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Mark Scheme (Results)

January 2012

GCE Statistics S1 (6683) Paper 1

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- 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.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- 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 may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

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 and can be used if you are using the annotation facility on ePEN.

- 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
- ⌐ The second mark is dependent on gaining the first mark
  ⌙

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

General Principals for Core Mathematics Marking

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

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q),\ \text{where} |pq| = |c|$, leading to x = ...

$(ax^2 + bx + c) = (mx + p)(nx + q),\ \text{where} |pq| = |c| \text{ and } |mn| = |a|$, leading to x = …

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*), leading to x = …

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c, \quad q \neq 0$, leading to x = …

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \rightarrow x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \rightarrow x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

January 2012
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1 (a)	14, 5	M1 A1 **(2)**
(b)	21 + 45 + 3 = 69	M1 A1 **(2)**
		Total 4
NOTES		
(a)	M1 for 2x7 or 14 or 5x1 or 5	
	A1 for both 14 and 5	
(b)	M1 for 21+45+(0<frequency <9)	
	A1 for 69 only.	
	69 no working, award M1A1 Incorrect answer with no working M0A0	

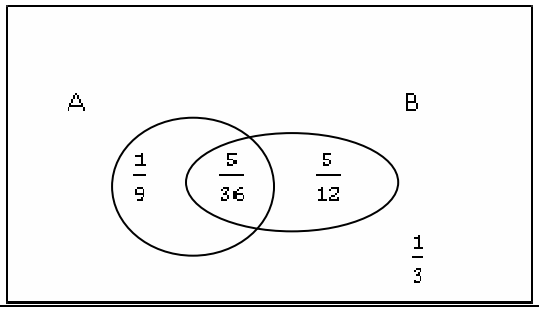
Question Number	Scheme	Marks
2 (a)	(R and S are mutually) exclusive.	B1 (1)
(b)	$\frac{2}{3} = \frac{1}{4} + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ use of Addition Rule $\frac{2}{3} = \frac{1}{4} + \mathrm{P}(B) - \frac{1}{4} \times \mathrm{P}(B)$ use of independence $\frac{5}{12} = \frac{3}{4}\ \mathrm{P}(B)$ $\mathrm{P}(B) = \frac{5}{9}$	M1 M1 A1 A1 (4)
(c)	$\mathrm{P}(A' \cap B) = \frac{3}{4} \times \frac{5}{9} = \frac{15}{36} = \frac{5}{12}$	M1A1ft (2)
(d)	$\mathrm{P}(B' \mid A) = \frac{(1 - (b)) \times 0.25}{0.25}$ or $\mathrm{P}(B')$ or $\frac{\frac{1}{9}}{\frac{1}{4}}$ $= \frac{4}{9}$	M1 A1 (2)
		Total 9

NOTES

(a) B1 for '(mutually) exclusive' or 'cannot occur at the same time' seen or equivalent.
'Intersection is zero' or 'no overlaps' without further explanation is B0.

(b) M1 for use of Addition Formula, including an intersection, with at least one probability substituted. Intersection must be explicitly considered for this mark.
Accept $\frac{2}{3} = \frac{1}{4} + \mathrm{P}(B) - 0$ for M1.
M1 for $\mathrm{P}(A \cap B) = \frac{1}{4}\mathrm{P}(B)$
A1 for completely correct equation or equivalent.
A1 for $\frac{5}{9}$ or exact equivalent..
Venn Diagram with 2 overlapping closed curves and correct values possibly without $\frac{1}{3}$, award M1M1A1.

(c) M1 for $\frac{3}{4}$ x 'their P(B)' or 'their P(B)'- P($A \cap B$) or $\mathrm{P}(A \cup B) - \mathrm{P}(B) = \frac{2}{3} - \frac{1}{4}$
Or $\mathrm{P}(A' \cap B) = \mathrm{P}(A') + $ 'their P(B)' $- \mathrm{P}(A' \cup B) = \frac{3}{4} + \frac{5}{9} - \frac{8}{9}$
A1 for $\frac{5}{12}$ or follow through from their method. Accept exact equivalent.
Correct answer only with no working M1A1 but must be clearly labelled (c).

(d)	M1 for using 1-'their P(B)' or (P($A \cup B$) – P(A))/P(A) or (P(A) – P($A \cap B$))/P(A) with a correct attempt at the numerator and denominator. If mutually exclusive is assumed then the last option gives $\frac{\frac{1}{4}}{\frac{1}{4}}$ for M1. A1 for $\frac{4}{9}$ or exact equivalent. For part (c) follow through their stated values; **do not** follow through incorrectly labelled regions on a Venn Diagram. Throughout the question we require probabilities between 0 and 1 for method marks. Venn Diagram: 	

Question Number	Scheme	Marks
3 (a)	$\frac{5}{21}+\frac{2k}{21}+\frac{7}{21}+\frac{k}{21}=1$	M1
	$\frac{12+3k}{21}=1$	
	$k=3$ * AG required for both methods	A1
		(2)
(b)	$\frac{11}{21}$	B1
		(1)
(c)	$\mathrm{E}(X)=2\times\frac{5}{21}+3\times\frac{6}{21}+4\times\frac{7}{21}+6\times\frac{1}{7}$	M1
	$=3\frac{11}{21}$ or $\frac{74}{21}$ or awrt 3.52	A1
		(2)
(d)	$\mathrm{E}(X^2)=2^2\times\frac{5}{21}+3^2\times\frac{6}{21}+4^2\times\frac{7}{21}+6^2\times\frac{1}{7}$	M1
	$=14$	A1
		(2)
(e)	$\mathrm{Var}(X)=14-\left(3\frac{11}{21}\right)^2$	M1
	$=1\frac{257}{441}$ or $\frac{698}{441}$ or awrt 1.6	A1
	$\mathrm{Var}(7X-5)=7^2\,\mathrm{Var}(X)$	M1
	$=77\frac{5}{9}$ or $\frac{698}{9}$ or awrt 77.6	A1
		(4)
		Total 11

NOTES

(a) M1 Award for verification. Sub in k=3 and show $\sum x\,\mathrm{P}(X=x)=1$. Require at least three correct terms seen or line 2 of scheme.
A1 Correct solution only including verification.

(b) B1 Award for exact equivalent.

(c) M1 At least two correct terms required for method, follow through 'their *k*' for method. Correct answer only, award M1 A1.

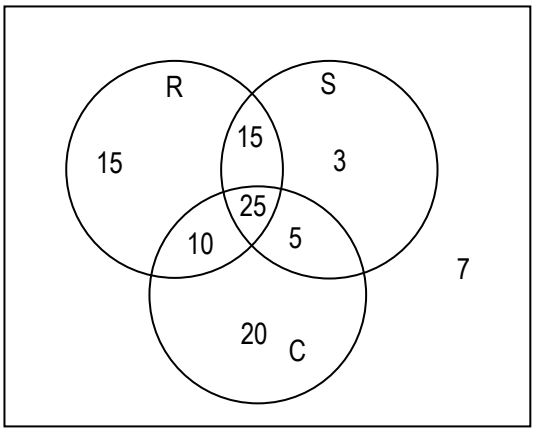
(d) M1 At least two correct terms required for method. M0 if probability is squared. Correct answer only, award M1 A1. Accept exact equivalent of 14 for A1.

(e) M1 for use of correct formula in both. 1.6 can be implied by correct final answer. Working needs to be clearly labelled to award first method mark without second stage of calculation.
If a new table for values of 7X – 5 is used, so Y = 7X – 5
$\mathrm{E}(Y^2)=\frac{9751}{21}$; $\mathrm{Var}(Y)=77\frac{5}{9}$ or $\frac{698}{9}$ or awrt 77.6 Award M1A1; M1A1
If any attempt to divide by 4 seen as part of working award M0 for that part.

Question Number	Scheme	Marks
4 (a)	60	B1 (1)
(b)	$Q_1 = 46$ $Q_2 = 56$ $Q_3 = 64$	B1 B1 B1 (3)
(c)	mean = 55.48…. or $\frac{2497}{45}$ awrt 55.5	B1
	sd = $\sqrt{\frac{143369}{45} - \left(\frac{2497}{45}\right)^2}$	M1
	= 10.342… (s = 10.459..) anything which rounds to 10.3 (or s = 10.5)	A1 (3)
(d)	Mean < median < mode or $Q_2 - Q_1 > Q_3 - Q_2$ with or without their numbers or median closer to upper quartile (than lower quartile) or (mean-median)/sd <0;	B1
	negative skew;	B1dep (2)
(e)	mean = $(55-5)\times 0.9$	M1
	= 45	A1
	sd = 10×0.9	M1
	= 9	A1 (4) **Total 13**
NOTES		
(a)	B1 60 only	
(b)	Award each B1 for correct answer only in this order.	
(c)	M1 for use of correct formula, including square root. Correct answers with no working B1M1A1.	
(d)	B1 any correct comparison of a pair of mean, median and mode using their values. B1 for 'negative skew' or allow (almost) symmetrical dependent upon correct reason.	
(e)	M1 for (55 or 55.5 - 5)×0.9 A1 for the correct answer only. M1 for (10 or 10.3 or 10.5))×0.9 A1 for the correct answer only.	

Question Number	Scheme	Marks
5 (a)	$S_{tt} = 2688 - \frac{158^2}{10} = 191.6$ awrt 192 $S_{tw} = 1760.62 - \frac{158 \times 111.75}{10} = -5.03$ awrt -5.03	M1 A1 A1 (3)
(b)	$r = \frac{-5.03}{\sqrt{191.6 \times 0.16}} = -0.908469\ldots$ awrt -0.908(5)	M1A1 (2)
(c)	$b = \frac{-5.03}{191.6} = -0.0263$ awrt -0.026 $a = 11.175 + 0.0263 \times 15.8$ $= 11.59$ $w = 11.6 - 0.0263t$	M1 A1 M1 A1 (4)
(d)	The explanatory variable is the age of each coin. This is because the age is set and the weight varies.	B1 B1 (2)
(e) (i)	awrt 11.5	B1
(ii)	Decrease(in weight of coin of 0.1052 g) = 0.1 or -0.1 or increase of -0.1 awrt(-0.1)	B1 (2)
(f)	Decrease; removing the fake will result in a better linear fit so *r* will be closer to -1	B1;B1 (2) **Total 15**
NOTES		
(a)	M1 for correct attempt at either method, A1 awrt 192 A1 awrt -5.03	
(b)	M1 for correct attempt at use of formula, square root required. A1 awrt -0.908(5)	
(c)	M1 require 'their -5.03' as numerator and /their 191.6' as denominator. A1 awrt -0.026 M1 for use of correct formula with *b* or 'their *b*'; require $--$ or + and values in the correct place. A1 for equation as written with values awrt 3 sf. with *w* and *t*. Accept fractional answers that are accurate to 3sf when evaluated as decimals	
(d)	B1 for 'Age' or *t* or 'years' B1 for 'you use age / t to predict w' or 'you can control t/ age' or 'weight depends on age' or similar	
(e)	B1 awrt 11.5 B1 awrt -0.1 but 'decrease of -0.1' is B0.	
(f)	B1 for Decrease only but 'mod r increases' explicitly stated in words or symbols award B1. B1 accept 'stronger correlation' or 'increase in correlation' or 'better linear fit' or ' *r* closer to -1' or 'points are closer to a straight line' or 'point is an outlier' or equivalent	

Special Case 1	Attempt to calculate S_{tw}		
	$\sum tw = 1669.62, \sum t = 153, \sum w = 91.75$ or $S_{tw} = 1660.62 - \frac{153 \times 91.75}{9}$ or awrt 101		
	or $S_{tw} > 0$ with some calculation	B1	
	"Increase"	B1	
			(2)
Special Case 2	Attempt to calculate S_{ww}		
	$\sum w^2 = 1248.96625 - 400 = 848.96625$ or awrt 849 or $S_{ww} = 848.96625 - \frac{91.75^2}{9}$		
	or awrt -86.4 or $S_{ww} < 0$	B2	
			(2)
Special Case 3	Argument based on standard deviation.		
	e.g. $\sigma_w \approx 0.126$ and $\overline{w} = 11.175$ so fake coin is over 69 sds away from the mean	B1	
	'(very) unlikely' or 'impossible'	B1	
			(2)

Question Number	Scheme	Marks
6 (a)	 3 closed curves and 25 in correct place 15,10,5 15,3,20 Labels *R, S ,C* and box	M1 A1 A1 B1
	All values/100 or equivalent fractions award accuracy marks.	(4)
(b)	7/100 or 0.07 M1 for ('their 7'in diagram or here)/100	M1 A1
		(2)
(c)	(3+5)/100 = 2/25 or 0.08	M1A1
		(2)
(d)	(25+15+10+5)/100 = 11/20 or 0.55	M1 A1
		(2)
(e)	$\mathrm{P}\left(S \cap C' \middle\vert R\right) = \frac{P\left(S \cap C' \cap R\right)}{P(R)}$ Require denominator to be 'their 65' or 'their $\frac{65}{100}$'	M1
	$= \frac{15}{65}$ require 'their 15' and correct denominator of 65	A1
	$= \frac{3}{13}$ or exact equivalents.	A1
		(3)
		Total 13

NOTES	
(b)	M1 for 'their 7'/100 seen. A1 Correct answer only In parts (c) and (d) we require "/100" for methods to be awarded. Also check their values and award correct method if they follow from their Venn Diagram.
(c)	M1 For ('their 3'+'their 5')/100. $\frac{8}{48}$ award M0. A1 Correct answer only or equivalent.
(d)	M1 Accept sum of their 4 values from the Venn diagram /100. A1 Correct answer only or equivalent
(e)	M1 Attempt to use correct formula for conditional probability. Award for correct formula and a denominator of 'their 65' or 'their 65/100'. A1 for 'their 15'/65 only. A1 for exact equivalent answers, including 15/65. In all parts correct answers with no working award full marks.

Question Number	Scheme	Marks
7 (a)	$P(W < 224) = P\left(z < \frac{224-232}{5}\right)$ $= P(z < -1.6)$	M1
	$= 1 - 0.9452$	M1
	$= 0.0548$ awrt 0.0548	A1
		(3)
(b)	$0.5 - 0.2 = 0.3$ 0.3 or 0.7 seen	M1
	$\frac{w-232}{5} = 0.5244$ 0.5244 seen	B1; M1
	$w = 234.622$ awrt 235	A1
		(4)
(c)	$0.2 \times (1-0.2)$	M1
	$2 \times 0.8 \times (1-0.8) = 0.32$	M1 A1
		(3)
		Total 10

NOTES

(a)

M1 for standardising with 232 and 5. (i.e. not 5^2 or $\sqrt{5}$) . Accept $\pm\frac{w-232}{5}$.

M1 for finding (1- a probability > 0.5)

A1 awrt 0.0548

(b)

M1 Can be implied by use of ± 0.5244 or $\pm$ (0.52 to 0.53)

B1 for ± 0.5244 only.

Second M1 standardise with 232 and 5 and equate to z value of (0.52 to 0.53) or (0.84 to 0.85)

1 – z used award second M0.

Require consistent signs i.e. $\frac{232-w}{5} = -0.5244$ or negative z value for M1.

A1 dependent upon second M mark for awrt 235 but see note below.

Common errors involving probabilities and not z values:

P(Z<0.2) = 0.5793 used instead of z value gives awrt 235 but award M0B0M0A0

P(Z<0.8) = 0.7881 used instead of z value award M0B0M0A0.

M1B0M0A0 for 0.6179, M1B0M0A0 for 0.7580

(c)

M1 for 0.16 seen

M1 for '$2\times p(1-p)$'

A1 0.32 correct answer only

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