Engage
Education
Foundation

Units 3 and 4 Further Maths: Exam 1

Practice Exam Question and Answer Booklet

Duration: 15 minutes reading time, 1 hour 30 minutes writing time

Structure of book:

Section	Number of questions	Number of questions to be answered	Number of Modules	Number of modules to be answered	Number of marks
A	13	13			13
B	54	27	6	3	27
		Total			40

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers and rulers.
- Students are not permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied:
- This question and answer booklet of 32 pages.

Instructions:
- You must complete all questions of the examination.
- Write all your answers in the spaces provided in this booklet.

Section A – Multiple-choice questions

Instructions

Answer all questions by circling your choice.

Choose the response that is correct or that best answers 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.

Core: Data analysis

Question 1

Native birds sitting on a nest are monitored in a national park during the breeding season. Among the statistics recorded were wing span, gender and number of off eggs in the nest. What kind of variables are these respectively?

    A. Categorical data; discrete numerical data; continuous numerical data

    B. Discrete numerical data; continuous numerical data; discrete numerical data

    C. Categorical data; discrete numerical data; discrete numerical data

    D. Continuous numerical data; categorical data; discrete numerical data

    E. Continuous numerical data; categorical data; continuous numerical data

Question 2

A 5 number summary is partially given below:

$$\text{minimum}, 12, 33, \text{3rd quartile}, 50$$

If the range and interquartile range are 42 and 26 respectively, what are the values of the minimum and 3rd quartile?

    A. 26 and 42

    B. 8 and 38

    C. 8 and 59

    D. 7 and 59

    E. 7 and 38

Use the following information to answer questions 3 and 4:

The amount of money (in dollars) students in a mathematics class have are listed below.

30, 41, 33, 49, 13, 33, 10, 7, 22, 20

Question 3
The median amount of money in the wallets is:

    A. 25
    B. 26
    C. 30
    D. 33
    E. 41

Question 4
The IQR is

    A. 10
    B. 15
    C. 20
    D. 24.5
    E. 22

Question 5
The heights of 16 toddlers at a kindergarten are taken and their average is 83.82cm. Joey is remarkably tall for his age, and is considered an outlier. It has been decided that his height won't be used in the calculation of the mean height. The new average, of the 15 remaining students, will be:-

    A. Unchanged with the original mean
    B. Greater than the original mean
    C. Less than the original mean
    D. Exactly $\frac{15}{16}$ times the original mean
    E. Not enough information is given to determine its nature.

Use the following information to answer questions 6 and 7:

The Sunny Morning breakfast cereal company produces cereal boxes of 2 sizes, 550g and 750g. The actual mass of cereal contained in the 550g box is known to be distributed in a bell shape manner with mean 550g and standard deviation of 2.5g.
The true mass of the cereal contained in the 750g box is again distributed in a bell shape manner with mean 750g but a standard deviation of 5.5g.

Question 6
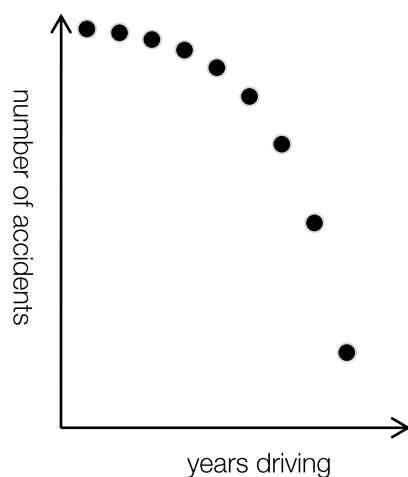What is the percentage of 550g packets which actually contains more than 557.5g of cereal?

    A. 99.85%
    B. 97.5%
    C. 2.5%
    D. 0.15%
    E. 0.075%

Question 7
Quality control is conducted on 1000 of the 750g boxes. The boxes are rejected if the recorded weight is less than 5.5g, or more than 11g over the advertised weight. How many boxes do we expect to reject?

    A. 50
   B. 160
    C. 185
    D. 250
    E. 320

Question 8

The road transport authority has collected data of the number of car accidents in a year and plotted it against the number of years the driver had been driving for. If a linear regression model is to be fitted to this data which pair of transformations are appropriate candidates?

    A.   A $\log(y)$ transformation and a $\log(x)$ transformation

    B.   A $\log(y)$ transformation and a $\frac{1}{x}$ transformation

    C.   A $\frac{1}{y}$ transformation and a $\log(y)$ transformation

    D.   A $\frac{1}{x}$ transformation and a $\log(x)$ transformation

    E.   A y^2 transformation and a x^2 transformation

Use the following information to answer questions 9 and 10:
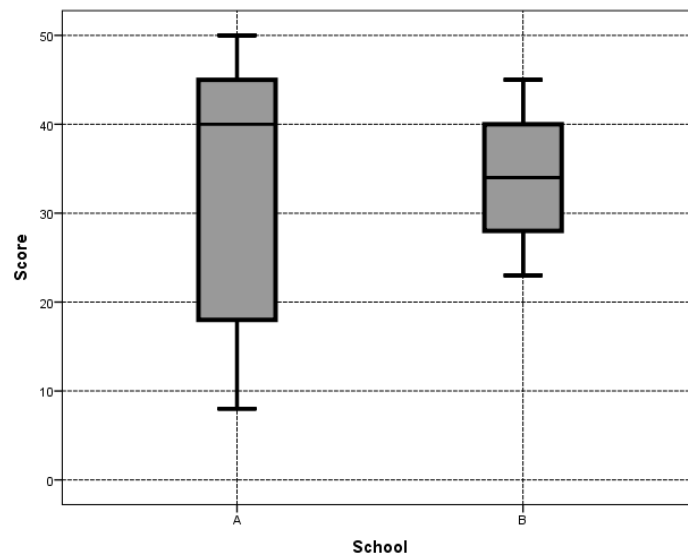
Year 10 students in two randomly selected schools, A and B have been given a basic numeracy test. The test was out of 50, and the results of cohorts have been displayed in the above 2 box-plots. 160 students sat the test from school A, and 220 sat the test from school B.

Question 9
Which of the following statements correctly describes the nature of the distributions?

    A.   School A is positively distributed while school B is negatively distributed.
    B.   School A is negatively distributed while school B is symmetrical in its distribution.
    C.   School A is positively distributed while school B is symmetrical in its distribution.
    D.   School A is negatively distributed while school B is positively distributed.
    E.   Both school A and B are negatively distributed.

Question 10
Which of the following statements is incorrect?

    A.   The top 40 students of school A all received higher test scores than any student from school B.
    B.   The bottom 40 students of school A all received lower test scores than any student from school B.
    C.   The median test score for school B is lower than school A. However the overall spread of the distribution of scores is less for school B than it is for school A.
    D.   The top 80 students of school A all received higher test scores than all of the top 55 students from school B.
    E.   The top 55 students of school B all received higher test scores than any of the bottom 80 students of school A.

Question 11
A bakery is open 6 days a week, it is closed on Sundays. It records the following seasonal indices:-

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Index	0.8	1.3	1.2		0.7	1.1

What is the seasonal index for Thursday?

    A. 0.8
    B. 0.9
    C. 1.0
    D. 1.1
    E. 1.2

Use the following information to answer questions 12 and 13:

Team	Handballs	Kicks
Devils	156	209
Wombats	172	215
Ravens	164	216
Thunder	191	207
Panthers	201	229
Reds	177	172
Dingos	106	170
Lizards	165	203
Wombats	159	214
Dropbears	210	187

The local football league has recorded the number of handballs and kicks for each of its 10 teams over the weekend. The league statistician wishes to find a relationship between the number of handballs and kicks. To do this she will take the **number of handballs** as the independent variable and the **number of kicks** as the dependent variable.

Question 12
A least squares regression line is fitted to this data. The equation of the line is closest to.

- A. $\text{number of handballs} = 0.251 \times \text{number of kicks} + 159.572$
- B. $\text{number of handballs} = 0.169 \times number\ of\ handballs + 250.61$
- C. $\text{number of kicks} = 0.159 \times \text{number of handballs} + 250.61$
- D. $\text{number of kicks} = 0.251 \times \text{number of handballs} + 159.572$
- E. $\text{number of kicks} = 0.136 \times \text{number of handballs} + 159.572$

Question 13
Which of the following statements about the value of Pearson's product-moment coefficient for **number of handballs** to **number of kicks** and its interpretation are correct?

- A. **0.370**; There is a strong positive linear association
- B. **0.370**; There is a moderate negative linear association
- C. **0.370**; There is a weak positive linear association
- D. **0.137**; There is a strong positive linear association.
- E. **0.137**; There is a weak positive linear association.

Section B

Instructions

Select **three** modules and answer **all** questions within the modules by circling your choice.

Choose the response that is **correct** or that best answers 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.

Module 1: Number patterns

Question 1

The following is an arithmetic sequence:

$$17, 24, 31, 38, 45...$$

If S_8 is the sum of the first 8 terms, what is it equal to?

    A.   220

    B.   330

    C.   332

    D.   660

    E.   664

Question 2

Upon receiving an inheritance of stamps from his grandfather, Ben has decided to collect stamps each week to add to the collection. If each week he collects an extra 6 stamps, and by the end of the 12th week he has a total of 219 stamps. How many stamps did he originally inherit from his grandfather?

    A.   140

    B.   145

    C.   146

    D.   147

    E.   148

Use the following information to answer questions 3 and 4:

Park authorities wish to control the population of kangaroos in a park. As a result of natural breeding the kangaroo population increases by 15% each year. The authorities remove 300 kangaroos at the end of each year. At the end of 2012 there are 2,500 kangaroos in the park.

Question 3
A difference equation which can be used to model the population of kangaroos in the park each year is:

   A. $p_{n+1} = 1.15(p_n - 300), with \; p_1 = 2,500$
   B. $p_{n+1} = 0.15(p_n - 300), with \; p_1 = 2,500$
   C. $p_{n+1} = 1.15p_n - 300, with \; p_1 = 2,500$
   D. $p_{n+1} = 0.85 \; p_n - 300, with \; p_1 = 2,500$

Question 4
According to this model, to the nearest whole kangaroo, what would be the kangaroo population size at the end of 2014?

   A. 2565
   B. 2615
   C. 2617
   D. 2660
   E. 2661

Use the following information to answer questions 5 and 6:

The 3rd term of a decaying geometric sequence is $\frac{4}{3}$, and the 5th term is $\frac{4}{27}$.

Question 5
What is the 1st term?

   A. 48
   B. 24
   C. 12
   D. 6
   E. 1

Question 6
What is the sum of the infinite series?

   A. 18
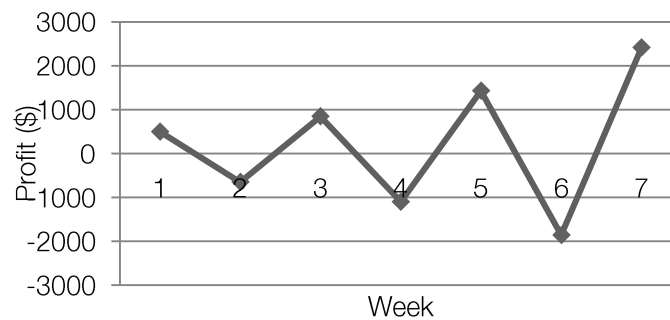   B. 24
   C. 30
   D. 32
   E. 72

Question 7

The following sequence is modelled by a first order difference equation of the form:

$$t_{n+1} = at_n + b$$

$$5, -19, 29, -67, 125, -259$$

What are a and b respectively?

A. $a = -6, b = -9$
B. $a = 2, \ b = -9$
C. $a = -2, \ b = 9$
D. $a = -2, \ b = -9$
E. $a = 2, b = 9$

Question 8

The above chart displays the profit or loss made by an ice-cream company over several weeks. The graph follows:

A. a geometrics sequence with $a > 1$
B. a geometric sequence with $0 < a < 1$
C. a geometric sequence with $-1 < a < 0$
D. a geometric sequence with $a < -1$
E. none of the above

Question 9

Which of the following statements about the infinite sum of a geometric sequence is **correct**?

A. It is possible to find the infinite sum of a geometric sequence simply by knowing r the common ratio.
B. If the common ration $r < 0$ then we can find the infinite sum of a geometric series.
C. If the common ratio $0 < r < 1,$ then we can find the infinite sum of a geometric series.
D. If the common ratio $0 \le r \le 1,$ then we can find the infinite sum of a geometric series.
E. None of the above.

Module 2: Geometry and Trigonometry

Question 1
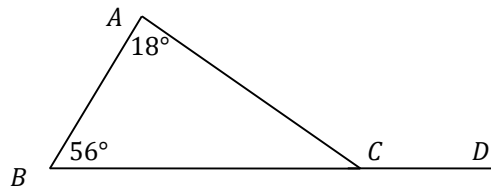
For the diagram above, the size of $\angle ACD$ is equal to:

    A. 18°
    B. 56°
    C. 74°
    D. 77°
    E. 124°

Question 2
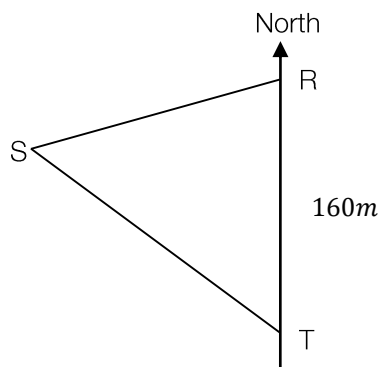
The point R is 160m due north of the point T. The true bearing from point T to point S is **295°**. The true bearing from point R to point S is **210°**. The distance from point S to point T is equal to:

    A. 79.82m
    B. 80.31m
    C. 95.43m
    D. 145.46m
    E. 290.02m

Use the following information to answer questions 3 and 4:

Jason and Amy set out on a hiking expedition from their house, which is situated in a forest. They begin walking for 3.5 km on a bearing of $S35°E$, until they reach a drinking fountain. From the drinking fountain they walk a further 3.5km on a bearing of $215°T$ to a picnic table where they stop for lunch. After lunch the pair decide to head home directly, by walking due north.

Question 3
In total, how far have Jason and Amy walked?

    A. 3.5 km
    B. 7.73 km
    C. 5.73 km
    D. 9.73 km
   E. 12.73 km

Question 4
What is the total area of forest which is bounded by the path that Jason and Amy travelled during their hike?

    A. $3.51\ km^2$
    B. $5.20\ km^2$
    C. $5.76\ km^2$
    D. $6.13\ km^2$
    E. $12.25\ km^2$

Question 5
Tina wishes to estimate the height of a flagpole. At 9 in the morning, the flagpole casts a shadow along the ground to a point M. The length of this shadow is 15.5m. Tina then stands along the shadow cast by the flagpole such that her own shadow also reaches the point M exactly. The distance from where Tina is standing to the base of the flagpole is 12m. If Tina is 170 cm tall, how high is the flagpole?

    A. 3.5m
    B. 7.53m
    C. 12.35m
    D. 15.5m
    E. 16m

Question 6
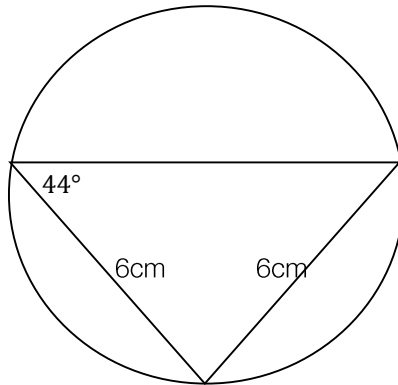
An isosceles triangle sits inside a circle such that the longest side of the triangle corresponds with the diameter of the circle. From the diagram above, what is the area of the circle to the nearest cm^2?

A. $29cm^2$
B. $59\ cm^2$
C. $60\ cm^2$
D. $231cm^2$
E. $234\ cm^2$

Question 7

The radius of a cricket ball is $\frac{2}{5}$ times the radius of a volleyball. Hence, the ratio of the volume of the cricket ball to the volume of the volleyball is:

A. 25:4
B. 4:25
C. 125:8
D. 8:125
E. 8:25

Question 8

A right angled triangle, is constructed such that its base is the shortest in length of all 3 sides, with a side length of $3x\ cm$. We are told that the remaining side lengths are $\frac{4}{3}$ times and $\frac{5}{3}$ times the length of the base respectively. We are told that the total area of the triangle is $294cm^2$. What is the total length of the triangles perimeter?

A. 12cm
B. 24cm
C. 24.5
D. 72cm
E. 84cm

Question 9

Jason wants to swim across a river to a point C, on the opposite bank. Jason has 2 points that he can begin his swim from, points A and B respectively. The distance between points A and B is known to be 120m. The bearing of C from point A is $37°T$, and the bearing of point C from point B is $N12°W$. As Jason is not a strong swimmer, he wants to swim the shortest distance possible. Assuming he swims in exactly straight lines from point to point, which point should he start at, and how many meters less will he swim?

    A.   Point A, 93.92m less.
    B.   Point B, 93.92m less.
    C.   Point A, 28.54 m less.
    D.   Point B, 28.54 m less.
    E.   He will swim the exact same distance starting from both points.

Module 3: Graphs and Relations

Question 1

John is given a base salary of $1,100 per month. On top of this, he is given a commission of 25% on his sales. If the product he sells is dishwashing machines, each for $300, how many dishwashing machines does he need to sell to earn $1,925?

    A. 9
    B. 10
    C. 11
    D. 12
    E. 13

Question 2

Two lines intersect at a point (2,4). The first line has a positive gradient and passes through the origin, with a gradient a. The second line has a gradient of $-a$. What is the y-intercept value of the second line?

    A. 0
    B. 2
    C. 4
    D. 8
    E. 10

Question 3

A line has an x-intercept of -7 and a y-intercept of -15. Which of the following is a possible equation for the line?

    A. $77y + 15x = -105$
    B. $15y + 77x = 105$
    C. $7y + 15x = -105$
    D. $7y + 15x = 105$
   E. $15y + 7x = -105$

Question 4

The total cost of a flight from Melbourne to Seoul, with an airline is given by the linear equation:

$$\text{total cost} = \text{base ticket price} + a \times (\text{baggage weight})$$

If a traveller with 10kg pays $1,515 in total. And his girlfriend with 15kg pays $1,622.50 in total. What is the cost of the base ticket price, and how much does the airline charge for each extra kilogram of baggage?

    A. base ticket price $= \$1,300$ $a = \$20.5$
    B. base ticket price $= \$1,300$ $a = \$21.5$
    C. base ticket price $= \$1,400$ $a = \$21.5$
    D. base ticket price $= \$1,400$ $a = \$20.5$
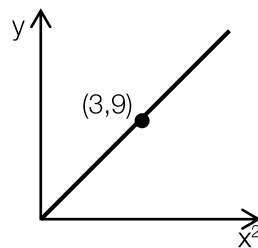   E. base ticket price $= \$1,350$ $a = \$21.5$
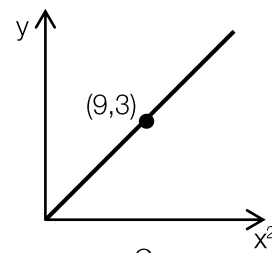
Question 5
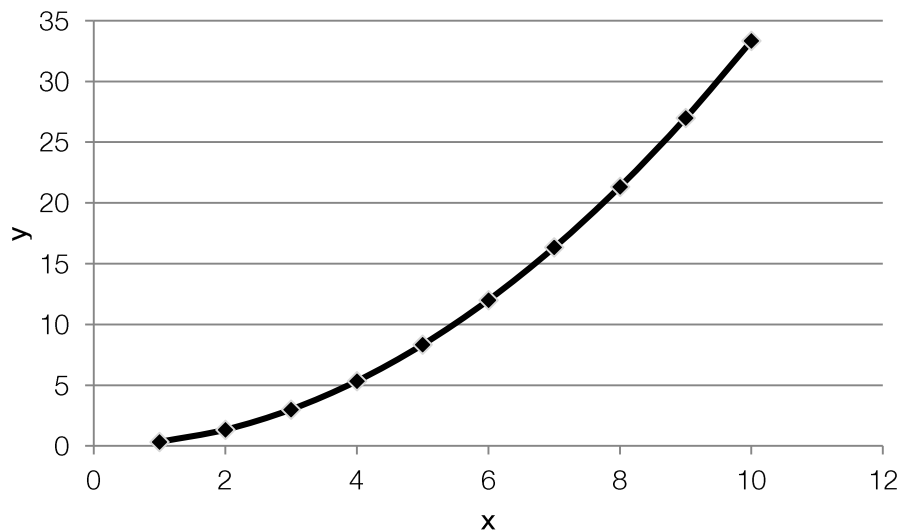
The above is a graph for the equation $y = \frac{1}{3} \times x^2$. In which of the following graphs, with y plotted against x^2 is the relationship the same?
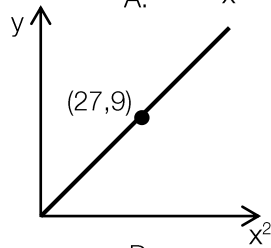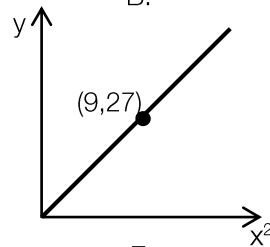

A. (9,9)

B. (3,9)

C. (9,3)

D. (27,9)

E. (9,27)
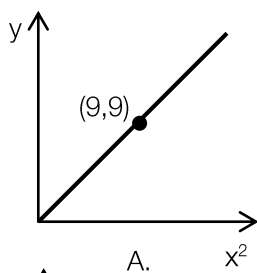
Question 6

$$\text{Equation 1: } 3y - 5x = 20$$

$$\text{Equation 2: } 4y + 3x = 20$$

Which of the following statements is false?

    A.   Equation 1 has a larger y-intercept than equation 2
    B.   Equation 1 has positive gradient, while equation 2 has a negative gradient
    C.   The x-intercept for equation 2 is larger than equation 1
    D.   The point of intersection for the two lines is $(-\frac{20}{29}, \frac{160}{29})$
    E.   At $x = 10$ equation 2 has a larger y value than equation 1

Use the following information to answer questions 7 and 8:

Alan wants to begin a business selling ice creams. To buy the ice-cream van will cost him $2,000 initially. Alan can make a single ice-cream for 20 cents, and he plans to sell them for $1 each.

Question 7

Which of the following equations describes the Cost to Alan's business as well as the Profit he will make?

A. $\text{cost} = 2{,}000 + 0.20 \times \text{number of ice creams sold}$
   $\text{profit} = 2000 + 0.80 \times \text{number of ice creams sold}$

B. $\text{cost} = -2{,}000 + 0.20 \times \text{number of ice creams sold}$
   $\text{profit} = 2000 - 0.80 \times \text{number of ice creams sold}$

C. $\text{cost} = 2{,}000 + 0.20 \times \text{number of ice creams sold}$
   $\text{profit} = -2000 + 0.80 \times \text{number of ice creams sold}$

D. $\text{cost} = 2{,}000 + 0.20 \times \text{number of ice creams sold}$
   $\text{profit} = -2000 + 1.00 \times \text{number of ice creams sold}$

E. $\text{cost} = 2{,}000 + 0.20 \times \text{number of ice creams sold}$
   $\text{profit} = 2000 + 1.20 \times \text{number of ice creams sold}$

Question 8

How many ice creams does Alan need to sell before he breaks even?

A. 2100
B. 2200
C. 2250
D. 2500
E. 2600

Question 9
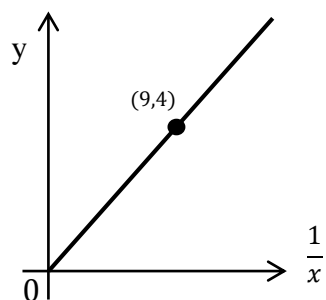
For the graph above, y is plotted against $\frac{1}{x}$. The relation between x and y is:

A. $y = {}^{9}/_{4x}$

B. $y = {}^{9x}/_{4}$

C. $y = {}^{4x}/_{9}$

D. $y = {}^{4}/_{9x}$

E. $y = {}^{10}/_{4x}$

Module 4: Business-related mathematics

Question 1

Juliana purchased a pair of skis on hire purchase. She paid $180 deposit and then $18.50 per month for three years.

The total amount that Juliana paid is:

    A. $624.00
    B. $864.00
    C. $752.00
    D. $846.00
    E. $198.50

Question 2

$5800 is invested at a simple interest rate of 3.2% per annum.

The amount of interest earned in the first year is:

    A. $185.60
    B. $371.20
    C. $5985.60
    D. $188.35
    E. $197.30

Question 3

A car is valued at $38 000 when new. Its value is depreciated by 25 cents for each kilometre it travels.

The number of kilometres the car travels before its value depreciates by $10 000 is closest to:

    A. 150000
    B. 112000
    C. 109000
    D. 28000
    E. 115000

Question 4

Estelle and Jo each invest $2000 for four years. Estelle's investment earns simple interest at the rate of 6.5% per annum. Jo's investment earns interest at the rate of 6.5% per annum compounding annually.

At the conclusion of three years, correct to the nearest cent, Estelle will have:

    A. $52.93 less than Jo
    B. $52.93 more than Jo
    C. $72.04 more than Jo
    D. $72.04 less than Jo
    E. The same as Jo

Question 5

A plumber charges $102 per hour to complete a job. A Goods and Services Tax (GST) of 10% is added to the charge.

Including GST, the cost of a job that takes three hours is:

    A. $306.00
    B. $10.20
    C. $336.60
    D. $30.60
    E. $360.30

Question 6

The price of a one-way ferry ride between two ports varies each day according to demand.

- On Monday the price is $58.00.
- The price on Tuesday is 25% greater than the price on Monday.
- The price on Wednesday is 10% less than the price on Tuesday.
- The price on Thursday is 25% less than the price on Wednesday.
- The price on Friday is 20% greater than the price on Thursday.
- The Saturday price is the same as the Friday price.

The price on Saturday is:

    A. $72.50
    B. $48.94
    C. $65.25
    D. $58.00
    E. $58.73

Question 7

Sarah invested $8000 at 4.6% per annum with interest compounding quarterly. After interest is paid at the end of each quarter, Rebecca adds $500 to her investment.

The value of her investment at the end of the third quarter, after the $500 has been added, is closest to:

    A. $9776.00
    B. $15571.00
    C. $21500.39
    D. $15071.00
    E. $11119.90

Question 8

A loan of $500 000 is taken out to purchase a house. The loan is to be repaid fully over twenty years with monthly payments of $3727.87. Interest is calculated monthly on the reducing balance.

The annual interest rate for this loan is closest to:

    A. 13.8%
   B. 24.2%
    C. 0.5%
    D. 6.5%
    E. 7.0%

Question 9

To purchase an original Picasso sketch Sophia has borrowed $180 000 at an interest rate of 4.45% per annum, fixed for ten years. Interest is calculated monthly on the reducing balance of the loan. Monthly repayments are set at $1500. After 10 years, Sophia renegotiates the conditions for the balance of her loan. The new interest rate will be 4.25% per annum. She will pay $1750 per month.

The total time it will take him to pay out the loan fully is closest to:

    A.   19 years
    B.   13 years
    C.   12 years
    D.   15 years
    E.   14 years

Module 5: Networks and decision mathematics
Question 1
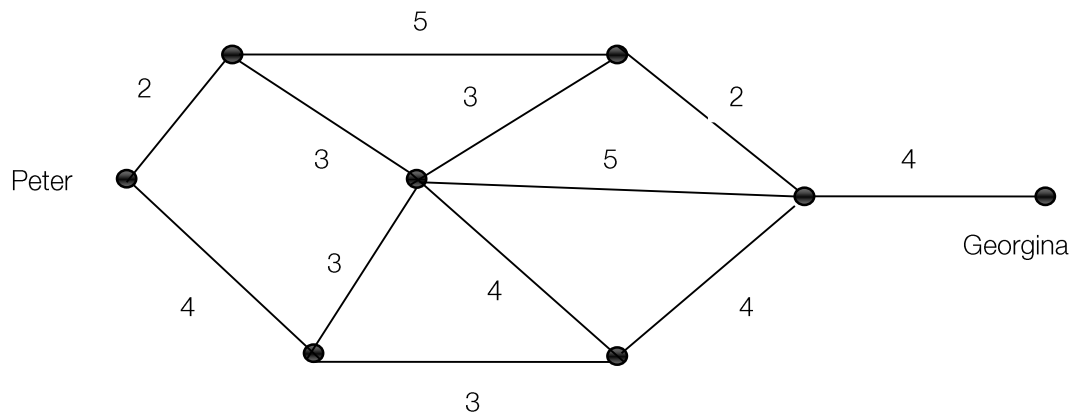Consider the following graph
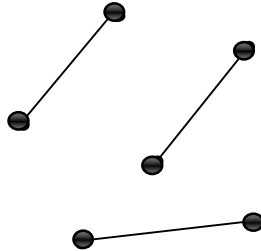
The smallest number of edges that need to be added to make this a connected graph is:

    A. 1
    B. 2
    C. 3
    D. 4
    E. 5

Question 2
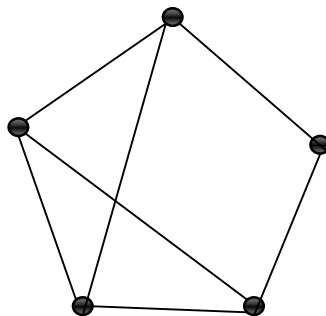The network shows the distances, in kilometres, along roads that connect the houses of Peter and Georgina.

The shortest distance, in kilometres, from Peter to Georgina is:

    A. 12
    B. 13
    C. 14
    D. 15
    E. 16

Question 3

A connected planar graph has 17 edges and 10 faces. The number of vertices for this graph is:

    A. 2
    B. 5
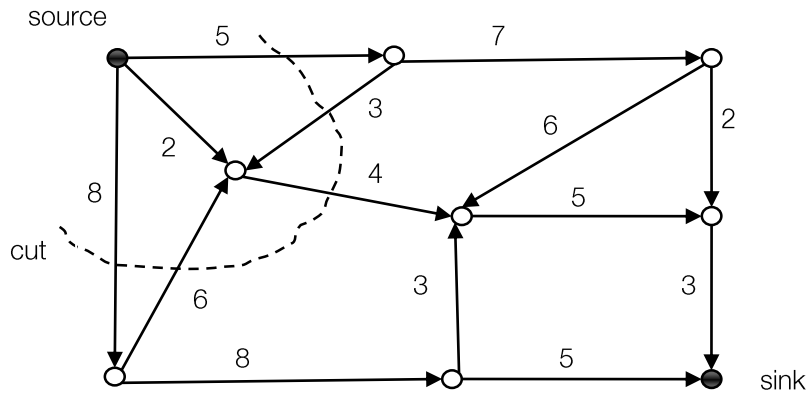   C. 7
    D. 9
    E. 20

Question 4

The number of edges in the above graph is:

    A. 4
    B. 5
    C. 6
    D. 7
    E. 8

Use the following information to answer questions 5 and 6:

In the network below, the values on the edges give the maximum flow possible between each pair of vertices. The arrows show the direction of flow. A cut that separates the source from the sink in the network is also shown.
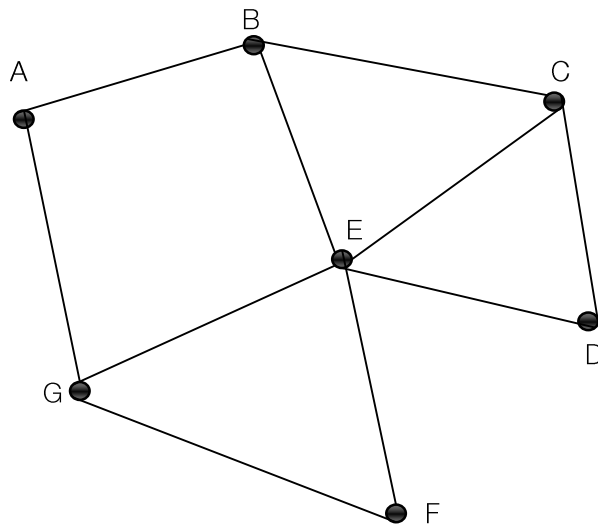

Question 5
The capacity of this cut is:

    A.   13
    B.   14
    C.   15
    D.   30
    E.   17

Question 6
The maximum flow between source and sink through the network is:

    A.   7
    B.   8
    C.   10
    D.   11
    E.   12

Question 7

Which one of the following statements is **true** regarding the network above?

    A.   *ABCEDFG* is a Hamilton circuit
    B.   Only one Hamilton pathway exists
    C.   There are no circuits
    D.   A Eulerian pathway exists
    E.   *FGABCDEF* is a Hamilton circuit

Question 8

A complete graph with eight vertices is drawn.

This network would best represent:

    A.   The journey that the post man takes to deliver the post to eight homes covering the minimum distance.
    B.   An eight-team squash competition where all teams play each other once.
    C.   The allocation of different task to eight workers.
    D.   A project where eight tasks must be completed in order to finish.
    E.   The cables required to connect eight houses to pay television that minimises the length of cables needed.

Question 9

A connected planar graph has five vertices, A, B, C, D and E.

The degree of each vertex is given in the following table.

Vertex	Degree
A	3
B	4
C	5
D	4
E	2

Which one of the following statements regarding this planar graph is true?

    A.   The sum of the degrees of the vertices equals 15
    B.   It contains an Eulerian circuit
    C.   Euler's formula $v + f = e + 2$ could not be used
    D.   It contains a Eulerian path
    E.   It would not form a connected graph

Module 6: Matrices

Question 1

If $\begin{bmatrix} 1 & 3 \\ 5 & 2 \end{bmatrix} + \begin{bmatrix} 8 & 7 \\ d & 6 \end{bmatrix} = \begin{bmatrix} 9 & 10 \\ 7 & 8 \end{bmatrix}$ then d equals:

    A.   -7
    B.   -2
    C.   2
    D.   4
    E.   8

Question 2

The order of the matrix $\begin{bmatrix} 4 \\ 4 \\ 4 \\ 4 \end{bmatrix}$ is:

    A. 2×2
    B. 1×4
    C. 4×1
    D.   4
    E.   16

Question 3

James bought only apples and bananas from his local fruit shop. The matrix N lists the number of apples (A) and bananas (B) that James bought:

$$\begin{matrix} & A & B \end{matrix}$$
$$N = \begin{bmatrix} 6 & 8 \end{bmatrix}$$

The matrix C lists the cost (in dollars) of one apple and one banana respectively.

$$C = \begin{bmatrix} 0.75 \\ 0.52 \end{bmatrix} \begin{matrix} A \\ B \end{matrix}$$

The matrix product, NC, gives:

    A.   The total number of pieces of fruit that James bought.
    B.   The individual number of apples and bananas that James bought and the individual amounts that James spent on these apples and bananas respectively.
    C.   The individual amounts that James spent on apples and bananas respectively.
    D.   The total amount spent by James on the fruit that he bought.
    E.   The total number of pieces of fruit that James bought and the total amount that he spent.

Question 4

The total cost of two pies and one soft drinks at Alessandra's shop is \$9. The total cost of five pies and three soft drinks is \$24. Let x be the cost of a pie and y be the cost of a soft drink.

The matrix $\begin{bmatrix} x \\ y \end{bmatrix}$ is equal to:

A. $\begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$

B. $\begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix} \begin{bmatrix} 9 \\ 24 \end{bmatrix}$

C. $\begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} 9 \\ 24 \end{bmatrix}$

D. $\begin{bmatrix} 3 & -1 \\ -5 & 2 \end{bmatrix} \begin{bmatrix} 9 \\ 24 \end{bmatrix}$

E. $\begin{bmatrix} -3 & 1 \\ 5 & -2 \end{bmatrix} \begin{bmatrix} 9 \\ 24 \end{bmatrix}$

Question 5

A system of three simultaneous linear equations is written in matrix form as follows:

$$\begin{bmatrix} 2 & -2 & 1 \\ 1 & -1 & 2 \\ 0 & 5 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 3 \\ 7 \end{bmatrix}$$

One of the simultaneous linear equations is

A. $2x + 3y - z = 4$

B. $5x + z = 7$

C. $z - 3y + x = 3$

D. $-2x - 3y + z = 4$

E. $5y + z = 7$

Question 6

Matrix M is a 2×4 matrix. Matrix P has five rows. N is another matrix.

If the matrix product $M(NP) = \begin{bmatrix} 2 & 9 \\ 3 & 5 \end{bmatrix}$ then the order of matrix N is:

A. 5×2

B. 2×2

C. 4×5

D. 2×5

E. 5×4

Use the following information to answer questions 7, 8 and 9:

In a country town, people only have the choice of doing their food shopping at a store called Safeworths (S) or at a newly opened store called Woolway (W). In the first week that Woolway opened, only 250 of the town's 700 shoppers did their food shopping at Safeworths. The remainder did their food shopping at Woolway. A market researcher predicts that

- Of those who do their food shopping at Safeworths this week, 60% will shop at Safeworths next week and 40% will shop at Woolway.
- Of those who do their food shopping at Woolway this week, 80% will shop at Woolway next week and 20% will shop at Safeworths.

Question 7
A state matrix S_1 that can be used to represent this situation is

A. $S_1 = \begin{bmatrix} 250 \\ 700 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$

B. $S_1 = \begin{bmatrix} 250 \\ 450 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$

C. $S_1 = \begin{bmatrix} 450 \\ 250 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$

D. $S_1 = \begin{bmatrix} 700 \\ 250 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$

E. $S_1 = \begin{bmatrix} 700 \\ 450 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$

Question 8
A transition matrix that can be used to represent this situation is

A.
$$\begin{matrix} & \text{This week} \\ & \begin{matrix} S & W \end{matrix} \end{matrix}$$
$T = \begin{bmatrix} 60 & 20 \\ 40 & 80 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$ Next week

B.
$$\begin{matrix} & \text{This week} \\ & \begin{matrix} S & W \end{matrix} \end{matrix}$$
$T = \begin{bmatrix} 0.6 & 0.2 \\ 0.4 & 0.8 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$ Next week

C.
$$\begin{matrix} & \text{This week} \\ & \begin{matrix} S & W \end{matrix} \end{matrix}$$
$T = \begin{bmatrix} 0.8 & 0.2 \\ 0.4 & 0.6 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$ Next week

D.
$$\begin{matrix} & \text{This week} \\ & \begin{matrix} S & W \end{matrix} \end{matrix}$$
$T = \begin{bmatrix} 0.4 & 0.2 \\ 0.6 & 0.8 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$ Next week

E.
$$\begin{matrix} & \text{This week} \\ & \begin{matrix} S & W \end{matrix} \end{matrix}$$
$T = \begin{bmatrix} 0.2 & 0.6 \\ 0.8 & 0.4 \end{bmatrix} \begin{matrix} S \\ W \end{matrix}$ Next week

Question 9

The assuming this trend continues the steady state matrix is

A. $SS = \begin{bmatrix} 233 \\ 467 \end{bmatrix}$

B. $SS = \begin{bmatrix} 467 \\ 233 \end{bmatrix}$

C. $SS = \begin{bmatrix} 250 \\ 450 \end{bmatrix}$

D. $SS = \begin{bmatrix} 333 \\ 366 \end{bmatrix}$

E. $SS = \begin{bmatrix} 133 \\ 566 \end{bmatrix}$

Formula Sheet

Core: Data analysis

Standardised score: $z = \dfrac{x - \bar{x}}{s_x}$

Least squares line: $y = a + bx$ where $b = r\dfrac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$

Residual value: $\text{residual value} = \text{actual value} - \text{predicted value}$

Seasonal index: $\text{seasonal index} = \dfrac{\text{actual figure}}{\text{deseasonalised figure}}$

Module 1: Number patterns

Arithmetic series: $a + (a + d) + \cdots + (a + (n-1)d) = \dfrac{n}{2}[2a + (n-1)d] = \dfrac{n}{2}(a + l)$

Geometric series: $a + ar + ar^2 + \cdots + ar^{n-1} = \dfrac{a(1 - r^n)}{1 - r}, r \neq 1$

Infinite geometric series: $a + ar + ar^2 + ar^3 + \cdots = \dfrac{a}{1 - r}, |r| < 1$

Module 2: Geometry and trigonometry

Area of a triangle: $\dfrac{1}{2}bc \sin A$

Heron's formula: $A = \sqrt{s(s-a)(s-b)(s-c)}$, where $s = \frac{1}{2}(a + b + c)$

Circumference of a circle: $2\pi r$

Area of a circle: πr^2

Volume of a sphere: $\dfrac{4}{3}\pi r^3$

Surface area of a sphere: $4\pi r^2$

Volume of a cone: $\dfrac{1}{3}\pi r^2 h$

Volume of a cylinder: $\pi r^2 h$

Volume of a prism: $\text{area of base} \times \text{height}$

Volume of a pyramid: $\dfrac{1}{3}\text{area of base} \times \text{height}$

Pythagoras' theorem: $c^2 = a^2 + b^2$

Sine rule: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule: $c^2 = a^2 + b^2 - 2ab \cos C$

Module 3: Graphs and relations

Straight line graphs

Gradient (slope):
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Equation:
$$y = mx + c$$

Module 4: Business-related mathematics

Simple interest:
$$I = \frac{PrT}{100}$$

Compound interest:
$$A = PR^n, \text{ where } R = 1 + \frac{r}{100}$$

Hire purchase:
$$\text{effective rate of interest} \approx \frac{2n}{n+1} \times \text{flat rate}$$

Module 5: Networks and decision mathematics

Euler's formula:
$$v + f = e + 2$$

Module 6: Matrices

Determinant of a 2 x 2 matrix:
$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, \det A = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

Inverse of a 2 x 2 matrix:
$$A^{-1} = \frac{1}{\det A} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}, \text{ where } \det A \neq 0$$

End of Booklet

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