



2016 VCAA Further Mathematics Exam 1 Solutions
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SECTION A Core
Data analysis

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B	B	A	E	C	D	E	E	C	B	A	D	C	A	E	D

Recursion and financial modelling

17	18	19	20	21	22	23	24
E	C	A	D	B	B	D	E

SECTION B
Module 1: Matrices

1	2	3	4	5	6	7	8
C	D	E	B	C	B	D	A

Module 2: Networks and decision mathematics

1	2	3	4	5	6	7	8
B	C	C	E	A	C	B	B

Module 3: Geometry and measurement

1	2	3	4	5	6	7	8
A	D	E	E	A	E	C	D

Module 4: Graphs and relations

1	2	3	4	5	6	7	8
B	A	D	D	C	E	E	B

SECTION A Core
Data analysis

Q1 $\frac{11}{58} \approx 0.19 = 19\%$

Q2

Q3

Q4 $60 = \mu - 2\sigma$, $\Pr(X > 60) = 1 - 0.025 = 0.975$
Expected number = $0.975 \times 456 \approx 445$

Q5 $z = \frac{x - \mu}{\sigma}$, $-0.26 = \frac{x - \mu}{9.3}$, $x - \mu = -2.418$
 $x + 2 - \mu = -0.418$, $\therefore x + 2 - \mu < 0$, $x + 2 < \mu$

Q6 $\frac{49}{53} \approx 0.92 = 92\%$

Q7 For $x \geq 1$, $\log_{10} x \geq 0$, frequency = $9 + 1 = 10$

Q8 The variables must have the same units for the parallel boxplots to be drawn.

Q9 $0.422 \times 10 = 4.22$, not 43.0 years

Q10 Predicted value = $43.0 + 0.422 \times 92.9 \approx 82.2$,
actual value = 81.8. Residual = $81.8 - 82.2 = -0.4$

Q11

Q12

Q13

Q14

Q15 Deseasonalised number of meals = $\frac{\text{actual}}{\text{SI}} = \frac{108}{0.71} \approx 152$

Q16 Same deseasonalised number of meals for each day of the week,
 \therefore the SI for Saturday is closest to 1.45.

Recursion and financial modelling

Q17

Q18 $V_0 = 100000$, $V_1 = 1.0025 \times 100000 - 555 = 99695$

$V_2 = 1.0025 \times 99695 - 555 = 99389.2375$

$V_3 = 1.0025 \times 99389.2375 - 555 = 99082.71059$

$V_4 = 98775.41737$, $V_5 = 98467.36$

Q19

Q20

Q21

Q22 Interest = $249500.00 \times \frac{4.8}{100 \times 12} = 998.00$

Principal reduction = $1500 - 998 = 502$

Q23 $N = 8$, $I\% = 3.9$, $PV = -5000$, $PMT = -200$,
 $P/Y = 4$, $C/Y = 4$, $FV = 7059.25$

Q24 $N = 60$, $I\% = 5.2$, $PV = -130784.93$, $FV = -66992.27$,
 $P/Y = 12$, $C/Y = 12$, $PMT = 3460.15$

SECTION B (go to next page)



Module 1: Matrices

- Q1 C
- Q2 D
- Q3 $12 \times 3 - 9m = 0, m = 4$ E
- Q4 B
- Q5 C
- Q6 B

Q7
$$\begin{bmatrix} 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.4 \\ 0.2 & 0.2 & 0.5 \end{bmatrix}^{50} \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix} \approx \begin{bmatrix} 105 \\ 109 \\ 86 \end{bmatrix}$$

Q8
$$\begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}^2 = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 2 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

The sum of one-step and two-step dominances was 3 for A, 4 for B, 5 for C and 2 for D, ∴ C was ranked number one.

If B had lost to A instead:

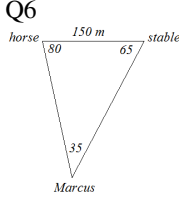
$$\begin{bmatrix} 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}^2 = \begin{bmatrix} 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

The sum of one-step and two-step dominances was 5 for A, 2 for B, 4 for C and 3 for D, ∴ A would have been ranked number one. A

Module 2: Networks and decision mathematics

- Q1 B
- Q2 Minimum cut = 6 + 10 + 2 = 18 C
- Q3 C
- Q4 $5 + 5 + 3 + 2 + k + 4 + 2 + 1 + 6 = 33, k = 5$ E
- Q5 8 edges A
- Q6 I and J C
- Q7 B
- Q8 Minimum total time is 24 min
Job1Chamath(5), Job2Alan(5), Job3Deidre(5), Job4Ewen(5), Job5Brianna(4)
or
Job1Chamath(5), Job2Alan(5), Job3Brianna(5), Job4Ewen(5), Job5Deidre(4) B

Module 3: Geometry and measurement

- Q1 Shaded area = $\frac{1}{2} \times 12 \times 10 - 5 \times 5 = 35$ A
- Q2 $\frac{DF}{1.8} = \frac{3.6}{2.4}, DF = 2.7$ D
- Q3 E
- Q4 $\frac{150 - 142}{15} \times 60 = 32$ min E
- Q5 $V = \frac{1}{2} \times \frac{4}{3} \times \pi \times 2^3 + \pi \times 2^2 \times 5 \approx 80$ A
- Q6  $\frac{x}{\sin 65^\circ} = \frac{150}{\sin 35^\circ}, x = 237$ E
- Q7 $OC = \frac{1}{2} \sqrt{10^2 + 24^2} = 13, OE = \sqrt{28^2 - 13^2} \approx 24.8$ C

Q8 Let 1 unit be the area of each white flag, ∴ the area of each black flag is 4 units.
∴ $\frac{\text{total area black}}{\text{total area white}} = \frac{16}{3}$ D

Module 4: Graphs and relations

- Q1 $23 - 12 = 11$ B
- Q2 A
- Q3 $y = 1.5x - 3, y = 0, x = 2$ D
- Q4 D
- Q5 C
- Q6 $y = kx^3, k = \frac{3}{2}$ E
- Q7 $3^+ z$ for $2c, \frac{3}{2} z$ for $1c, \frac{3x^+}{2} z$ for $xc, \therefore y \geq \frac{3x}{2}$ E
- Q8 $10k = 800, k = 80; 80a = 600, \therefore a = 7.5$ B

Please inform mathline@itute.com re conceptual and/or mathematical errors