

GCE 2005

January Series



Mark Scheme

Mathematics A

(MAS3)

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Key to Mark Scheme

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 or F	follow through from previous incorrect result	
CAO	correct answer only	
AWFW	anything which falls within	
AWRT	anything which rounds to	
AG	answer given	
SC	special case	
OE	or equivalent	
A2,12 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	
c	candidate	
SF	significant figure(s)	
DP	decimal place(s)	

Abbreviations used in Marking

MC – x	deducted x marks for mis-copy
MR – x	deducted x marks for mis-read
ISW	ignored subsequent working
BOD	given benefit of doubt
WR	work replaced by candidate
FB	formulae booklet

Application of Mark Scheme

No method shown:

Correct answer without working	mark as in scheme
Incorrect answer without working.....	zero marks unless specified otherwise

More than one method/choice of solution:

2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only

Crossed out work

do not mark unless it has not been replaced

Alternative solution using a correct or partially correct method

award method and accuracy marks as appropriate

MAS3

Q	Solution	Marks	Total	Comments
1	$H_0 : \mu_X = \mu_Y$ $H_1 : \mu_X > \mu_Y$ Under H_0 , $\bar{X} - \bar{Y} \sim N\left(0, \frac{5^2}{10} + \frac{5^2}{8}\right)$ $= N(0, 5.625)$ Critical value of z is 1.6449 Sample value of z is $\frac{3.75}{\sqrt{5.625}} = 1.58$ $1.58 < 1.6449$ so accept H_0 Not enough evidence to support Vikram's theory.	B1 M1 A1 A1 B1 M1A1F A1F	8	both addition of two variances correct divisors ft on standard error ft on test stat
Total			8	
2(a)	$\hat{\mu} = \frac{3030}{10} = 303$ $\hat{\sigma}^2 = \frac{148}{9}$ $= 16.44$	B1 B1	2	AWRT 16.4
(b)(i)	$\nu = 10 - 1 = 9$ 98% interval: $t = 2.821$ Confidence limits for μ are $303 \pm 2.821 \sqrt{\frac{16.44}{10}}$ giving (299, 307)	B1 B1 M1 A1 A1	5	(299.4, 306.6)
(ii)	$\chi^2 = 2.088, 21.666$ Confidence limits for σ^2 are $\frac{9 \times 16.44}{21.666}, \frac{9 \times 16.44}{2.088}$ giving (6.83, 70.9) 98% confidence interval for σ is (2.61, 8.42)	B1 M1 A1A1 A1F	5	both with their value of s (6.81 – 6.83, 70.7 – 70.9) ft on CI for variance
(c)	If mean is as low as 299 and SD is as high as 8.42 270 is more than 3 SDs below mean so claim is unlikely to be justified.	B1 B1 E1	3	uses bottom of mean CI; uses top of variance CI; valid deduction.
Total			15	

MAS3 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$f(t) = \begin{cases} 0.2e^{-0.2t} & t \geq 0, \\ 0 & \text{otherwise} \end{cases}$	B1 B1	2	$0.2e^{-0.2t}$ $t \geq 0$ and zero range
(ii)	$f(t) = \int_0^t 0.2e^{-0.2x} dx$ $= \left[-e^{-0.2x} \right]_0^t = 1 - e^{-0.2t}$	M1 A1	2	integrates pdf integration and limits
(iii)	$P(2 \leq T \leq 8) = F(8) - F(2)$ $= (1 - e^{-1.6}) - (1 - e^{-0.4})$ $= 0.7981 - 0.3297$ $= 0.468$	M1 A1 A1	3	or $e^{-0.4} - e^{-1.6}$ AWRT; CAO
(b)(i)	$P(T > 10) = 1 - F(10)$ $= e^{-2} = 0.135$	M1 A1	2	AWRT; CAO
(ii)	$0.15 + 0.85 \times P(T \leq 5)$ $= 0.15 + 0.85(1 - e^{-1})$ $= 0.687$	M1 A1 A1	3	or $1 - 0.85 \times P(T > 5)$ $= 1 - 0.85 \times e^{-1}$ AWRT $= 0.687$
Total			12	
4(a)(i)	Sign test.	B1	1	
(ii)	Only direction of changes is known not the size.	E1	1	
(b)	$H_0: p = P(\text{feel better}) = 0.5$ $H_1: p > 0.5$ Omit patient who said, “no change”: $n = 11$ $X =$ number who feel better. Under H_0 , $X \sim B(11, 0.5)$ Sample value of X is 9 $P(X \geq 9) = P(X \leq 2)$ $= 0.0327$ $0.0327 < 5\%$ so reject H_0 The evidence supports the therapist’s belief.	B1 B1 B1 B1 M1 A1 A1F	7	both; OE may be implied; condone $n = 12$ AWRT ft on appropriate probability
Total			9	

MAS3 (cont)

Q	Solution	Marks	Total	Comments
5(a)	$H_0: \sigma_X = \sigma_Y$ or $\sigma_X^2 = \sigma_Y^2$ $H_1: \sigma_X \neq \sigma_Y$ or $\sigma_X^2 \neq \sigma_Y^2$ $\nu_1 = 6, \nu_2 = 8$ Critical value of F is 3.581 Sample statistic is $\frac{9.88}{6.24}$ $= 1.58$ $1.58 < 3.581$ so accept H_0 . Reasonable to believe that $\sigma_X = \sigma_Y$	B1 B1 B1 M1 A1 E1	6	both CAO AWRT
(b)(i)	Pooled estimate of variance is $\frac{(6 \times 9.88) + (8 \times 6.24)}{7 + 9 - 2}$ $= 7.8$ $\nu = 14$ Critical value of t is 2.145 $\bar{x} - \bar{y} = 19.4 - 15.9 = 3.5$ Confidence limits for $\mu_X - \mu_Y$ are $3.5 \pm 2.145 \sqrt{7.8} \sqrt{\frac{1}{7} + \frac{1}{9}}$ giving (0.481, 6.52)	M1 A1 B1 B1 M1 A2	8	CAO AWRT
(ii)	All of confidence interval is above 0 Supports Katy's belief.	E2	2	E1 for zero not in CI
	Total		16	
	Total		60	