2021 VCAA Further Mathematics Exam 1 Solutions

SECTION A Core

Data analysis

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

9	10	11	12	13	14	15	16
C	B	D	D	C	B	C	E

Recursion and financial modelling

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

SECTION B

Module 1: Matrices

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

Module 2: Networks and decision mathematics

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

Module 3: Geometry and measurement

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

Module 4: Graphs and relations

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

SECTION A Core

Data analysis

Q5 $Q_1 = 148$, $Q_3 = 159$, $IQR = 11$,
upper fence $= Q + 1.5IQR = 175.5$ E

Q7 84% unsuccessful, $\frac{84}{100} \times 800 = 672$ D

Q8 Overall score $\geq 69.5 + 1.80 \times 6.5 = 81.2$ C

Q9 $3\sigma = 160 - 115$, $\sigma = 15$, $\mu = 160 - 15 = 145$ C

Q10 $time = -day + 44$, when $day = 10$, $time = 34$ B

Q11 Graph scatterplot and regression line, six points below the regression line D

Q14 $\frac{206 \times 5 - 186 - 346}{3} = 166$ B

Q15 $\left(\frac{29685}{27194} + \frac{25420}{23183.5} + \frac{31496}{29243}\right) \div 3 \approx 1.088$ C

Q16 Actual = deseasonalised × SI $= 1952 \times 1.25 = 2440$ E

Recursion and financial modelling

Q17 $L_1 = 37 + C$, $L_2 = 25 = L_1 + C = 37 + 2C$, $C = -6$ A

Q18 $449060.08 - 422051.93 = 27008.15$ C

Q19 TVM Solver B

Q20 First year: $0.9 \times 72000 = 64800$
Second year: $0.9 \times 64800 = 58320$
Third year: 0.9×58320 C

Q21 TVM Solver: nominal rate pa $\approx 5.4499976569879...$
Effective rate pa $\approx 5.59\%$ D

Q22 TVM Solver: PMT ≈ -174.11 B

Q23 TVM Solver: I% $= 3.6$, $R = 1 + \frac{3.6}{12 \times 100} = 1.003$ A

Q24 TVM Solver: PMT (Scheduled monthly) $\approx -2246.5283...$
TVM Solver: I% ≈ 2.21 B

SECTION B

Module 1: Matrices

Q3 $\begin{bmatrix} a & 4 \\ 18 & b \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 10 \\ 6 \end{bmatrix}$, $\Delta = ab - 18 \times 4 = 0$, $ab = 72$ A

Q4 $\begin{bmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \end{bmatrix}\begin{bmatrix} R \\ A \\ M \\ O \\ N \end{bmatrix} = \begin{bmatrix} N \\ O \\ R \\ M \\ A \end{bmatrix}$ E

Q7 $S_1 = TS_0 - C$, $S_2 = TS_1 - C$

$S_2 - S_1 = T(S_1 - S_0)$, $S_2 = T(S_1 - S_0) + S_1 = \begin{bmatrix} 23.04 \\ 55.78 \\ 16.18 \end{bmatrix}$ A

Q8 Mon: $\begin{bmatrix} 0.5 \\ 0.5 \\ 0 \end{bmatrix}$, Tue: $\begin{bmatrix} 0.4 & 0.1 & 0.2 \\ 0.2 & 0.5 & 0.2 \\ 0.4 & 0.4 & 0.6 \end{bmatrix}\begin{bmatrix} 0.5 \\ 0.5 \\ 0 \end{bmatrix} = \begin{bmatrix} 0.25 \\ 0.35 \\ 0.4 \end{bmatrix}$

Wed: $\begin{bmatrix} 0.4 & 0.1 & 0.2 \\ 0.2 & 0.5 & 0.2 \\ 0.4 & 0.4 & 0.6 \end{bmatrix}\begin{bmatrix} 0.25 \\ 0.35 \\ 0.4 \end{bmatrix}$

% not expected to change
$= (0.4 \times 0.25 + 0.5 \times 0.35 + 0.6 \times 0.4) \times 100\% = 51.5\%$ D

Module 2: Networks and decision mathematics

Q3 $f = 2 + e - v = 2 + 6 - 4 = 4$ B

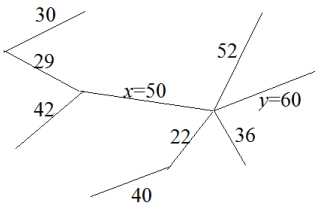
Q5 No Eulerian trail D

Q6 $x \le 3$ in order not to affect the minimum completion time B

Q7 C

	J	K	L	M	N
J	0	2	1	0	1
K	2	1	2	1	0
L	1	2	0	1	1
M	0	1	1	0	0
N	1	0	1	0	0

Q8 B



Module 3: Geometry and measurement

Q1 Lomé 1° E is closest to the Greenwich meridian 0° D

Q2 $\frac{1}{12} \times 360° = 30°$ C

Q3 Length scale factor $= \sqrt{9} = 3$, $3 \times 12 = 36$ cm D

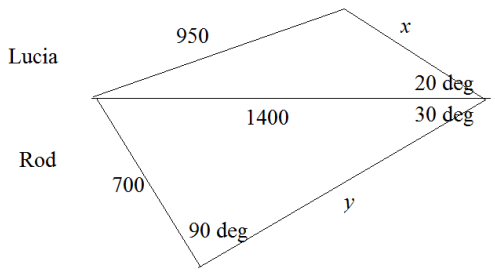
Q4 Area $= \frac{1}{2} \times 4 \times 4 \sin 60°$ C

Q5 $\pi r^2 h = \frac{1}{3} \pi r^2 (12)$, $h = 4$ A

Q6 Radius $= 3$, area $= (24 - 3) \times 6 - \frac{7}{2} \pi 3^2 \approx 27$ B

Q7 $\frac{180° - a°}{2} + b° = 180°$, $a° = 2b° - 180°$ D

Q8 Use the sine rule/cosine rule to find $x \approx 495$ and $y \approx 1212$,
$(1212 + 700) - (495 + 950) = 467$ B



Module 4: Graphs and relations

Q3 $\frac{m-6}{5} = \frac{6}{-8}$, $m = 2.25$ D

Q4 Wed Eastpark (7 hours), Thur Northpark (4 hours)
Fee $= \$14 + \$2.30 \times 4 = \$23.20$ C

Q5 $280n > 16000 + 52n$, $n > 70.1754...$ E

Q6 $y = k\frac{1}{x}$, $2 = k5$, $k = \frac{2}{5}$ D

Q7 Z in highlighted cell is not a maximum value. B

	$(0,40)$	$K(40,20)$	$(50,0)$
Choice A	$Z = 40$	$Z = 60$	$Z = 50$
Choice B	$Z = 120$	$Z = 100$	$Z = 50$
Choice C	$Z = 120$	$Z = 200$	$Z = 100$
Choice D	$Z = 80$	$Z = 160$	$Z = 150$
Choice E	$Z = 120$	$Z = 260$	$Z = 250$

Q8 For max profit at $x = 20$ and $y = 40$, $P = ax + by$ must have the same gradient as $x + 2y = 100$ $\therefore \frac{a}{b} = \frac{1}{2}$.
When $a = 15$, $b = 30$ $\therefore$ max $P = 15 \times 20 + 30 \times 40 = 1500$ E

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