2023 VCE General Mathematics 1 external assessment report

General comments

Students generally found questions accessible in the General Mathematics examination 1 in 2023. They were challenged by some questions involving the application of the key skills and key knowledge from the study design, such as:

- Questions 8, 14 and 16 from Data analysis
- Questions 17, 21, 22, 23 and 24 from Recursion and financial modelling
- Questions 27, 30 and 32 from Matrices
- Question 40 from Networks and decision mathematics.

Specific information

The examination comprised 40 multiple-choice questions covering all areas of study.

- Questions 1–16: Data analysis
- Questions 17–24: Recursion and financial modelling
- Questions 25–32: Matrices
- Questions 33–40: Networks and decision mathematics.

Students were permitted to use approved CAS technology in this examination.

The tables below indicate the percentage of students who chose each option. The correct answers are indicated by shading.

The statistics in this report may be subject to rounding, resulting in a total of more or less than 100 per cent.

Data analysis

The table indicates the percentage of students who chose each option. Grey shading indicates the correct response.

Question	Correct answer	% A	% B	% C	% D	% E
1	B	1	**90**	6	2	1
2	A	**88**	4	1	0	7
3	E	1	2	3	4	**89**
4	D	1	5	7	**82**	4

Question	Correct answer	% A	% B	% C	% D	% E
5	**B**	4	**84**	6	4	1
6	**C**	9	11	**54**	13	13
7	**A**	**60**	15	6	7	12
8	**C**	17	15	**43**	13	11
9	**B**	9	**59**	18	10	3
10	**A**	**59**	9	5	22	4
11	**D**	7	5	24	**60**	3
12	**D**	10	6	4	**76**	4
13	**C**	4	12	**68**	13	3
14	**B**	13	**37**	11	8	30
15	**C**	6	5	**66**	9	15
16	**D**	5	39	9	**43**	4

Students generally answered the questions in the Data analysis section very well. Students did not score as highly on three questions: Questions 8 and 14, which required students to use the given graph, and Question 16, which required students to determine a seasonal index.

Question 8

This question could be solved by inspection of the graph. Five points – (16,18), (23,28), (29,39), (31,41) and (36,49) – are within two marks of that predicted by the line.

Question 14

This question could be solved by inspection of the graph. The median winning time is the middle value of the ordered winning times. This can be found by counting up to the 12th value from the bottom of the graph. The median winning time occurs at the point (2006,117.2). The median winning time is 117.2 seconds.

A common incorrect response was identifying the point (2011,118.3), which is the middle value of the unordered winning times.

Question 16

The actual number of visitors in January is not given. If the value for the actual number of visitors is 100, then the de-seasonalised number of visitors would be $100 \times \left(1 + \frac{35}{100}\right) = 135$.

Referring to the formula sheet, $\text{seasonal index} = \frac{\text{actual figure}}{\text{deseasonalised figure}}$.

Therefore, $seasonal\ index = \frac{100}{135} = 0.74...$

Recursion and financial modelling

Question	Correct answer	% A	% B	% C	% D	% E
17	**D**	13	29	10	**43**	4
18	**C**	33	2	**60**	4	1
19	**E**	16	11	4	5	**62**
20	**C**	2	5	**82**	6	5
21	**E**	7	14	20	11	**48**
22	**D**	17	19	17	**39**	8
23	**D**	22	16	15	**37**	9
24	**B**	4	**27**	10	37	21

Students did not score as highly on questions involving the use of recurrence relations or the finance solver, or where questions required two or more steps.

Question 17

Using the given recurrence relation:

$T_0 = 5, \quad T_{n+1} = -T_n$

$T_1 = -5$

$T_2 = -(-5) = 5$

Question 21

This question can be solved after substituting the given information into the reducing balance depreciation formula:

$600 = 3000\left(1 - \frac{r}{100}\right)^4$

Solving this equation will give an interest rate of $r = 33\%$

Question 22

Four steps are required.

Step 1: Determine the annual interest rate.

$$R = 1 + \frac{r}{1200} \qquad 1.00325 = 1 + \frac{r}{1200} \qquad r = 3.9\%$$

Use Finance Solver to determine:

Step 2: the number of payments	Step 3: the amount owing prior to the final payment	Step 4: the final payment.
N = SOLVE = 300	N = 299	N = 1
I% = 3.9	I% = 3.9	I% = 3.9
PV = 500 000	PV = 500 000	PV = 2605.647…
PMT = −¿2611.65	PMT = −¿2611.65	**PMT = SOLVE = −¿2614.1157…**
FV = 0	**FV = SOLVE = −¿2605.647…**	FV = 0
P/Y = 12	P/Y = 12	P/Y = 12
C/Y = 12	C/Y = 12	C/Y = 12

Question 23

Two steps are required.

Step 1: Determine the annual interest rate.

After one payment, Tavi owes $19 527.56.

The amount of interest can be found by solving: 20 000 – 653.65 + interest = 19 527.56

The amount of interest per quarter = $181.21.

20 000

The annual interest rate

Step 2: Determine the effective interest rate.

Referring to the formula sheet:

$$\left[\left(1+\frac{r}{100n}\right)^{n}-1\right]$$

Therefore,

$$\text{effective interest rate} = \left[\left(1+\frac{3.6242}{400}\right)^{4}-1\right] \times 100\% = 3.673\ldots$$

Question 24

A perpetuity has a constant value.

Therefore $P_0 = P_n = P_{n+1} = a$

$$a = Ra - d$$

$$a + d = Ra$$

$$\frac{a+d}{a} = R$$

Matrices

Question	Correct answer	% A	% B	% C	% D	% E
25	**A**	**89**	6	1	2	2
26	**B**	2	**90**	4	3	2
27	**A**	**39**	11	21	7	21
28	**D**	3	5	5	**69**	19
29	**E**	4	9	15	10	**62**
30	**D**	2	12	42	**39**	5
31	**C**	5	8	**74**	10	3
32	**C**	9	54	**18**	12	5

Students did not score as highly on questions involving the interpretation of transition matrices.

Question 27

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

The second column in the transition matrix is . In the long term, all of the birds will remain at location *N*. No birds will remain at locations *M* or *O*.

Question 30

There are four statements to consider:

1. All square matrices have an inverse.

2. The inverse of a matrix could be the same as the transpose of that matrix.

3. If the determinant of a matrix is equal to zero, then the inverse does not exist.

4. It is possible to take the inverse of an identity matrix.

Statements 2, 3 and 4 are true.

Students should note that the inverse of a symmetric matrix will be the same as the transpose of that matrix.

Question 32

One approach is to create a transition matrix and an initial state matrix. These can be used to find the number of students expected to spend their lunch break at the playground, basketball courts, oval and library on Tuesday and Wednesday.

$$T = \begin{matrix} \\ P \\ B \\ O \\ L \end{matrix} \begin{matrix} \begin{matrix} P & B & O & L \end{matrix} \\ \begin{bmatrix} 0.2 & 0.4 & 0.3 & 0.4 \\ 0.3 & 0.3 & 0.3 & 0.2 \\ 0.4 & 0.2 & 0.3 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.3 \end{bmatrix} \end{matrix} \quad S_0 = \begin{matrix} \begin{bmatrix} 150 \\ 50 \\ 220 \\ 40 \end{bmatrix} \\ \begin{matrix} P \\ B \\ O \\ L \end{matrix} \end{matrix} \quad S_1 = \begin{matrix} \begin{bmatrix} 132 \\ 134 \\ 140 \\ 54 \end{bmatrix} \\ \begin{matrix} P \\ B \\ O \\ L \end{matrix} \end{matrix} \quad S_2 = \begin{matrix} \begin{bmatrix} 143.6 \\ 132.6 \\ 127 \\ 56.8 \end{bmatrix} \\ \begin{matrix} P \\ B \\ O \\ L \end{matrix} \end{matrix}$$

From S_2, 127 students are expected to spend their lunch break at the oval. Of these students, 0.3 × 140 = 42 were at the oval on Tuesday.

$$\frac{42}{127} \times 100 = 33\%$$

A common error in this question was to use the 0.3 (t_{33}) from the transition diagram, which gives the expected proportion of students who stay at the oval from one day to the next.

Networks and decision mathematics

Question	Correct answer	% A	% B	% C	% D	% E
33	**D**	3	11	30	**56**	1
34	**A**	**77**	5	7	6	4
35	**C**	3	3	**74**	12	7
36	**B**	10	**75**	6	5	2
37	**B**	7	**66**	14	5	7
38	**D**	13	10	10	**60**	6
39	**B**	6	**62**	12	6	14
40	**E**	15	8	21	15	**40**

Students generally answered the questions in the Networks and decision mathematics section very well.

Question 40

This question should be solved by inspection of the network and/or by the use of the 'maximum-flow minimum-cut' theorem.

An increase in the capacity of flow along the edge *CE* to 12 will lead to an increase in the maximum of 1.

An increase in the capacity of flow along the edge *FH* to 14 will not lead to an increase in the maximum flow.

An increase in the capacity of flow along the edge *GH* to 16 will lead to an increase in the maximum of 4.

A reverse of the direction of flow along the edge *CF* will lead to an increase in the maximum of 6.

A reverse of the direction of flow along the edge *GF* will lead to an increase in the maximum of 7.