: can be implied from 0.5078 or 0.3575 (accept 3 dp rounding) or **correct answer**
	P(H > 10) = **1 – (0.5078 or 0.3575)**	M1	Requires 1 - either probability Accept 3dp rounding Can be implied by (0.492) but **not** by (0.642 to 0.643)
	= **0.492**	A1	AWRT (0.4922)
SC	For calculation of individual terms award B1 B2 for 0.492 (AWRT); award B1 for 0.642 to 0.643 (AWFW)		
	Total	**6**	

Q	Answer	Marks	Comments
7	$\left.\begin{matrix}\mathrm{E}(Y) = 3.5 \\ \mathrm{E}(Y^2) = 13\end{matrix}\right\}$	B1	for $\mathrm{E}(Y)$
	$\mathrm{Var}(Y) = 13 - 3.5^2$	M1	on their $\mathrm{E}(Y)$ and $\mathrm{E}(Y^2)$
	$= 0.75$	A1ft	Var $(Y) > 0$
	$\mathrm{E}(T) = 3 \times \mathrm{E}(Y) = 10.5$	B1	
	$\mathrm{Var}(T) = 3^2 \times \mathrm{Var}(Y)$ $= 9 \times 0.75$ $= 6.75$	M1 A1	$9 \times$ their $\mathrm{Var}(Y) > 0$ CAO
	Alternative T: 3, 6, 9, 12 T^2: 9, 36, 81, 144 P: $\frac{1}{20}$, $\frac{2}{20}$, $\frac{3}{20}$, $\frac{14}{20}$ $\mathrm{E}(T)$: $\frac{3}{20}$, $\frac{12}{20}$, $\frac{27}{20}$, $\frac{168}{20}$; 10.5 $\mathrm{E}(T^2)$: $\frac{9}{20}$, $\frac{72}{20}$, $\frac{243}{20}$, $\frac{2016}{20}$; 117	(M1A1) (M1A1)	
	$\mathrm{Var}(T) = \mathrm{E}(T^2) - [\mathrm{E}(T)]^2$	(M1)	(used)
	$= 117 - 10.5^2$ $= 6.75$	(A1)	
	Total	**6**	

Q	Answer	Marks	Comments
8(a)(i)	P(D = 2) = 0.90 × 0.95 = **0.85 to 0.86**	B1	AWFW (0.855 or 171/200 OE)
8(a)(ii)	P(D = 1) = (0.90 × 0.05) + (0.10 × 0.95) **or** = 1 – [0.855 + (0.10 × 0.05)] = **0.14**	M1 A1	May be implied by a **correct** answer Do **not** ignore extra terms CAO (7/50 OE)
8(b)(i)	$P(D_W \cap I_W)$ = 0.90 × 0.80 = **0.72**	M1 A1	May be implied by a **correct** answer CAO (18/25 OE)
8(b)(ii)	$P(D_B \cap I_B)$ = **(b)(i)** × 0.95 (× 1) **or** = 0.90 × 0.80 × 0.95 (× 1) **or** = **(a)(i)** × 0.80 **0.68 to 0.685**	M1 A1	May be implied by a **correct** answer AWFW (0.684 or 171/250 OE)
8(b)(iii)	$P(D_T \cap I'_T)$ = 0.95 × 0 = **0**	B1	CAO : award on value only
	Total	**8**	

9(a)	$v^2 = 2^2 + 2 \times 5 \times 9.8(1)$	M1 A1	Use of $v^2 = u^2 + 2as$ with u = 2, a = 9.8(1) and s = 5
	10.1	A1	
9(b)	0 = 4 – 9.8t	M1 A1	Use of $v = u + at$ with v = 0, u = 4 and a = –9.8(1)
	0.408	A1	
9(c)	(I =) 0.1 × 4 – 0.1 × (–10.1)	M1	
	1.41	A1	
	Total	**8**	

Q	Answer	Marks	Comments
10(a)	$5g - T = 5a$	M1A1	M1 Three term equation of motion with $5g$ or 49, $5a$ (not $5ga$) and T A1 Correct equation.
	$T - 3g = 3a$ $2g = 8a$	M1A1	M1 Three term equation of motion with $3g$ or 29.4, $3a$ (not $3ga$) and T A1 Correct equation.
	$a\left(=\frac{2g}{8}\right) = 2.45\ \text{ms}^{-2}$ AG	A1	A1 Correct acceleration from correct working Note: Do not penalise candidates who consistently use signs in the opposite direction throughout, provided they then give their final answer as 2.45 If the final answer is -2.45 don't award the final A1 mark Special Case: Whole String Method $2g = 8a$ and $a = \frac{2g}{8} = 2.45$ OE M1A1A1
10(b)	$T = 3 \times 9.8 + 3 \times 2.45\ (= 36.75)$	M1	M1 Substitution of $a = 2.45$ into a three term equation of motion to find the tension. Contains T, mg and ma where $m = 3$ or 5
	= 36.8 N (to 3 sf)	A1	A1 Correct tension. Accept 36.75 or 36.7
	Total	**7**	

Q	Answer	Marks	Comments
11	$v = 0,\ 3t^2 - 2t - 5 = 0$ $(3t - 5)(t + 1) = 0$	M1	
	$t = \frac{5}{3}$	A1	
	$a = \frac{dv}{dt}$	M1	
	$= 6t - 2$	A1	
	(when $t = \frac{5}{3}$), $a = 8$	A1	
	Total	**5**	

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