General Mathematics

Written Examination 1

Multiple-Choice Question Book

2024 Insight Year 12 Trial Exam Paper

- **Reading time:** 15 minutes
- **Writing time:** 1 hour and 30 minutes
- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one bound reference, one approved technology (calculator or software) and, if desired, one scientific calculator. Calculator memory DOES NOT need to be cleared. For approved computer-based CAS, full functionality may be used.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

- Multiple-Choice Question Book of 27 pages
- Formula Sheet
- Answer Sheet for multiple-choice questions
- Working space is provided throughout the book.

Instructions

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

At the end of the examination

- You may keep the Multiple-Choice Question Book and the Formula Sheet.

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

Number of questions: 40
Number of questions to be answered: 40
**Number of marks:** 40

Instructions

- 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

Use the following information to answer Questions 1–3.

The boxplot below shows the number of heavy vehicles crossing a bridge each hour over 24 hours.

number of heavy vehicles
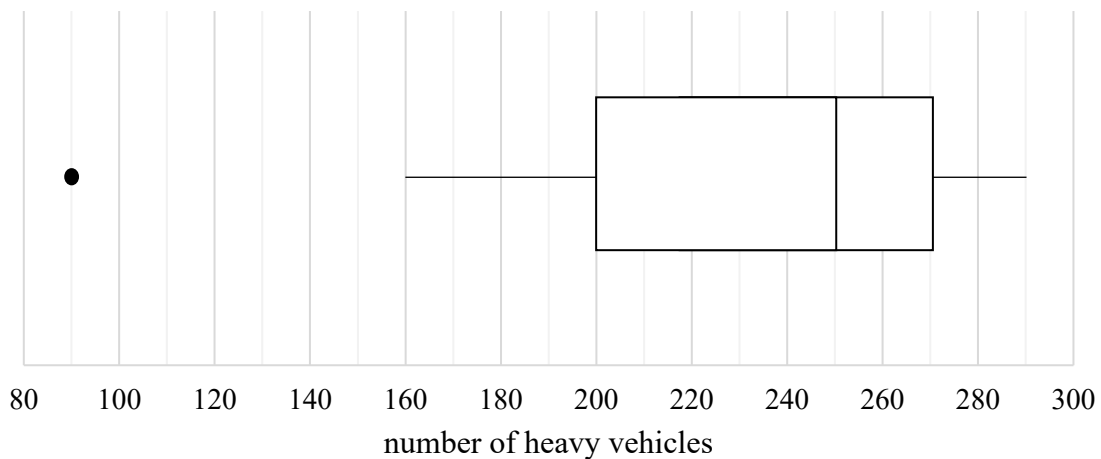
Question 1

The shape of the distribution of this boxplot is best described as

A. positively skewed.

B. positively skewed with an outlier.

C. negatively skewed.

D. negatively skewed with an outlier.

Question 2

For how many of the 24 hours were 160 to 200 heavy vehicles recorded?

A.   4

B.   5

C.   6

D.   12

Question 3

The boxplot shows the data for number of *heavy vehicles*.

If, instead, the data was for the number of *vans* and the number of *truck*s recorded each hour over 24 hours, which type of graph would be best used to represent this?

A.   histogram

B.   parallel boxplots

C.   two-way frequency table

D.   scatterplot

Question 4

The histogram below shows the *revenue* for one day of trading for 28 stores in a shopping complex, plotted on a logarithmic (base 10) scale.
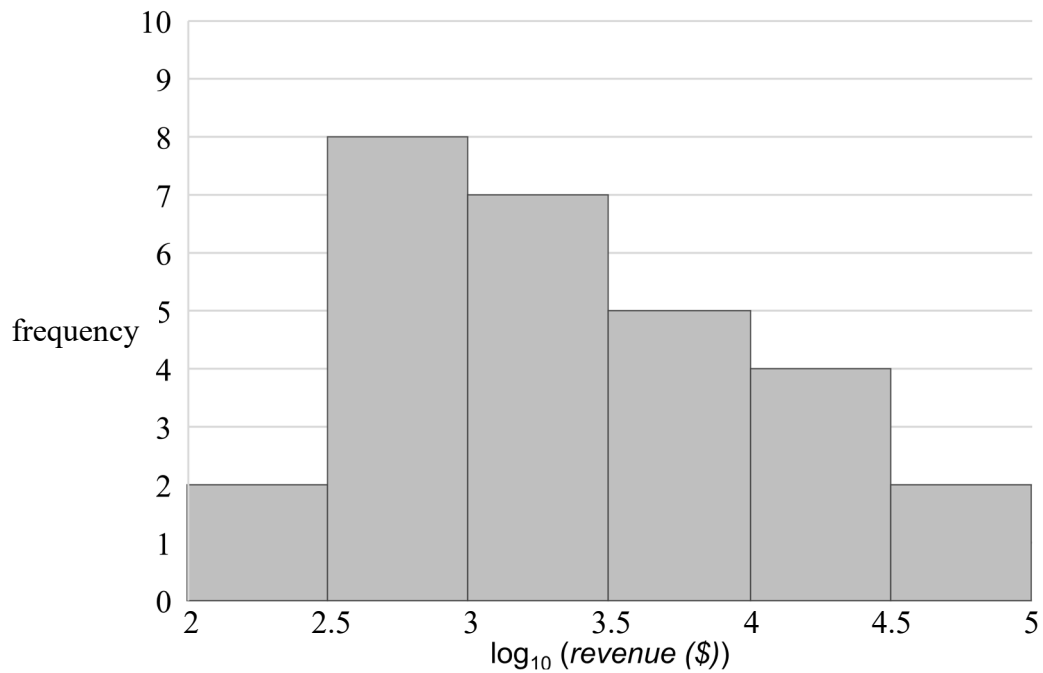
The revenue for Spenders was $\$10\,000$. The revenue for The Donut Hole was approximately $\$320$.

The number of stores that had revenues between these amounts is closest to

A.   8

B.   12

C.   16

D.   20

Question 5

The age and height of a species of plant is recorded, so that height is predicted from age.

A reciprocal transformation of the response variable is applied, and a least squares line fitted to the data.

Following the transformation, which is the response variable?

A. *age*

B. $\dfrac{1}{age}$

C. *height*

D. $\dfrac{1}{height}$

Question 6

The table below shows the number of customers for a week at a store.
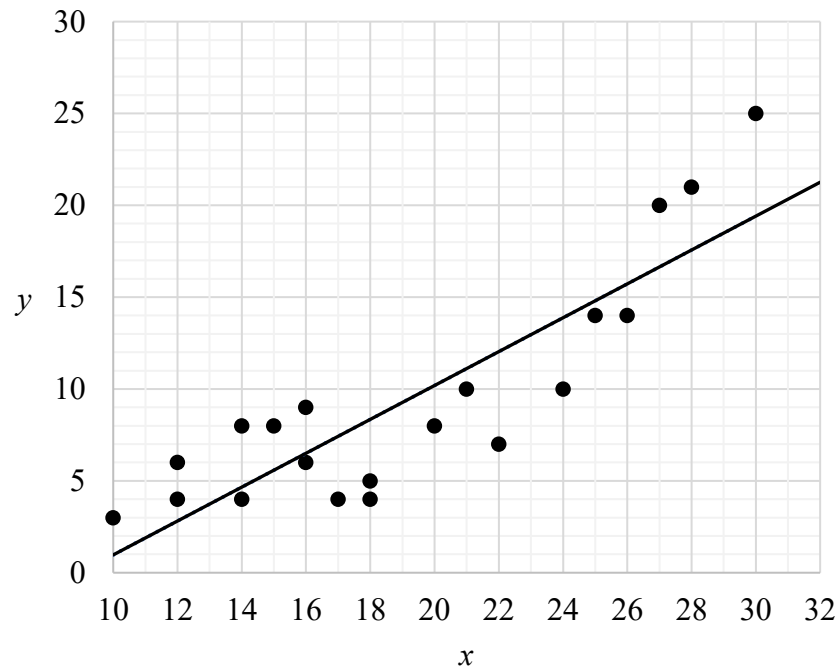
Day	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Customers	12	14	15	19	20	24	21

The seasonal index for Wednesday is closest to

A. 0.84

B. 0.96

C. 1.19

D. 17.9

Question 7

The scatterplot below displays 20 data values recorded, where x is plotted against y. A least squares regression line has been fitted to the scatterplot.

The equation of the least squares line is closest to

A. $y = -8.3 + 0.92x$

B. $y = -8.3 - 0.92x$

C. $y = 1.8 + 0.92x$

D. $y = 1.8 - 0.92x$

Question 8

A negative association exists between a person's blood pressure and the dosage of blood pressure medication taken.

The correlation coefficient is -0.819.

From this information it can be concluded that

A.   a lower dosage of blood pressure medication will cause a decrease in blood pressure.

B.   a higher dosage of blood pressure medication will cause a decrease in blood pressure.

C.   higher blood pressure will be caused by a lower dosage of medication.

D.   a decrease in blood pressure is associated with a higher dosage of medication.

Question 9

Thirty competitors participated in a dance competition, where their scores are normally distributed.

The scores for five of the competitors are shown below.

Competitor	Score
Freyja	25
Grant	27
Helen	19
Indi	24
Jared	21

The sum of the scores for the remaining 25 competitors is 574.

Those who obtained a standardised score of 1.6 or higher went on to the next round. The standard deviation for the 30 scores is 1.2.

Which of the five competitors shown will continue to the next round of the competition?

A.   Grant only

B.   Grant and Freyja

C.   Grant, Freyja and Indi

D.   Grant, Freyja, Indi and Jared

Question 10

The number of people attending a soccer competition and the associated costs, in thousands, are fitted with a least squares line:

$$costs\ (\$) = 4.5 + 0.245 \times number\ of\ attendees$$

Using this equation, which of the statements I to V are correct?

- I – When the number of attendees is zero, the costs are predicted to be $4.50.

- II – The costs are predicted to be $45\,000$ when there are no attendees.

- III – When there are 5000 people attending the competition, the costs are predicted to be $1229.50.

- IV – The costs are predicted to be $2\,944\,500$ when there are $12\,000$ people attending the competition.

- V – For every additional attendee at the competition, the costs are predicted to increase by $245.

A. I and III

B. II and IV

C. IV and V

D. I, III and V

Question 11

Consider the data below.

x	y
23	20
24	14
25	18
26	25
28	70
29	120
30	200
31	120
32	280
33	310
33	250
34	480
34	400
35	500
36	800
36	680
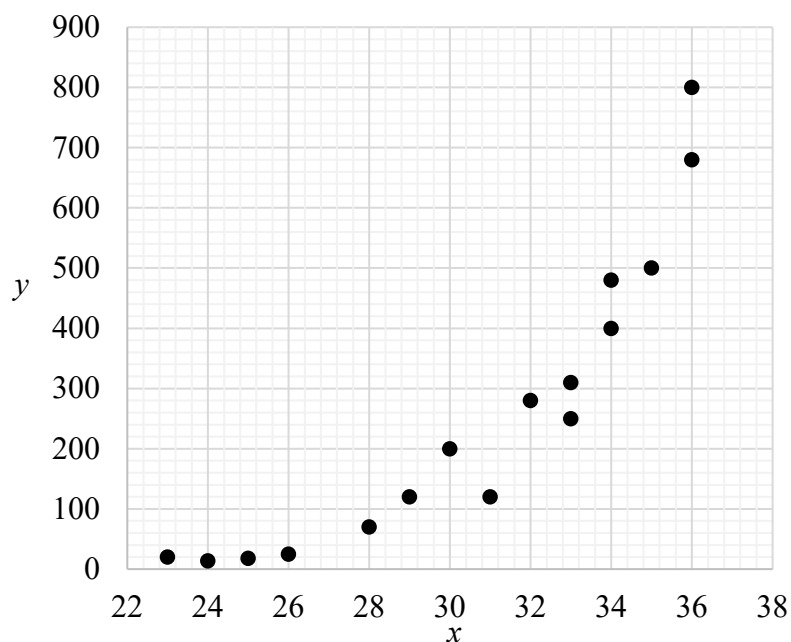
The scatterplot is non-linear.

To linearise the data, a squared transformation is applied to the variable x and a least squares line of best fit is applied to the transformed data.

The equation of the least squares line is

A. $y = -567.1 + 0.88x$

B. $y = -567.1 + 0.88x^2$

C. $y = -863.8 + 59.4x$

D. $y = -863.8 + 59.4x^2$

Question 12

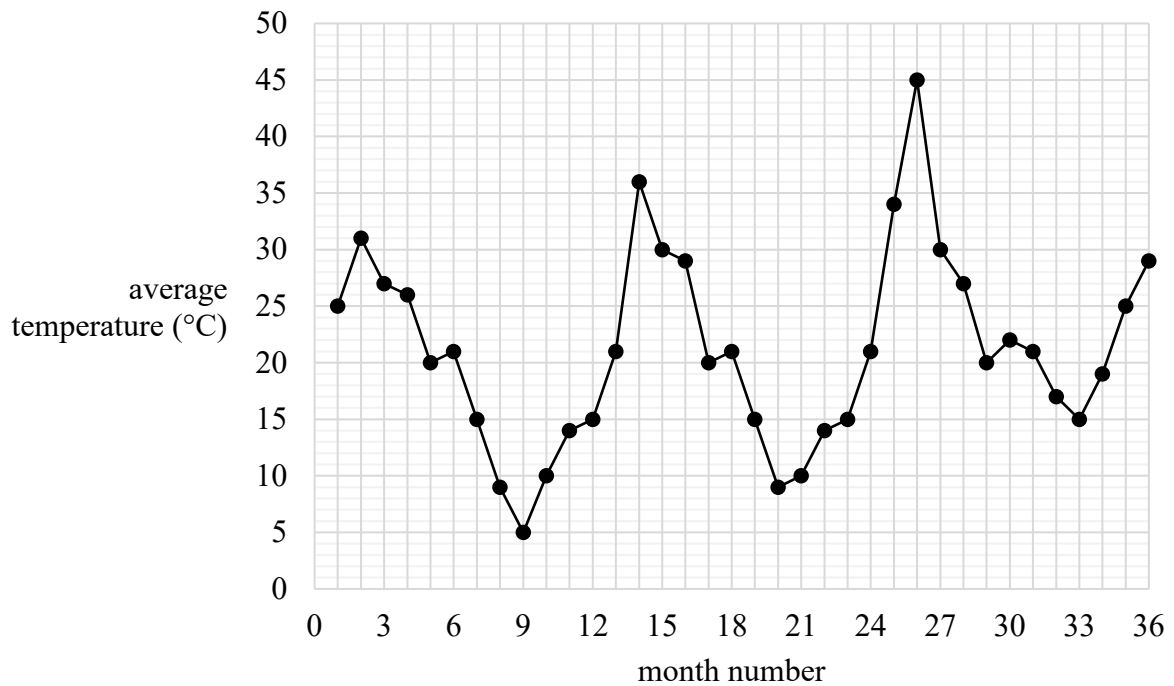A transformed equation is applied to the variables *day number* and *weight*.

$$\log_{10}(weight) = 1.8 + 0.049 \times day\ number$$

Using the equation, the predicted weight on day number 20 is closest to

A. -10

B. 3

C. 371

D. 603

Use the following information to answer Questions 13 and 14.

The time series plot below shows a city's average monthly temperature over 36 months.

Question 13

This time series plot is best described as having

A. seasonality only.

B. seasonality with irregular fluctuations.

C. increasing trend with irregular fluctuations.

D. seasonality with an increasing trend and irregular fluctuations.

Question 14

A nine-median smoothing is applied to the time series data.

Referring to the smoothed data, the last data point would be

A.   a value of 17 at month 32.

B.   a value of 21 at month 32.

C.   a value of 22 at month 32.

D.   a value of 17 at month 33.

Question 15

The data below shows the number of people visiting a medical centre each week.

Week	1	2	3	4	5	6	7	8
Number	405	390	275	310	345	510	580	620

The four-mean smoothed number, with centring, for week 5 is closest to

A.   345

B.   372

C.   398

D.   428

Question 16

The seasonal index for sales revenue in February is 0.4. To correct for seasonality, the actual sales revenue should be

A.   increased by 150%.

B.   increased by 60%.

C.   increased by 40%.

D.   reduced by 40%.

Recursion and financial modelling

Question 17

The following recurrence relation generates a sequence of numbers.

$T_0 = 170, T_{n+1} = T_n + 35$

The number 310 appears in this sequence as

A. T_2

B. T_3

C. T_4

D. T_5

Question 18

Jem deposited $4000 into an investment account that earns interest at the rate of 4.68% per annum, compounding quarterly.

The recurrence relation that represents this investment is

A. $V_0 = 4000, V_{n+1} = 1.0039V_n$

B. $V_0 = 4000, V_{n+1} = 1.0018V_n$

C. $V_0 = 4000, V_{n+1} = 1.0117V_n$

D. $V_0 = 4000, V_{n+1} = 1.0468V_n$

Question 19

Ursula is offered two rates for her investment account:

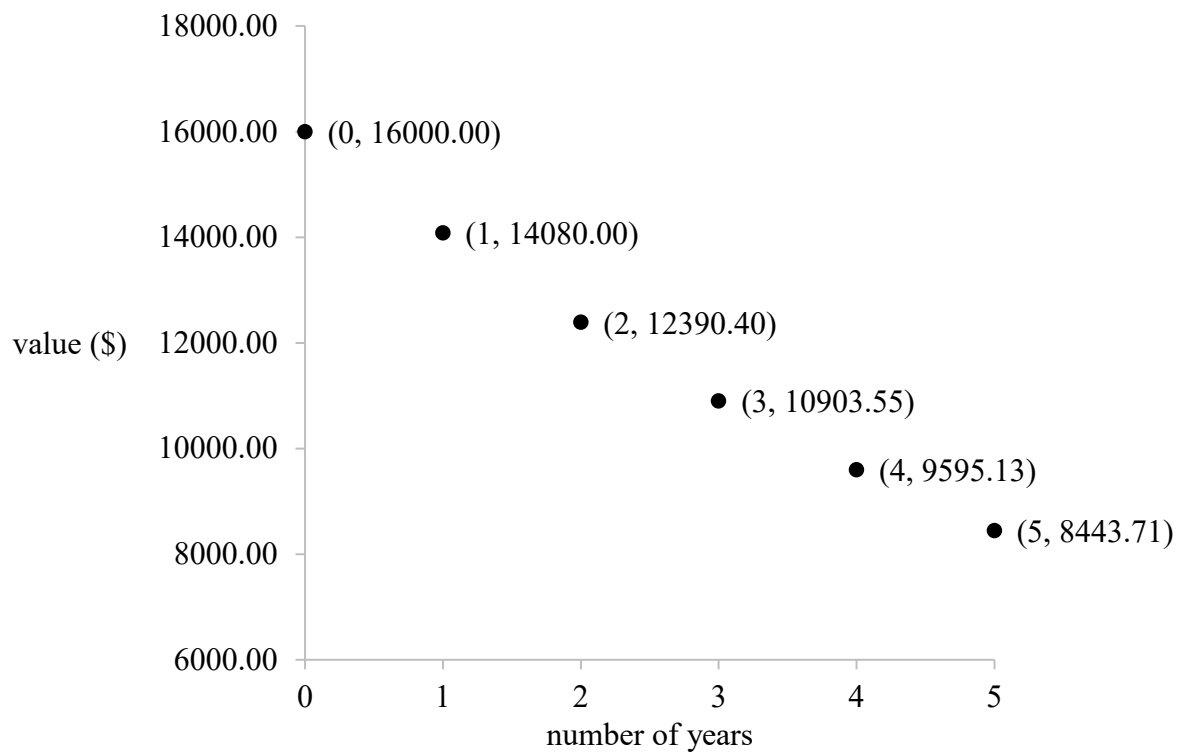Option 1: 3.45% per annum, compounding quarterly

Option 2: 3.41% per annum, compounding daily

The difference in the effective interest rates is closest to

A.   0.040%

B.   0.026%

C.   0.020%

D.   0.019%

Question 20

The graph below shows the depreciation of an asset on a reducing balance basis.

After how many years will the asset be worth less than $3000?

A.   12

B.   13

C.   14

D.   15

Question 21

A commercial dishwasher is purchased for $9800. The value of the machine is depreciated using a unit cost method of depreciation.

It is used 140 times a week.

After 3 years, the machine is worth $4558.40.

The depreciation in the value of the dishwasher, per wash, is

A. $0.21
B. $0.22
C. $0.23
D. $0.24

Use the following information to answer Questions 22 and 23.

Four lines of an amortisation table for an annuity with monthly withdrawals are shown below.

Payment number	Withdrawal ($)	Interest ($)	Principal reduction ($)	Balance ($)
117	1920	30.99	1889.01	5401.51
118	1920	22.96	1897.04	3504.46
119	1920	14.89	1905.11	1599.36
120			1599.36	0

Question 22

The balance after payment 116 is

A. $8001.14

B. $7620.28

C. $7321.51

D. $7290.52

Question 23

The withdrawal amount for payment 120 is

A. $1920

B. $1606.15

C. $1599.36

D. $1592.56

Question 24

Leva is planning her retirement in 15 years' time.

She currently has $220 000 invested in an annuity investment that earns interest at a rate of 3.2% per annum, compounding monthly, and makes additional payments into the account each month.

Leva determines that when she retires, she will need to withdraw $3500 per month over a 20-year period. She is expecting that this annuity will need to earn interest at a rate of 3.5% per annum, compounding monthly.

What is the amount of money Leva will need to deposit into the account each month over the next 15 years?

A. $1076.05

B. $2011.65

C. $2300.20

D. $3500

Matrices

Question 25

Consider the following matrices.

$$A = \begin{bmatrix} 5 & 2 \\ 0 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} 4 \\ 6 \\ 7 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & 8 & 4 \\ 8 & 5 & 6 \\ 4 & 6 & 2 \end{bmatrix} \qquad D = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \qquad E = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

Which of the following does not appear in the set of matrices shown?

A.   symmetric matrix

B.   square matrix

C.   identity matrix

D.   permutation matrix

Question 26

The number of coats (C), jackets (J) and scarves (S) sold over two weeks is represented in the matrix below.

$$\begin{array}{c} \\ W1 \\ W2 \end{array} \begin{array}{ccc} C & J & S \\ \begin{bmatrix} 17 & 18 & 32 \\ 10 & 21 & 19 \end{bmatrix} \end{array}$$

Which of the following shows the calculation to determine the total number of items sold each week?

A. $\begin{bmatrix} 17 & 18 & 32 \\ 10 & 21 & 19 \end{bmatrix} \times \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

B. $\begin{bmatrix} 17 & 18 & 32 \\ 10 & 21 & 19 \end{bmatrix} \times \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$

C. $\begin{bmatrix} 17 & 18 & 32 \\ 10 & 21 & 19 \end{bmatrix} \times \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 1 \end{bmatrix} \times \begin{bmatrix} 17 & 18 & 32 \\ 10 & 21 & 19 \end{bmatrix}$

Question 27

The element in row i and column j of matrix M is m_{ij}.

M is a 3×2 matrix, constructed using the rule $m_{ij} = 2(i - j)$.

M is

A. $\begin{bmatrix} 0 & -2 \\ 2 & 0 \\ -2 & 2 \end{bmatrix}$

B. $\begin{bmatrix} 0 & 2 \\ 2 & 0 \\ 0 & 2 \end{bmatrix}$

C. $\begin{bmatrix} 0 & -2 \\ 2 & 0 \\ 4 & 2 \end{bmatrix}$

D. $\begin{bmatrix} 0 & -2 \\ 2 & 0 \\ 0 & 4 \end{bmatrix}$

Question 28

A species of insect has a life span of three years.

Consider the Leslie matrix, L, which models the female population distribution of this species.

$$L = \begin{array}{c} \begin{array}{ccc} E & J & A \end{array} \\ \begin{bmatrix} 0 & 2 & 3 \\ 0.7 & 0 & 0 \\ 0 & 0.92 & 0 \end{bmatrix} \begin{array}{c} E \\ J \\ A \end{array} \end{array}$$

Which of these statements is incorrect?

A. On average, 30% of female eggs are not expected to survive to become juveniles.

B. On average, 92% of female juveniles are expected to survive to become adults.

C. On average, 2 female eggs are expected to be produced by female juveniles.

D. On average, 3 female eggs are not expected to survive to become female adults.

Question 29

A round-robin darts tournament is held between five people. Five competitors, Valerie (V), Wylam (W), Xavier (X), Yasmin (Y) and Zelie (Z), participate in the tournament.

Each competitor plays each of the other competitors once only, and each match results in a winner and a loser. The results of the tournament can be presented in a matrix, where a '1' in the matrix shows that the competitor named in that row defeated the competitor named in that column.

Which **one** of the following matrices could represent the results of that tournament?

A.

$$\begin{array}{c} \\ V \\ W \\ X \\ Y \\ Z \end{array} \begin{array}{ccccc} V & W & X & Y & Z \\ \left[\begin{array}{ccccc} 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 \end{array}\right] \end{array}$$

B.

$$\begin{array}{c} \\ V \\ W \\ X \\ Y \\ Z \end{array} \begin{array}{ccccc} V & W & X & Y & Z \\ \left[\begin{array}{ccccc} 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \end{array}\right] \end{array}$$

C.

$$\begin{array}{c} \\ V \\ W \\ X \\ Y \\ Z \end{array} \begin{array}{ccccc} V & W & X & Y & Z \\ \left[\begin{array}{ccccc} 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \end{array}\right] \end{array}$$

D.

$$\begin{array}{c} \\ V \\ W \\ X \\ Y \\ Z \end{array} \begin{array}{ccccc} V & W & X & Y & Z \\ \left[\begin{array}{ccccc} 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \end{array}\right] \end{array}$$

Question 30

Matrix P is a permutation matrix and matrix A is a row matrix.

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \end{bmatrix} \qquad A = \begin{bmatrix} r & i & n & s & e \end{bmatrix}$$

When P and A are multiplied, the result is

A.   risen.

B.   siren.

C.   reins.

D.   resin.

Use the following information to answer Questions 31 and 32.

The transition matrix below models the movement by a group of Year 7 students between four areas of a school at lunchtime each day: oval (O), courtyard (C), basketball court (B) and library (L).

$$T = \begin{array}{c} \\ \\ \begin{array}{cccc} O & C & B & L \end{array} \\ \begin{bmatrix} 0.2 & 0.1 & 0.2 & 0 \\ 0.4 & 0.6 & 0.25 & 0.4 \\ 0.1 & 0.1 & 0.45 & 0.3 \\ 0.3 & 0.2 & 0.1 & 0.3 \end{bmatrix} \begin{array}{l} O \\ C \\ B \\ L \end{array} \end{array} \quad \text{next day}$$

today

Question 31

In the long term, which one of the following is correct?

A.   The number of students at the oval is approximately double those at the basketball court.

B.   The number of students at the library is more than double those at the courtyard.

C.   A similar number of students will be at the library and the oval.

D.   Approximately a quarter of those at the courtyard will be at the oval.

Question 32

On Tuesday, there were twice as many students in the courtyard as there were at the oval.

There were three times as many at the basketball court as the oval. There were twice as many at the library as there were at the courtyard.
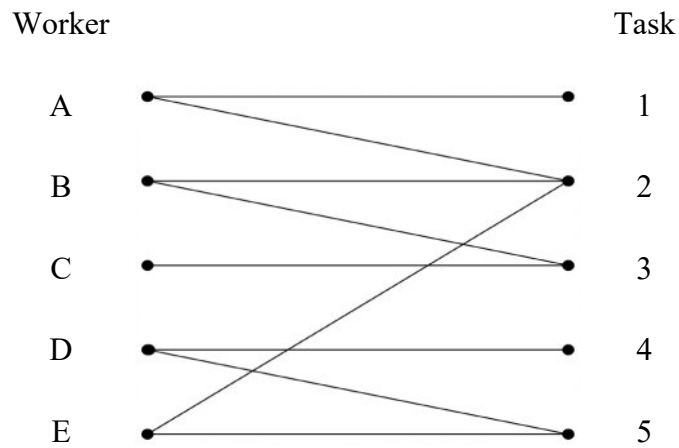
There were 79 Year 7 students in the courtyard at lunch on Wednesday. The total number that were in the library and on the basketball court on Tuesday was

A.   140

B.   110

C.   80

D.   60

Networks and decision mathematics

Question 33

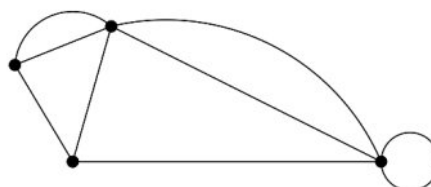The bipartite graph below shows which tasks five people are able to complete.
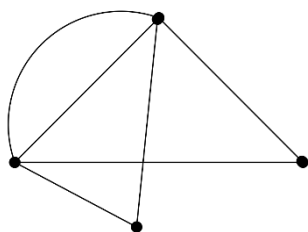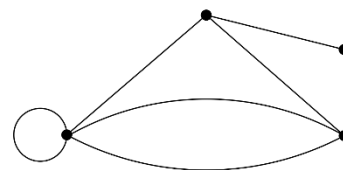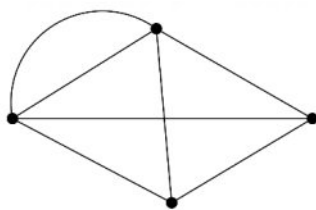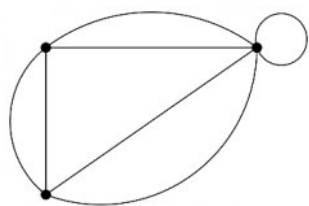

Each person completes a different task.

Task 2 is completed by

A. worker A.

B. worker B.

C. worker C.

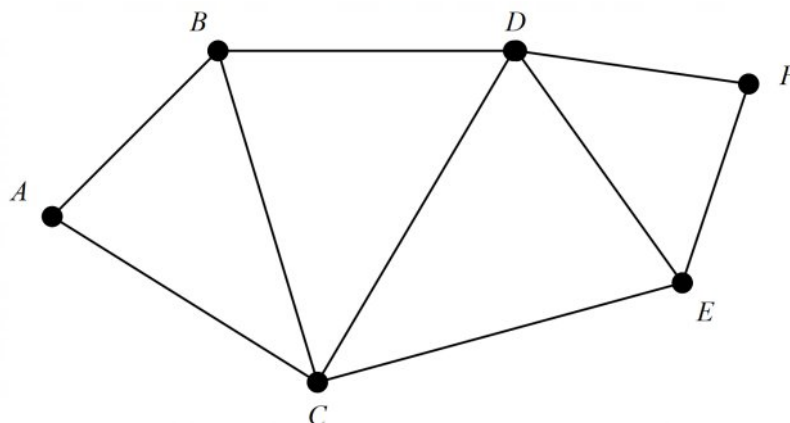**D.** worker E.

Question 34

How many of the network diagrams shown below have a degree sum of 14?

A.   1

B.   2

C.   3

D.   4

Question 35

How many additional edges are required for the network diagram below to become a complete graph?

A.   3

B.   6

C.   8

D.   11

Question 36

A simple network has eight vertices, labelled A to H.

Which one of these could exist as an Euler circuit on the network?

A. $A–B–C–D–E–F–G–H$

B. $F–A–B–D–C–E–H–G–F$

C. $B–H–I–C–F–D–A–E–G–B$

D. $C–G–A–D–H–B–F–C$

Question 37

Consider the activity table below.

Activity	Duration (hours)	Immediate predecessors
A	3	–
B	4	–
C	4	–
D	2	A
E	5	A
F	2	B, D
G	3	C
H	4	E
I	5	E
J	1	F, G, H
K	3	G
L	4	I
M	2	J, K, L

A dummy activity is needed from

A. G to J.

B. B to F.

C. F to J.

D. J to M.

Question 38

Consider the adjacency matrix below, which represents a planar graph.

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

How many faces, edges and vertices does it have?

A.   3 faces, 5 edges, 5 vertices

B.   7 faces, 6 edges, 5 vertices

C.   5 faces, 7 edges, 5 vertices

D.   4 faces, 7 edges, 5 vertices

Use the following information to answer Questions 39 and 40.

The flow of water through a network of pipes, in litres per minute, is shown below.
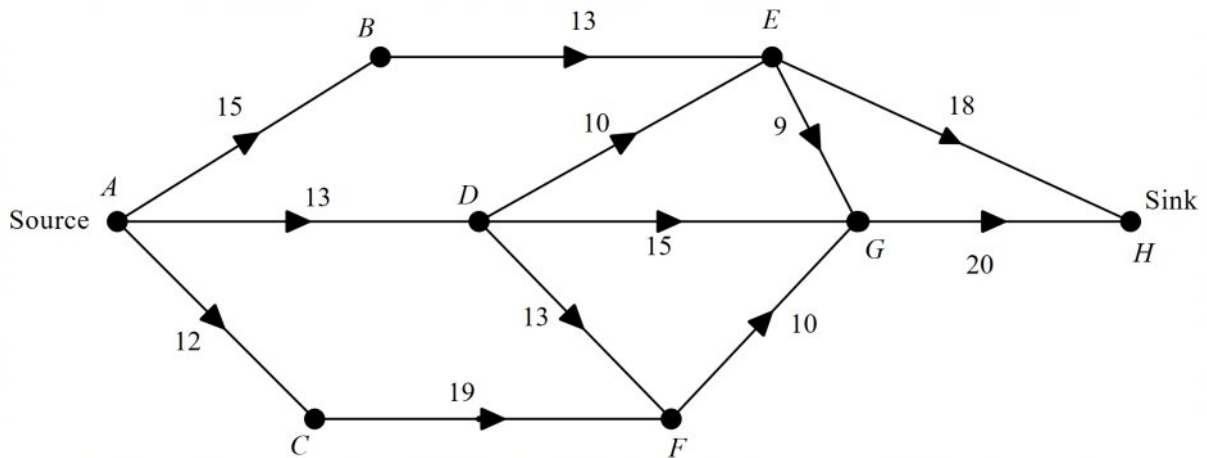
Question 39

The maximum capacity of water, in litres per minute, that can flow through pipes
$A–D–E–G–H$ is

A.   9

B.   10

C.   13

D.   52

Question 40

The maximum flow, in litres per minute, from source to sink is

A.   33

B.   36

C.   38

D.   39

End of Multiple-Choice Question Book