

## 2023 Trial Examination

STUDENT  
NUMBER

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Letter

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# GENERAL MATHEMATICS

## Units 3 & 4 – Written examination 1

Reading time: 15 minutes

Writing time: 1 hour and 30 minutes

### MULTIPLE-CHOICE QUESTION BOOK

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	24	24	24
B	16	16	16
			<b>Total 40</b>

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers, one bound reference, one approved graphics calculator or approved CAS calculator or CAS software and, if desired, one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

#### Materials supplied

- Question book of 21 pages.
- Multiple Choice answer sheet

#### Instructions

- Print your name in the space provided on the top of this page.
- All written responses must be in English.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the examination room.**

## SECTION A – Data analysis & Recursion and financial modelling

### Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** for the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

## Data analysis

### Question 1

Data relating to the following four variables was recorded in a study of past earthquakes

- location on earth (latitude and longitude)
- country
- magnitude (on Richter scale as a log value)
- time (in 24 hour)

The number of these variables that are categorical variables is

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4

### Question 2

An earthquake of magnitude 4.2 was recorded recently.

This magnitude is calculated using the log scale.

The numerical value of this earthquake is approximately

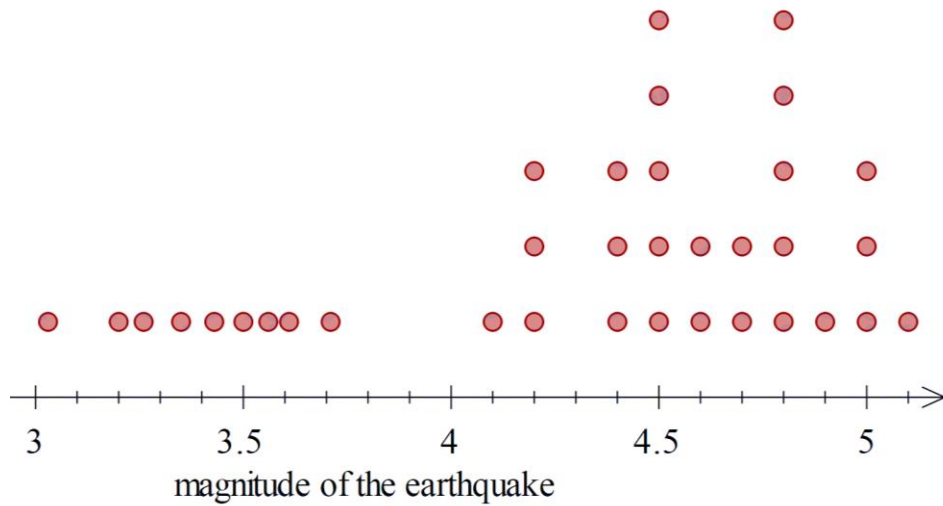
- A. 100000
- B. 15848.93
- C. 1.0179
- D. 0.6232
- E. 1708019.81

SECTION A – continued

Use the following information to answer Questions 3 and 4

**Question 3**

The dot plot below represents the magnitude of 35 earthquakes around the world.



The median magnitude of earthquakes recorded is

- A. 4.2
- B. 4.4
- C. 4.5
- D. 4.6
- E. 4.7

**Question 4**

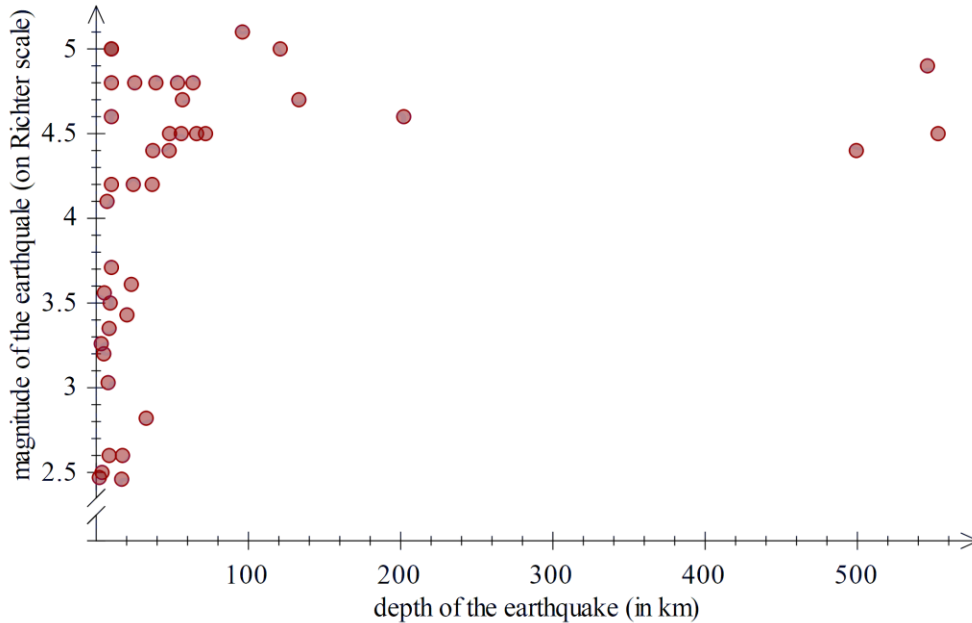
The percentage of the 35 earthquakes with a magnitude of at least 4.5 is closest to

- A. 19%
- B. 40%
- C. 46%
- D. 54%
- E. 60%

**SECTION A – continued  
TURN OVER**

**Question 5**

The following scatterplot shows the relationship between depth of the earthquake and magnitude of the earthquake on Richter scale.



From this scatterplot, we can conclude that

- A. there is an increasing trend of depths of earthquake.
- B. there is a strong linear association between depth and magnitude of earthquakes.
- C. there is a non-linear association between depth and magnitude of earthquakes.
- D. there is a strong, negative association between depth and magnitude of earthquakes.
- E. there is negative, non-linear association between depth and magnitude of earthquakes.

**Question 6**

There are 230 teachers working at a particular school.

The number of years teachers work at this school is approximately normally distributed with a mean age of 8 years and standard deviation of 1.5 years.

Using the 68-95-99.7% rule, the number of teachers at this school who work at least 5 years is closest to

- A. 6
- B. 98
- C. 112
- D. 193
- E. 224

**SECTION A – continued**

*Use the following information to answer Questions 7 and 8*

The association between the number of students enrolled in a particular school and funding, in hundreds of dollars, received from the government each year is linearly associated.

The equation of least squares regression line is given by

$$\text{Amount of funding (in '00 \$)} = 4560 + 26.81 \times \text{number of students enrolled}$$

**Question 7**

From the equation of least squares regression line, it can be concluded that on average, for each additional student enrolled, the funding increases by

- A. \$27
- B. \$456
- C. \$268
- D. \$2681
- E. \$45630

**Question 8**

Using the equation of least squares regression line, the amount of funding for this school when 1650 students are enrolled will be closest to

- A. \$4879650
- B. \$4423650
- C. \$487960
- D. \$442360
- E. \$48797

**SECTION A – continued**  
**TURN OVER**

Use the following information to answer Questions 9 and 10

The following table summarises the results of a math teacher teaching General maths and Math methods for a number of years.

<i>Exam grade</i>	<i>Math subject</i>	
	<i>General maths</i>	<i>Math methods</i>
A (80% and above)	28	23
B (75 – 84%)	40	17
C (65 – 75%)	25	37
D (50 – 64%)	15	18
E (less than 50%)	12	12
<b>Total</b>	120	107

### Question 9

The variables *exam grade* (A to E) and *math subject* (general maths, math methods) are

- A. a numerical and a categorical variable respectively.
- B. a categorical and a numerical variable respectively.
- C. both nominal variables.
- D. both ordinal variables.
- E. an ordinal and a nominal variable respectively.

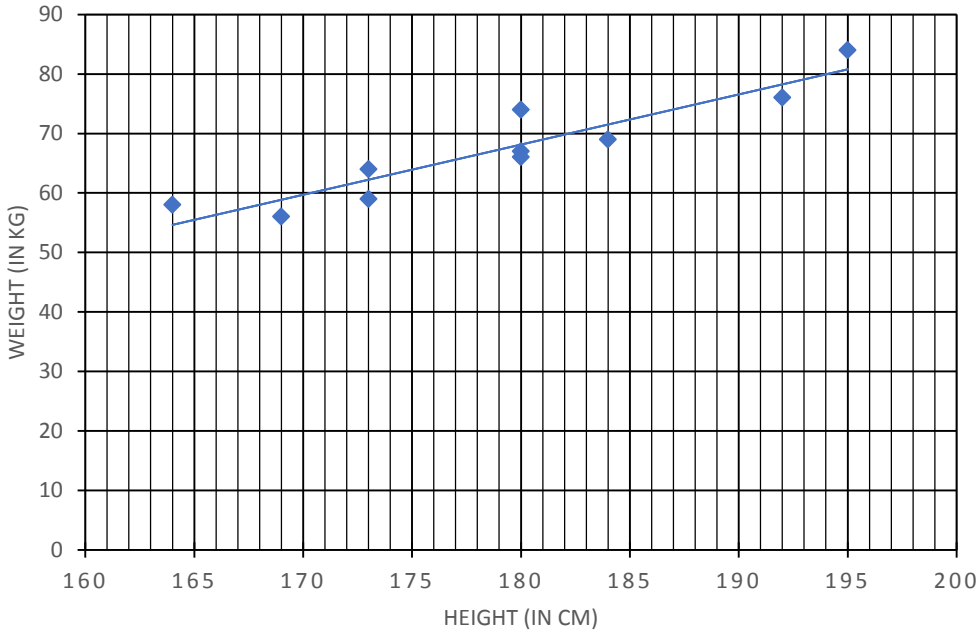
### Question 10

Of the students who received a B grade, the percentage who chose math methods is closest to

- A. 17%
- B. 25%
- C. 30%
- D. 40%
- E. 70%

Use the following information to answer Questions 11, 12 and 13

The scatterplot below displays the weight, in kg, of ten students, plotted against their height, in centimetres. A least squares regression line has been fitted to the scatterplot.



**Question 11**

The equation of least squares regression line is closest to

- A.  $weight = 0.83 - 81.67 \times height$
- B.  $weight = -81.67 + 0.83 \times height$
- C.  $height = -81.67 + 0.83 \times weight$
- D.  $weight = 52.34 + 0.83 \times height$
- E.  $height = -81.67 + 0.83 \times weight$

**Question 12**

The coefficient of correlation  $r$  is equal to 0.930.

The percentage of variation in weight that is **not** explained by variation in height is closest to

- A. 0.9%
- B. 8.6%
- C. 13.5%
- D. 86.5%
- E. 93.0%

**SECTION A – continued  
TURN OVER**

**Question 13**

The median height, in centimetres, of these ten students closest to

- A. 67
- B. 74
- C. 173
- D. 180
- E. 184

**Question 14**

The daily number of haircuts at a salon over a two-week period is shown in the table below.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	48	65	51	87	125	105	108
2	57	60	48	101	99	119	103

The four-mean smoothed number of haircuts, with centering, at the salon on Friday in Week 2 is closest to

- A. 92
- B. 99
- C. 106
- D. 118
- E. 146

**Question 15**

The seasonal index for sales of umbrellas in summer is 0.80.

To correct for seasonality, the actual umbrella sales for summer should be

- A. increased by 25%
- B. increased by 20%
- C. increased by 80%
- D. reduced by 25%
- E. reduced by 80%

**SECTION A – continued**



**Question 16**

Which of the following is not true?

- A. The median of a data set could be negative.
- B. The range of a data set cannot be negative.
- C. The inter-quartile range of a data set could be the same as the range of the same data set.
- D. The standardised score of a data set could be zero.
- E. The standard deviation of a data set cannot be negative.

**SECTION A – continued**  
**TURN OVER**

**Recursion and financial modelling****Question 17**

The balance of an investment,  $V_n$ , in dollars, after  $n$  years is modelled by the recurrence relation

$$V_0 = 12\,000, \quad V_{n+1} = V_n + 140$$

The value of the investment after two years is

- A. \$12 000
- B. \$12 140
- C. \$12 280
- D. \$13 680
- E. \$15 360

*Use the following information to answer Questions 18 and 19*

The balance of a loan,  $V_n$ , in dollars, after  $n$  months is modelled by the recurrence relation.

$$V_0 = 360\,000, \quad V_{n+1} = 1.003V_n - 2040$$

**Question 18**

The balance of the loan first falls below \$355 000 after how many months?

- A. 2
- B. 3
- C. 4
- D. 5
- E. 6

**Question 19**

With a small change to the final payment, the loan is expected to be repaid in full in

- A. 20 years
- B. 21 years
- C. 22 years
- D. 24 years
- E. 25 years

**SECTION A – continued**

**Question 20**

Danny owns a machine in a factory that is used for 8 hours per day for all 365 days of the year.

The value of the machine is depreciated by Danny using the unit cost method.

The value of the machine depreciates by \$4650 each year.

If the machine cost Danny \$85 000, it is depreciated by approximately

- A. \$1.59 *per hour*
- B. \$1.59 *per day*
- C. \$0.16 *per hour*
- D. \$0.16 *per day*
- E. \$0.58 *per hour*

**Question 21**

A rule for the balance,  $T_n$ , after  $n$  years, of an investment account earning compound interest calculated quarterly is given by  $T_n = 4000 \times 1.0105^{4n}$ .

Let  $V_n$  be a new recurrence relation that models the balance of this investment account after  $n$  quarters.

This recurrence relation is

- A.  $V_0 = 4000, V_{n+1} = 1.043V_n$
- B.  $V_0 = 4000, V_{n+1} = V_n + 4042$
- C.  $V_0 = 4000, V_{n+1} = V_n + 168$
- D.  $V_0 = 4000, V_{n+1} = 1.0105V_n$
- E.  $V_0 = 4000, V_{n+1} = 1.042V_n$

**Question 22**

Which of the following is **not** true regarding nominal and effective interest rates as they apply to loans and investments?

- A. An effective interest rate is the same as a nominal interest rate if interest compounds annually.
- B. A nominal rate of 12% per annum is equivalent to a nominal rate of 1% per month.
- C. An effective interest rate can be lower than a nominal interest rate.
- D. A nominal rate of 8% per annum is equivalent to an effective rate of 8.243216% if compounded quarterly.
- E. An effective interest rate is higher for an investment compounded monthly as compared to the investment compounded quarterly.

**SECTION A – continued**  
**TURN OVER**

**Question 23**

Bruce invests \$6000 for five years at 3.72% per annum, compounding annually.

Mai invests a certain amount of money for five years too, in an account which earns simple interest at the rate of 4.02% per annum.

They both will have the same amount in their accounts at the end of five years.

The amount that Mai invests, to the nearest dollar, is

- A. \$3583
- B. \$5182
- C. \$5997
- D. \$6000
- E. \$7206

**Question 24**

Johan invested \$12 500 into an investment account paying compound interest of 0.81% quarterly.

At the end of each quarter, after the interest was credited, Johan added an additional amount of money.

Johan's investment after one year is \$17772.63. The additional amount that Johan added at the end of each quarter is closest to

- A. \$1201
- B. \$1289
- C. \$4868
- D. \$5171
- E. \$5247

**END OF SECTION A**

**SECTION B – Matrices and Networks and decision mathematics****Instructions for Section B**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** for the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

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Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

**Matrices**

*Use the following information to answer Questions 1 and 2*

A vehicle rental business rents cars ( $C$ ) and motorcycles ( $M$ ) in three states: Victoria ( $V$ ), Western Australia ( $W$ ) and Queensland ( $Q$ ).

Matrix  $A$  shows the daily rental cost, in dollars, for each type of car and motorcycle

$$A = \begin{array}{cc|c} & C & M & \\ \hline & 120 & 80 & V \\ & 100 & 85 & W \\ & 135 & 90 & Q \end{array}$$

The element in row  $i$  and column  $j$  in matrix  $A$  is  $a_{ij}$ .

**Question 1**

The daily cost of renting a car in Queensland is shown in element

- A.  $a_{11}$
- B.  $a_{31}$
- C.  $a_{13}$
- D.  $a_{22}$
- E.  $a_{32}$

**Question 2**

In school holidays, the rental services increase their daily rental price for all vehicles at each location by 5%.

Which of the following matrix calculations can be used to calculate the daily rental price of cars and motorcycles in school holidays?

- A.  $0.05A$
- B.  $5A$
- C.  $1.5A$
- D.  $1.05A$
- E.  $6A$

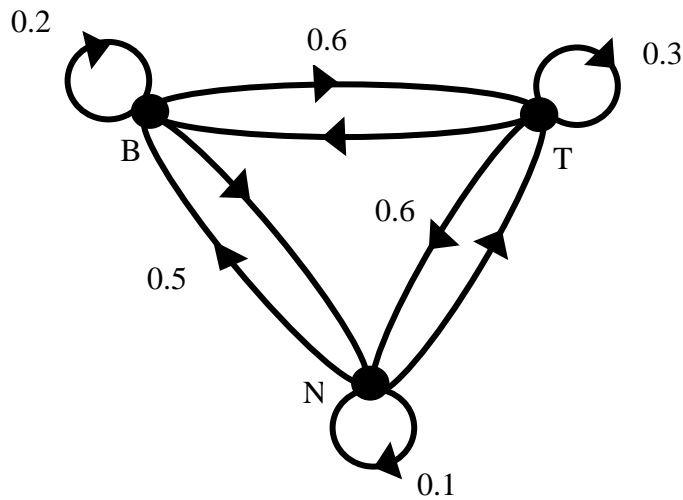
**SECTION B – continued**  
**TURN OVER**

Use the following information to answer Questions 3 and 4

Each day, members of a local club can choose to visit the club to play Badminton ( $B$ ), Tennis ( $T$ ) or none ( $N$ ).

The transition diagram below shows the transition from day to day.

The transition diagram is incomplete.



### Question 3

On a particular day 30 played badminton, 40 played tennis and 20 decided not to play any of the games.

The number of members who did not change their preference the following day is

- A. 12
- B. 14
- C. 16
- D. 19
- E. 20

**SECTION B** – continued

**Question 4**

Which one of the following transition matrices represents this transition diagram?

**A.**

$$\begin{array}{c} \textit{this day} \\ B \quad N \quad T \\ \left[ \begin{array}{ccc} 0.2 & 0.4 & 0.1 \\ 0.2 & 0.2 & 0.6 \\ 0.6 & 0.4 & 0.3 \end{array} \right] \begin{array}{l} B \\ N \\ T \end{array} \textit{ next day} \end{array}$$

**B.**

$$\begin{array}{c} \textit{this day} \\ B \quad N \quad T \\ \left[ \begin{array}{ccc} 0.2 & 0.5 & 0.1 \\ 0.2 & 0.1 & 0.6 \\ 0.6 & 0.4 & 0.3 \end{array} \right] \begin{array}{l} B \\ N \\ T \end{array} \textit{ next day} \end{array}$$

**C.**

$$\begin{array}{c} \textit{this day} \\ B \quad N \quad T \\ \left[ \begin{array}{ccc} 0.2 & 0.2 & 0.6 \\ 0.4 & 0.2 & 0.4 \\ 0.1 & 0.6 & 0.3 \end{array} \right] \begin{array}{l} B \\ N \\ T \end{array} \textit{ next day} \end{array}$$

**D.**

$$\begin{array}{c} \textit{this day} \\ B \quad N \quad T \\ \left[ \begin{array}{ccc} 0.2 & 0.5 & 0 \\ 0 & 0.1 & 0.6 \\ 0.6 & 0 & 0.3 \end{array} \right] \begin{array}{l} B \\ N \\ T \end{array} \textit{ next day} \end{array}$$

**E.**

$$\begin{array}{c} \textit{this day} \\ B \quad N \quad T \\ \left[ \begin{array}{ccc} 0.2 & 0.1 & 0.6 \\ 0.2 & 0.5 & 0.1 \\ 0.6 & 0.4 & 0.3 \end{array} \right] \begin{array}{l} B \\ N \\ T \end{array} \textit{ next day} \end{array}$$

**SECTION B – continued**  
**TURN OVER**

**Question 5**

Matrix  $P$  is a  $5 \times 6$  matrix.

Matrix  $Q$  is a  $6 \times 5$  matrix.

Matrix  $R$  is a  $5 \times 5$  matrix.

Matrix  $S$  is a  $6 \times 6$  matrix.

Which one of the following matrix products could have an inverse?

- A.  $PQ$
- B.  $QS$
- C.  $SQ$
- D.  $RS$
- E.  $SR$

**Question 6**

Matrix  $P$  is a permutation matrix.

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

The matrix  $P$  is multiplied by a  $(5 \times 1)$  column matrix.

The element in the second row and first column of the column matrix moves to which element in the resulting product matrix?

- A. row 2, column 1
- B. row 5, column 2
- C. row 4, column 1
- D. row 5, column 1
- E. row 3, column 1

**SECTION B** – continued



**Question 7**

The communication matrix below shows the communication links between five people: Abbey (A), Babita (B), Carly (C), Dan (D) and Elly (E).

		<i>receiver</i>				
		<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
<i>sender</i>	<i>A</i>	0	1	1	0	0
	<i>B</i>	1	0	0	1	0
	<i>C</i>	0	0	0	1	1
	<i>D</i>	0	1	0	0	0
	<i>E</i>	0	0	0	1	0

In this matrix:

- the ‘1’ in row A, column B indicates that Abbey can communicate directly with Babita
- the ‘0’ in row C, column A indicates that Carly cannot communicate directly with Abbey.

Carly needs to communicate with Abbey.

The sequence of communication links that will successfully allow Carly to communicate with Abbey is

- A. C-D-A
- B. C-D-B-A
- C. C-E-D-A
- D. C-E-A
- E. C-B-A

**Question 8**

The matrix  $L$  below is a Leslie matrix that shows the way population changes over time and the matrix  $S_0$  is the initial stage matrix.

$$L = \begin{matrix} & \begin{matrix} \text{from age group} \\ 1 & 2 & 3 & 4 \end{matrix} \\ \begin{matrix} 0 & 1.4 & 1.2 & 0.3 \\ 0.6 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0.1 & 0 \end{matrix} & \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} \end{matrix} \text{ to age group, } S_0 = \begin{bmatrix} 800 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Which of the following is **not** true?

- A. The total population of all age groups remains the same over time.
- B. 60% of the population in age group 1 progresses to age group 2.
- C. The birth rate for group 3 is 1.2.
- D. The population in age group 3 is 240 after two time periods.
- E. The population in age group 1 at the start is 800.

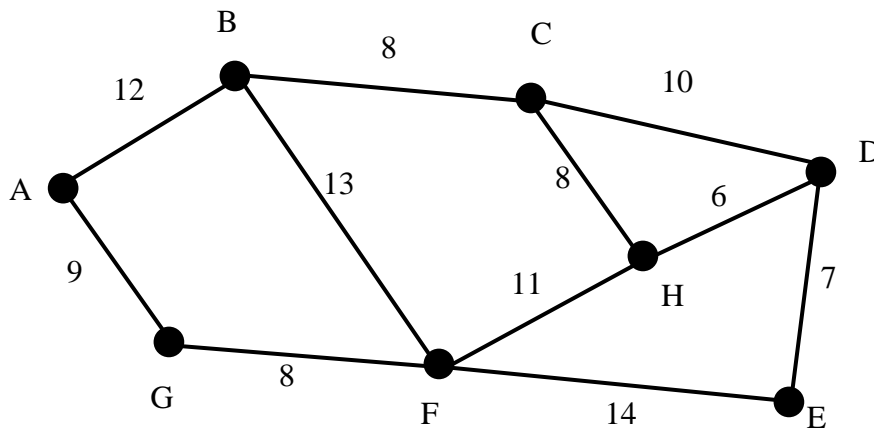
**SECTION B – continued  
TURN OVER**

## Networks and decision mathematics

Use the following information to answer Questions 1 and 2

The network below shows the distances, in kilometres, along a series of roads.

The vertices A, B, C, D, E, F, G and H represent the intersections of these roads.



### Question 1

Dijkstra's algorithm can be used to find the

- A. critical path.
- B. shortest path.
- C. minimum cut.
- D. minimum allocation.
- E. minimum spanning tree.

### Question 2

Which of the following is not true about the network?

- A. It is a connected graph.
- B. It is a planar graph.
- C. It is a complete graph.
- D. The Euler's formula is true for this graph.
- E. The graph has five faces.

**SECTION B** – continued

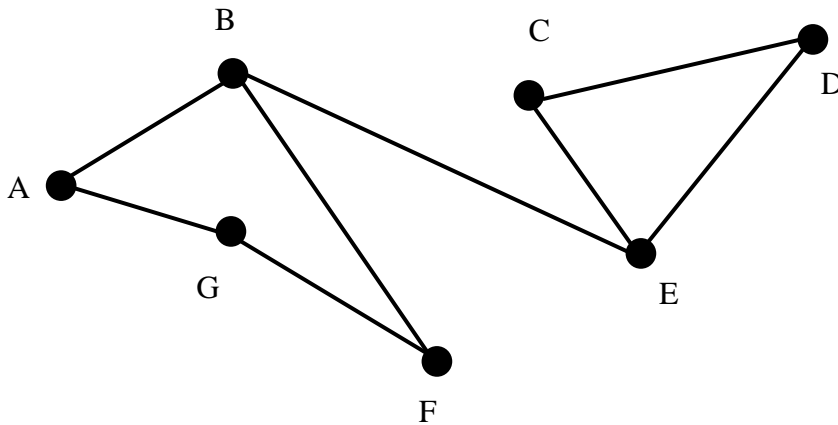
**Question 3**

An aviation company employs six different pilots to fly their planes to 10 different cities. This flight plan could be represented graphically by.

- A. a spanning tree.
- B. a Hamiltonian path.
- C. an Eulerian trail.
- D. a bipartite graph.
- E. a complete graph.

**Question 4**

The graph below has seven vertices labelled A, B, C, D, E, F and G, and eight edges.

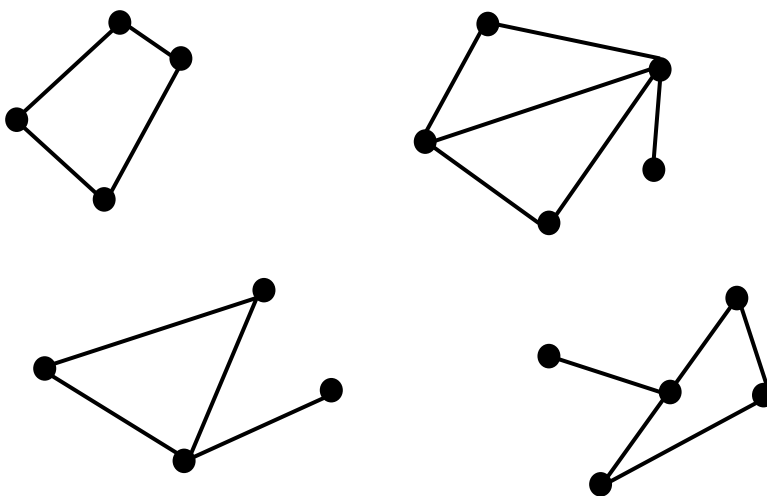


Which one of the following edges is a bridge?

- A. *BC*
- B. *AG*
- C. *CE*
- D. *BF*
- E. *BE*

**SECTION B – continued**  
**TURN OVER**

**Question 5**

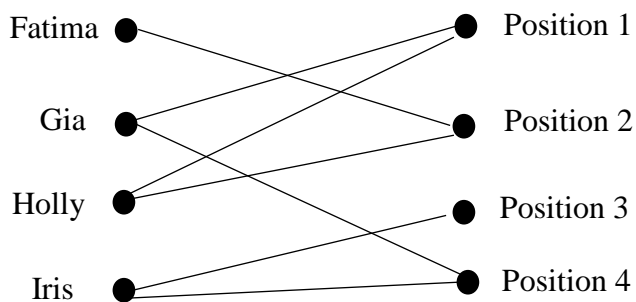


How many of the graphs above have an Eulerian trail?

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4

**Question 6**

The coach of a four-person relay team is deciding on the order of the runners. The bipartite graph below shows the best position of runners.



Use the bipartite graph to determine which statement is correct.

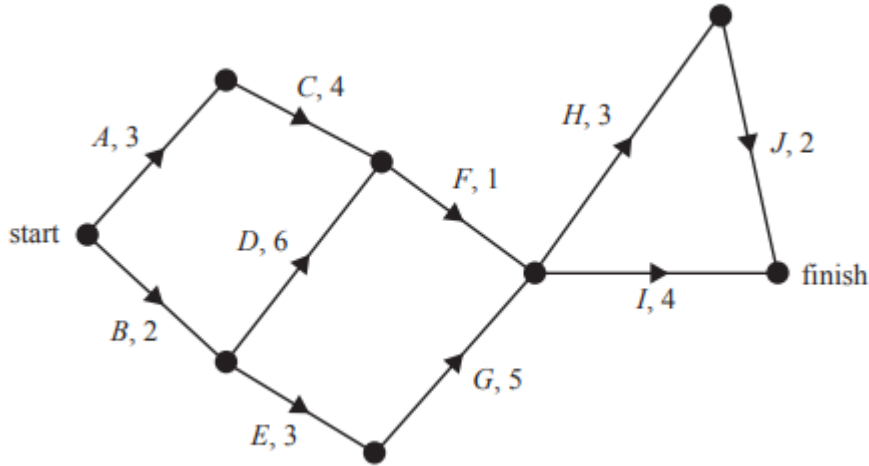
- A. Fatima should run in position 3.
- B. Gia should run in position 4 and Holly in position 1.
- C. Holly should run in position 2.
- D. Iris should run in position 3 and Holly in position 4.
- E. Gia should run in position 1 and Holly in position 2.

**SECTION B – continued**

Use the following information to answer Questions 7 and 8

This project involves 10 activities, A to J.

The directed network below shows these activities and their completion times, in hours.



**Question 7**

Which of the two activities have a float time of two hours?

- A. A and B
- B. A and C
- C. F and G
- D. D and F
- E. H and I

**Question 8**

Which of the following activities is **not** on the critical path?

- A. E
- B. G
- C. J
- D. H
- E. F

**END OF QUESTION AND ANSWER BOOK**