

2010

VCE Further Mathematics Trial Examination 2

Suggested Solutions

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Kilbaha Multimedia Publishing ABN 47 065 111 373
PO Box 2227
Kew Vic 3101
Australia
Tel: (03) 9817 5374
Fax: (03) 9817 4334
kilbaha@gmail.com
<http://kilbaha.com.au>

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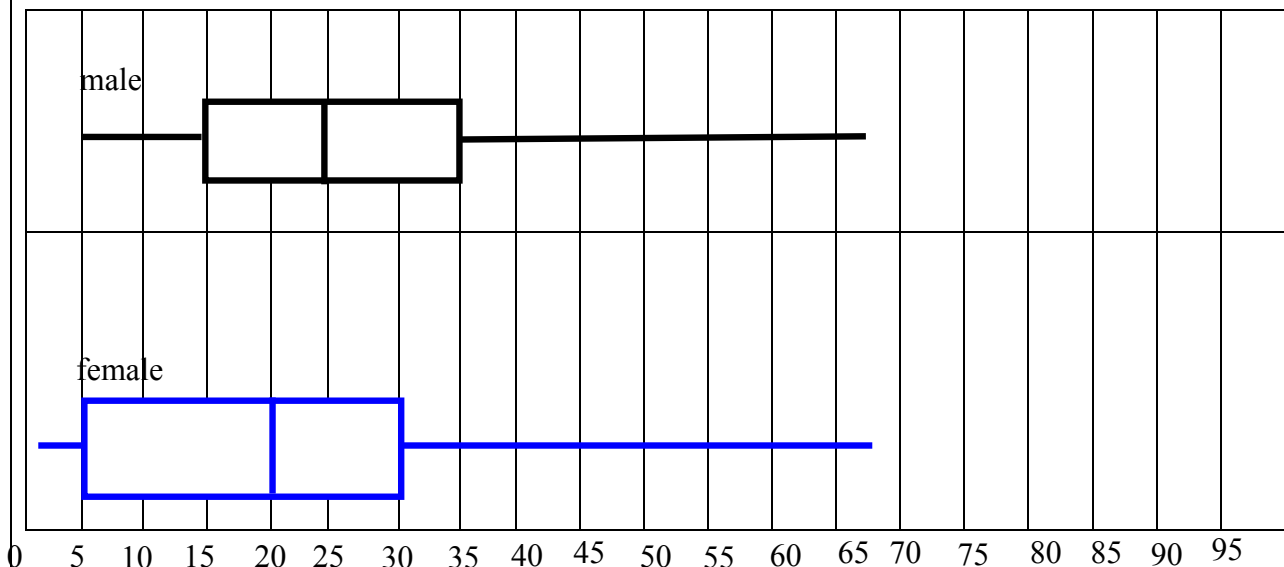
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Core

Question 1

a.Using TI-83 calculator press stat edit and enter the data for females in L_1 Press stat calc 1-Var stats enter L_1 enter. This gives $\bar{x} = 21.5$

(1 mark)

b. The median, lower and upper quartile, maximum and minimum values can be obtained from the same screen as **1 a.**

1 mark for correct upper and lower quartile

1 mark for correct median and whiskers

(2 marks)

c.An outlier is a value that is greater than $1.5 \times IQR + Q_3$ For female $IQR = 25$ and $Q_3 = 30$

$$1.5 \times IQR + Q_3 = 1.5 \times 25 + 30 = 67.5$$

 $66 < 67.5$ so 66 is not an outlier for females.For male $IQR = 20$ and $Q_3 = 35$

$$1.5 \times IQR + Q_3 = 1.5 \times 20 + 35 = 65$$

 $66 > 65$ so 66 is an outlier for males.

1 mark for using definition of an outlier

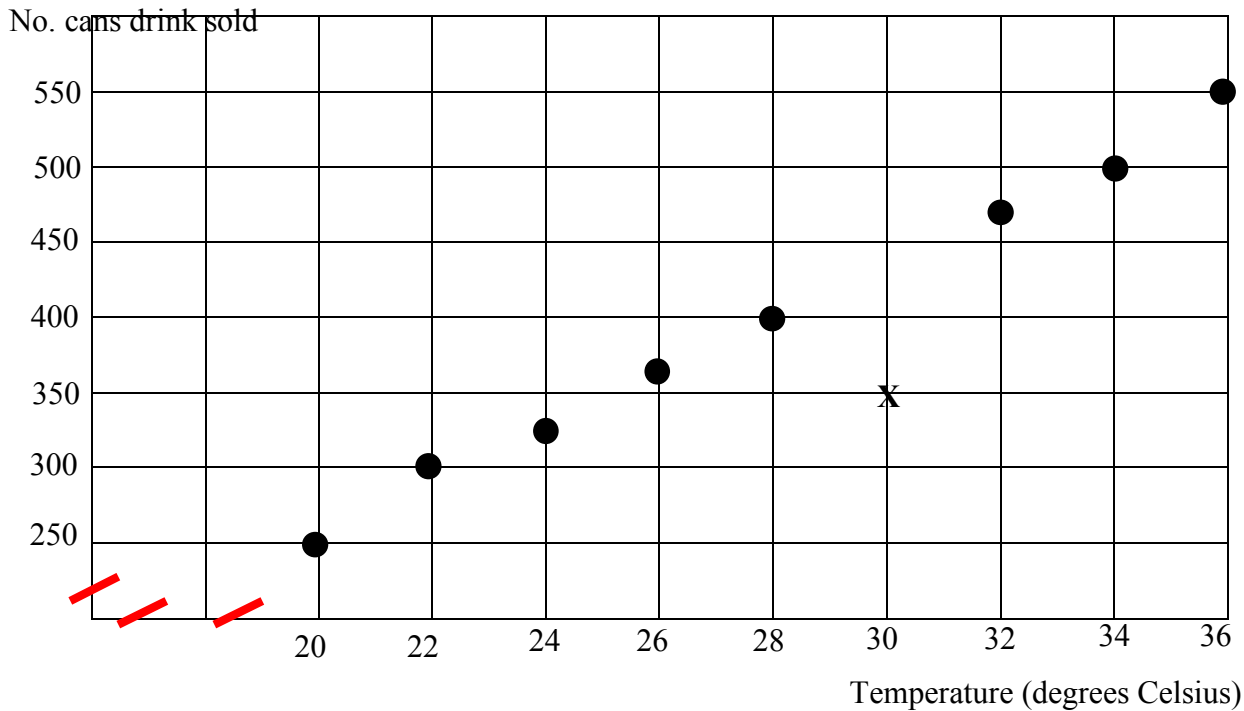
1 mark for correct answer

(2 marks)

Core

Question 2

a.



(1 mark) for correct point

b.

On calculator press stat edit and enter temperature in L_1 and number of drinks sold in L_2 . Go to stat calc LinReg $(ax + b)$ $L_1 L_2$. This gives $r^2 = 91.6\%$, to one decimal place

91.6% of the variation in the number of drinks sold can be explained by the variation in the temperature.

1 mark for each of the three answers.

(3 marks)

c.

Using the same screen as for b. $a = 17.25$ and $b = -93$

So equation is

$$\text{Number of drinks sold} = -93 + 17.25 \times \text{temperature}$$

1 mark for each of the two values.

(2 marks)

Core**Question 2 (continued)****d.**

$$440 = -93 + 17.25 \times t$$

$$533 = 17.25 \times t$$

$$t = \frac{533}{17.25} = 30.9^\circ C$$

(1 mark)

Question 3**a.**

$$\frac{1}{26} = 0.04$$

(1 mark)

b.

On calculator press stat edit. Put the temperature values in L₁, and the number of hot dogs sold in L₂

In L₃ put $L_3 = \frac{1}{L_1}$

Go to stat calc LinReg($ax + b$) L₃,L₂

This gives $a = 2290$ and $b = 15$

$$\text{Number of hot dogs sold} = 2290 \times \frac{1}{\text{temperature}} + 15$$

(1 mark)

c.

$$\text{Number of hot dogs sold} = 2290 \times \frac{1}{15} + 15 = 168$$

(1 mark)

Module 1 Number patterns and applications**Question 1**

<p>a(i) $25 + 12 + 12 = 49$</p> <p>(1 mark)</p>	<p>a(ii) This is an arithmetic sequence with $a = 25$ and $d = 12$</p> $t_n = a + (n - 1)d$ $t_n = 25 + (n - 1)12$ $t_n = 25 + 12n - 12$ $t_n = 13 + 12n$ <p>(1 mark)</p>
<p>b.</p> <p>This is an arithmetic sequence</p> $S_n = \frac{n}{2}[2a + (n - 1)d]$ $S_{16} = \frac{16}{2}[2 \times 25 + 15 \times 12]$ $S_{16} = 8 \times (50 + 180) = 1840 \text{ people.}$ <p>(1 mark)</p>	

Module 1 Number patterns and applications**Question 2**

<p>a. i.</p> $5 \times (1 + 0.4) = 7$ <p style="text-align: right;">(1 mark)</p>	<p>a. ii.</p> <p>This is a geometric sequence with $a = 5$ and $r = 1.4$</p> $t_n = ar^{n-1}$ $t_n = 5(1.4)^{n-1}$ <p style="text-align: right;">(1 mark)</p>
<p>b.</p> <p>This is a geometric sequence with $a = 5$, $n=10$ and $r = 1.4$</p> $S_n = \frac{a(r^n - 1)}{r - 1}$ $S_{10} = \frac{5(1.4^{10} - 1)}{1.4 - 1} = 349$ <p style="text-align: right;">(1 mark)</p>	
<p>c.</p> <p>Enter two equations into calculator in sequence mode.</p> <p>Press $y =$</p> $nMin = 1$ $\mu(n) = 2n + 13$ $\mu(nMin) = 25$ $v(n) = 5(1.4)\Lambda(n - 1)$ $v(nMin) = 5$ <p>Press 2nd table</p> <p>When $n = 11, \mu(n) > v(n)$</p> <p>But when $n = 12, v(n) > \mu(n)$</p> <p>Hence it will take 12 days.</p> <p style="text-align: right;">(1 mark)</p>	

Module 1 Number patterns and applications**Question 2 (continued)****d.**

$$\text{Number infected} = 25 + 40 + 1.2 \times 40 + (1.2)^2 \times 40 + \dots$$

$$(1.2)^{18} \times 40$$

Number infected = 65 + sum of geometric sequence

where $a = 1.2 \times 40$, $r = 1.2$ and $n = 18$

$$\text{Number infected} = 65 + \frac{1.2 \times 40(1.2^{18} - 1)}{1.2 - 1}$$

$$\text{Number infected} = 65 + 6150 = 6215$$

(1 mark)

Question 3

<p>a. i.</p> <p>In one lot of 20 minutes, Number bacteria = double 4 = 8</p> <p style="text-align: right;">(1 mark)</p>	<p>a. ii.</p> <p>3 lots of 20 minutes in 1 hour. 4,8,16,32 32 bacteria after one hour.</p> <p style="text-align: right;">(1 mark)</p>
<p>b.</p> <p>32 is 8 times greater than 4, so 8 times.</p> <p style="text-align: right;">(1 mark)</p>	<p>c.</p> $B_t = 8B_{t-1} \quad B_0 = 4$ <p style="text-align: right;">(1 mark)</p>

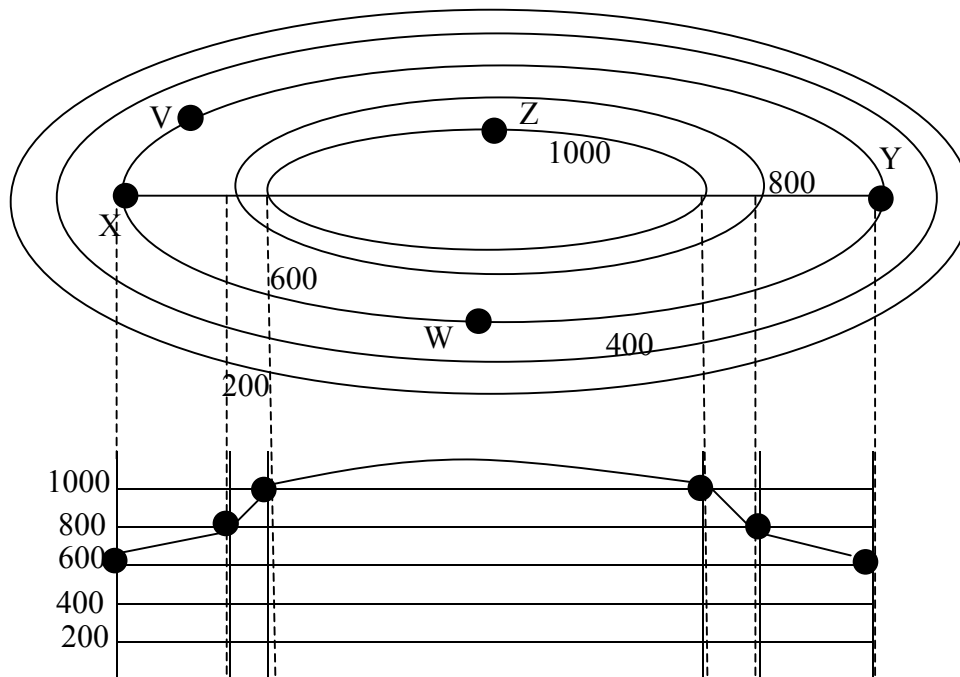
Module 1 Number patterns and applications**Question 3 (continued)**

<p>d.</p> <p>Use calculator in sequence mode</p> <p>Press $y =$</p> <p>$nMin = 1$</p> <p>$\mu(n) = 8 \times \mu(n - 1)$</p> <p>$\mu(nMin) = 4$</p> <p>Press 2nd table and go to $n = 6$.</p> <p>This is 5 hours later.</p> <p>$\mu(n) = 131,072$</p> <p style="text-align: right;">(1 mark)</p>	<p>e.</p> <p>Using the same computer table as in d, the answer can be seen to be 4 hours.</p> <p style="text-align: right;">(1 mark)</p>
<p>f.</p> <p>3600 killed in 1 hour.</p> <p>From table for d, when time is 4 hours, number bacteria = 16384</p> <p>Number of hours to eliminate = $\frac{16384}{3600} = 4.6$ hours to 1 d.p.</p> <p style="text-align: right;">(1 mark)</p>	

Module 2 Geometry and trigonometry

Question 1

a.



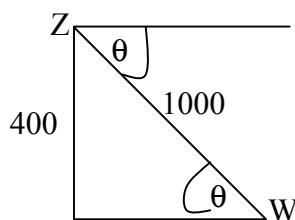
(1 mark)

b.

W and Y are on the same contour line so there is no gradient. Gradient = 0

(1 mark)

c.



$$\sin \theta = \frac{400}{1000}$$

$$\theta = \sin^{-1}\left(\frac{400}{1000}\right) = 24^\circ \text{ to the nearest degree.}$$

(1 mark)

Module 2 Geometry and trigonometry**Question 1 (continued)****d.**

$$\text{Gradient} = \tan \theta = \tan 23.57817848 = 0.44$$

(1 mark)

Question 2**a.**

$$\angle XVW = 20^\circ$$

$$\angle VWX = 70^\circ \text{ (angles in triangle sum to } 180^\circ \text{)}$$

$$\angle VWY = 180 - 70 = 110^\circ$$

(angles in straight line add to 180°)

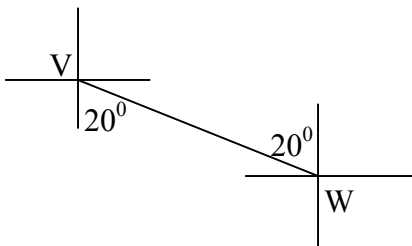
(1 mark)

b.Since triangle VWY is isosceles

$$\angle WVY = \angle WYV$$

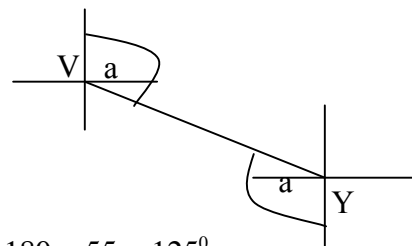
$$\therefore \angle WVY = \frac{1}{2}(180 - 110) = 35^\circ$$

(1 mark)

c.

$$\text{Bearing of V from W} = 360 - 20 = 340^\circ$$

(1 mark)

d.

$$a = 180 - 55 = 125^\circ$$

(1 mark)

Module 3 Graphs and relations

Question 3

<p>a.</p> $\frac{1}{2} \times 18 = 9 \text{ m}$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> $\text{Surface area} = \frac{1}{2}(2\pi r^2 + 2\pi rh)$ $\text{Surface area} = \frac{1}{2}(2\pi \times 9^2 + 2\pi \times 9 \times 22)$ $\text{Surface area} = 876.5 \text{ m}^2$ <p style="text-align: right;">(1 mark)</p>
<p>c.</p> <p>$V = \text{Volume of cuboid} + \text{volume of half cylinder}$</p> $V = 18 \times 22 \times 12 + \frac{1}{2} \times \pi \times 9^2 \times 22$ $V = 7551.16 \text{ m}^3$ <p style="text-align: right;">(1 mark)</p>	<p>d.</p> $\text{Heating cost/hour} = 7551.16 \times \frac{0.02}{100}$ $\text{Heating cost/hour} = \1.51 $\text{Heating cost/day} = \36.25 <p style="text-align: right;">(1 mark)</p>

Question 4

<p>a.</p> <p>There are 8 equal angles at the centre that all add to 360°.</p> $\text{Each angle} = \frac{360}{8} = 45^\circ$ $\angle AOB = 45^\circ$ <p>$\triangle AOB$ is isosceles</p> $\therefore \angle OAB = \frac{1}{2}(180 - 45) = 67.5^\circ$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> $\frac{AO}{\sin 67.5^\circ} = \frac{20}{\sin 45^\circ}$ $AO = \frac{20}{\sin 45^\circ} \times \sin 67.5^\circ = 26.13 \text{ m}$ <p style="text-align: right;">(1 mark)</p>
<p>c.</p> <p>Area of Piazza = $8 \times \text{Area of triangle } AOB$</p> $\text{Area of Piazza} = 8 \times \frac{1}{2} \times 26.13^2 \times \sin 45^\circ$ $\text{Area of Piazza} = 1931.18 \text{ m}^2$ <p style="text-align: right;">(1 mark)</p>	

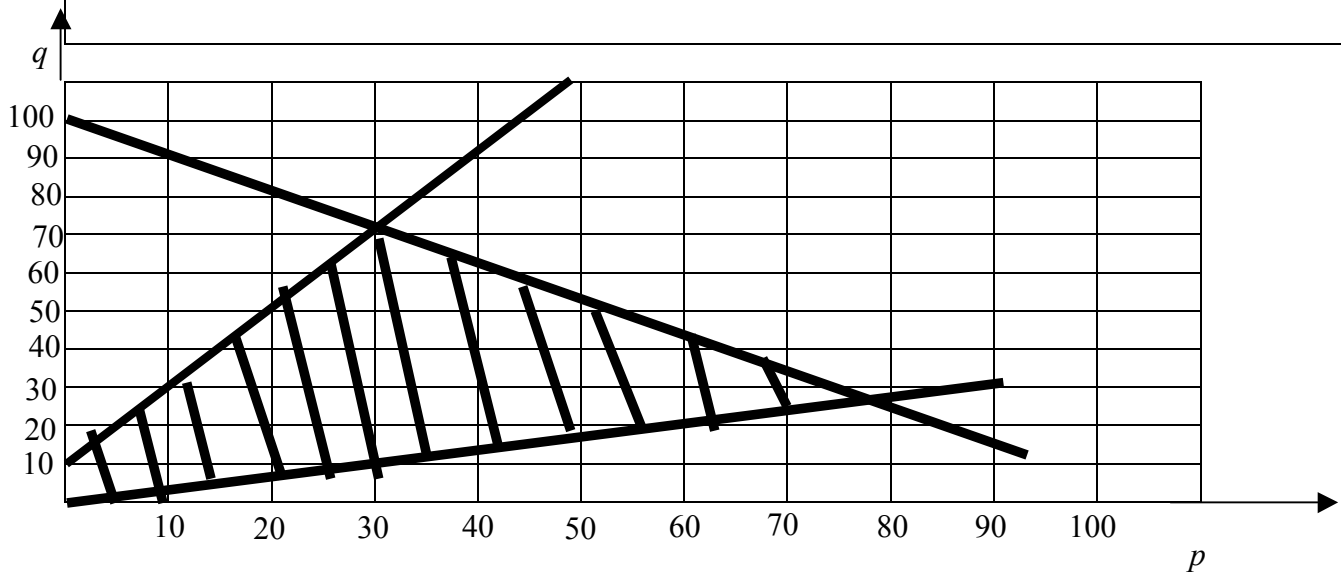
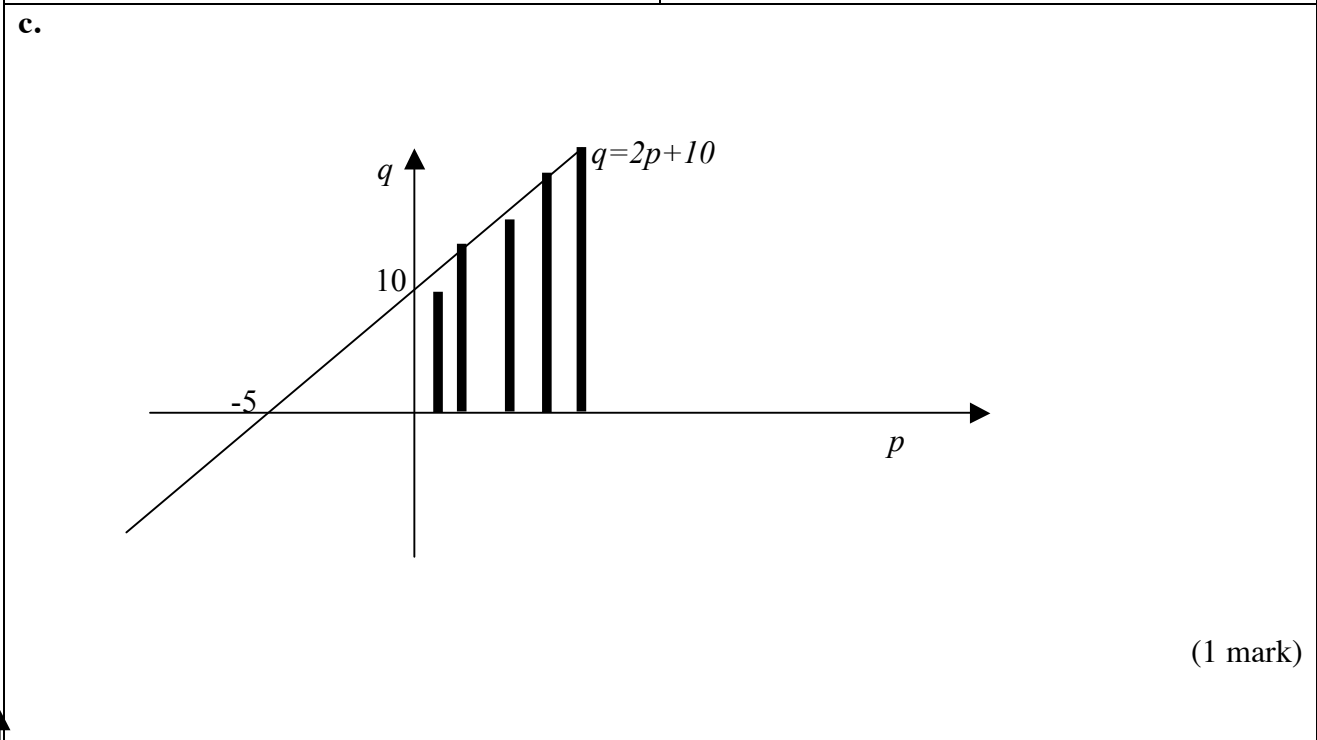
Module 3 Graphs and relations**Question 1**

<p>a. i. b. $65 \times 10 = \\$650$</p> <p style="text-align: right;">(1 mark)</p>	<p>a. ii. $65 \times x = \\$65x$</p> <p style="text-align: right;">(1 mark)</p>
<p>b. $C = \\$(20x + 37,890)$</p> <p style="text-align: right;">(1 mark)</p>	<p>c. $65x = 20x + 37,890$ $45x = 37,890$ $x = 842$</p> <p style="text-align: right;">(1 mark)</p>
<p>d. $37890 - 3789 = \\$34,101$</p> <p style="text-align: right;">(1 mark)</p>	<p>e. $SP = 65 \times 30000 = \\$1,950,000$ $CP = 40 \times 30000 + 3789 = \\$1,203,789$ $CP < SP$ \therefore Profit $\text{Profit} = 1,950,000 - 1,203,789$ $\text{Profit} = \\$746211$</p> <p style="text-align: right;">Profit (1 mark) Actual profit (1 mark)</p>

Module 3 Graphs and relations

Question 2

<p>a.</p> $p + q \leq 100$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> $p \leq 3q$ <p style="text-align: right;">(1 mark)</p>
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1 mark for each of the two lines and 1 mark for correct shading

(3 marks)

Module 3 Graphs and relations**Question 2 (continued)****e.**

$$\text{Profit} = 30p + 21q$$

(1 mark)

f.

The corner points are (0,0), (0,10), (30,70) and (75,25)

Profit at (0,0) = \$0

Profit at (0,10) = $21 \times 10 = \$210$

Profit at (30,70) = $30 \times 30 + 21 \times 70 = \2370

Profit at (75,25) = $30 \times 75 + 21 \times 25 = \2775

\therefore make 75 units of glasswork and 25 units of plastic.

(1 mark)

Module 4 Business-related mathematics**Question 1**

<p>a.</p> $\frac{48}{25} = \$1.92$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> <p>Increase = $57 - 48 = \\$9$</p> $\% \text{ increase} = \frac{9}{48} \times 100 = 18.75\%$ <p style="text-align: right;">(1 mark)</p>
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Question 2

<p>a.</p> $\text{Total earned} = 280 + \frac{12}{100} \times 1300 = \436 <p style="text-align: right;">(1 mark)</p>	<p>b.</p> <p>Commission = $464.50 - 150 = 314.50$</p> <p>Let percentage be $x\%$</p> $\frac{x}{100} \times 1850 = 314.50$ $x = 314.50 \div 1850 \times 100 = 17\%$ <p style="text-align: right;">(1 mark)</p>
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Question 3

<p>a.</p> $\text{Stamp duty} = 60 + \frac{4}{100} (45000 - 3000) = \1740 <p style="text-align: right;">(1 mark)</p>	<p>b. i.</p> <p>There are 60 months in 5 years.</p> <p>Instalments paid = $950 \times 60 = \\$57,000$</p> <p style="text-align: right;">(1 mark)</p>
<p>b. ii.</p> <p>Total amount paid = $57,000 + 5000 = \\$62,000$</p> <p style="text-align: right;">(1 mark)</p>	<p>b. iii.</p> <p>Interest = $57,000 - 45,000 = \\$12,000$</p> <p style="text-align: right;">(1 mark)</p>
<p>b. iv.</p> $R = \frac{100I}{Pt} = \frac{100 \times 12000}{45000 \times 5} = 5.3\%$ <p style="text-align: right;">(1 mark)</p>	

Module 4 Business-related mathematics**Question 4**

<p>a.</p> $\frac{6}{12} = 0.5\%$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> $\frac{0.5}{100} \times 50000 = \250 <p style="text-align: right;">(1 mark)</p>
<p>c.</p> $50000(1.005)^{60} = \$67442.51$ <p style="text-align: right;">(1 mark)</p>	<p>d.</p> <p>Press Apps Finance Enter TVM Solver Enter</p> $N = 60$ $I = 6$ $PV = 50000$ $PMT =$ $FV = 0$ $P / Y = 12$ $C / Y = 12$ <p>End</p> <p>Put cursor on <i>PMT</i> and press alpha solve.</p> $PMT = \$966.64$ <p style="text-align: right;">(1 mark)</p>

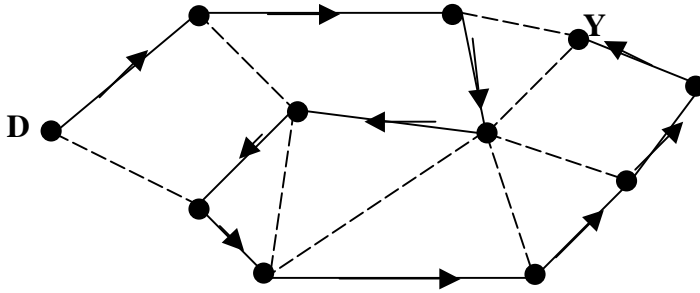
Question 5

<p>a.</p> <p>Amount depreciation = 45000 – 18800</p> <p>Amount depreciation = 26200</p> $\text{Cost/km} = \frac{26200}{42000} = 0.62 = 62 \text{ cents.}$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> $\text{Depreciation} = 14000 \times \frac{62}{100} = 8733.33$ <p>Value after two years = 18,800 – 8733.33</p> <p>Value after two years = \$10,066.67</p> <p style="text-align: right;">(1 mark)</p>
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Module 5 Networks and decision mathematics

Question 1

a. i.



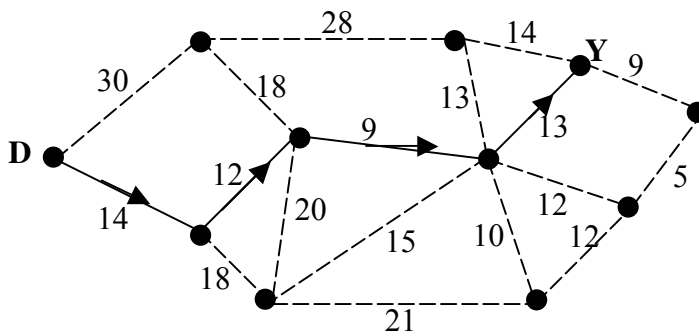
(1 mark)

a. ii.

This is a Hamiltonian path.

(1 mark)

b. i.



(1 mark)

b. ii.

$$14 + 12 + 9 + 13 = 48 \text{ km.}$$

(1 mark)

Module 5 Networks and decision mathematics

Question 1 (continued)

c.

$18 + 12 + 9 + 15 + 10 + 12 + 5 + 13 + 9 = 103 \text{ km.}$

(1 mark)

Question 2

a.

(1 mark)

b.

$$D^1 = \begin{matrix} & A & B & C & D & E \\ \begin{matrix} A \\ B \\ C \\ D \\ E \end{matrix} & \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{matrix}$$

(1 mark)

c.

Yacht	One – Step Dominance
<i>Alpha Star</i>	2
<i>Battering Ram</i>	3
<i>Challenger</i>	1
<i>Defending Champ</i>	3
<i>Earnest Endeavour</i>	1

(1 mark)

d.
Battering Ram and *Defending Champ*

(1 mark)

Module 5 Networks and decision mathematics**Question 2 (continued)**

<p>e.</p> $D^2 = \begin{matrix} & A & B & C & D & E \\ \begin{matrix} A \\ B \\ C \\ D \\ E \end{matrix} & \begin{bmatrix} 0 & 1 & 1 & 0 & 2 \\ 1 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 2 & 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 1 & 0 \end{bmatrix} \end{matrix}$ <p style="text-align: right;">(1 mark)</p>	<p>f.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Yacht</th> <th style="padding: 5px;">Two – Step Dominance</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"><i>Alpha Star</i></td> <td style="padding: 5px;">4</td> </tr> <tr> <td style="padding: 5px;"><i>Battering Ram</i></td> <td style="padding: 5px;">4</td> </tr> <tr> <td style="padding: 5px;"><i>Challenger</i></td> <td style="padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;"><i>Defending Champ</i></td> <td style="padding: 5px;">5</td> </tr> <tr> <td style="padding: 5px;"><i>Earnest Endeavour</i></td> <td style="padding: 5px;">2</td> </tr> </tbody> </table> <p style="text-align: right;">(1 mark) for any two correct. (2 marks) for all five correct</p>	Yacht	Two – Step Dominance	<i>Alpha Star</i>	4	<i>Battering Ram</i>	4	<i>Challenger</i>	1	<i>Defending Champ</i>	5	<i>Earnest Endeavour</i>	2
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<i>Earnest Endeavour</i>	2												
<p>g.</p> <p>$D^1 + D^2$ gives $A = 2 + 4 = 6$ $B = 3 + 4 = 7$ $C = 1 + 1 = 2$ $D = 3 + 5 = 8$ $E = 1 + 2 = 3$</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Place</th> <th style="padding: 5px;">Yacht</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">1</td> <td style="padding: 5px;"><i>Defending Champ</i></td> </tr> <tr> <td style="padding: 5px;">2</td> <td style="padding: 5px;"><i>Battering Ram</i></td> </tr> <tr> <td style="padding: 5px;">3</td> <td style="padding: 5px;"><i>Alpha Star</i></td> </tr> <tr> <td style="padding: 5px;">4</td> <td style="padding: 5px;"><i>Earnest Endeavour</i></td> </tr> <tr> <td style="padding: 5px;">5</td> <td style="padding: 5px;"><i>Challenger</i></td> </tr> </tbody> </table> <p style="text-align: right;">(1 mark) for 2 correct (2 marks) for all correct.</p>		Place	Yacht	1	<i>Defending Champ</i>	2	<i>Battering Ram</i>	3	<i>Alpha Star</i>	4	<i>Earnest Endeavour</i>	5	<i>Challenger</i>
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<p>h.</p> <p>If B defeated A, then A defeated C, D and E. This means that E defeated B, C and D. Hence, D defeated B and C. So C defeated B i.e. <i>Battering Ram</i>.</p> <p style="text-align: right;">(1 mark)</p>													

Module 6 Matrices**Question 1**

<p>a.</p> $A = \begin{bmatrix} 8 & 2 \\ 3 & 12 \end{bmatrix}$ <p>(1 mark)</p>	<p>b. i.</p> $\begin{bmatrix} 8 & 2 \\ 3 & 12 \end{bmatrix} + \begin{bmatrix} 4 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 5 & 1 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$ <p>(1 mark)</p>
<p>b. ii.</p> $\begin{bmatrix} 20 & 8 \\ 13 & 25 \end{bmatrix}$ <p>(1 mark)</p>	<p>c.</p> <p>8 is the number in the first row, second column. It represents the number of behinds obtained by Hawood.</p> <p>(1 mark)</p>
<p>d.</p> $\begin{bmatrix} 6 \\ 1 \end{bmatrix}$ <p>(1 mark)</p>	<p>e.</p> $\begin{bmatrix} 20 & 8 \\ 13 & 25 \end{bmatrix} \times \begin{bmatrix} 6 \\ 1 \end{bmatrix}$ <p>(1 mark) for correct matrices (1 mark) for multiplication.</p>
<p>f. i.</p> $\begin{bmatrix} 120 + 8 \\ 78 + 25 \end{bmatrix} = \begin{bmatrix} 128 \\ 103 \end{bmatrix}$ <p>(1 mark)</p>	<p>f. ii.</p> <p>2×1</p> <p>(1 mark)</p>

Module 6 Matrices

Question 2

<p>a. i.</p> <p style="text-align: right;">(1 mark)</p>	
<p>a. ii.</p> <p>This Week</p> <p style="padding-left: 40px;"><i>H</i> <i>I</i></p> $\begin{bmatrix} 0.58 & 0.85 \\ 0.42 & 0.15 \end{bmatrix} \begin{matrix} H \\ I \end{matrix} \text{ Next Week}$ <p style="text-align: right;">(1 mark)</p>	<p>b.</p> $S_0 = \begin{bmatrix} 24 \\ 10 \end{bmatrix}$ <p style="text-align: right;">(1 mark)</p>
<p>c.</p> $S_2 = T^2 S_0$ $S_2 = \begin{bmatrix} 0.58 & 0.85 \\ 0.42 & 0.15 \end{bmatrix}^2 \begin{bmatrix} 24 \\ 10 \end{bmatrix} = \begin{bmatrix} 22.8466 \\ 11.1534 \end{bmatrix}$ <p>Expect 11 to be injured.</p> <p style="text-align: right;">(1 mark)</p>	<p>d.</p> $S_{100} = T^{100} S_0$ $S_{100} = \begin{bmatrix} 22.76 \\ 11.24 \end{bmatrix}$ <p>Expect about 23 players to be healthy in the long term.</p> <p style="text-align: right;">(1 mark)</p>

Module 6 Matrices**Question 3**

Let number of people who bought beef, chicken, vegetable and curry pies last week be x , $3x$, x and x , respectively.

$$\begin{bmatrix} 0.6 & 0.1 & 0.1 & 0.2 \end{bmatrix} \begin{bmatrix} x \\ 3x \\ x \\ x \end{bmatrix} = [0.6x + 0.3x + 0.1x + 0.2x]$$

$$= [1.2x]$$

$$1.2x = 12,000$$

$$x = 10,000$$

$$6x = 60,000$$

(1 mark)

End of Suggested Solutions 2010 Further Mathematics VCE Trial Examination 2

Kilbaha Multimedia Publishing
PO Box 2227
Kew Vic 3101
Australia

Tel: (03) 9817 5374
Fax: (03) 9817 4334
kilbaha@gmail.com
<http://kilbaha.com.au>