

# Mark Scheme (Results)

January 2013

GCE Maths – Statistics S1 (6683/01)

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January 2013

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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.
- Unless indicated in the mark scheme a correct answer with no working should gain full marks for that part of the question.

## 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.

In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme.

### 3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used.

- bod – benefit of doubt
  - ft – follow through
  - the symbol  $\checkmark$  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
  - $\square$  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 incorrect answers should never be awarded A marks.
  5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
  - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
  - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.
7. Ignore wrong working or incorrect statements following a correct answer.
8. The maximum mark allocation for each question/part question(item) is set out in the marking grid and you should allocate a score of '0' or '1' for each mark, or "trait", as shown:

	0	1
aM		•
aA	•	
bM1		•
bA1	•	
bB	•	
bM2		•
bA2		•

**January 2013  
6683 Statistics S1  
Mark Scheme**

Question Number	Scheme	Marks
<b>1.</b>		
(a)	$(S_{tt}) = 8702 - \frac{258^2}{10} \quad \text{or} \quad (S_{gt}) = 1550.2 - \frac{258 \times 63.6}{10}$ $(S_{tt} =) 2045.6, \quad (S_{gt} =) -90.68 \quad \text{awrt (2046),} \quad \text{awrt } -90.7$	M1 A1, A1 (3)
(b)	$r = \frac{-90.68}{\sqrt{2045.6 \times 7.864}} = -0.714956... \quad \text{awrt } -0.715$	M1 A1 (2)
(c)	Positive e.g. high $v$ corresponds to low $t$ and low $t$ corresponds to high $g$ so expect high $v$ to corresponds to high $g$ <u>or</u> expect more revision to result in a better grade	B1 B1 (2)
<b>Notes</b>		
(a)	M1 for at least one correct expression 1 <sup>st</sup> A1 for $S_{tt} =$ awrt 2046 (Condone $S_{xx} = \dots$ or even $S_{yy} = \dots$ ) 2 <sup>nd</sup> A1 for $S_{gt} =$ awrt -90.7 (Condone $S_{xy} = \dots$ )	
(b)	M1 for attempt at correct formula. Must have their $S_{tt}$ , $S_{gt}$ and given $S_{gg}$ in the correct places. Condone missing “-” Award M1A0 for awrt -0.71 with no expression seen M0 for $\frac{1550.2}{\sqrt{8702 \times 7.864}}$ Correct answer only is 2/2	
(c)	1 <sup>st</sup> B1 for saying "positive". Ignore mention of skew. 2 <sup>nd</sup> B1 for suitable reason that mentions at least $v$ and $g$ and supports positive correlation. e.g. “the less <u>revision</u> done the lower the <u>grade</u> ” is B1 “should do better with more <u>revision</u> ” is B0 since does not mention <u>grades</u> “both coefficients are similar” or two sketches of negative correlation with labelled axes is B1 since $v$ , $t$ and $g$ are implied Allow use of letters $v$ and $g$ Allow equivalent terms e.g. “study” instead of “revision” or “score” instead of “grade”	
<b>7</b>		

Question Number	Scheme	Marks								
<p><b>2.</b></p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>F(3) = 1 gives <math>\frac{3^3 + k}{40} = 1</math>  So <math>k = \underline{13}</math></p> <p><math>P(X = 1) = \frac{14}{40}</math> or 0.35 (o.e.)  Use of <math>P(X = 2) = F(2) - F(1)</math> or <math>P(X = 3) = F(3) - F(2)</math>  <math>P(X = 2) = \frac{7}{40}</math> or 0.175, <math>P(X = 3) = \frac{19}{40}</math> or 0.475</p> <p><math>\text{Var}(4X - 5) = 4^2 \text{Var}(X)</math>  So <math>\text{Var}(4X - 5) = \frac{259}{20}</math> or 12.95</p>	<p>M1  A1cso  (2)</p> <p>B1  M1  A1, A1  (4)</p> <p>M1  A1  (2)</p> <p><b>8</b></p>								
<b>Notes</b>										
<p>(a)</p> <p><b>Verify</b></p> <p>(b)</p> <p>(c)</p>	<p>M1 for use of <math>F(3) = 1</math> Attempt at <math>\frac{3^3 + k}{40} = 1</math> must be seen  <math>27 + k = 40</math> without reference to <math>F(3) = 1</math> is M0  A1cso for no incorrect working seen and M1 scored.</p> <p>Allow M1 for <math>\frac{3^3 + 13}{40} = 1</math> but the A1 requires an <u>explicit</u> comment such as “so <math>k = 13</math>”</p> <p>If a table such as this is seen then award B1M1A1A1. Ignore labels on 2<sup>nd</sup> row</p> <table border="1" data-bbox="481 1205 1150 1330"> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td></td> <td><math>\frac{7}{20}</math> or 0.35</td> <td><math>\frac{7}{40}</math> or 0.175</td> <td><math>\frac{19}{40}</math> or 0.475</td> </tr> </table> <p>Otherwise apply the following:</p> <p>B1 for <math>\frac{14}{40}</math> or 0.35 or any exact equivalent. Can be labelled <math>F(1)</math>, <math>P(X = 1)</math> or <math>p(x)</math> and associated with <math>x = 1</math> or given in a table but must have a label.</p> <p>M1 for clear method showing how to obtain <math>P(X = \dots)</math> from <math>F(x)</math>  M1 can be implied if either <math>P(X = 2)</math> or <math>P(X = 3)</math> is correct</p> <p>1<sup>st</sup> A1 for <math>P(X = 2) = \frac{7}{40}</math> or 0.175 or exact equivalent</p> <p>2<sup>nd</sup> A1 for <math>P(X = 3) = \frac{19}{40}</math> or 0.475 or exact equivalent</p> <p>M1 for correct use of the variance formula (<math>4^2 \text{Var}(X)</math> alone secures M1)  A value for <math>\text{Var}(X)</math> is not required for this M1</p> <p>A1 for any exact equivalent to 12.95 Correct answer only is 2/2</p>		1	2	3		$\frac{7}{20}$ or 0.35	$\frac{7}{40}$ or 0.175	$\frac{19}{40}$ or 0.475	
	1	2	3							
	$\frac{7}{20}$ or 0.35	$\frac{7}{40}$ or 0.175	$\frac{19}{40}$ or 0.475							

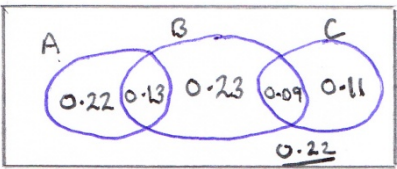
Question Number	Scheme	Marks
<p><b>3.</b></p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p><math>\sum t = 140</math> (or <math>\bar{t} = 17.5</math>) and <math>\sum m = 32</math> (or <math>\bar{m} = 4</math>)</p> <p><math>(S_{tm}) = 469.5 - \frac{"140" \times "32"}{8}</math></p> <p><math>(S_{tm} =) -90.5</math></p> <p><math>b = \frac{S_{tm}}{S_{tt}} = \frac{-90.5}{354}</math></p> <p><math>b = -0.255649...</math> (allow <math>\frac{181}{708}</math>)      <math>-0.25</math> or awrt <math>-0.26</math></p> <p><math>a = \frac{"32"}{8} - b \times \frac{"140"}{8}</math></p> <p>So equation of the line is <b><math>m = 8.47 - 0.256t</math></b> (allow <math>m = \frac{11999}{1416} - \frac{181}{708}t</math>)</p> <p><math>(8.47 - 0.256 \times 10 =) 5.9...</math>      awrt <b><u>5.9</u></b></p> <p>Should be reliable since 10 is in the range (of the data )</p>	<p>B1 B1</p> <p>M1</p> <p>A1cso</p> <p>(4)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>(4)</p> <p>B1</p> <p>(1)</p> <p>B1</p> <p>(1)</p> <p><b>10</b></p>
<b>Notes</b>		
	<p>(a) 1<sup>st</sup> B1 for 140 seen in correct context or correctly labelled  2<sup>nd</sup> B1 for 32 seen in correct context or correctly labelled.  (allow a fully correct expression – not "...+...+..." ) 4480 used correctly is B1B1  M1 for attempting a correct expression. Follow through their 140 and their 32  You may see attempt at <math>\sum (t - \bar{t})(m - \bar{m})</math>. This must have all the products seen.  A1cso requires a correct expression seen and no incorrect working leading to <math>-90.5</math></p> <p>(b) 1<sup>st</sup> M1 for a correct expression for <math>b</math>. Follow through their <math>S_{tm}</math>. Condone missing “–”  1<sup>st</sup> A1 for awrt <math>-0.26</math> or condone <math>-0.25</math>  2<sup>nd</sup> M1 for a correct method for <math>a</math>. Follow through their sums from part (a) and their value of <math>b</math>  2<sup>nd</sup> A1 for a correct equation for <math>m</math> and <math>t</math> with <math>a =</math> awrt <math>8.47</math> and <math>b =</math> awrt <math>-0.256</math>  Must be an equation in <math>m</math> and <math>t</math>, use of <math>x</math> or <math>y</math> scores A0 here.</p> <p>(c) B1 for awrt <math>5.9</math> Accept 6 if the correct expression (awrt <math>8.47 - 10 \times</math> awrt <math>0.256</math>) is seen</p> <p>(d) B1 for suggesting it is reliable and mentioning 10 within the range (of the data.)  or suggesting it is reliable since <u>interpolating</u> or <u>not extrapolating</u></p> <p>NB “it is reliable since <u>it</u> is in the range” is B0 since “<u>it</u>” is not explicit enough  Condone extra non-relevant comments but penalise contradictory comments.  e.g. “near the extreme so <u>not reliable</u> but not extrapolated so reliable” is B0 since <u>contradicts</u>  “reliable since 10 is within the range (of temps) <u>and 5.9 within range of times</u>” is B1 since <u>irrelevant</u></p>	



Question Number	Scheme	Marks
<p><b>4.</b></p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p><b>S.C.</b></p>	$\frac{127-100}{15}$ <p>So <math>P(L &gt; 127) = P(Z &gt; 1.8)</math> or <math>1 - P(Z &lt; 1.8)</math> o.e.  <math>= 1 - 0.9641 = \underline{\mathbf{0.0359}}</math> (awrt <b>0.0359</b>)</p> $\frac{d-100}{15} = -1.2816 \quad (\text{Calculator gives } -1.2815515\dots)$ $d = 80.776 \quad (\text{awrt } \underline{\mathbf{80.8}})$ <p>Require <math>P(L &gt; 133   L &gt; 127)</math></p> $= \frac{P(L > 133)}{P(L > 127)} = \frac{P(Z > 2.2)}{P(L > 127)}$ $= \frac{1-0.9861}{1-0.9641} = \frac{0.0139}{0.0359}$ $= 0.3871\dots = \text{awrt } \underline{\mathbf{0.39}}$ <p>An attempt at <math>P(L &lt; 133   L &gt; 127)</math> that leads to awrt 0.61 (M0M1A0A0)</p>	<p>M1</p> <p>A1</p> <p>A1</p> <p>(3)</p> <p>M1, B1</p> <p>A1</p> <p>(3)</p> <p>M1</p> <p>dM1</p> <p>A1</p> <p>A1</p> <p>(4)</p> <p><b>10</b></p>
<b>Notes</b>		
<p>(a)</p> <p>(b)</p> <p><b>Calc</b></p> <p>(c)</p> <p><b>ALT</b></p>	<p>M1 for attempting to standardise with 127, 100 and 15. Allow <math>\pm</math></p> <p>1<sup>st</sup> A1 for <math>Z &gt; 1.8</math>. Allow a diagram but must have 1.8 and correct area indicated. Must have the Z so <math>P(L &gt; 127)</math> with or without a diagram is insufficient. May be implied by 0.0359</p> <p>2<sup>nd</sup> A1 for awrt 0.0359 (calc. gives 0.035930266...). Correct ans only 3/3. M1A0A1 not poss.</p> <p>M1 for an attempt to standardise with 100 and 15 and set <math>= \pm</math> any z value (<math> z  &gt; 1</math>)</p> <p>B1 for <math>z = \pm 1.2816</math> (or better) seen anywhere [May be implied by 80.776(72...) or better seen]</p> <p>A1 for awrt 80.8 (can be scored for using 1.28 but then they get M1B0A1)</p> <p>The 80.8 must follow from correct working.</p> <p>If answer is awrt 80.8 <b>and</b> awrt 80.777 or 80.776... or better seen then award M1B1A1</p> <p>If answer is awrt 80.8 or 80.77 then award M1B0A1 (unless of course <math>z = 1.2816</math> is seen)</p> <p>1<sup>st</sup> M1 for clear indication of correct conditional probability or attempt at correct ratio</p> <p>So clear attempt at <math>\frac{P(L &gt; 133)}{P(L &gt; 127)}</math> is sufficient for the 1<sup>st</sup> M1</p> <p>2<sup>nd</sup> dM1 dependent on 1<sup>st</sup> M1 for <math>P(L &gt; 133)</math> leading to <math>P(Z &gt; 2.2)</math>.</p> <p>1<sup>st</sup> A1 for 0.0139 or better seen coming from <math>P(Z &gt; 2.20)</math>. Dependent on both Ms</p> <p>2<sup>nd</sup> A1 for awrt 0.39. Both Ms required</p> <p>If they assume Alice did not check that the phone was working you may see:  <math>[P(L &lt; 127).0] + P(L &gt; 127).P(L &gt; 133   L &gt; 127)</math> Provided the <u>conditional probability</u> is seen as part of this calculation the 1<sup>st</sup> M1 can be scored and their final answer will be 0.0139(4/4)</p> <p>An answer of 0.0139 without sight of the conditional probability is 0/4.</p>	

Question Number	Scheme	Marks
<p>5. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p>	<p>Width = 4 (cm)  Area of <math>14 \text{ cm}^2</math> represents frequency 28 and area of <math>4h</math> represents 18  Or <math>\frac{4h}{18} = \frac{14}{28}</math> (o.e.) <span style="float: right;"><math>h = \underline{2.25}</math> (cm)</span></p> <p><math>m = (240) + \frac{10}{22} \times 80</math> (o.e.)  <math>= 276.36\dots</math> (<math>\frac{3040}{11}</math>) <span style="float: right;">((£)<u>276</u> <math>\leq m &lt;</math> (£)276.5)</span></p> <p><math>\sum fy = 31600</math> leading to <math>\bar{y} = \underline{316}</math></p> <p><math>\sigma_y = \sqrt{\frac{12452800}{100} - (\bar{y})^2} = 157.07\dots</math> (awrt <u>157</u>) Allow <math>s = 157.86\dots</math></p> <p>Skewness = 0.764... (awrt <u>0.76</u> or <u>0.75</u>)  [If <math>n+1</math> used in (b) and <math>m = \text{£}278</math> accept awrt 0.73 or 0.72]  <u>Positive</u> skew</p> <p><math>z = \pm \frac{80}{150}</math>  <math>P(240 &lt; X &lt; 400) = \underline{0.40 \sim 0.41}</math></p> <p>(e) suggests a reasonable fit for this range BUT  (d) since skew it will not be a good fit overall</p>	<p>B1 M1 A1</p> <p>M1 A1</p> <p>M1A1 M1A1</p> <p>B1 B1ft</p> <p>M1 A1</p> <p>B2/1/0</p> <p>(3) (2) (4) (2) (2) (2)</p> <p><b>15</b></p>
<b>Notes</b>		
	<p>(a) B1 for width (ignore units)  M1 for clear method using area and frequency <u>or</u> their width <math>\times</math> their height = 9  e.g. seeing both fd of 0.7 and 0.225 (may see fd in the table) [Must use correct interval]</p> <p>(b) M1 for <math>\frac{10}{22} \times 80</math> or <math>\frac{10.5}{22} \times 80</math> (o.e.). Allow use of <math>(n + 1)</math> leading to <math>\text{£}278.18\dots</math> or <math>[278, 278.5)</math>  A1 Do not award if incorrect end-point seen but answer only is 2/2</p> <p>(c) 1<sup>st</sup> M1 attempt at <math>\sum fy</math> with at least 3 correct products or ans. that rounds to 30 000 (to 1 sf) <math>\&amp;/100</math>  2<sup>nd</sup> M1 for correct expression including <math>\sqrt{\quad}</math>. Follow through <math>\bar{y}</math>. Need <math>\sum fy^2</math> correct but condone a minor transcription error e.g. 12458200.</p> <p>(d) 1<sup>st</sup> B1 for awrt 0.76/0.75 for <math>m = \text{£}276</math> or awrt 0.73/0.72 for <math>m = \text{£}278</math>  2<sup>nd</sup> B1ft for a correct description of their skew based on their measure <u>or</u> if no measure given based on their values of mean and median. (correlation is B0)</p> <p>(e) M1 for an attempt to standardise using the 320 and 150 and either 240 or 400 (implied by 0.53)  A1 for answer in range <math>[0.40, 0.41]</math> (tables gives 0.4038, calculator 0.40619...) Ans only 2/2</p> <p>(f) For B2 we need 2 comments that make reference to each of part (e) and part (d)  One comment should suggest it is <u>not</u> good since <u>skew</u>. The other it <u>is</u> since matches <u>range in (e)</u>  1<sup>st</sup> B1 for one relevant comment  2<sup>nd</sup> B1 for both comments NB Do not use B0B1</p>	

Question Number	Scheme	Marks								
<p><b>6. (a)</b></p> <table border="1" data-bbox="272 280 636 398"> <tr> <td><math>b</math></td> <td>1</td> <td>3</td> <td>5</td> </tr> <tr> <td><math>P(B = b)</math></td> <td><math>\frac{1}{3}</math></td> <td><math>\frac{1}{3}</math></td> <td><math>\frac{1}{3}</math></td> </tr> </table> <p><b>(b)</b> Discrete Uniform {distribution}</p> <p><b>(c)</b> <math>[E(B) =] 3</math> (by symmetry)</p> <p><b>(d)</b> <math>[E(R) =] 2 \times \frac{2}{3} + 4 \times \frac{1}{6} + 6 \times \frac{1}{6}</math> <math>= \underline{3}</math></p> <p><b>(e)</b> <math>[E(R^2) =] 2^2 \times \frac{2}{3} + 4^2 \times \frac{1}{6} + 6^2 \times \frac{1}{6} \quad \left[ = \frac{34}{3} \right]</math> <math>[\text{Var}(R) =] \frac{34}{3} - 3^2 = \frac{7}{3}</math> (or any exact equivalent. NB 2.33 is A0)</p> <p><b>(f)</b> Coin lands on <b>2</b>, choose <b>blue</b> die; coin lands on <b>5</b> choose <b>red</b> die <math>P(\text{Avisha wins}) = \frac{1}{2} \times \left( \frac{1}{3} + \frac{1}{3} \right) + \frac{1}{2} \times \frac{1}{6}</math> <math>= \frac{5}{12}</math> (allow awrt 0.417)</p>	$b$	1	3	5	$P(B = b)$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Also allow <math>b</math> values 1,1,3,3,5,5 and probabilities all <math>\frac{1}{6}</math></p> </div> <p>B1 B1</p> <p>(2)</p> <p>B1</p> <p>(1)</p> <p>B1</p> <p>(1)</p> <p>M1</p> <p>A1</p> <p>(2)</p> <p>M1</p> <p>dM1, A1</p> <p>(3)</p> <p>B2/1/0</p> <p>M1</p> <p>A1</p> <p>(4)</p> <p style="text-align: right;"><b>13</b></p>	
$b$	1	3	5							
$P(B = b)$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$							
<b>Notes</b>										
	<p><b>(a)</b> 1<sup>st</sup> B1 for correctly identifying values of <math>b</math> as 1, 3, 5 or 1,1,3,3,5,5 2<sup>nd</sup> B1 for probabilities all <math>= \frac{1}{3}</math> or exact equivalent (or of course 6 cases of <math>\frac{1}{6}</math>) Any correct probability distribution or probability function is 2/2. Must be in part (a)</p> <p><b>(b)</b> B1 for "Discrete Uniform". Both words required.</p> <p><b>(c)</b> B1 for answer of 3 o.e. Accept <math>E(X) = 3</math></p> <p><b>(d)</b> M1 for an attempt at correct formula. At least 2 correct products seen. If later divide by <math>n (\neq 1)</math> M0 A1 for an answer of 3. Correct answer only scores both marks.</p> <p><b>(e)</b> 1<sup>st</sup> M1 for a correct attempt at <math>E(R^2)</math>. At least 2 correct products seen. Condone <math>\text{Var}(R) = \text{etc}</math> May be implied by sight of <math>\frac{34}{3}</math> or 11.3 or better. 2<sup>nd</sup> dM1 Dep. on 1<sup>st</sup> M1 for clear attempt at <math>E(R^2) - [E(R)]^2</math> Must see their values <u>used</u>. NB <math>\text{Var}(R) = E(R^2) - [E(R)]^2 = \frac{34}{3} - 3^2</math> is M1M0A0 since do not <u>use</u> their <math>[E(R)]^2</math></p> <p><b>(f)</b> B2/1/0 Both correct B1B1, one correct B1B0. Do not use B0B1 [e.g. always red or RR is B1B0] NB Allow other descriptions of the die e.g. 1<sup>st</sup> or fair for blue, 2<sup>nd</sup> for red if they are clear. M1 for evaluating correct probabilities i.e. only <math>\frac{1}{3}, \frac{1}{12}</math> seen <u>or</u> if incorrect choice made: M1 for an answer of : if choose RR (<math>\frac{1}{4}</math>), if choose BB (<math>\frac{1}{3}</math>), if choose RB (<math>\frac{1}{6}</math>) NB <math>\frac{5}{12}</math> as answer scores M1A1. Need to see choices of die stated for B marks.</p>									

Question Number	Scheme	Marks
<p>7.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p><math>P(A \cup B) = 0.35 + 0.45 - 0.13</math> <u>or</u> <math>0.22 + 0.13 + 0.32</math>  <math>= \underline{0.67}</math></p> <p><math>P(A'   B') = \frac{P(A' \cap B')}{P(B')}</math> <u>or</u> <math>\frac{0.33}{0.55}</math>  <math>= \frac{3}{5}</math> <u>or</u> <math>0.6</math></p> <p><math>P(B \cap C) = 0.45 \times 0.2</math>  <math>= \underline{0.09}</math></p> <div style="display: flex; align-items: center;">  <div style="border: 1px solid black; padding: 5px; margin-left: 20px;"> <p>Allow 1<sup>st</sup> B1 for 3 intersecting circles in a box with zeros in the regions for <math>A \cap C</math>  Do not accept "blank" for zero</p> </div> </div> <p><math>P(B \cup C)' = 0.22 + \underline{0.22}</math> <u>or</u> <math>1 - [0.56]</math> <u>or</u> <math>1 - [0.13 + 0.23 + 0.09 + 0.11]</math> o.e.  <math>= \underline{0.44}</math></p>	<p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>B1 B1ft B1 B1 (4)</p> <p>M1 A1 (2)</p> <p style="text-align: right;"><b>12</b></p>
<b>Notes</b>		
<p>NB May see Venn diagram for <math>A</math> and <math>B</math> only used for (a) and (b) but M marks are awarded for <u>correct expressions only</u>. No fit from an incorrect diagram for M marks.</p> <p>(a) M1 for attempt to use the addition rule. Correct substitution i.e. correct expression seen  A1 for 0.67 only. Correct answer only scores 2/2</p> <p>(b) M1 for a correct ratio of probabilities or a correct formula and at least one correct prob  For a correct formula allow "1 – their (a)" instead of 0.33 but not for correct ratio case.  Do not award for assuming independence i.e. <math>\frac{P(A' \cap B')}{P(B')} = \frac{0.65 \times 0.55}{0.55}</math> is M0. M0 if num &gt; denom  A1 for 3/5 or any exact equivalent.</p> <p>(c) M1 for correct expression. Need correct values for <math>P(B)</math> and <math>P(C)</math> seen.  A1 for 0.09 or any exact equivalent. Correct answer only is 2/2</p> <p>(d) <b>No labels <math>A, B, C</math> in (d) loses 1<sup>st</sup> B1 but can score the other 3 by implication</b>  B1 for box with <math>B</math> intersecting <math>A</math> and <math>C</math> but <math>C</math> not intersecting <math>A</math>. No box is B0  B1ft for 0.13 and their 0.09 in correct places. [ft <math>P(B \cap C)</math> from (c)]  B1 for any 2 of 0.22, <u>0.22</u>, 0.11 and 0.23 correct  B1 for all 4 values correct</p> <p>(e) M1 for a correct expression or follow through from their Venn diagram  NB <math>P(B') \times P(C') = 0.55 \times 0.8</math> is OK. Do not fit "blank" for zero and M0 for negative probs.  A1 for 0.44 only. Correct answer only is 2/2</p>		

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