Version 1.0



**General Certificate of Education (A-level) 2011** 

**Mathematics** 

MS2B

(Specification 6360)

**Statistics 2B** 

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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#### **Key to mark scheme abbreviations**

M	mark is for method
m or dM	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
В	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
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
c	candidate
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 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 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.

## MS2B

1(a) $Y - N(\mu_T, 4)$ $n = 16, \overline{y} = 450$ $n = 1.96$ <td< th=""><th>Question</th><th>Solution</th><th>Marks</th><th>Total</th><th>Comments</th></td<>	Question	Solution	Marks	Total	Comments
$n=16, \overline{y}=450 $ $(known variance) \Rightarrow use z$ $For 95\% CI  z_{vir} = 1.96$ $450\pm 1.96 \times \frac{2}{\sqrt{16}} $ $450\pm 0.98$ $(449,451)$ $M1$ $N = N(\mu_x, \sigma^2)$ $(unknown variance) \Rightarrow use t_{s-1}$ $n=9  \overline{x} = \frac{4950}{9} = 550$ $s_{s-1}^2 = \frac{334}{8} = 41.75  (s_{s-1} = 6.461) $ $For 90\% CI  t_{vir} = 1.860$ $550\pm 1.860 \times \frac{\sqrt{41.75}}{\sqrt{9}}$ $M1$ $(546.554)$ $M1$ $(546.554)$ $M1$ $(546.554)$ $M1$ $(546.554)$ $M1$ $(546.554)$ $M1$ $(546.554)$ $M1$ $(545 \text{ not in } 90\% CI$ $\therefore \text{ Reject claim}$ $\text{Evidence to suggest that mean content of a bottle of tomato sauce is not 545 grams and hence to reject Holly's claim at 10% level of significance.  (60p) \text{ on } (60p) $	<b>1</b> (a)				
$(known variance) \Rightarrow use z$ $For 95\% CI  z_{om} = 1.96$ $450 \pm 1.96 \times \frac{2}{\sqrt{16}}$ $450 \pm 0.98$ $(449,451)$ $A1  3  awrt$ $(b)(i)  X \sim N(\mu_X, \sigma^2)$ $(unknown variance) \Rightarrow use t_{n-1}$ $n = 9  \overline{x} = \frac{4950}{9} = 550$ $s_{n-1}^2 = \frac{334}{8} = 41.75  (s_{n-1} = 6.461)$ $For 90\% CI  t_{ow} = 1.860$ $B1$ $550 \pm 1.860 \times \frac{\sqrt{41.75}}{\sqrt{9}}$ $M1$ $(546,554)$ $A1  5  awrt$ $(ii)  545 \text{ not in } 90\% CI$ $\therefore \text{ Reject claim}$ $\text{Evidence to suggest that mean content of a bottle of tomato sauce is not 545 grams and hence to reject Holly's claim at 10% level of significance.  (b)(i)  B1 Alternative  H_{ij} \mu_X = 545 H_{ij} \mu_X = $		$Y \sim N(\mu_Y, 4)$			
For 95% CI $z_{coi} = 1.96$ $450 \pm 1.96 \times \frac{2}{\sqrt{16}}$ $450 \pm 0.98$ $(449.451)$ $A1$ $3 \text{ awrt}$ $(b)(i)  X - N(\mu_X, \sigma^2)$ $(unknown variance) \Rightarrow use \ t_{n-1}$ $n = 9  \&  \overline{x} = \frac{4950}{9} = 550$ $s_{n-1}^2 = \frac{334}{8} = 41.75  (s_{n-1} = 6.461)$ $For 90\% \text{ CI }  t_{coin} = 1.860$ $550 \pm 1.860 \times \frac{\sqrt{41.75}}{\sqrt{9}}$ $550 \pm 4.0$ $(546.554)$ $A1$ $A1$ $(546.554)$ $A1$ $A1$ $A1$ $(640 \text{ on } (b)(i))$ $545 \text{ not in } 90\% \text{ CI } (b)(i)$ $A16 \text{ or } (b)(i)$ $A17 \times (b)(i)$ $A18 \times (b)(i)$ $A19 \times (b)(i)$ $A10 \times (b)(i)$ $A11 \times (b)(i)$ $A11$		$n=16,  \overline{y}=450 $			
		(known variance) $\Rightarrow$ use z			
$(449,451) \qquad \qquad \text{Al} \qquad 3 \qquad \text{awrt}$ $(b)(i) \qquad X - N(\mu_X, \sigma^2) \qquad \qquad$		For 95% CI $z_{crit} = 1.96$	В1		
(b)(i) $X \sim N(\mu_x, \sigma^z)$ (unknown variance) $\Rightarrow$ use $t_{n-1}$ $n=9$ & $\overline{x}=\frac{4950}{9}=550$ $s_{n-1}^2=\frac{334}{8}=41.75$ ( $s_{n-1}=6.461$ ) B1 both  For 90% CI $t_{cm}=1.860$ B1 $550\pm1.860\times\frac{\sqrt{41.75}}{\sqrt{9}}$ M1 $ \begin{cases} their \overline{x}\pm t_s\times\frac{their s_{n-1}}{\sqrt{9}}\\ (must have a t_s-value) \end{cases} $ $550\pm4.0$ A1ft A1 5 awrt  (ii) $545$ not in 90% CI $t_{cm}=1.860$ A1ft (dep on Evidence to suggest that mean content of a bottle of tomato sauce is not $545$ grams and hence to reject Holly's claim at $10\%$ level of significance.  B1 $ \begin{cases} A1 & 3 \\ both \end{cases} $ $A1 & 5 \\ awrt \end{cases} $ $A1 & 5 \\ awrt \end{cases} $ $A1 & 5 \\ awrt $ $A1 & 6 \\ awrt $ $A2 & 6 \\ awrt $ $A3 & 6 \\ awrt $ $A2 & 6 \\ awrt $ $A3 & 6 \\ awrt $ $A2 & 6 \\ awrt $ $A3 & 6 \\ awrt $ $A4 & 6 \\ awrt $ $A2 & 6 \\ awrt $ $A3 & 6 \\ awrt $ $A4 & 6 \\ awrt $ $A2 & 6 \\ awrt $ $A3 & 6 \\ awrt $ $A4 & 6 \\ awrt $ $A4 & 6 \\ awrt $ $A2 & 6 \\ awrt $ $A3 & 6 \\ awrt $ $A4 &$			M1		
(unknown variance) $\Rightarrow$ use $t_{n-1}$ $n=9$ & $\overline{x}=\frac{4950}{9}=550$ $s_{n-1}^2=\frac{334}{8}=41.75$ ( $s_{n-1}=6.461$ )  For 90% CI $t_{crit}=1.860$ B1 $550\pm1.860\times\frac{\sqrt{41.75}}{\sqrt{9}}$ M1 $550\pm4.0$ Alft  (546,554)  A1 $total = \frac{1}{8}$ Alternative  Alternative  Alternative  (dep on (b)(i))  B1  Alternatives (such as):  Claim justified at 1% level of significance  Claim significance  Satisfy and some significance level  Alternative $t_{n-1}$ B1  Alternative $t_{n-1}$ B1  Alternative $t_{n-1}$ Comment in context  E1  10% significance level  B1 $t_{crit} = 3.355 > 2.32$ Accept $t_{n-1}$ 1% significance level		(449,451)	A1	3	awrt
	(b)(i)	$X \sim N(\mu_X, \sigma^2)$			
		(unknown variance) $\Rightarrow$ use $t_{n-1}$			
For 90% CI $t_{crit} = 1.860$ $550 \pm 1.860 \times \frac{\sqrt{41.75}}{\sqrt{9}}$ M1  M1 $550 \pm 4.0$ (546,554)  A1ft  A1 $5 = \text{awrt}$ Alternative  H <sub>0</sub> : $\mu_x = 545$ H <sub>1</sub> : $\mu_x \neq 545$ t = $\frac{550 - 545}{\sqrt{41.75}} = 2.32$ Reject claim  at 10% level of significance.  B1ft (dep on (b)(i))  B1ft (dep on (b)(i))  B1  Alternative  H <sub>0</sub> : $\mu_x = 545$ H <sub>1</sub> : $\mu_x \neq 545$ t = $\frac{550 - 545}{\sqrt{41.75}} = 2.32$ Reject H <sub>0</sub> Comment in context  E1  Alternatives (such as):  Claim justified at 1% level of significance level  B1  3  10% significance level  B1 $t_{crit} = 3.355 > 2.32$ Accept H <sub>0</sub> 1% significance level			R1		hoth
$550\pm1.860\times\frac{\sqrt{41.75}}{\sqrt{9}}$ $550\pm4.0$ $(546,554)$ Alft $A1$ $545 \text{ not in } 90\% \text{ CI}$ $\therefore \text{ Reject claim}$ Evidence to suggest that <b>mean</b> content of a bottle of tomato sauce is not 545 grams and hence to reject Holly's claim at <b>10% level of significance</b> .  B1ft (dep on (b)(i))  E1ft (dep on (b)(i))  B1 $Alternative$ $(dep on (b)(i))$ B1 $Alternative H_0: \mu_x = 545$ $H_1: \mu_x \neq 545$ $t = \frac{550 - 545}{\sqrt{41.75}} = 2.32$ $t_{crit} = 1.86 < 2.32$ $Reject H_0$ $Comment in context E1  B1  Alternatives (such as):  Claim justified at 1% level of significance level  10% significance level$		$s_{n-1}^2 = \frac{334}{8} = 41.75  (s_{n-1} = 6.461)$	Бī		botti
(ii) $550 \pm 4.0$ A1ft  (546,554) A1 5 awrt  Alternative  H <sub>0</sub> : $\mu_{\chi} = 545$ H <sub>1</sub> : $\mu_{\chi} \neq 545$ Evidence to suggest that mean content of a bottle of tomato sauce is not 545 grams and hence to reject Holly's claim at 10% level of significance.  B1ft (dep on (b)(i))  E1ft (dep on (b)(i))  B1 1  Alternative  H <sub>0</sub> : $\mu_{\chi} = 545$ H <sub>1</sub> : $\mu_{\chi} \neq 545$ $t = \frac{550 - 545}{\sqrt{41.75}/9} = 2.32$ Reject H <sub>0</sub> Comment in context  E1  Alternatives (such as):  Claim justified at 1% level of significance  Claim justified at 1% level of significance level		For 90% CI $t_{crit} = 1.860$	В1		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$550 \pm 1.860 \times \frac{\sqrt{41.75}}{\sqrt{9}}$	M1		
(ii) 545 not in 90% CI  ∴ Reject claim Evidence to suggest that mean content of a bottle of tomato sauce is not 545 grams and hence to reject Holly's claim at 10% level of significance.  B1ft (dep on (b)(i))  E1ft (dep on (b)(i))  B1 (dep on (b)(i))  B1 (dep on (b)(i))  B1 (dep on (b)(i))  Comment in context  E1  10% significance level  B1  Alternative  H <sub>0</sub> : $\mu_x = 545$ H <sub>1</sub> : $\mu_x \neq 545$ $t = \frac{550 - 545}{\sqrt{41.75/9}} = 2.32$ Reject H <sub>0</sub> Comment in context  E1  10% significance level  B1  Alternative  H <sub>0</sub> : $\mu_x = 545$ H <sub>1</sub> : $\mu_x \neq 545$ $t = \frac{550 - 545}{\sqrt{41.75/9}} = 2.32$ Reject H <sub>0</sub> Comment in context  E1  10% significance level  B1  Alternatives (such as):  Claim justified at 1% level of significance level		$550 \pm 4.0$	A1ft		
(ii) 545 not in 90% CI  ∴ Reject claim Evidence to suggest that mean content of a bottle of tomato sauce is not 545 grams and hence to reject Holly's claim at 10% level of significance.  B1ft (dep on (b)(i))  E1ft (dep on (b)(i))  E1ft (dep on (b)(i))  B1  Alternatives (such as):  Claim justified at 1% level of significance  B1ft (dep on (b)(i))  E1ft (dep on (b)(i))  B1  3  H <sub>0</sub> : $\mu_x = 545$ H <sub>1</sub> : $\mu_x \neq 545$ E1ft (dep on (b)(i))  Comment in context  E1  10% significance level  B1  Accept H <sub>0</sub> 1% significance level		(546,554)	A1	5	awrt
claim at 10% level of significance. E1ft (dep on (b)(i))  B1  Comment in context  E1  Alternatives (such as):  Claim justified at 1% level of significance  E1ft (dep on (b)(i))  B1  Tomment in context $t_{crit} = 1.86 < 2.32$ Reject $H_0$ Comment in context  E1 $t_{crit} = 3.355 > 2.32$ Accept $H_0$ 1% significance level	(ii)	∴ Reject claim Evidence to suggest that <b>mean</b> content of a bottle of tomato sauce is not	(dep on		$H_0: \mu_X = 545$ $H_1: \mu_X \neq 545$ $t = \frac{550 - 545}{\sqrt{41.75/9}} = 2.32$
Alternatives (such as): $t_{crit} = 3.355 > 2.32$ Claim justified at 1% level of significance $1\% \text{ significance level}$ B1 $t_{crit} = 3.355 > 2.32$ Accept $H_0$ $1\% \text{ significance level}$			(dep on		Reject $H_0$
Claim justified at 1% level of significance			B1	3	
Claim justified at 1% level of significance  Accept H <sub>0</sub> 1% significance level		Alternatives (such as):			t = 3 355 > 2 32
significance 1% significance level		Claim justified at 10/ level of			
		Total		11	

Ques	`	Solution		Marks	Total	Comments
Ques	2(a)	Solution		IVIAI NS	1 Ulai	Comments
	_(**)	C         L         LD         OP           M         156         144         120         60           F         216         135         108         81           Tot         372         279         228         141	Tot 480 540 1020	B1 B1	2	For each correct row
	(b)	<ul> <li>H<sub>0</sub>: No association between gen and the way students vote</li> <li>H<sub>1</sub>: Association between gender and the way students vote</li> </ul>		B1		For at least $H_0$ correct
		$\begin{array}{c ccccc} O_i & E_i & \left(O_i - E_i\right)^2 / E_i \\ \hline 156 & 175.06 & 2.075 \\ \hline 216 & 196.94 & 1.844 \\ \hline 144 & 131.29 & 1.230 \\ \hline 135 & 147.71 & 1.093 \\ \hline 120 & 107.29 & 1.505 \\ \hline 108 & 120.71 & 1.337 \\ \hline 60 & 66.35 & 0.608 \\ \hline 81 & 74.65 & 0.541 \\ \hline \end{array}$		M1 M1 M1		Attempt at $E_i$ Attempt at $(O_i - E_i)^2 / E_i$ Attempt at $\sum \left(\frac{(O_i - E_i)^2}{E_i}\right)$
		$X^{2} = 10.233$ $V = 3 \implies \chi_{crit}^{2} = 11.345$		A1 B1		awfw 10.2 to 10.3 (A1 dependent on all 3 method marks)
		$X^2 < \chi^2_{crit}$ : accept $H_0$ Accept claim at 1% level.	udonto	B1ft A1		ft on their v value
		Evidence to suggest that the way st vote is independent of gender.	Total	E1	9	

Question	Solution	Marks	Total	Comments
3(a)(i)	$X \sim P_o(0.6)$			
	$P(X \le 1) = 0.8781$	B1	1	Awrt 0.878
(ii)	For matches: The number of run outs: $Y \sim P_0(0.15)$ $P(Y \ge 1) = 1 - P(Y = 0)$			
	$= 1 - e^{-0.15} $ $= 1 - 0.8607$	M1		must <b>use</b> $P_0(0.15)$
	= 0.1393	A1		awrt 0.139
	$P(X \le 1 \text{ and } Y \ge 1) = 0.8781 \times 0.1393$ = 0.122	M1 A1	4	their (a)(i)×their $P(Y \ge 1)$ awrt
(b)	<ul><li>X and Y are independent.</li><li>Number of catches and runouts independent</li></ul>	В1	1	
(c)(i)	For Season: $S \sim P_o(9.6)$ $P(S=10) = \frac{e^{-9.6} \times 9.6^{10}}{10!}$	M1		Use of $\lambda = 9.6$ in correct Poisson expression
	= 0.124	A1	2	
(ii)	$T \sim P_o(9.6 + 2.4) = P_o(12)$	B1		$P_o$ (12) used or seen
	$P(T \ge 15) = 1 - P(T \le 14)$ $= 1 - 0.7720$ $= 0.228$	B2,1	3	(1-0.8444 = 0.155 to 0.156) <b>B1</b>
	Total		11	

Question	Solution	Marks	Total	Comments
<b>4(a)(i)</b>	$E(X) = \sum_{x} x \times P(X = x) = 2.8$	B1		
	$E(X^2) = \sum_{x} x^2 \times P(X = x) = 9$			
	$Var(X) = 9 - 2.8^2$	M1		$\left(\text{their E}\left(X^{2}\right) - \text{their E}^{2}\left(X\right)\right)$
	=1.16	A1	3	cao
(ii)	$E(C) = 2 \times E(V) = 9.4$	D16		on their E(V)
(n)	$E(S) = 3 \times E(X) = 8.4$	B1ft		on their $E(X)$
	$Var(S) = 3 \times Var(X) = 3.48$	B1ft	2	$3 \times \text{ their Var}(X) \text{ from (i)} > 0$
				NB There was a problem with part 4(a)(ii) which affected the marking of this part.  Please see the Report on the Examination for details.
(b)	E(Y) = 3.5			
	$E(Y^2) = 13$	B1		for $E(Y)$
	$Var(Y) = 13 - 3.5^2 = 0.75$	M1		on their $E(Y)$ and $E(Y^2)$
		A1ft		Var(Y) > 0
	$E(T) = 3 \times E(Y) = 10.5$	B1		cao
	$Var(T) = 3^2 \times Var(Y)$			
	$=9\times0.75$	M1		$9 \times \text{their } Var(Y) > 0$
	= 6.75	A1		cao
	Alternative:			
	T 3 6 9 12			
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	(M1A1)		
	$E(T^2)$ %20 72/20 243/20 2016/20 117			
		(M1A1)		
	$\operatorname{Var}(T) = \operatorname{E}(T^{2}) - \left\lceil \operatorname{E}(T) \right\rceil^{2}$			
	$=117-10.5^{2}$	(M1)		(used)
	= 6.75	(A1)	6	

Question	Solution	Marks	Total	Comments
4(c)(i)	P(X>1) = 0.8	B1	1	
(ii)	$P(T=3) = \frac{1}{20} \text{ and } P(T=3 \text{ or } 6) = \frac{3}{20}$ $P(X+T \le 9 \text{ and } X > 1)$ $= P([2,3 \text{ or } 6],[3,3 \text{ or } 6],[4,3])$ $= 0.1 \times \frac{3}{20} + 0.4 \times \frac{3}{20} + 0.3 \times \frac{1}{20}$ $= 0.015 + 0.06 + 0.015$ $= 0.09$	B4	4	Alternative: $P(T=3) = \frac{1}{20} \text{ and } P(T=6) = \frac{2}{20}$ $P(X+T \le 9 \text{ and } X > 1)$ $= P([(2,3,4),3],[(2,3),6])$ $= 0.8 \times \frac{1}{20} + 0.5 \times \frac{2}{20}$ $= 0.04 + 0.05 = 0.09$ sc [any 4 correct p's from table B2] $[0.12 \text{ B3}] [0.096 \text{ or } 0.072 \text{ B2}]$ $\begin{cases} P(T=3) = \frac{1}{20} \text{ and } P(T=3 \text{ or } 6) = \frac{3}{20} \\ P(T=3) = \frac{1}{20} \text{ and } P(T=6) = \frac{2}{20} \end{cases}$ B1
(iii)	$P(X+T \le 9   X > 1) = \frac{0.09}{0.80}$ $= \frac{9}{80} (0.1125)$	M1 A1	2	$\frac{\text{their (c)(ii)}}{0.80} \ \ (0  cao$
	Total		18	

Question	Solution	Marks	Total	Comments
5(a)(i)	$H_0: \mu = 165$	D.1		
	$H_1: \mu > 165$	B1	1	
(::)				
(ii)	David (5%) James (1%)			
		M1		
	$z = \frac{167.1 - 165}{\sqrt{101.2}/\sqrt{1000}}$	A1		awfw 2.08 to 2.09
	/10 = 2.09	711		uwiw 2.00 to 2.0)
	$z_{crit} = 1.6449$ $z_{crit} = 2.3263$	D1		(h a 4h)
	$(t_{crit} = 1.660)$ $(t_{crit} = 2.364)$	B1		(both)
	Reject H <sub>0</sub> Accept H <sub>0</sub>	A1		(both) dependent on M1
	Evidence (a)			
	Evidence to Suggest that the Suggest an	E1		
	mean height of increase in the	E1		
	students in final mean height of year has increased final year			
	at 5% level students at 1%		_	
	level		6	
(iii)	Population not stated as being Normal			Large sample size of 100
(111)	/ not known.	B1	1	indicates that the distribution
				of the sample mean is very
	Heights of all students may not be			likely to be Normal even though <b>the parent population</b>
	Normal/ Known			not given as being Normal.
				Hence $\overline{X} \sim N(\mu, s^2/n)$
				(* / n)
(b)(i)	David: $\mu = 165$			
	∴ rejected $H_0$ when $H_0$ correct			
	⇒ Type I error	M1		
		A1		
(ii)	James:			
	$\mu = 165$			
	$\therefore$ accepted $H_0$ when $H_0$ correct	M1		
	⇒ No error	A1	4	
	Total	<u> </u>	12	

Question	Solution	Marks	Total	Comments
6(a)	0.1 + f(x)			B1 for concave curve from
	0.08			$(0,1)$ to $\left(\frac{1}{2},\frac{3}{32}\right)$
	0.04	D.C.		B1 for horizontal straight line
	2 4 6 8 10 12	В3	3	$f = \frac{3}{32} \operatorname{from} \left( \frac{1}{2}, \frac{3}{32} \right) \operatorname{to} \left( \frac{1}{2}, \frac{3}{32} \right)$
				B1 for correct axes
(b)(i)	$P\left(X \ge 8\frac{1}{3}\right) = \left[\frac{3}{32} \times \left(11 - 8\frac{1}{3}\right)\right]$ $= \frac{3}{32} \times \frac{8}{3}$	M1		Any correct method attempted in either part
	$=\frac{32}{4}$			
	$-\frac{1}{4}$	A1		AG
(ii)	$P(X \ge 3) = \frac{3}{32} \times (11 - 3)$			
	$=\frac{3}{4}$			Any correct method attempted
	$-\frac{1}{4}$	A1	3	AG
(c)(i)	Interquartile Range = $5\frac{1}{3}$	B1		cao
(ii)	Median = $5\frac{2}{3}$	B2		cao
	Alternative :		3	sc if B0 then: M1 for correct method seen
	$\left  \frac{1}{64} + \frac{3}{32} \left( m - \frac{1}{2} \right) \right  = \frac{1}{2}$			$\frac{1}{2} \left( 8\frac{1}{3} + 3 \right)$ or $\frac{1}{2} \times 11\frac{1}{3}$
	$\Rightarrow 3\left(m - \frac{1}{2}\right) = 15.5 \Rightarrow m = 5\frac{2}{3}$			or $\frac{3}{32}(11-m) = \frac{1}{2} \Rightarrow 11-5\frac{1}{3}$
(d)	$P[(X < m) \cap (X \ge 3)] = \frac{1}{4}$ $P(X < m   X \ge 3) = \frac{\frac{1}{4}}{\frac{3}{4}} = \frac{1}{3}$	B1		$\left(\frac{3}{4} - \frac{1}{2}\right)$ attempted
	$P(X < m   X \ge 3) = \frac{\frac{1}{4}}{\frac{3}{4}} = \frac{1}{3}$	M1		$\frac{\text{(their } p)}{\sqrt[3]{4}}  \text{for } 0$
		A1	3	cao
				Alternative:
				(Ratio of relevant two areas)
				$P(X < m   X \ge 3) = \frac{2\frac{2}{3}}{8} = \frac{1}{3}$
	Total		12	cao
	TOTAL		75	