GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics and Statistics B
(MBS5)

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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
A2,1 ..... 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
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

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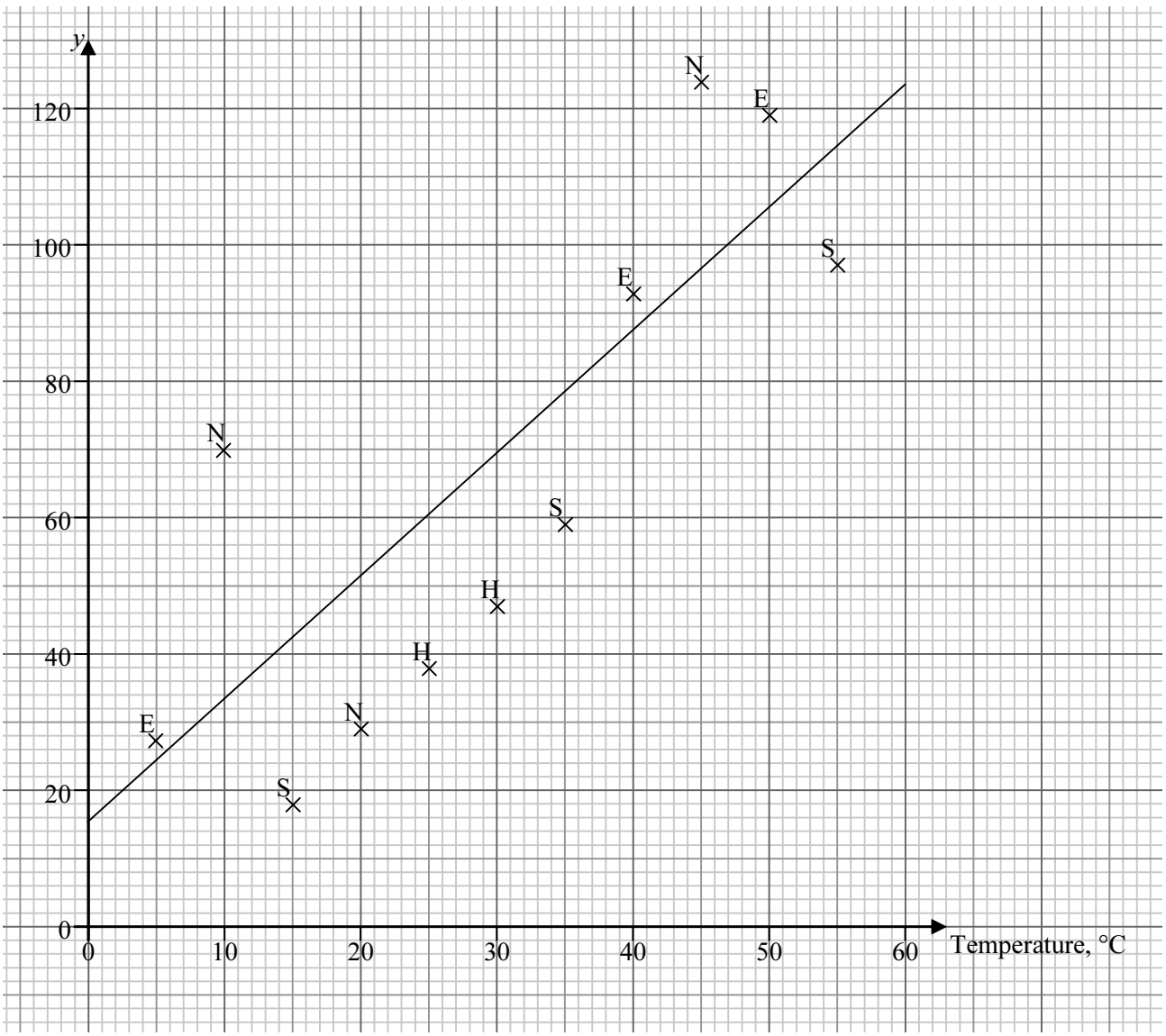
Question Number and Part	Solution	Marks	Total	Comments
1(a)	$r = 0.552$	B3	3	0.552 (0.551 ~ 0.552) allow M2 A1 if method shown allow B2 for (0.55 ~ 0.553)
(b)	Tendency for large value of x to be associated with large values of y.	E1		large values of x associated with large values of y or equivalent
	Evidence not very strong.	E1	2	evidence not strong
	Total		**5**	
2(a)(i)	$z = \frac{500-506}{5} = -1.2$	M1		method for z - ignore sign
	probability < 500 = 1 – 0.88493	M1		any correct use of normal tables - generous
	= 0.115	A1	3	0.115 (0.1145 ~ 0.1155)
(ii)	$z_1 = \frac{495-506}{5} = -2.2$			
	$z_2 = \frac{505-506}{5} = -0.2$	M1 m1		method both z's ignore sign both signs correct
	probability between 495 and 505			
	= 0.98610 – 0.57926	M1		completely correct method
	= 0.407	A1	4	0.407 (0.406 ~ 0.4075)
(b)	506 – 3.0902 × 5 = 490.5g	B1		3.0902 or 3.09
		M1		(their z) × 5
		m1		completely correct method
		A1	4	490.5 (490 ~ 491)
(c)	$498 + 1.2816 \times \frac{5}{\sqrt{n}} < 500$	B1 M1		1.2816 or 1.282 or 1.28 reasonable attempt at expression involving n
	$\sqrt{n} > 1.2816 \times \frac{5}{2}$	m1		completely correct expression involving n allow incorrect z-value, allow </>/ =
	$n > 3.204^2$			
	$n > 10.26$	m1		method of solution, allow n = / < 10.26
	Anu must select 11 jars	A1	5	11 cao, allow > 10
	Total		**16**	

MBS5 (cont)

Graph for Question 3



MBS5 (cont)

Question Number and Part	Solution	Marks	Total	Comments
3(a)	see graph on previous page	B1 M1 A1	 3	scales and labels method for scatter diagram accurate plot by eye, allow one small slip
(b)	$y = 15.65 + 1.80x$	B2 B1		15.65 (15.6 ~ 15.7) 1.80 (1.795 ~ 1.805) allow M1 m1A1 if method shown
	$x = 0$ $y = 15.6$ $x = 60$ $y = 123.7$	M1 A1	 5	method for line A1 correct line by eye
(c)(i)	non-linear, erratic	E1		
(ii)	Both Sita and Elizabeth consistent with linear relationship, Elizabeth consistently higher estimate of y than Sita	E1 E1	 3	both linear Elizabeth higher
(d)(i)		B1	1	accurate plot
(ii)	Sita's results consistent with Herbert's	E1	1	Sita consistent with Herbert
(iii)	107	B1	1	107 (100 ~ 110)
(iv)	involves extrapolation	E2	2	extrapolation
(v)	Herbert to carry out trial at 60^0C. Use his value.	E1 E1	 2	Herbert reasonable suggestion
	Total		**18**	
4(a)(i)	$0.15 \times 0.30 = 0.045$	B1	1	0.045 cao
(ii)	$0.25 \times (0.18 + 0.24) = 0.105$	M1 M1 A1	 3	method for Hughes 2 or more 0.25 times their Hughes 2 or more 0.105 cao
(iii)	$0.15 \times 0.24 + 0.25 \times (0.18 + 0.24)$ $+ 0.20 \times (0.28 + 0.18 + 0.24) + 0.4 = 0.681$	M1 M1 m1 A1	 4	reasonable attempt at enumerating possibilities correct expression for at least 2 possibilities completely correct method - allow 1 slip A1 0.681 cao
(b)(i)	$0.4 + 0.15 \times 0.24 = 0.436$	M1 m1 A1	 3	reasonable attempt to enumerate possibilities completely correct method 0.436 cao
(ii)	$0.15 \times (0.28 + 0.18 + 0.24)$ $+ 0.25 \times (0.18 + 0.24) = 0.21$	M1 M1 m1 A1	 4	reasonable attempt to enumerate possibilities correct expression for one (out of 2) possibilities completely correct method 0.21 cao
	Total		**15**	

MBS5 (cont)

Question Number and Part	Solution	Marks	Total	Comments
5(a)	$x = \frac{4256}{400} = 10.64$	B1		10.64 allow 10
	95% confidence interval for mean			
	$10.64 \pm 1.96 \times \frac{3.68}{\sqrt{400}}$	B1 M1		1.96 use of $3.68/\sqrt{400}$
	10.64 ± 0.361	m1		correct method for interval - their mean - allow incorrect z-value
	(10.28, 11.00)	A1	5	10.28 (10.275 ~ 10.3) and 11.00 (10.995 ~ 11.005) or 10.64 cao ± 0.361 (0.36 ~ 0.361)
(b)(i)	$x = \frac{2342}{200} = 11.71$			
	95% confidence interval for mean			
	$11.71 \pm 1.96 \times \frac{3.42}{\sqrt{200}}$	M1		completely correct method
	11.71 ± 0.474			
	(11.24 , 12.18)	A1	2	11.24 (11.2 ~ 11.3) and 12.18 (12.15 ~ 12.2) **or** 11.71 (11.7 ~ 11.71) ± 0.474 (0.473 ~ 0.475)
(ii)	Since confidence intervals for mean before and after the offer do not overlap	E1√		confidence intervals do not overlap
	there is strong evidence that the mean has increased	E1	2	correct conclusion based on correct calculation and reason
(iii)	Have **total** sales of petrol increased?			
	How much does the scheme cost? Have other sales increased? etc	E1 E1	2	Any sensible point A second sensible point
	Total		**11**	

MBS5 (cont)

Question Number and Part	Solution	Marks	Total	Comments
6(a)	$H_0\ \mu = 18$	B1		one correct hypothesis - generous
	$H_1\ \mu \neq 18$	B1		both correct - ungenerous
	$x = 32.11$	B1		32.1 (32.05 ~ 32.15)
	$z = \dfrac{32.11-18}{\frac{17}{\sqrt{11}}} = 2.75$	M1 A1		correct method for z 2.75 (2.75 ~ 2.755)
	critical values are ± 1.96	B1√		ft ±1.96, ignore sign
	reject H_0 significant evidence mean not equal to (greater than) 18	A1√	7	reject H_0, must be compared with correct tail of z.
(b)(i)	$H_0\ \mu = 18$ - no change	B1		no change
(ii)	$H_1\ \mu < 18$	B1		$\mu < 18$
(iii)	–1.6449	B1		–1.6449 or –1.645 or –1.64 or –1.65
(iv)	Accept H_0 mean equals 18	B1	4	correct conclusion based on correct answers to (i),(ii) and (iii)
(c)(i)	$H_0\ \mu = 18$ - no change	B1		no change, allow $\mu \leq 18$
(ii)	$H_1\ \mu > 18$	B1		$\mu > 18$
(iii)	1.6449	B1		1.6449 or 1.645 or 1.64 or 1.65
(iv)	Reject H_0 significant evidence mean greater than 18	B1	4	correct conclusion based on correct answers to (i),(ii) and (iii)
	Total		**15**	
	TOTAL		**80**	