

# 2007

## VCE Further Mathematics Trial Examination 2

# Suggested Solutions

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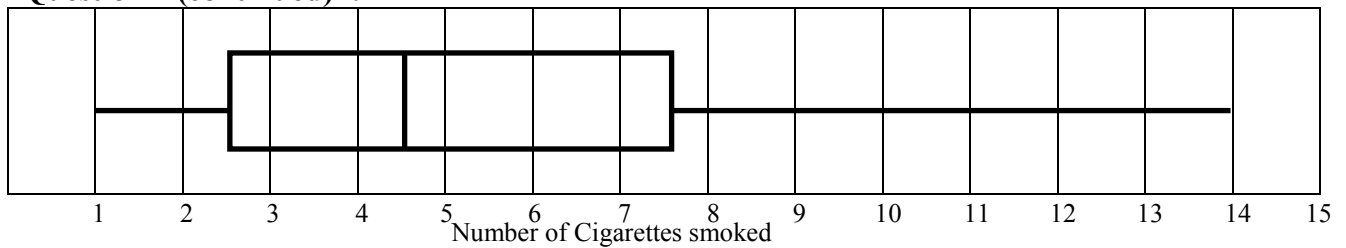
Question 1 a.

|                     | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Total |
|---------------------|--------|--------|--------|---------|---------|---------|-------|
| <b>Smoke</b>        | 4      | 16     | 21     | 36      | 39      | 50      | 166   |
| <b>Do not Smoke</b> | 71     | 59     | 54     | 39      | 36      | 25      | 284   |

$\frac{1}{2}$  mark for each correct value

|                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>b.</b></p> $\frac{93}{150} \times 100 = 62\%$ <p>(1 mark)</p>                                                                                                                                                                                                                                               | <p><b>c.</b></p> <p>Smoking/non smoking is a categorical variable<br/>(1 mark)</p>                                                                                            |
| <p><b>Question 2 a.</b></p> <p>On graphics calculator enter data for number of cigarettes smoked for 12 children in Stat Edit in <math>L_1</math>. Go to Stat calc 1 Var Stats <math>L_1</math> Enter and read off the value for the median Med=4.5</p> <p><math>\left(\frac{1}{2} \text{ mark}\right)</math></p> | <p><b>b.</b></p> <p>Using the same screen on the calculator read off <math>Q_1</math>, the lower quartile = 2.5</p> <p><math>\left(\frac{1}{2} \text{ mark}\right)</math></p> |
| <p><b>c.</b></p> <p>Using the same screen on the calculator read off <math>Q_3</math>, the upper quartile = 7.5</p> <p><math>\left(\frac{1}{2} \text{ mark}\right)</math></p>                                                                                                                                     | <p><b>d.</b></p> <p>Interquartile range = <math>Q_3 - Q_1 = 7.5 - 2.5 = 5</math></p> <p><math>\left(\frac{1}{2} \text{ mark}\right)</math></p>                                |
| <p><b>e.</b></p> $1.5 \times 5 = 7.5$ $Q_1 - 7.5 < 0$ $Q_3 + 7.5 = 15$ <p>No data lies inside the range <math>0 &lt; x &lt; 15</math></p> <p><math>\therefore</math> no outliers</p> <p>(1 mark)</p>                                                                                                              |                                                                                                                                                                               |

Question 1 (continued) f.



(1 mark)

g. 75%

(1 mark)

Question 3

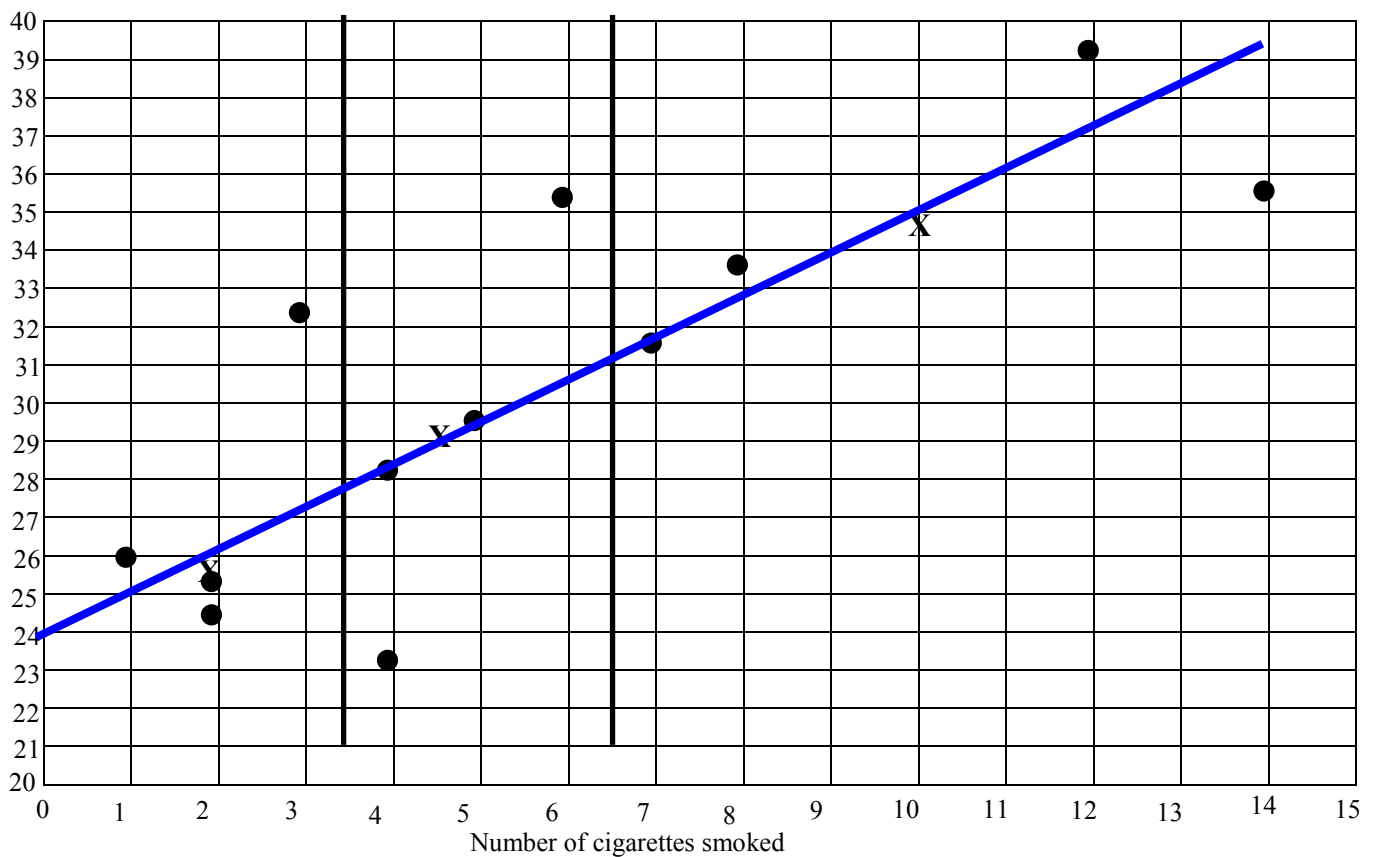
a. On graphics calculator enter data for the time taken to run 200 m for 12 children in Stat Edit in  $L_2$ . Go to Stat calc 1 Var Stats  $L_2$  Enter and read off the value for the mean, 30.5 and the standard deviation, 5.0

(1 mark)

b. On graphics calculator go to 2<sup>nd</sup> Dist normal cdf Enter  $-1, 2.5$ ) enter. this gives  $0.835 = 83.5\%$

(1 mark)

c.



(1 mark)

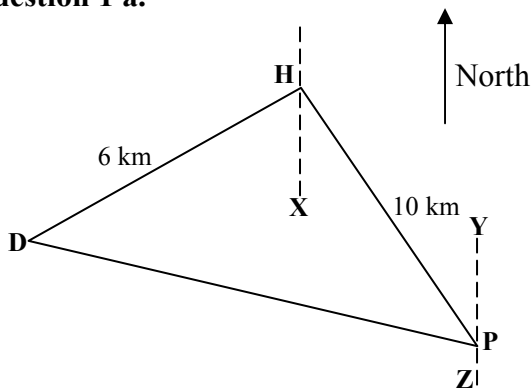
Question 3 (continued)

|                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>d.</b></p> $\text{gradient} = \frac{y_u - y_l}{x_u - x_l}$ $x_l = 2$ $y_l = \frac{25.4 + 26}{2} = 25.7$ $x_u = \frac{8 + 12}{2} = 10$ $y_u = \frac{33.9 + 35.6}{2} = 34.75 \quad (1 \text{ mark})$ $\text{gradient} = \frac{34.75 - 25.7}{10 - 2}$ $= 1.13 \text{ to two decimal places. } (1 \text{ mark})$ | <p><b>e.</b></p> <p>Put ruler on line joining points (2, 25.7) and (10, 34.75). Move ruler one third of the way towards (4.5, 29.05). This is</p> $x_m = \frac{4 + 5}{2} = 4.5$ <p>and</p> $y_m = \frac{28.3 + 29.8}{2} = 29.05$ <p>(1 mark)</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Question 1 a.</b><br/>Customers increase by 30 each year.<br/><math>2004 = 140 + 30 = 170</math><br/><math>2005 = 170 + 30 = 200</math><br/>(1 mark)</p>                                                                                                             | <p><b>b.</b><br/>Arithmetic sequence<br/><math>t_n = a + (n - 1)d</math><br/><math>t_{11} = 80 + 10 \times 30</math><br/><math>t_{11} = 80 + 300</math><br/><math>t_{11} = 380</math><br/>or use graphics calculator in sequence mode.<br/><math>y =</math><br/>enter<br/><math>nMin = 1</math><br/><math>m_n = 80 + (n - 1)30</math><br/><math>m(nMin) = 80</math><br/>Press 2nd table<br/>Go to <math>n = 11</math>, to find <math>m(n) = 380</math><br/>(1 mark)</p> |
| <p><b>c.</b><br/>Use sequence mode <math>y =</math><br/><math>nMin = 1</math><br/><math>\mu_n = 80 + (n - 1)30</math><br/><math>\mu(nMin) = 80</math><br/>Press 2nd table<br/>Go to <math>\mu_n = 500</math>, to find <math>n = 15</math><br/>Year = 2015<br/>(1 mark)</p> | <p><b>d.</b><br/>From the table in (c)<br/>Number of customers in 2009 = 320<br/>Number of customers in 2019 = 620<br/><math>S_n = \frac{n}{2}(a + l) = \frac{11}{2}(320 + 620) = 5170</math><br/>(1 mark)</p>                                                                                                                                                                                                                                                          |
| <p><b>e.</b><br/><math>N = 800 - 40d</math><br/>(1 mark)</p>                                                                                                                                                                                                               | <p><b>Question 2 a.</b><br/><math>4\% = 0.04</math><br/><math>3.00 + 0.04 \times 3.00 = \\$3.12</math><br/>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>b.</b><br/>This is a geometric sequence with<br/><math>r = 1.04</math><br/><math>a = 3.00</math><br/><math>C_n = 3.00(1.04)^{n-1}</math><br/>(1 mark)</p>                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Question 2 c.</b></p> $t_{10} = 3(1.04)^9$ $t_4 = 3(1.04)^3$ $t_{10} - t_4 = 3(1.04)^9 - 3(1.04)^3 = 0.8953$ <p>= 90 cents</p> <p>or use graphics calculator sequence mode with equation</p> $m(n) = 3(1.04)^n$ <p>This gives <math>m(n) = 4.27</math> when <math>n = 10</math><br/>and <math>m(n) = 3.37</math> when <math>n = 4</math><br/><math>4.27 - 3.37 = 0.90 = 90</math> cents.</p> <p style="text-align: right;">(1 mark)</p> | <p><b>d.</b></p> <p>Total cost if she sells one rose per year</p> $S_n = \frac{a(r^n - 1)}{r - 1}$ $S_6 = \frac{3(1.04^{10} - 1)}{(1.04 - 1)} = 36.01832137$ <p style="text-align: right;">(1 mark)</p> <p>total cost for 8000 per year</p> $= 8000 \times 36.01832137 = \$288,146.57$ <p style="text-align: right;">(1 mark)</p>                                                                                                                                                                        |
| <p><b>Question 3 a.</b></p> $a = 1 + \frac{20}{100} = 1.2$ <p style="text-align: right;">(1 mark)</p>                                                                                                                                                                                                                                                                                                                                         | <p><b>b.</b></p> <p>A minus sign is necessary because overheads decrease the profit.</p> <p>– 10,000</p> <p style="text-align: right;">(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>c.</b></p> <p>Use graphics calculator in sequence mode.</p> <p>y =<br/>enter</p> <p><math>nMin = 1</math></p> $\mu(n) = 1.2 \mu(n - 1) - 10000$ $\mu(nMin) = 65000$ <p>Press 2nd table</p> <p>Go to <math>n = 8</math>, to find <math>\mu(n) = 103748</math></p> <p>Profit = \$103,748</p> <p style="text-align: right;">(1 mark)</p>                                                                                                   | <p><b>d.</b></p> <p>Equation is now <math>\mu_n = 1.2\mu(n - 1) - 30000</math></p> <p style="text-align: right;">(1 mark)</p> <p>Use graphics calculator in sequence mode.</p> <p>y =<br/>enter</p> <p><math>nMin = 1</math></p> $\mu(n) = 1.2 \mu(n - 1) - 30000$ $\mu(nMin) = 103748$ <p>Press 2nd table and look for the first negative value in <math>\mu(n)</math>.</p> <p>8 years later she will make her first loss.</p> <p>This is the year 2016.</p> <p style="text-align: right;">(1 mark)</p> |

**Question 1 a.**



$$\begin{aligned}\angle DHX &= 40^\circ \\ \angle XHP &= \angle HPY = 30^\circ \text{ (alternate angles)} \\ \therefore \angle DHP &= 40^\circ + 30^\circ = 70^\circ\end{aligned}$$

(1 mark)

**b.**

Using cosine rule

$$DP^2 = 6^2 + 10^2 - 2 \times 6 \times 10 \cos 70^\circ$$

$$DP = \sqrt{6^2 + 10^2 - 2 \times 6 \times 10 \cos 70^\circ}$$

$$DP = 9.74 \text{ km}$$

(1 mark)

**c.**

$$\frac{\sin \angle HPD}{6} = \frac{\sin 70^\circ}{9.74461845}$$

$$\sin \angle HPD = \frac{6 \sin 70^\circ}{9.74461845}$$

$$\angle HPD = \sin^{-1} \left( \frac{6 \sin 70^\circ}{9.74461845} \right) = 35^\circ \text{ (1 mark)}$$

$$\angle DPZ = 360 - (30 + 35) = 295^\circ T \text{ (1 mark)}$$

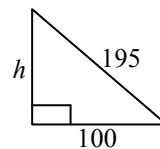
**d.**

$$\text{Area} = \frac{1}{2} bc \sin A$$

$$\text{Area} = \frac{1}{2} \times 6 \times 10 \sin 70^\circ = 28.19 \text{ km}^2$$

(1 mark)

**Question 2 a.**



$$h^2 = 195^2 - 100^2$$

$$h = \sqrt{195^2 - 100^2}$$

$$h = 167.4 \text{ m to one decimal place}$$

(1 mark)

**b.**

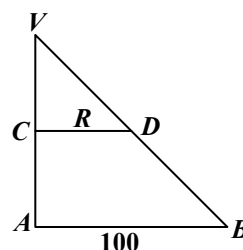
Triangles  $VCD$  and  $VAB$  are similar AAA

$$\therefore \frac{R}{100} = \frac{3}{4}$$

$$\therefore R = 75 \text{ m.}$$

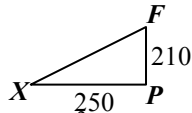
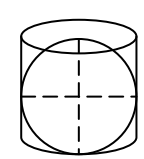
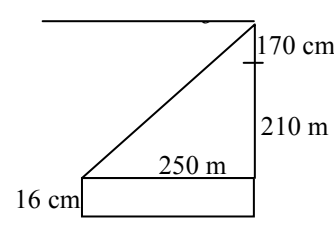
(1 mark)

**c.**



(1 mark)

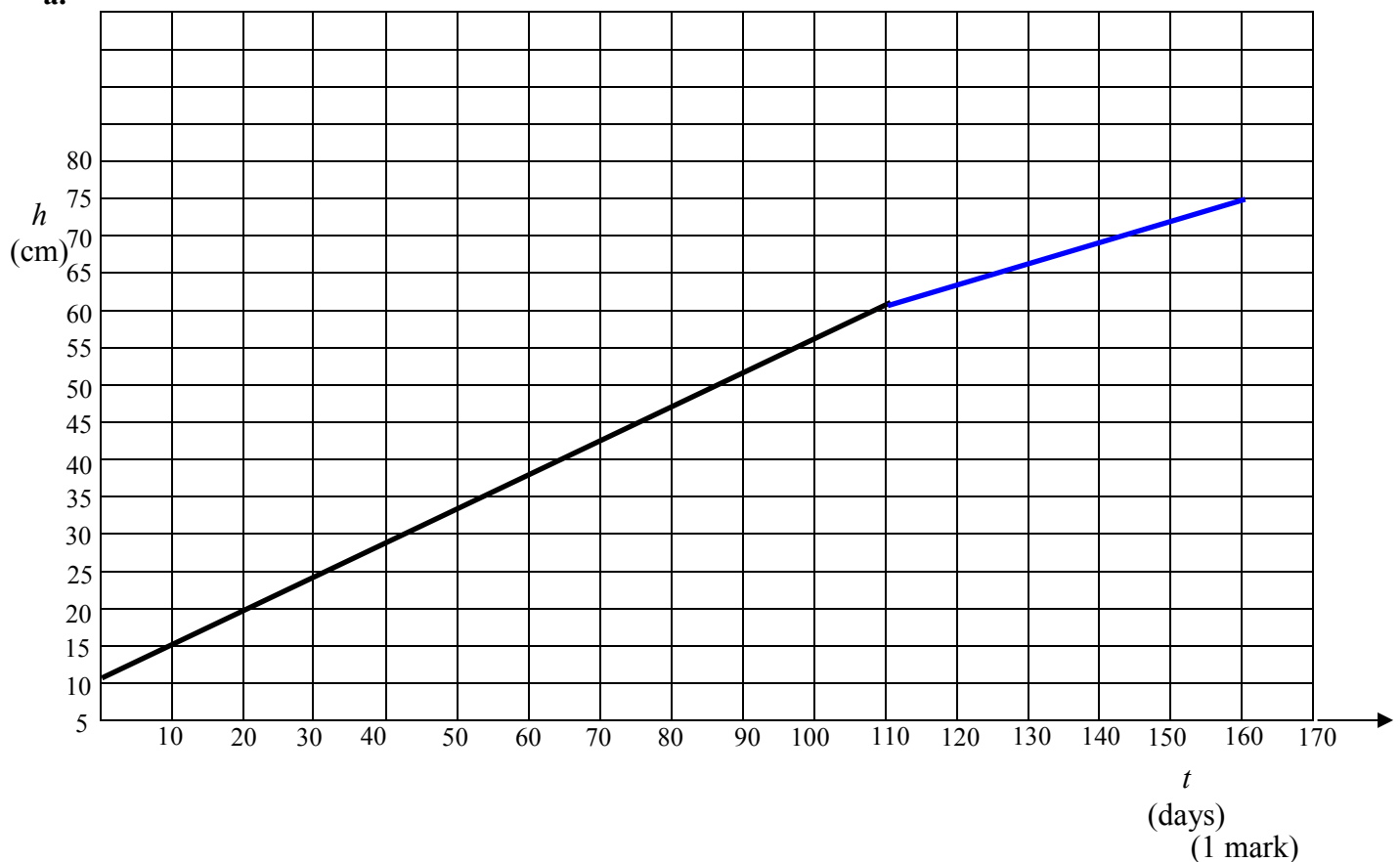


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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Question 2 (continued) c.</b></p> <p>Original volume = <math>\frac{1}{3}\pi r^2 h</math></p> <p>Original volume = <math>\frac{1}{3}\pi \times 100^2 \times 167.4</math><br/>= 1753008.701</p> <p>Volume removed = <math>\frac{1}{3}\pi \times 75^2 \times 125.55</math><br/>= 739550.5456 (1 mark)</p> <p>Volume of coal remaining<br/>= 1753008.701 - 739550.5456<br/>= 1013458.2 m<sup>3</sup><br/>(1 mark)</p>                                                                                                             | <p><b>Question 3 a.</b></p>  <p><math>XF^2 = 210^2 + 250^2</math><br/><math>XF = \sqrt{210^2 + 250^2}</math><br/>= 326.5 m<br/>(1 mark)</p>                                                                                                                        |
| <p><b>b.</b></p> <p>Radius of sphere = 8</p> <p><math>V</math> of sphere = <math>\frac{4}{3}\pi r^3</math><br/>= <math>\frac{4}{3}\pi 8^3 = 2144.66 \text{ cm}^3</math><br/>(1 mark)</p>  <p><math>R</math> of cylinder = 8</p> <p><math>V</math> of cylinder = <math>\pi r^2 h = \pi \times 8^2 \times 16 = 3216.99</math></p> <p>Space = <math>3216.99 - 2144.66 = 1072 \text{ cm}^3</math><br/>to the nearest cm<sup>3</sup><br/>(1 mark)</p> | <p><b>c.</b></p>  <p>(1 mark)</p> <p><b>Question 3 d.</b></p> <p><math>\tan \theta = \frac{210 + 1.7 - 0.16}{250} = \frac{211.54}{250}</math><br/>(1 mark)</p> <p><math>\theta = \tan^{-1}\left(\frac{211.54}{250}\right) = 40^\circ 14'</math><br/>(1 mark)</p> |

|                                                                   |                                                       |
|-------------------------------------------------------------------|-------------------------------------------------------|
| <b>Question 1 a.</b><br>30 cm.<br>(1 mark)                        | <b>b.</b><br>One complete cycle = 4 secs.<br>(1 mark) |
| <b>c.</b><br>30 cm to the right of the rest position.<br>(1 mark) |                                                       |

**Question 2**

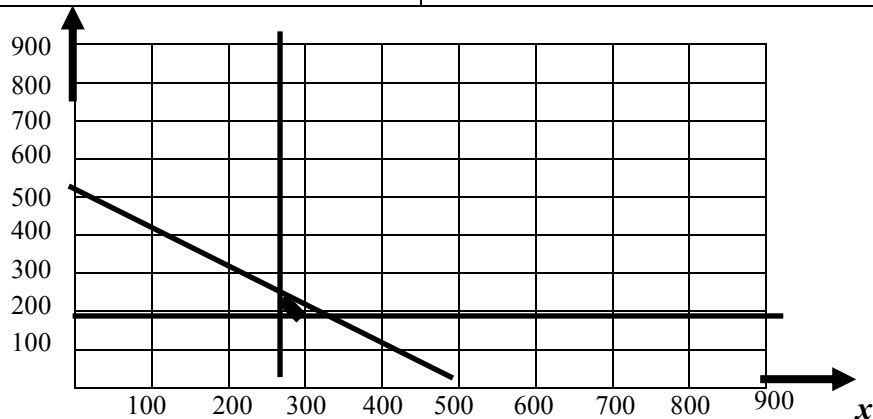
**a.**



|                                                                                                   |                                                                                                                                             |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>b.</b><br>Plant grows 50 cm in 110 days.<br>$\frac{50}{110} = 0.45 \text{ cm/day}$<br>(1 mark) | <b>c.</b><br>$h = 0.45t + 10$<br>(1 mark)                                                                                                   |
| <b>d.</b><br>Value of $a$ is $h$ value at end of first period of growth = 60<br>(1 mark)          | <b>e.</b><br>$h = 0.1t + 60$<br>$t = 160$<br>$h = 0.1 \times 160 + 60 = 76 \text{ cm.}$<br>Join (110,60) and (160,76) on graph.<br>(1 mark) |

|                                                                                        |                                                                                 |
|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| <b>Question 3 a.</b><br>$y \geq 180$<br><div style="text-align: right;">(1 mark)</div> | <b>b.</b><br>$x + y \leq 500$<br><div style="text-align: right;">(1 mark)</div> |
|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|

c.



( $\frac{1}{2}$  mark for horizontal line) , ( $\frac{1}{2}$  mark for vertical line) , ( $\frac{1}{2}$  mark for line  $x + y = 500$ )

( $\frac{1}{2}$  mark for shading)

|                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>d.</b><br>$P = 45x + 60y$<br><div style="text-align: right;">(1 mark)</div>                      | <b>e.</b><br>Points of intersection on graph are<br>(260,180), (260,240) and (320,180)<br>At (260,180) $P = 45 \times 260 + 60 \times 180 = 22,500$<br>At (260,240) $P = 45 \times 260 + 60 \times 240 = 26,100$<br>At (320,180) $P = 45 \times 320 + 60 \times 180 = 25,200$<br>$\therefore$ 260 kg. of day cream and 240 kg. of night cream.<br><div style="text-align: right;">(1 mark)</div> |
| <b>f.</b><br>From (e), maximum profit is \$26,100<br><div style="text-align: right;">(1 mark)</div> |                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                  |
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| <p><b>Question 1 a.</b><br/>\$14,0247<br/>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>b.</b><br/><math>140247 + 17335 - 12036.55 + 8642</math><br/><math>= \\$154187.45</math><br/>(1 mark)</p>                  |
| <p><b>c.</b><br/>Minimum monthly balance for December<br/><math>= 140247</math><br/>Interest for December =<br/><math>140247 \times \frac{8}{12 \times 100} \times 1 = 934.98</math><br/>(1 mark)<br/>Minimum monthly balance for January<br/><math>= 142150.9</math><br/>Interest for January =<br/><math>142150.9 \times \frac{8}{12 \times 100} \times 1 = 947.67</math><br/>Minimum monthly balance for February<br/><math>= 142150.9</math><br/>Interest for February =<br/><math>142150.9 \times \frac{8}{12 \times 100} \times 1 = 947.67</math><br/>Total interest <math>= 934.98 + 2 \times 947.67 = \\$2829.52</math><br/>(1 mark)</p> | <p><b>d.</b><br/><math>112\% = 160677</math><br/><math>12\% = \frac{160677 \times 12}{112} = \\$17215.39</math><br/>(1 mark)</p> |
| <p><b>Question 2 a.</b><br/>Increase <math>= 38150 - 35000 = 3150</math><br/><math>\% \text{ increase} = \frac{3150}{35000} \times 100 = 9\%</math><br/>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><b>b.</b><br/><math>35000(1.09)^4 = \\$49,405</math><br/>(1 mark)</p>                                                         |
| <p><b>c.</b><br/>Enter formula <math>y = 35000(1.09)^{\wedge} x</math><br/>in graphics calculator. Go to table to where<br/><math>x = 21, y = 213808</math> (1 mark)<br/>So in 21st year, where 2004 is year 0.<br/><math>\therefore 2025</math> (1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                                    | <p><b>d.</b><br/><math>35000 + \frac{35000 \times 16 \times 5}{100} = \\$63,000</math><br/>(1 mark)</p>                          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                             |
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| <p><b>Question 2 (continued) e.</b></p> <p>Enter <math>y_2 = 35000 + \frac{35000 \times 16 \times x}{100}</math></p> <p>in the graphics calculator. (1 mark)</p> <p>Keep the <math>y_1</math> equation from (c) in the calculator.</p> <p>Go to table.</p> <p>When <math>x = 14, y_1 &gt; y_2 \therefore 2018</math> (1 mark)</p>                                                                                                          |                                                                                                                                                                                             |
| <p><b>Question 3</b></p> <p><b>a. i.</b></p> <p>\$2000</p> <p>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                 | <p><b>a. ii.</b></p> $1 + \frac{9.8}{12 \times 100}$ <p>= 1.008</p> <p>(1 mark)</p>                                                                                                         |
| <p><b>b.</b></p> <p>Use graphics calculator</p> <p>Press Apps Finance Enter TVM Solver Enter</p> <p><math>N =</math></p> <p><math>I = 9.8</math></p> <p><math>PV = 200000</math></p> <p><math>PMT = -2000</math></p> <p><math>FV = 0</math></p> <p><math>P / Y = 12</math></p> <p><math>C / Y = 12</math></p> <p>Put cursor on <math>FV</math> and press alpha solve</p> <p><math>N = 204.22</math> months = 17 years.</p> <p>(1 mark)</p> | <p><b>c.</b></p> <p>Amount repaid</p> <p>= <math>204.2172486 \times 2000 = 408434.4972</math></p> <p>Interest = <math>408434.4972 - 200000</math></p> <p>= \$208,434.50</p> <p>(1 mark)</p> |

|                                                                                                                                           |          |          |          |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |          |          |           |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|
| <b>Question 1 a.</b><br>$A = 2, B = 3, C = 3, D = 3, E = 1$<br>$2 + 3 + 3 + 3 + 1 = 12$<br><div style="text-align: right;">(1 mark)</div> |          |          |          |          | <b>b.</b><br><b>D.</b><br><div style="text-align: right;">(1 mark)</div> It is the only town that can be reached from A, B, C and E<br><div style="text-align: right;">(1 mark)</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |          |          |           |
| <b>c.</b><br>A, C and D<br><div style="text-align: right;">(1 mark)</div>                                                                 |          |          |          |          | <b>d.</b><br><div style="text-align: center;">To</div> <div style="text-align: center;">A   B   C   D   E</div> <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">From</div> <div style="display: flex; flex-direction: column; align-items: center;"> <div>A</div> <div>B</div> <div>C</div> <div>D</div> <div>E</div> </div> <div style="font-size: 2em; margin: 0 10px;">[</div> <div style="display: flex; flex-direction: column; align-items: center;"> <div>0</div> <div>1</div> <div>1</div> <div>0</div> <div>0</div> </div> <div style="font-size: 2em; margin: 0 10px;">]</div> <div style="display: flex; flex-direction: column; align-items: center;"> <div>2</div> <div>2</div> <div>2</div> <div>0</div> <div>0</div> </div> <div style="font-size: 2em; margin: 0 10px;">]</div> </div> e.g. D can be reached from A in 2 ways,<br>ABD or ABCD<br>(1 mark) for getting any two rows correct<br>(1 mark) for getting remaining rows correct. |          |          |          |           |
| <b>Question 2 a.</b>                                                                                                                      | <b>J</b> | <b>K</b> | <b>L</b> | <b>M</b> | Step1<br>– Min.<br>in rows                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>J</b> | <b>K</b> | <b>L</b> | <b>M</b>  |
| <b>R</b>                                                                                                                                  | 6        | 7        | 5        | 11       | <b>R</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | $6-5=1$  | $7-5=2$  | $5-5=0$  | $11-5=6$  |
| <b>WS</b>                                                                                                                                 | 10       | 5        | 3        | 12       | <b>WS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $10-3=7$ | $5-3=2$  | $3-3=0$  | $12-3=9$  |
| <b>CP</b>                                                                                                                                 | 11       | 3        | 4        | 13       | <b>CP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $11-3=8$ | $3-3=0$  | $4-3=1$  | $13-3=10$ |
| <b>WP</b>                                                                                                                                 | 8        | 4        | 6        | 10       | <b>WP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $8-4=4$  | $4-4=0$  | $6-4=2$  | $10-4=6$  |
| Step 2 – Minimum in columns                                                                                                               |          |          |          |          | (1 mark)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |          |          |           |
|                                                                                                                                           | <b>J</b> | <b>K</b> | <b>L</b> | <b>M</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>J</b> | <b>K</b> | <b>L</b> | <b>M</b>  |
| <b>R</b>                                                                                                                                  | $1-1=0$  | $2-0=2$  | $0-0=0$  | $6-6=0$  | <b>R</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 2        | 0        | 0         |
| <b>WS</b>                                                                                                                                 | $7-1=6$  | $2-0=2$  | $0-0=0$  | $9-6=3$  | <b>WS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6        | 2        | 0        | 3         |
| <b>CP</b>                                                                                                                                 | $8-1=7$  | $0-0=0$  | $1-1=0$  | $10-6=4$ | <b>CP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7        | 0        | 0        | 4         |
| <b>WP</b>                                                                                                                                 | $4-1=3$  | $0-0=0$  | $2-0=2$  | $6-6=0$  | <b>WP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3        | 0        | 2        | 0         |

(1 mark)

|                                                                                                                                                                                                               |                       |                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Question 2 a. (continued)</b><br>Allocating jobs.<br>$R \longrightarrow J$<br>$CP \longrightarrow K$<br>$WS \longrightarrow L$<br>$WP \longrightarrow M$<br><div style="text-align: right;">(1 mark)</div> |                       | <b>b.</b><br>Minimum time = $6 + 3 + 3 + 10 = 22$ hours<br><div style="text-align: right;">(1 mark)</div>                                                                                                                      |
| <b>Question 3 a.</b>                                                                                                                                                                                          |                       |                                                                                                                                                                                                                                |
| Activity                                                                                                                                                                                                      | Immediate Predecessor | <b>b.</b><br>The critical path is the longest path.<br>ACDI<br><div style="text-align: right;">(1 mark)</div>                                                                                                                  |
| <i>A</i>                                                                                                                                                                                                      | -----                 |                                                                                                                                                                                                                                |
| <i>B</i>                                                                                                                                                                                                      | <i>A</i>              |                                                                                                                                                                                                                                |
| <i>C</i>                                                                                                                                                                                                      | <i>A</i>              |                                                                                                                                                                                                                                |
| <i>D</i>                                                                                                                                                                                                      | <i>B</i>              |                                                                                                                                                                                                                                |
| <i>E</i>                                                                                                                                                                                                      | <i>C</i>              |                                                                                                                                                                                                                                |
| <i>F</i>                                                                                                                                                                                                      | <i>E</i>              |                                                                                                                                                                                                                                |
| <i>G</i>                                                                                                                                                                                                      | <i>A, B</i>           |                                                                                                                                                                                                                                |
| <i>H</i>                                                                                                                                                                                                      | -----                 |                                                                                                                                                                                                                                |
| <i>I</i>                                                                                                                                                                                                      | <i>D, F, G, H</i>     |                                                                                                                                                                                                                                |
| (1 mark)                                                                                                                                                                                                      |                       |                                                                                                                                                                                                                                |
| <b>c.</b><br>$5 + 8 + 12 + 8 = 33$ hours.<br><div style="text-align: right;">(1 mark)</div>                                                                                                                   |                       | <b>d.</b><br>This will alter the critical path to ABEFI<br>Time taken = $5 + 6 + 4 + 14 + 8 = 37$ hours.<br>This means it will take four hours longer to finish the project.<br><div style="text-align: right;">(1 mark)</div> |
| <b>e.</b><br>No effect, as F is not on the critical path.<br><div style="text-align: right;">(1 mark)</div>                                                                                                   |                       |                                                                                                                                                                                                                                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Question 1 a.</b></p> $M = \begin{matrix} & R & W & C \\ X & a & b & c \\ Y & d & e & f \end{matrix}$ <p>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p><b>b.</b></p> <p>2 rows and 3 columns so <math>2 \times 3</math></p> <p>(1 mark)</p>                                                                                                             |
| <p><b>c.</b></p> $N = \begin{bmatrix} P \\ Q \\ R \end{bmatrix}$ <p>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>d.</b></p> $MN = \begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix} \begin{bmatrix} P \\ Q \\ R \end{bmatrix} = \begin{bmatrix} aP + bQ + cR \\ dP + eQ + fR \end{bmatrix}$ <p>(1 mark)</p> |
| <p><b>e.</b></p> <p><math>dP + eQ + fR</math> represents the selling price of wines for company <math>Y</math></p> <p>(1 mark)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                     |
| <p><b>Question 2 a.</b></p> $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -\frac{7}{31} & \frac{2}{31} & \frac{8}{31} \\ \frac{8}{31} & \frac{11}{31} & -\frac{18}{31} \\ \frac{9}{31} & -\frac{7}{31} & \frac{3}{31} \end{bmatrix} \begin{bmatrix} 36.1 \\ 30.65 \\ 32.45 \end{bmatrix} = \begin{bmatrix} 2.20 \\ 30.65 \\ 32.45 \end{bmatrix}$ <p>Use graphics calculator to get inverse matrix of</p> <p>matrix <math>\begin{bmatrix} 3 &amp; 2 &amp; 4 \\ 6 &amp; 3 &amp; 2 \\ 5 &amp; 1 &amp; 3 \end{bmatrix}</math> which is <math>\begin{bmatrix} -\frac{7}{31} &amp; \frac{2}{31} &amp; \frac{8}{31} \\ \frac{8}{31} &amp; \frac{11}{31} &amp; -\frac{18}{31} \\ \frac{9}{31} &amp; -\frac{7}{31} &amp; \frac{3}{31} \end{bmatrix}</math></p> <p>Then use graphics calculator to do the multiplication to get the answer.</p> <p>1 mark for inverse matrix<br/>1 mark for giving answers as fractions<br/>1 mark for correct solution</p> <p>(3 marks)</p> | <p><b>b.</b></p> <p>The cost of a tin of dog food is \$2.20</p> <p>(1 mark)</p>                                                                                                                     |



## Module 6 Matrices

|                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                           |          |          |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|-----|-----|-----|-------------------------------|------|-----|-----|----------|------|-----|-----|
| <p><b>Question 3 a.</b></p> <p>0.05 = 5 %</p> <p>(1 mark)</p>                                                             | <p><b>b.</b></p> <p>Next Purchase</p> <table><tr><td></td><td><i>A</i></td><td><i>B</i></td><td><i>C</i></td></tr><tr><td><i>A</i></td><td>0.9</td><td>0.1</td><td>0.2</td></tr><tr><td><i>T = Current Purchase B</i></td><td>0.05</td><td>0.8</td><td>0.1</td></tr><tr><td><i>C</i></td><td>0.05</td><td>0.1</td><td>0.7</td></tr></table> <p>(1 mark)</p>                                                               |          | <i>A</i> | <i>B</i> | <i>C</i> | <i>A</i> | 0.9 | 0.1 | 0.2 | <i>T = Current Purchase B</i> | 0.05 | 0.8 | 0.1 | <i>C</i> | 0.05 | 0.1 | 0.7 |
|                                                                                                                           | <i>A</i>                                                                                                                                                                                                                                                                                                                                                                                                                  | <i>B</i> | <i>C</i> |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |
| <i>A</i>                                                                                                                  | 0.9                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.1      | 0.2      |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |
| <i>T = Current Purchase B</i>                                                                                             | 0.05                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.8      | 0.1      |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |
| <i>C</i>                                                                                                                  | 0.05                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.1      | 0.7      |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |
| <p><b>c.</b></p> <p><math>\begin{bmatrix} 0.3 \\ 0.6 \\ 0.1 \end{bmatrix}</math></p> <p>(1 mark)</p>                      | <p><b>d. i.</b></p> <p><math>\begin{bmatrix} 0.9 &amp; 0.1 &amp; 0.2 \\ 0.05 &amp; 0.8 &amp; 0.1 \\ 0.05 &amp; 0.1 &amp; 0.7 \end{bmatrix} \begin{bmatrix} 0.3 \\ 0.6 \\ 0.1 \end{bmatrix} = \begin{bmatrix} 0.35 \\ 0.505 \\ 0.145 \end{bmatrix}</math></p> <p>(1 mark)</p>                                                                                                                                              |          |          |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |
| <p><b>d. ii.</b></p> <p>The percentage of customers expected at Charisma pharmacy next week is 14.5%.</p> <p>(1 mark)</p> | <p><b>e.</b></p> <p>Find <math>T \wedge 40 S_0</math><br/>and <math>T \wedge 50 S_0</math></p> <p>These both give <math>K = \begin{bmatrix} 0.588 \\ 0.235 \\ 0.176 \end{bmatrix}</math></p> <p>To enter <math>T \wedge 40 K_0</math> into calculator press<br/>2nd matrix A <math>\wedge</math> 40 2nd matrix B enter</p> <p>So expect 17.6% of customers in the Charisma pharmacy in the long term.</p> <p>(1 mark)</p> |          |          |          |          |          |     |     |     |                               |      |     |     |          |      |     |     |

## End of suggested solutions 2007 Further Mathematics VCE Trial Examination 2

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