

2018 VCE Further Mathematics Trial Examination 1 Suggested Answers



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Section A Core – Data Analysis

Question 1 B Number of women surveyed = 10 Number of women who purchased 24 or more newspapers = 3 Percentage = $3 \div 10 \times 100 = 30\%$	Question 2 C 4, 8, 15, 19, 20, 20, 31, 33, 36, 42 Median = 20 Upper quartile = 33
Question 3 E The range is $13 - 4 = 9$ Use calculator to find mean = 8.4 and standard deviation = 2.8 to one decimal place.	Question 4 D Let x be the number of tonnes of garbage 25% is greater than 4 $\log_{10} x = 4$ $x = 10^4 = 10000$
Question 5 C 150 out of 6000 = $0.025 = 2.5\%$ 2.5% have a speed greater than 100 km/hr. This is 2 standard deviations above the mean. $2 = \frac{100 - 90}{s}, s = 5$	Question 6 A <i>Sales</i> are numerical since the percentages are amounts. <i>Shops</i> are categorical since they are a category. They could be given names rather than numbers.
Question 7 C Macaroni is the middle segment. For shop 3 it goes from 30% to 70% = 40%	Question 8 E Shop 1 sold 20% Spaghetti and 25% Cannelloni, so A is not true. Shop 3 sold 30% and Shop 4 sold 20% Cannelloni, so B is not true. Shop 2 sold 30% Spaghetti Which was different from the 20% sold in Shop 1, so C is not true. Shop 4 sold 30% Macaroni, while Shop 2 sold 10%. 30 is not less than double 10, so D is not true. Shop 1 sold 55% Macaroni and 45% of the other two pastas combined, so E is true.

Section A Core – Data Analysis

Question 9 A Put the 10 points into the calculator and get the regression line equation. This gives $Sales = 2277 - 87 \times \text{maximum temperature}.$	Question 10 E Residual = actual value – predicted value Predicted value = $2277 - 87 \times 15 = 972$ $= 1300 - 972 = 328$
Question 11 B The sale of soup decreases by about \$87 for each 1°C rise in maximum temperature, so not A The coefficient of determination is never negative so not C. Pearson’s correlation coefficient = -0.72, which indicates a moderate negative association, so not D. The scatterplot says nothing about what causes the change, only about the association between the two variables, so not E. The coefficient of determination = 0.516 which tells us that 51.6% of the variation in sales can be explained by the variation in maximum temperature, so $100 - 51.6 = 48.4\%$ cannot be explained by the variation in maximum temperature.	Question 12 D There is an increasing trend. It is seasonal because the distance between the peaks and troughs is regular over a period of 1 year. Cycles are periodic movements over a period greater than one year, which is not the case here.
Question 13 D First quarter in 2016 is 9 For 9 get $(4 + 8 + 6 + 4 + 6) \div 5 = 5.6$ $= \\$5600$	
Question 14 B Seasonal index = Value for November $\div$ Yearly average Yearly average = $(7000 + 8000 + 9000 + 3500 + 7000 + 7500 + 9000 + 12000 + 9000 + 14500 + 16200 + 11300) \div 12 = 9500$ Seasonal Index = $16200 \div 9500 = 1.7$	Question 15 A Seasonal index for fourth quarter $= 4 - (1.3 + 0.9 + 1.1) = 0.7$ Deseasonalised sales for fourth quarter $= 823000 + 21400 \times 4 = 908600$ Actual sales = Deseasonalised sales $\times$ SI $= 908600 \times 0.7 = \\$636020$
Question 16 C $0.3 \text{ increase on } 0.7 = \frac{0.3}{0.7} \times 100 = 42.9\%$	

Section A Core – Recursion and financial modelling

Question 17 A Use calculator to generate the first 6 terms. Or -10 $3 \times -10 + 9 = -21$ $3 \times -21 + 9 = -54$ $3 \times -54 + 9 = -153$ $3 \times -153 + 9 = -450$	Question 18 B After 1 year = 0.64×8000 After 2 years = $0.64^2 \times 8000$ After 3 years = $0.64^3 \times 8000$ This pattern gives After n years = $0.64^n \times 8000$
Question 19 E 6% per annum = $6 \div 12 = 0.5\%$ per month $R = 1 + 0.5 \div 100 = 1.005$ $V_0 = 2000 \quad V_{n+1} = 1.005V_n + 600$	Question 20 C Depreciation over 10 years = $6000 - 150$ Depreciation over 1 year = $(6000 - 150) \div 10$ Depreciation over 4 years $= (6000 - 150) \div 10 \times 4$ $= (6000 - 150) \times 0.4$ Value of carpet after 4 years $= 6000 - (6000 - 150) \times 0.4$
Question 21 A In a perpetuity account, the amount paid out in income always equals the interest paid, so it is a constant value. Hence, not C, D or E. Interest of 3% per annum = $3 \div 12 = 0.25\%$ per month. Interest = $0.0025 \times 600000 = \\1500	Question 22 D After 1 year, value = $28000(1 - R)$ After 8 years, value = $28000(1 - R)^8 = 4000$ Use solve on the calculator to get $R = 0.2159$ $r = 100 \times 0.2159 = 21.59\%$
Question 23 B Use calculator $N =$ $I = 5$ $PV = -50000$ $PMT = 1200$ $FV = 0$ $P/Y = 12$ $C/Y = 12$ This gives $N = 45.86$ months $45.86 \div 12 = 3.8$ year 0.8 of a year = $0.8 \times 12 = 9.6$ months 3 years 9.6 months is closest to 3 years 10 months from the given alternatives.	Question 24 C $N = 25 \times 12 = 300$ $I = 4$ $PV = 8000000$ $PMT =$ $FV = 0$ $P/Y = 12$ $C/Y = 12$ This gives $PMT = \\$-4222.6947$ $N = 15 \times 12 = 180$ $I = 4$ $PV = 8000000$ $PMT = -4222.6947$ $FV =$ $P/Y = 12$ $C/Y = 12$ This gives $FV = \\$417076.2961$ Now $PV = 417076.2961$, $PMT = -5500$, $FV = 0$ Need to find N which equals 87.56 months $= 7.3$ years $15 + 7.3 = 22.3$, which is closest to 22 years.

Module 1 – Matrices

Question 1 D $2A$ has order 3×4 $2AB$ has order 3×4 by 4×2 which is a 3×2	Question 2 A No solution or many solutions when the determinant = 0 $4a + 30 = 0$ $a = -7.5$ This gives two lines $4x - 5y = 3$ and $6x - 7.5y = 1$ Multiplying the first of these equations by 1.5 gives $6x - 7.5y = 4.5$ When this line is compared with the line $6x - 7.5y = 1$ it can be seen that they are parallel and so have no points in common.
Question 3 C First row by first column gives T Second row by first column gives R Third row by first column gives S Fourth row by first column gives P Fifth row by first column gives Q $\begin{bmatrix} T \\ R \\ S \\ P \\ Q \end{bmatrix}$	Question 4 C Profit on a dress = $100 - 50 = \\$50$ Profit on a shirt = $90 - 30 = \\$60$ Half the pants sold for a profit of $60 - 40 = \\$20$ and the other half sold for a profit of $30 - 40 = -\\$10$ which is a loss. Overall for the pants there was a profit of $20 - 10 = \\$10$ Total profit can be found from $\begin{bmatrix} 200 & 140 & 120 \end{bmatrix} \begin{bmatrix} 50 \\ 60 \\ 10 \end{bmatrix}$
Question 5 B $\begin{bmatrix} 1 & 0 & 1 \\ 3 & -1 & 0 \\ 2 & 3 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 9 \\ 1 \\ 12 \end{bmatrix} \quad \text{Inverse of } \begin{bmatrix} 1 & 0 & 1 \\ 3 & -1 & 0 \\ 2 & 3 & -1 \end{bmatrix} \text{ is } \frac{1}{12} \begin{bmatrix} 1 & 3 & 1 \\ 3 & -3 & 3 \\ 11 & -3 & -1 \end{bmatrix}$ $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{12} \begin{bmatrix} 1 & 3 & 1 \\ 3 & -3 & 3 \\ 11 & -3 & -1 \end{bmatrix} \begin{bmatrix} 9 \\ 1 \\ 12 \end{bmatrix}$	

Question 6 B

$$Z = \begin{bmatrix} 5 & 12 & 19 & 26 \\ 3 & 10 & 17 & 24 \\ 1 & 8 & 15 & 22 \end{bmatrix}$$

When $i = 1$ and $j = 1$

$2i + 7j = 9$ not 5, so not A

$7j - 2i = 5$ so maybe B

$7i - 2j = 5$, so maybe C

$7i + 2j = 9$ not 5, so not D

$2i - 7j = -5$ not 5, so not E

When $i = 1$ and $j = 2$

$7j - 2i = 12$ so maybe B

$7i - 2j = 3$, not 12, so not C

Answer is B.

Question 7 C

One step dominance scores:

$$A = 1 + 1 = 2$$

$$B = 1 + 1 + 1 = 3$$

$$C = 1$$

$$D = 1 + 1 = 2$$

$$E = 1 + 1 = 2$$

Two step dominance matrix

$$\begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 2 & 2 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 2 & 0 & 2 & 0 & 1 \\ 0 & 0 & 1 & 2 & 0 \end{bmatrix}$$

Two step dominance scores:

$$A = 0 + 1 + 0 + 1 + 1 = 3$$

$$B = 1 + 0 + 2 + 2 + 0 = 5$$

$$C = 0 + 1 + 0 + 0 + 1 = 2$$

$$D = 2 + 0 + 2 + 0 + 1 = 5$$

$$E = 0 + 0 + 1 + 2 + 0 = 3$$

One step dominance score + two step dominance score:

$$A = 2 + 3 = 5$$

$$B = 3 + 5 = 8$$

$$C = 1 + 2 = 3$$

$$D = 2 + 5 = 7$$

$$E = 2 + 3 = 5$$

B comes first and C comes last.

Question 8 E

First week 30% of 400 = 120 go to Blaxland, so not A.

Second week

$$\begin{bmatrix} 0.3 & 0.7 & 0.1 \\ 0.2 & 0.1 & 0.6 \\ 0.5 & 0.2 & 0.3 \end{bmatrix} \begin{bmatrix} 180 \\ 120 \\ 100 \end{bmatrix} = \begin{bmatrix} 148 \\ 108 \\ 144 \end{bmatrix} \quad \text{This means most shopped at Ardeen in week 2, so not C.}$$

$$\begin{bmatrix} 0.3 & 0.7 & 0.1 \\ 0.2 & 0.1 & 0.6 \\ 0.5 & 0.2 & 0.3 \end{bmatrix}^2 \begin{bmatrix} 180 \\ 120 \\ 100 \end{bmatrix} = \begin{bmatrix} 134 \\ 127 \\ 139 \end{bmatrix} \quad \text{This means most shopped at Costers in week 3, so not D.}$$

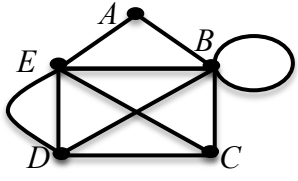
In the long term, most people will shop at Ardeen, so not B.

In week 2, 108 shop at Blaxland

$$\frac{108}{400} \times 100 = 27\%$$

E is true.

Module 2 – Networks and decision mathematics

Question 1 E A tree has no loops, so not B. A tree has no multiple edges so not D. A tree has no cycles so not A or C	Question 2 D  Vertex A = degree 2 Vertex B = degree 6 Vertex C = degree 3 Vertex D = degree 4 Vertex E = degree 5 Sum of degrees of vertices = $2 + 6 + 3 + 4 + 5 = 20$
Question 3 A An Eulerian circuit exists when all the vertices are of even degree. P has degree 4, Q has degree 2, R has degree 2, S has degree 4, T has degree 3 and U has degree 3. If an extra line were drawn from T to U, then they would both have an even degree.	Question 4 B Looking at Table 2, each person would have to do a task with a 0 in the column. W would do task P, U would do task Q, V would do task R and T would do task S
Question 5 C From Table 1 W takes 7 minutes to do task P. U takes 5 minutes to do task Q. V takes 9 minutes to do task R. T takes 4 minutes to do task S. Total time = $7 + 5 + 9 + 4 = 25$ minutes.	Question 6 B $A - F - G - H - M = 10 + 3 + 4 + 5 + 3 = 25$ days $C - D - I - K - L - M = 12 + 10 + 7 + 8 + 6 + 3 = 46$ days $C - D - E - F - G - H - M$ = This is not a path. $B - I - G - H - M = 11 + 7 + 4 + 5 + 3 = 30$ days $B - I - K - L - M = 11 + 7 + 8 + 6 + 3 = 35$ days. The critical path is the longest path.

Question 7 E

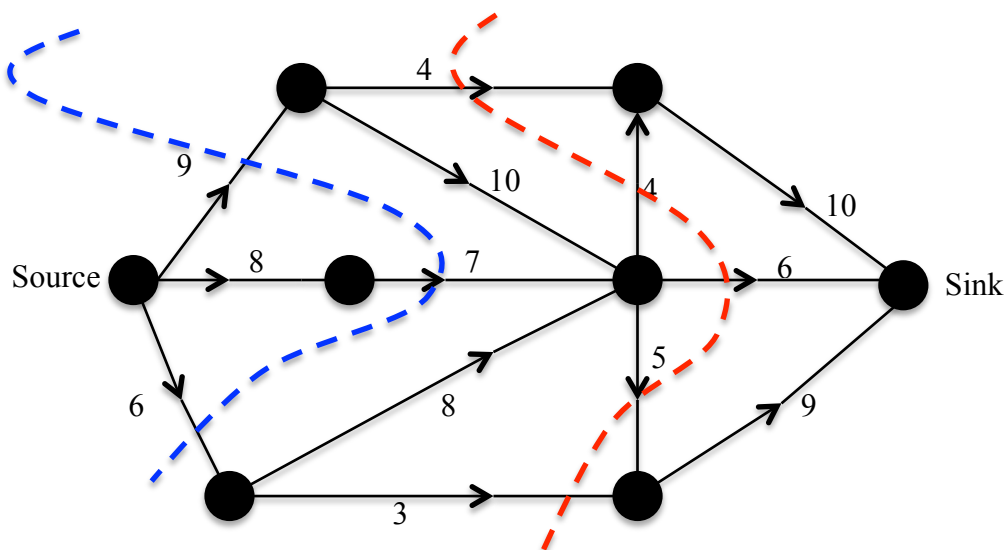
If A takes $10 + 5 = 15$ days, $AE = 21$ days but $CD = 22$ days, which is longer so critical path does not change.

If J takes $11 + 5 = 16$ days, $CJ = 28$ days but $CDI = 29$ days, which is longer so critical path does not change.

If F takes $3 + 20 = 23$ days, $AFGH = 42$ days but $CDIKL = 43$ days, which is longer so critical path does not change.

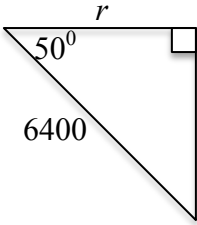
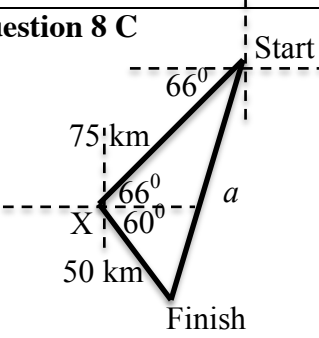
If K takes $5 + 8 = 13$ days, the critical path is lengthened and remains the critical path.

If E takes $6 + 7 = 13$ days, $AE = 23$ days and $CD = 22$ days, so there will be a new critical path, AETKLM

Question 8 C

Minimum cut $4 + 4 + 6 + 5 + 3 = 22 = \text{Maximum flow}$

Alternatively, $9 + 7 + 6 = 22$

Question 1 A Area of minor sector = $\pi r^2 \times \frac{60}{360}$ $= \pi \times 4^2 \times \frac{60}{360} = 8.4 \text{ cm}^2$	Question 2 B $\angle BCA = \cos^{-1}(0.5) = 60^\circ$ $\angle BCD = 180 - 60 = 120^\circ$
Question 3 D Ratio of surface areas, B:A = 342:38 = 9:1 Ratio of lengths, B:A = $\sqrt{9}:\sqrt{1}=3:1$ This means that lengths in A are $\frac{1}{3}$ the lengths in B Perpendicular height in A = $\frac{1}{3} \times 12 = 4 \text{ cm}$.	Question 4 A $\angle EBA = 75^\circ$ (vertically opposite to $\angle DBF$) $\angle BAC = 75^\circ$ (alternate angle to $\angle EBA$) $\angle BCA = 75^\circ$ (base angles of isosceles triangle) $\angle ABC = 180 - 75 - 75$ $= 30^\circ$ (angles in triangle sum to 180)
Question 5 C  $r = 6400 \times \cos(50^\circ) = 4113.84$ Distance around part of circumference of this circle $= 2 \times \pi \times 4113.84 \times (114 + 2) \div 360 = 8329 \text{ km}$	Question 6 E If 7 more triangles are drawn in the octagon, each with its apex at the centre, then there will be 8 equal triangles. The angle at the apex of each triangle = $360 \div 8 = 45^\circ$. The base angles of each triangle are equal and their size is $(180 - 45) \div 2 = 67.5^\circ$ a is one of these base angles and so equals 67.5°
Question 7 A Surface area = Surface area of cylinder without the top + surface area of curved surface of hemisphere. Radius of base of cylinder = 9 m Radius of hemisphere = 9 m Height of cylinder = $20 - 9 = 11 \text{ m}$ $SA = 2\pi r \times h + \pi r^2 + \frac{1}{2} \times 4\pi r^2$ $SA = 2\pi \times 9 \times 11 + \pi \times 9^2 + \frac{1}{2} \times 4\pi \times 9^2$ $= 1385 \text{ cm}^2$	Question 8 C  Angle at X = $60 + 66 = 126^\circ$ Using cosine rule, $a^2 = 75^2 + 50^2 - 2 \times 75 \times 50 \times \cos(126^\circ)$ $a^2 = 12533.4$ $a = \sqrt{12533.4} = 112 \text{ km}$

Module 4 – Graphs and relations

Question 1 E Both points have the same x value, so $x = \text{the constant value of } 3$ $x = 3$	Question 2 C Equation of line is $y = mx + c$ $m = \frac{10 - 4}{5 - 3} = 3$ $y = 3x + c$ When $x = 3, y = 4$ $4 = 9 + c$ $c = -5$ Y intercept is $(0, -5)$
Question 3 B The temperature was above 16°C for slightly more than 5 hours so B is false. The maximum temperature was 18°C, There was no change in temperature from 11 am to 1 pm. The greatest change in temperature was from 3 pm to 4 pm and the greatest rise in temperature was from 6 am to 7 am.	Question 4 A Let $x = \text{cost of burger}$ and $y = \text{cost of hotdog}$. Using calculator to solve the simultaneous equations, $2x + 7y = 24$ and $3x + 5y = 22.8$ gives $x = 3.60$ and $y = 2.40$ Cost of burger = \$3.60 Cost of hotdog = \$2.40 Rory's cost = $4 \times 3.60 + 2 \times 2.40 = \\19.20
Question 5 A This is a straight line graph passing through origin. So, equation of this line is $y = mx^2$ When $x^2 = 4, y = 6$ $6 = m \times 4$ $m = \frac{6}{4} = \frac{3}{2}$ $y = \frac{3}{2}x^2$	Question 6 E For 800 shirts, $C = 24.6 \times 800 + 360 = 20040$ Let discount price = \$$x$. Selling price = $600 \times 36 + 200 \times x$ Profit = $600 \times 36 + 200 \times x - 20040 = 3960$ Solve this on calculator to get $x = \\$12$

Module 4 – Graphs and relations**Question 7 D**

On line $y = 3x + 4$, when $x = a, y = 16$,

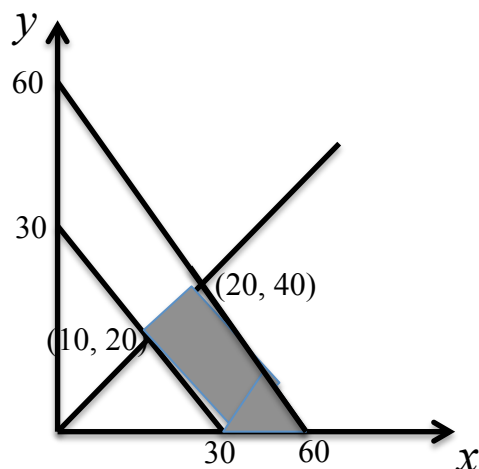
$$16 = 3a + 4, \text{ so } a = 4$$

On line $y = 5x - 4$, when $x = b, y = 26$,

$$26 = 5b - 4, \text{ so } b = 6$$

On line $y = cx + 14$, when $x = 6, y = 26$,

$$26 = 6c + 14, \text{ so } c = 2$$

Question 8 D

Solving $y = 2x$ and $x + y = 30$ gives the point $(10, 20)$

Solving $y = 2x$ and $x + y = 60$ gives the point $(20, 40)$

From the graph it can be seen that the x value cannot be less than 10, so not C

The $x + y$ value cannot be greater than 60, so not A or E.

The y value must be less than $2x$, so not B.

End of Suggested Solutions 2018 VCE Further Mathematics Trial Examination 1

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