

# 2022 VCE Further Mathematics Trial Examination 1 Suggested Solutions



**Kilbaha Education**

Quality educational content

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**Section A Core – Data Analysis****Question 1 C**

Fruit name is nominal. Age group is ordinal (makes sense to order it; younger, older etc.)

**Question 2 C**

66/110 i.e. 60% of under 12 prefer grapes

72/160 i.e. 45% of 12 and over prefer grapes

Option C shows this.

**Question 3 E**

Under 6 attempts means 5 attempts or less.

This adds to 15 occasions.

$15/21 = 0.7142\dots \sim 71\%$

**Question 4 B**

Range =  $8 - 1 = 7$

IQR =  $6 - 3 = 3$

**Question 5 B**

*Number of attempts* is numerical data.

There are only **two** categories of *amount of sleep*

so this information can be shown on a back-to back stem plot.

**Question 6 A**

Adding frequencies gives us 20 insects.

The median mass is somewhere between  $10^{-1}$  and  $10^0$ , that is between 0.1 gram and 1 gram.

0.78 is the only option that satisfies this.

**Question 7 C**

46 is 2 standard deviations below the mean.

2.5% of the sample is expected to be 2 standard deviations below the mean.

$$2.5\% \text{ of } 640 = 16$$

**Question 8 B**

48 and 54 are 1 standard deviation below the mean and 2 standard deviations above the mean respectively.

Expected % of boxes to be within these limits is  $68 + 13.5 = 81.5\%$



**Section A Core – Data Analysis**

**Question 9 A**

The gradient of the least squares line will give the expected change in *height* for every one unit change in *weight*.

$$\begin{aligned} \text{gradient of least squares line} &= r \frac{S_y}{S_x} \\ &= 0.7062 \times \frac{7.426}{8.241} = 0.63635 \dots \end{aligned}$$

**Question 10 D**

$$r = \pm\sqrt{0.87329} \sim \pm 0.934$$

The gradient of the least squares line is **negative**, so  $r$  will be **negative**.

$$r = -0.934$$

**Question 11 E**

Predicted success rate

$$= 84.2 - 0.327 \times 150 = 35.15$$

Residual = actual – predicted

$$= 42.30 - 35.15$$

$$= 7.15$$

**Question 12 B**

Choose two points that the line passes through, or **very** near to.

For example, (35,70) and (25, 59)

$$\text{Gradient} = \frac{70-59}{35-25} = 1.1$$

Substitute (35,70) into  $y = mx + c$

$$70 = 1.1 \times 35 + c$$

$$c = 31.5$$

**Question 13 D**

Need the median of 35, 36, 45, 38, 40

When arranged in ascending order, 38 is the middle value.

**Question 14 D**

Use technology to find the equation of the least squares regression line.

		Title	Linear Re..
1	34		
2	32	RegEqn	a+b*x
3	35	a	31.3030...
4	36	b	1.28671...
5	45	r <sup>2</sup>	0.42994...

DI = "Title"

**Section A Core – Data Analysis****Question 15 C**

Long term yearly average =

$$\frac{27.2 + 19.9 + 12.6 + 21.5}{4} = 20.3$$

$$SI_{\text{autumn}} = \frac{12.6}{20.3} = 0.62$$

**Question 16 A**

$$\text{Deseasonalised value} = \frac{\text{actual}}{SI}$$

$$\begin{aligned} \text{actual} &= \text{deseasonalised value} \times SI = 22.2 \times 0.98 \\ &= 21.756 \sim 21.8 \end{aligned}$$



**Section A Core – Recursion and financial modelling****Question 17 D**

Number of copies per year  
 $= \frac{960}{0.03} = 32000$

**Question 18 B**

Flat rate =

$$\frac{960}{24000} \times 100 = 4\%$$

**Question 19 B**

The sequence is:

5, 15, 35, 75, 155, ... where  $T_0 = 5$

$$T_4 - T_3 = 155 - 75 = 80$$

**Question 20 E**

Jim's number of followers is 97% of the last month's number (a loss of 3%) with 200 added on each time.

**Question 21 A**

Amount of principal reduction  
= payment – interest.

Payment = principal reduction + interest  
 $= 1115.45 + 2184.55 = 3300$

**Question 22 C**

Using figures from the table, interest rate per month  $= \frac{2187.50}{750000} \times 100 \sim 0.219667$   
Annual interest rate  $= 0.219667 \times 12 = 3.5\%$

## Section A Core – Recursion and financial modelling (continued)

## Question 23 D

Rate	Effective Rate
eff(4.2,4)	4.26661426551
eff(4.2,12)	4.28180071986
eff(4.25,52)	4.33979445696
eff(4.3,12)	4.38576628342
eff(4.3,4)	4.36983575422

Use technology to convert the nominal rates to effective rates.

4.3% p.a. compounding monthly gives the highest effective rate of about 4.39%

## Question 24 C

Calculate how much is owing after the first year

Field	Value
N	12
I(%)	8.5
PV	32000
Pmt	-658
FV	-26617.51377644
PpY	12

This amount now becomes the present value.

Calculate how much is owing after the second year.

Field	Value
N	12
I(%)	8.5
PV	26617.5137776
Pmt	-700
FV	-20235.158644798
PpY	12

$$\text{Principal reduction} = 32000 - 20235.16 = \$11764.84$$

$$\text{Total payments} = 12 \times 658 + 12 \times 700 = \$16296$$

$$\text{Total interest paid} = 16296 - 11764.84 = \$4531.16$$

**End of solutions Section A Core**

**Module 1 – Matrices****Question 1 C**

The matrix is symmetric about its leading diagonal, so it is an example of a symmetric matrix.

**Question 2 A**

$$A = \begin{bmatrix} 9 & 7 \\ 1 & 1 \end{bmatrix} - \begin{bmatrix} 6 & 9 \\ 0 & -3 \end{bmatrix} = \begin{bmatrix} 3 & -2 \\ 1 & 4 \end{bmatrix}$$

**Question 3 D**

Inspecting the position of the '1' in each row of the permutation matrix:

5<sup>th</sup> letter becomes 1<sup>st</sup>

3<sup>rd</sup> letter becomes 2<sup>nd</sup>

2<sup>nd</sup> letter becomes 3<sup>rd</sup>

1<sup>st</sup> letter becomes 4<sup>th</sup>

4<sup>th</sup> letter becomes 5<sup>th</sup>

AGENT becomes TEGAN

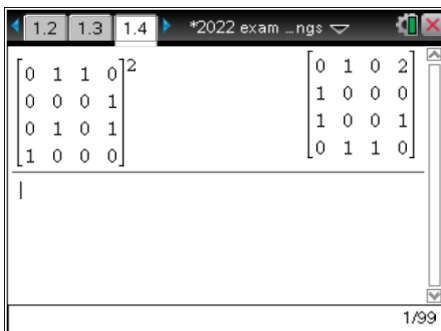
**Question 4 D**

Can do by inspection, or by squaring the one-step dominance matrix.

One-step dominant matrix is

$$\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

Squaring it results as follows.



**Question 5 E**

Columns must add to 1.0, so eliminate options C and D.

Now, 68% of Warburn viewers don't change, and 83% of Yarragrove viewers don't change.

This is indicated in option E.

**Question 6 B**

Option B does not follow the rule.

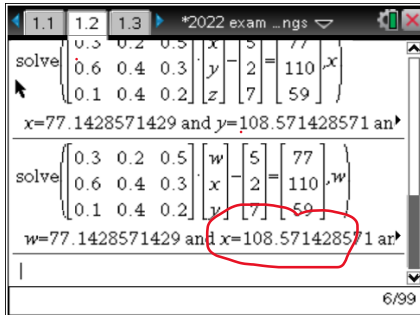
$n_{21}$  must be 5, not 1 as is shown.

$$3 \times 2 - 1 = 5$$

**Module 1 – Matrices (continued)****Question 7 B**

$$\text{Solving } T \times F_2 - B = \begin{bmatrix} 77 \\ 110 \\ 59 \end{bmatrix}$$

Gives  $X = 108.571\dots \sim 109$

**Question 8 C**

The numbers in the rooms remain constant, so if 27 participants change from room A to room B for session 2, 27 must change from room B to room A.

$$36\% \text{ of } x = 27$$

$$x = \frac{27}{0.36} = 75$$

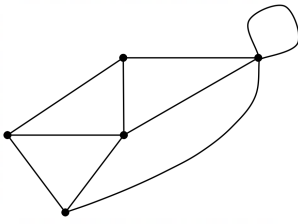
$$25\% \text{ of } y = 27$$

$$y = \frac{27}{0.25} = 108$$

Total number of participants = 183

**End of Module 1 Solutions**

**Module 2 – Networks and decision mathematics**

**Question 1 E**

Only the middle vertex has an even degree.  
(remember that a loop counts as 2)

**Question 2 D**

$$\begin{aligned} e &= v + f - 2 \\ &= 9 + 4 - 2 = 11 \end{aligned}$$

**Question 3 B**

Option B involves an edge (connecting C and G) being used twice.

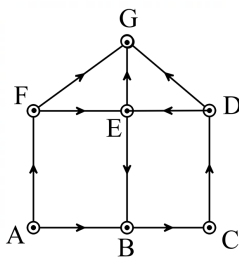
AGCDEF CG ABCFH

**Question 4 D**

C and D both have A and B as immediate predecessors, so a dummy must run from either A or B to start of both C and D.

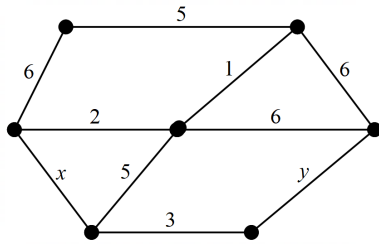
E has both C and D as immediate predecessors, so a dummy must run from end of either C or D to the start of E.

This is satisfied in option D.

**Question 5 A**

Following the arrows, we see that B  
D, E and G are all reachable from C.  
A and F are unreachable.



**Question 6 B**

The spanning tree includes  $x$  and  $y$ . The smallest edge coming from the end of  $y$  weighs 3. Smallest edge coming from end of  $x$  weighs 2, so spanning tree length =  $1 + 2 + 3 + 5 + x + y = 19$ .

$x + y = 8$ , so eliminate options A, D and E.

Now if  $y = 7$ , this edge would **not** be in the minimal spanning tree (as its greater than 6), so eliminate option C.

A quick check will show that if  $x = 3$  and  $y = 5$ , the minimal spanning tree will have a length of 19.

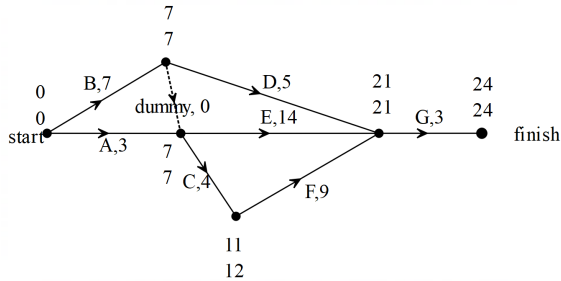
**Module 2 – Networks and decision mathematics (continued)**

**Question 7 C**

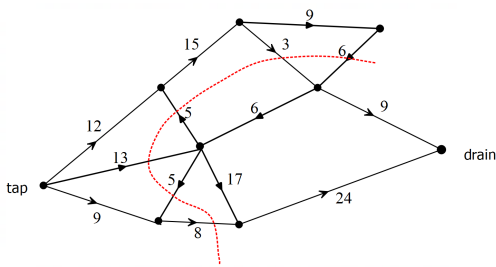
Forward and backward scanning show that the earliest completion time is 24 hours and that the critical path is BEG. Activity E has two immediate predecessors, A and B.

Float time for activity D =  $21 - 7 - 5 = 9$  hours.

Latest start time for activity F is 12 hours, **not** 11.



**Question 8 B**



Minimum cut gives maximum flow. The minimum cut, as shown, has capacity of  $6 + 3 + 13 + 8 = 30$