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INSIGHT
YEAR 12 Trial Exam Paper

2011

FURTHER MATHEMATICS

UNIT 3

Written examination 1

MULTIPLE-CHOICE QUESTION BOOK

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of modules</i>	<i>Number of modules to be answered</i>	<i>Number of marks</i>
A	13	13	13		13
B	54	27	6	3	27
					Total 40

- Students are permitted to bring the following items into the examination: pens, pencils, highlighters, erasers, sharpeners, rulers, one bound reference that may be annotated (can be typed, handwritten or a textbook), one approved graphics calculator (memory DOES NOT have to be cleared) and, if desired, one scientific calculator.
- Students are NOT permitted to bring blank sheets of paper or white out liquid/tape into the examination.

Materials provided

- The Question book of 43 pages, with an answer sheet for the multiple-choice questions.
- A separate sheet with miscellaneous formulas.
- Working space is provided throughout the question book.

Instructions

- Write your **name** in the box provided on the multiple-choice answer sheet.
- Remove the formula sheet during reading time.
- Unless otherwise indicated, diagrams in this book are **not** drawn to scale.

At the end of the examination

- You may keep this Question book.

Students are NOT permitted to bring mobile phones or any other electronic devices into the examination.

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SECTION A**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.

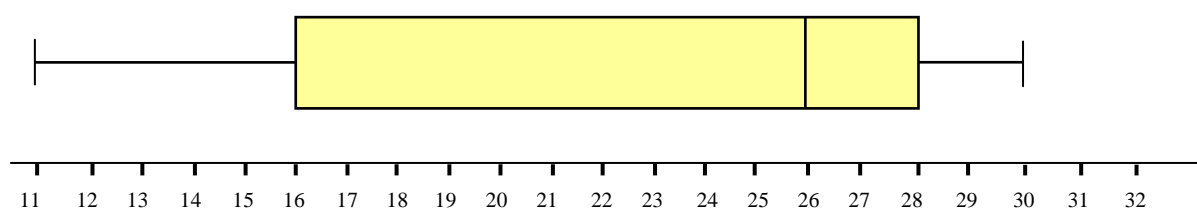
A correct answer scores 1, an incorrect answer scores 0.

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

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

Core: Data analysis**Question 1**

Which of the following sets of data does the box plot below represent?



- A. 11, 11, 16, 26, 26, 28, 30
- B. 11, 12, 12, 13, 15, 16, 16, 17, 18, 20, 22, 26, 26, 27, 27, 28, 28, 28, 29, 29, 30, 30, 30
- C. 11, 11, 12, 12, 12, 16, 17, 18, 25, 26, 27, 28, 28, 29, 29, 30, 30, 31, 32
- D. 11, 11, 11, 16, 16, 26, 26, 28, 28, 30
- E. 11, 11, 11, 12, 13, 14, 16, 16, 18, 20, 25, 26, 27, 28, 28, 29, 29, 30, 30, 30, 30

The following information refers to Questions 2 and 3.

A survey is conducted to investigate the amount of time per day each student in a randomly chosen group of 50 high school students spends on social networking sites. These times are approximately normally distributed with a mean of 4.25 hours and a standard deviation of 1.25 hours.

Question 2

The number of students who do not spend between 1.75 hours and 5.5 hours on social networking sites is closest to

- A. 68
- B. 18
- C. 82
- D. 41
- E. 9

Question 3

Linda is a high school student who participated in this survey. She spends 3.75 hours a day on social networking sites. Which of the following is closest to the standardised time Linda spent on social networking sites (her standard z score)?

- A. 0.59 hours
- B. 0.8 hours
- C. 0.4 hours
- D. -0.8 hours
- E. -0.4 hours

The following information refers to Questions 4 and 5.

The following table shows the recycling attitudes of adults with different education levels in a local community group.

Recycling attitudes	Education level		
	Year 10 or less	Year 11 or 12	University
Always recycles	3	9	13
Sometimes recycles	8	7	9
Never recycles	8	5	2

Question 4

We can conclude from the table that the type of investigation is

- A. time series analysis of the recycling attitudes of adults in a local community group.
- B. bivariate analysis of the recycling attitudes of adults in a local community group versus their education level.
- C. bivariate analysis of the education level of adults in a local community group versus their recycling attitudes.
- D. univariate analysis of the recycling attitudes of adults in a local community group.
- E. univariate analysis of the education level of adults in a local community group.

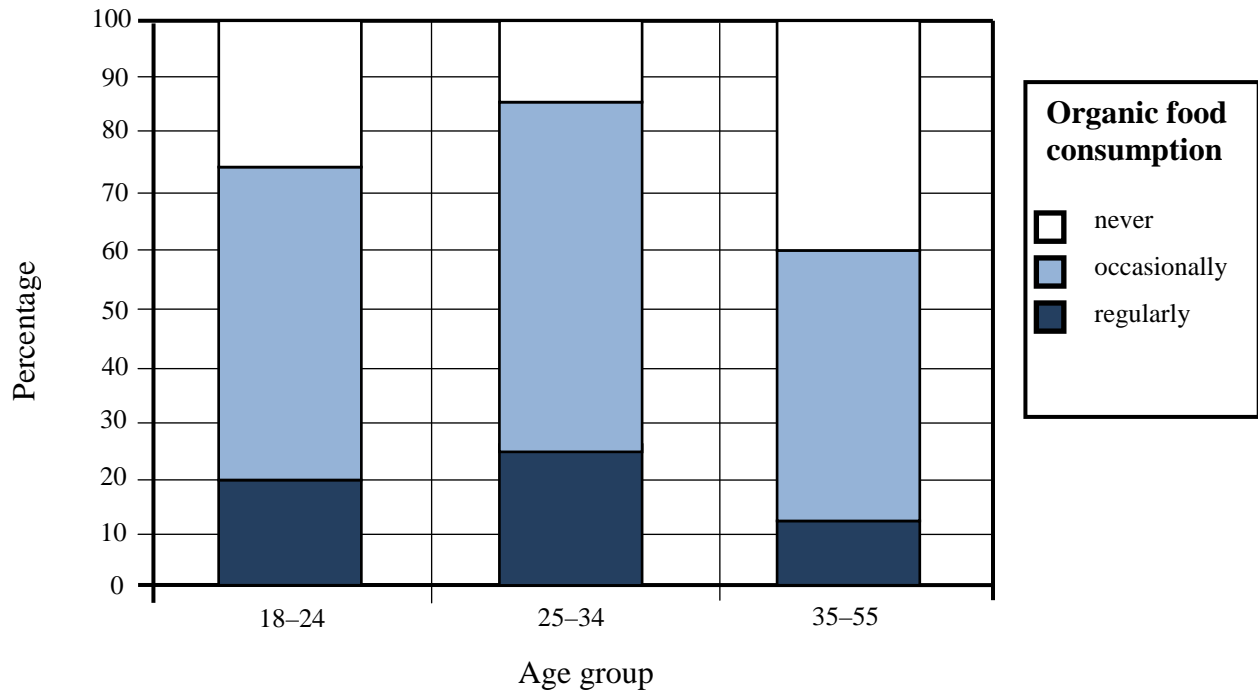
Question 5

We can conclude from the table that

- A. 29.2% of adults with Year 11 or 12 education level sometimes recycle.
- B. 33.3% of adults with Year 11 or 12 education level never recycle.
- C. 15.8% of adults with Year 10 or less education level sometimes recycle.
- D. 54.2% of adults with university education level always recycle.
- E. 37.5% of adults with university education level never recycle.

Question 6

A study investigating the relationship between a person's organic food consumption (never, occasionally or regularly) and age group (18–24, 25–34, 35–55) was conducted. The results are summarised in the percentage segmented bar chart below.



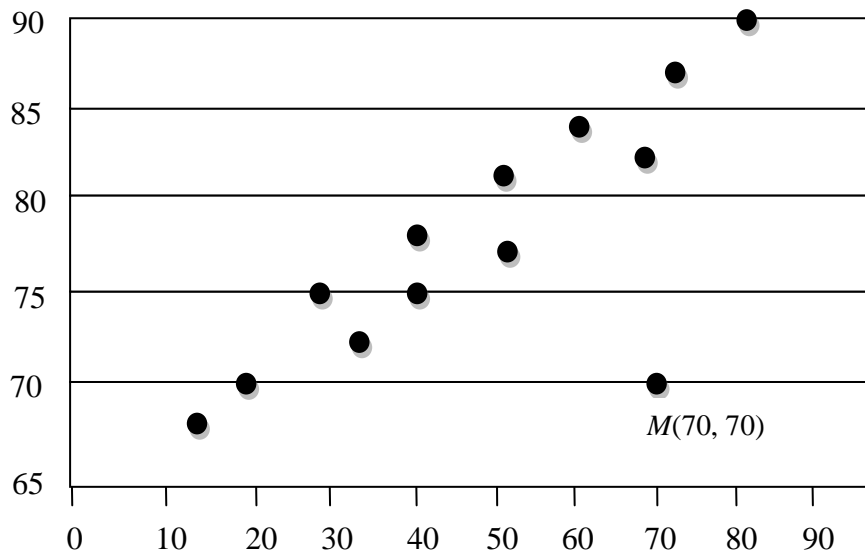
The percentage of people 25–34 years old who consumed organic food occasionally is closest to

- A. 20
- B. 25
- C. 54
- D. 60
- E. 84

SECTION A– continued
TURN OVER

Question 7

Consider the following scatterplot and point M with coordinates $(70, 70)$.



Removal of point M would cause

- A. an increase in the gradient of the least squares regression line equation.
- B. a decrease in the gradient of the least squares regression line equation.
- C. an increase in the range of x values.
- D. a decrease in the range of y values.
- E. a decrease in the Pearson's correlation coefficient.

The following information refers to Questions 8, 9 and 10.

A study is conducted to investigate the association between babies' first crawling age and the average temperature during the month they first try to crawl. Researchers want to learn whether babies take longer to learn to crawl in cold months than they do in warmer months (perhaps due to them wearing warmer outfits that restrict their movement in the colder months).

The table below lists the *crawling ages* (in weeks) of 15 babies and the *average monthly temperature* (in degrees Celsius).

Baby's name	Crawling age (weeks)	Average monthly temperature when baby crawled (°Celsius)
Lily	33	15
Cooper	30	20
Jack	29	25
Rose	34	10
Ruby	26	35
Oliver	28	31
Charlotte	29	29
Hannah	33	12
Georgia	30	19
Thomas	27	38
Noah	28	39
Lucas	31	25
Emma	32	26
Matilda	28	40
William	34	14

Question 8

Using average monthly temperature as the independent variable, a least squares regression line is fitted to the data.

The equation of the least squares regression line is closest to which of the following?

- A. average monthly temperature = $129.49 - 3.46 \times \text{crawling age}$
- B. average monthly temperature = $35.90 - 0.23 \times \text{crawling age}$
- C. average monthly temperature = $-3.46 + 129.49 \times \text{crawling age}$
- D. crawling age = $-0.23 + 35.90 \times \text{average monthly temperature}$
- E. crawling age = $35.90 - 0.23 \times \text{average monthly temperature}$

SECTION A – continued
TURN OVER

Question 9

The value of Pearson's product-moment correlation coefficient (PMCC) and the coefficient of determination for *crawling age* and *average monthly temperature* are respectively closest to

- A. 0.79, -0.89
- B. -0.89, 0.79
- C. 0.95, 0.90
- D. -0.95, 0.90
- E. -0.35, 0.13

Question 10

The least squares regression line equation from Question 8 is then used to predict the crawling age of Matilda.

The residual value (in weeks) for this prediction will be closest to

- A. 7.4
- B. -7.4
- C. 1.3
- D. -1.3
- E. 3.5

The following information refers to Questions 11 and 12.

A trend line that can be used to forecast **deseasonalised** quarterly profit for a flower shop is given by:

$$\text{deseasonalised profit} = 12\,850 + 109 \times \text{quarter number}$$

where Quarter 1 is the summer of 2011, Quarter 2 is the autumn of 2011, and so on.

The seasonal indices for summer, autumn, winter and spring are shown in the table below. The seasonal index for autumn and spring are missing but are known to be equal to each other.

Seasonal index			
Summer	Autumn	Winter	Spring
1.26		0.42	

Question 11

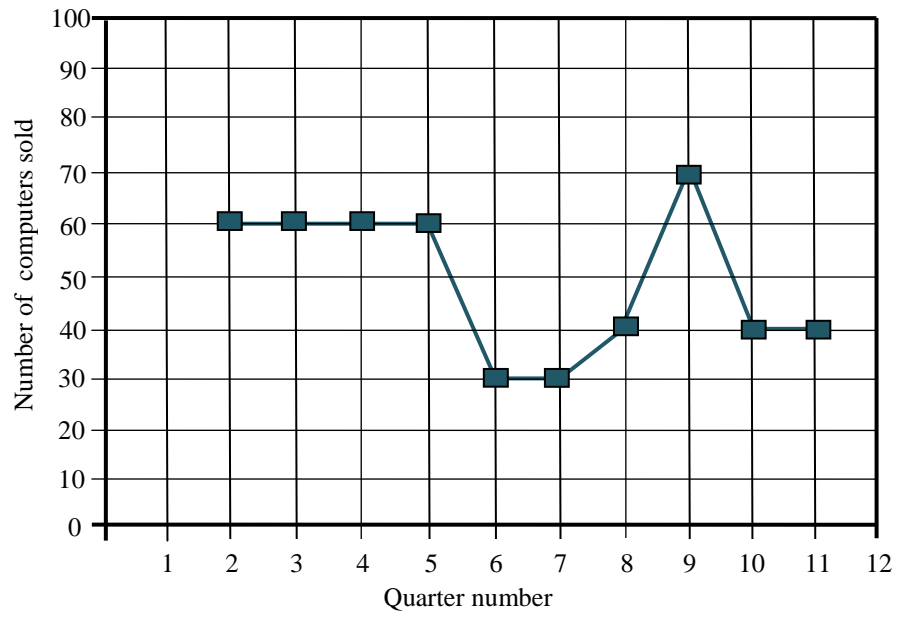
The profit that the flower shop obtains in Spring is typically

- A. 32% above the quarterly average.
- B. 58% below the quarterly average.
- C. 34% below the quarterly average.
- D. 16% above the quarterly average.
- E. 18% above the quarterly average.

Question 12

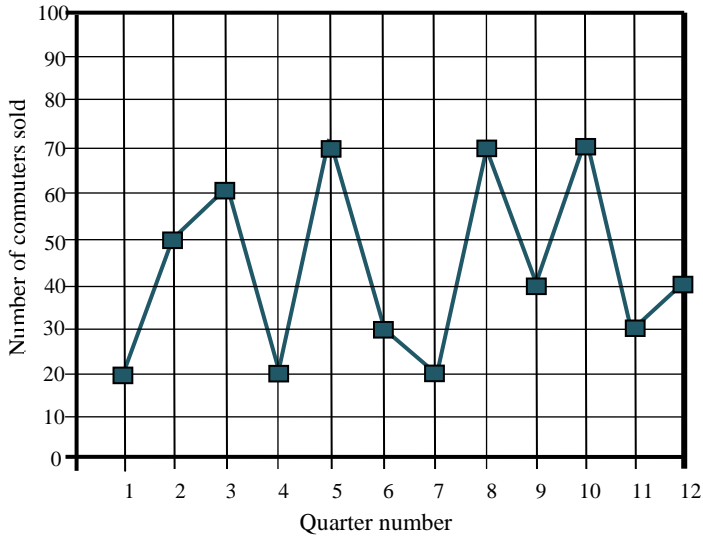
The **actual** profit for autumn 2013 is predicted to be closest to

- A. \$32 340
- B. \$13 940
- C. \$16 170
- D. \$15 918
- E. \$13 831

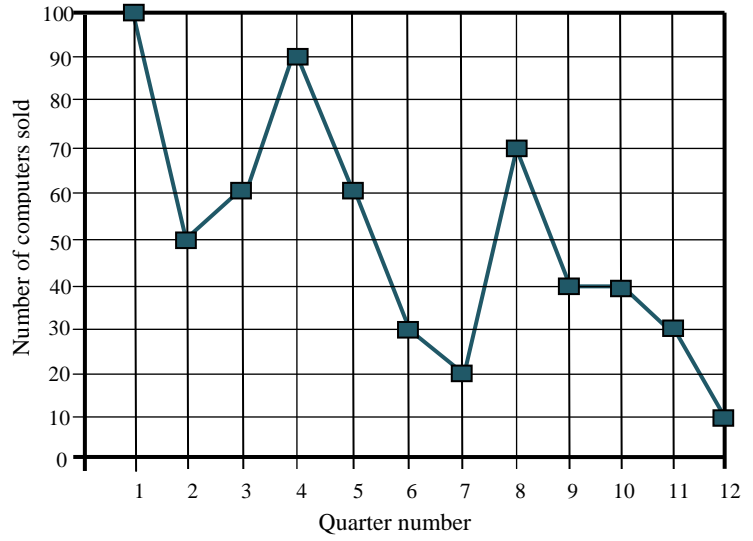
Question 13

The data on the previous page has been smoothed using three median smoothing. Which one of the following graphs shows the data before it was smoothed?

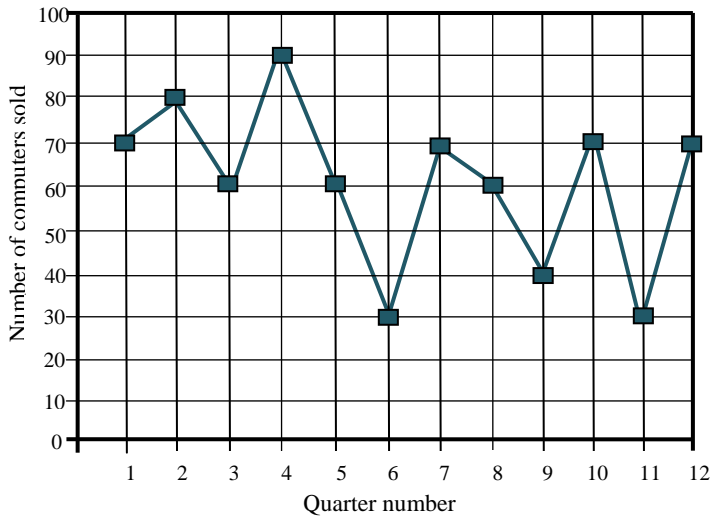
A.



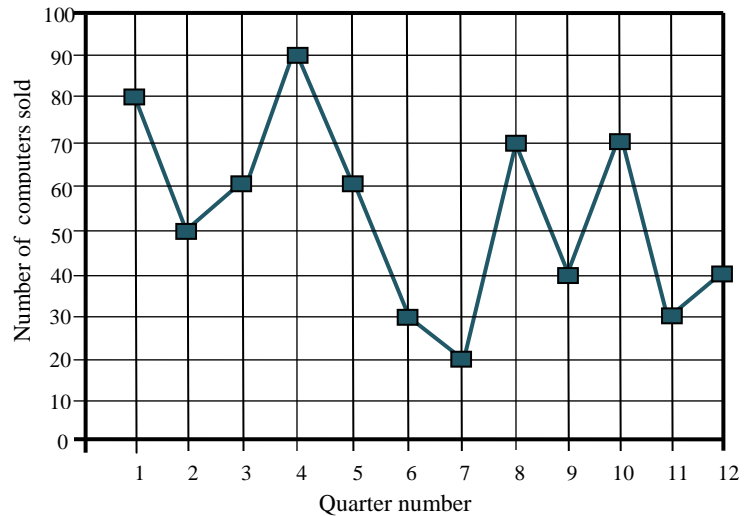
B.



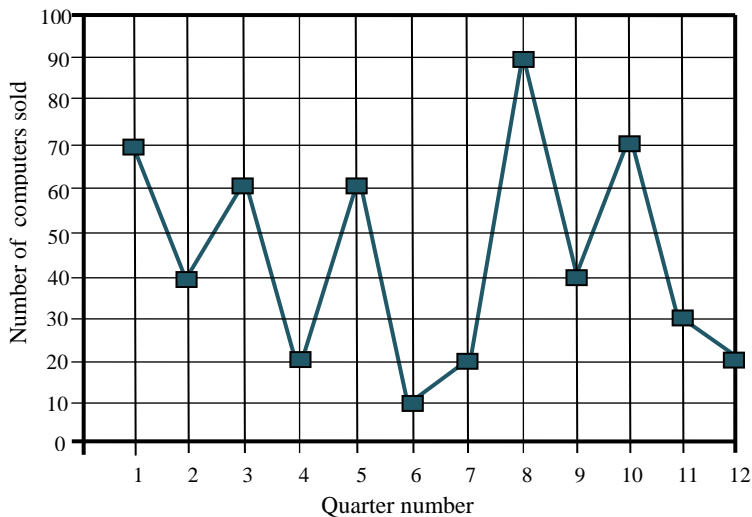
C.



D.



E.



**END OF SECTION A
TURN OVER**

SECTION B**Instructions for Section B**

Select **three** modules and answer **all** questions within the modules selected on the answer sheet provided.

Indicate the modules you are answering by shading the matching boxes on your multiple-choice answer sheet.

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

One mark will be awarded for a correct answer; no marks will be awarded for an incorrect answer.

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

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

Module	Page
Module 1: Number patterns	13
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Module 6: Matrices	39

Module 1: Number patterns

Before answering these questions you must **shade** the Number patterns box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

For the arithmetic sequence $-15, -11\frac{1}{4}, -7\frac{1}{2}, -3\frac{3}{4}, \dots$ the values of a (the first term) and d , (the common difference) are

- A. $a = -15, d = 12.25$
- B. $a = -15, d = 3.75$
- C. $a = -15, d = -3.75$
- D. $a = 15, d = -3.75$
- E. $a = 15, d = 12.25$

Question 2

For the sequence $-56, 28, -14, 7, \dots$ the sum of the first eight terms is closest to

- A. -37.5
- B. -37.2
- C. 37.5
- D. 37.2
- E. -434

Question 3

Initially there are 500 trees at a tree farm, and every month 30% of these trees are cut down to produce paper. If t_1 is the initial number of trees and t_2 gives the number of trees remaining in the farm one month later, then which of the following is true for t_n ?

- A. $t_n = 500(0.3^{n-1})$
- B. $t_n = 350(0.7^{n-1})$
- C. $t_n = 500(0.7^{n-1})$
- D. $t_n = 350(0.3^{n-1})$
- E. $t_n = 500(0.7^n)$

Question 4

Clair, the florist, prepared 6150 wedding bouquets for the summer wedding season.

On the first day, she sold 300 bouquets.

Every day after that, she sold 70 more bouquets than the previous day.

On the fifth day, she prepared 3210 more bouquets and she continued selling them together with the rest of the bouquets in the same pattern.

The total number of days that she could sell her bouquets is

- A. 13
- B. 10
- C. 8
- D. 100
- E. 85

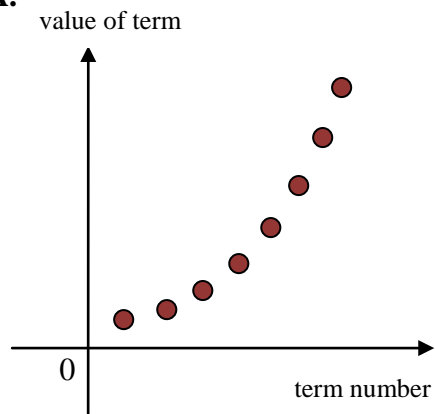
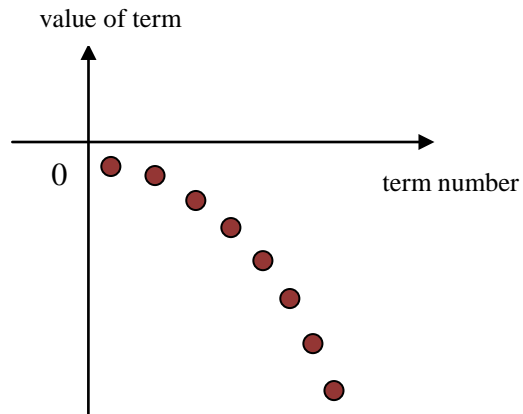
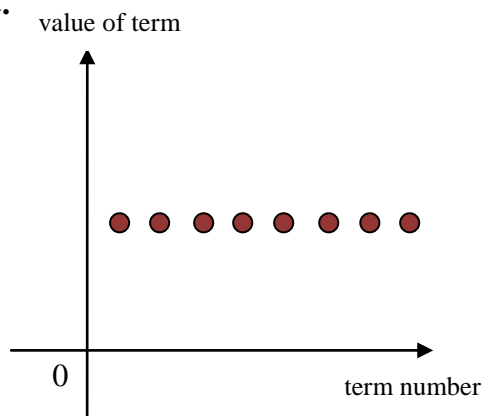
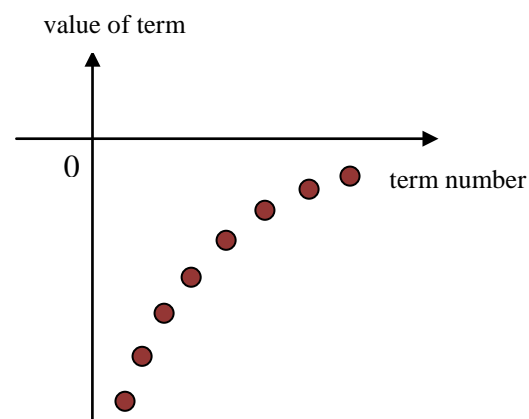
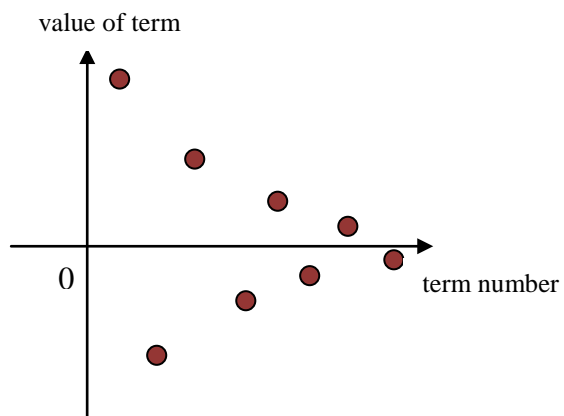
Question 5

The trunk diameter of a tree was 36.6 cm at the start of the first year. Each year the diameter increased by 4%. The trunk diameter of the tree after 9 years of growth is closest to

- A. 48
- B. 50
- C. 52
- D. 54
- E. 56

Question 6

For a particular geometric sequence, the common ratio is positive and less than 1. The graph that most closely matches this sequence is

A.**B.****C.****D.****E.**

SECTION B – continued
TURN OVER

Question 7

A second order difference equation is defined by: $t_n = 5t_{n-1} - 3t_{n-2}$

Given that $t_7 = 7$ and $t_9 = 24$, the eighth term of this difference equation is

- A. 7
- B. 9
- C. 11
- D. 13
- E. 15

Question 8

The first four terms of a sequence are: 5, 7, 17, 31.

The difference equation for the sequence could be

- A. $t_{n+1} = 2t_n - 3, \quad t_1 = 5$
- B. $t_{n+1} = t_n + 2, \quad t_1 = 5$
- C. $t_{n+2} = t_n + 2t_{n+1} - 2, \quad t_1 = 5 \quad \text{and} \quad t_2 = 7$
- D. $t_{n+2} = 2t_n + t_{n+1}, \quad t_1 = 5 \quad \text{and} \quad t_2 = 7$
- E. $t_{n+2} = t_n + t_{n+1} + 5, \quad t_1 = 5 \quad \text{and} \quad t_2 = 7$

Question 9

Alex bought a brand new car for \$54 000. The value of the car changes according to the rule:

$$C_{n+1} = 0.76C_n + 2000, \quad C_0 = 54\,000$$

where C_n is the value of the car n years after Alex bought it.

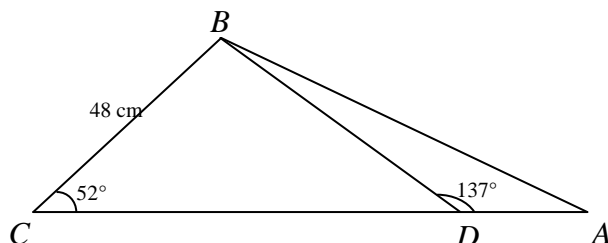
Knowing that Alex does yearly renovations to the car to increase its value, from this difference equation, it can be concluded that

- A. the value of the car depreciates by 76% every year and increases by \$2000 due to the renovations.
- B. the value of the car depreciates by 76% every year and decreases to \$43 040 after the first year's renovations.
- C. the value of the car depreciates by 24% every year and increases by \$54 000 due to the renovations.
- D. the value of the car depreciates by \$2000 every year and increases by \$0.76 due to the renovations.
- E. the value of the car depreciates by 24% every year and decreases to \$43 040 after the first year's renovations.

Module 2: Geometry and trigonometry

Before answering these questions you must **shade** the Geometry and trigonometry box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

The following information refers to Questions 1 and 2.

**Question 1**

The size of the angle CBD is

- A. 43°
- B. 85°
- C. 37°
- D. 45°
- E. 115°

Question 2

Given that the length of BC is 48 cm, the length of CD , in cm, is

- A. $\frac{48 \sin 43^\circ}{\sin 85^\circ}$
- B. $\frac{48 \sin 52^\circ}{\sin 137^\circ}$
- C. $\frac{48 \sin 85^\circ}{\sin 43^\circ}$
- D. $\frac{\sin 52^\circ}{48 \sin 43^\circ}$
- E. $\frac{\sin 43^\circ}{48 \sin 52^\circ}$

Question 3

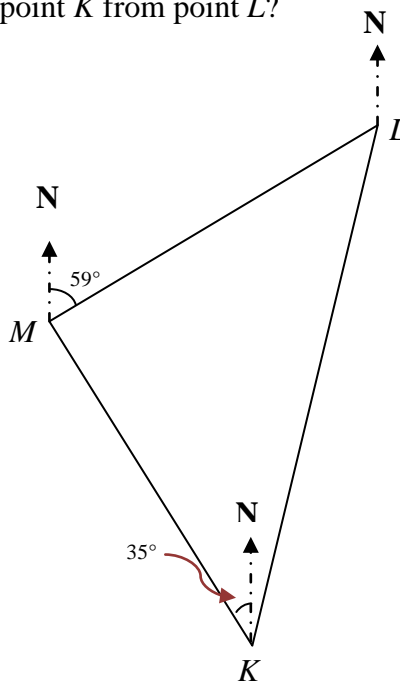
A triangle, DEF , has side lengths $d = 52$ cm and $e = 45$ cm, and the size of angle DEF is 51° . Find the size of angle EFD , to the nearest degree, given that angle EDF is an obtuse angle.

- A. 116°
- B. 64°
- C. 42°
- D. 65°
- E. 13°

Question 4

On the diagram below, the length of KM and the length of LM are equal. The bearing of point L from point M is 59° and the left part of angle MKL is 35° , as indicated. Which of the following is the bearing of point K from point L ?

- A. 135°T
- B. 059°T
- C. 186°T
- D. 012°T
- E. 192°T

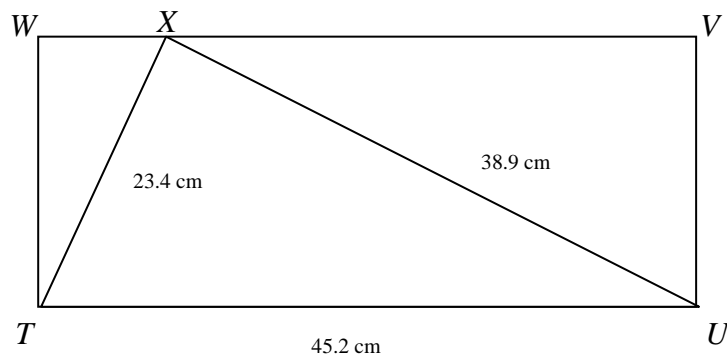


SECTION B – continued
TURN OVER

Question 5

The five side lengths of a pentagon are 12 cm, 28 cm, 28 cm, 31 cm and 33 cm. Another pentagon has a side length of 16.5 cm on its longest side, and is similar to the larger pentagon. The perimeter of this smaller pentagon, in cm, is

- A. 132
- B. 115.5
- C. 66
- D. 85
- E. 18

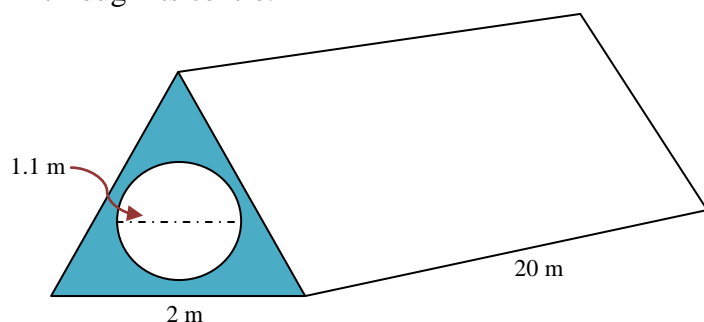
Question 6

The diagram above shows a triangle inside a rectangle. The size of angle XTU is closest to

- A. 89°
- B. 76°
- C. 59°
- D. 31°
- E. 51°

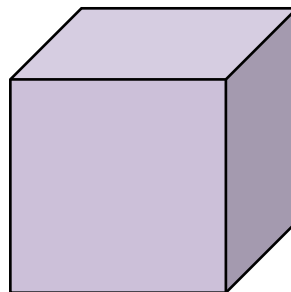
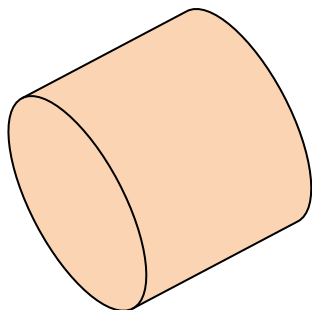
Question 7

A concrete pipe is in the shape of a triangular prism of length 20 m. The cross-section of the pipe is an equilateral triangle with a side length of 2 m and it has a circular hole of diameter 1.1 m through its centre.



The volume of concrete in the pipe is closest to

- A. 15.6 m^3
- B. 44.0 m^3
- C. 34.6 m^3
- D. 48.2 m^3
- E. 50 m^3

Question 8

The cylinder shown above has a surface area of 75.4 cm^2 . The height of the cylinder and its diameter are equal.

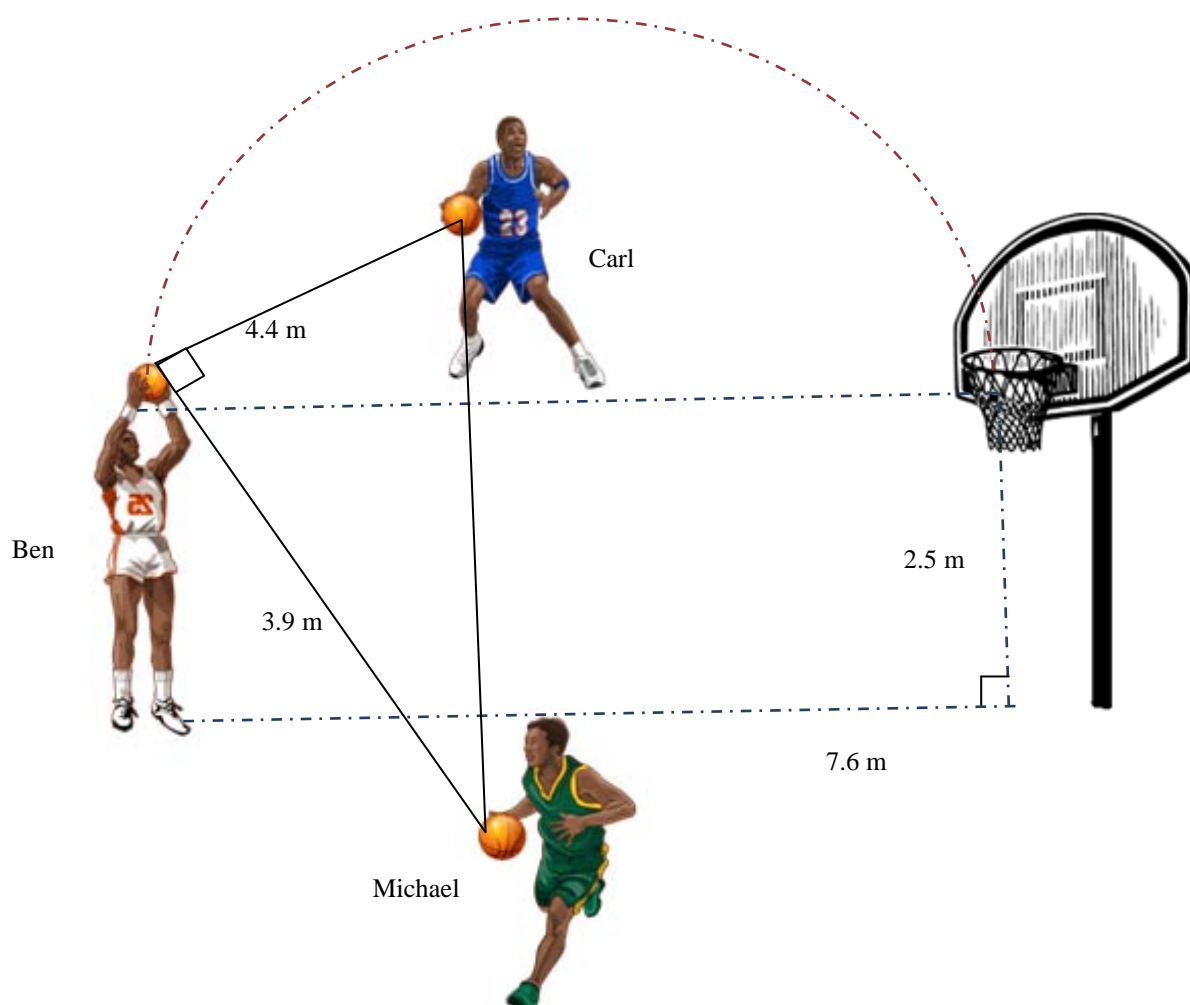
The cube shown above has the same side length as the height of the cylinder. The surface area of the cube is closest to

- A. 108 cm^2
- B. 96 cm^2
- C. 64 cm^2
- D. 4 cm^2
- E. 2 cm^2

SECTION B – continued
TURN OVER

Question 9

Carl, Michael and Ben play basketball together. The diagram below shows their positions on the court. These positions form a right-angled triangle.



At the start of the game, Carl passes the ball to Michael and then Michael passes it to Ben. The distance between Michael and Ben is 3.9 m and the distance between Ben and Carl is 4.4 m.

Ben shoots the ball into the basket, with the ball following a semicircular pattern. The straight line distance between Ben and the basketball hoop is 7.6 m.

Given that the basketball hoop is 2.5 m from ground level, the total distance that the ball travelled during this part of the game, until it reached the ground, is closest to

- A. 10.8 m
- B. 24.2 m
- C. 21.7 m
- D. 30.2 m
- E. 52.4 m

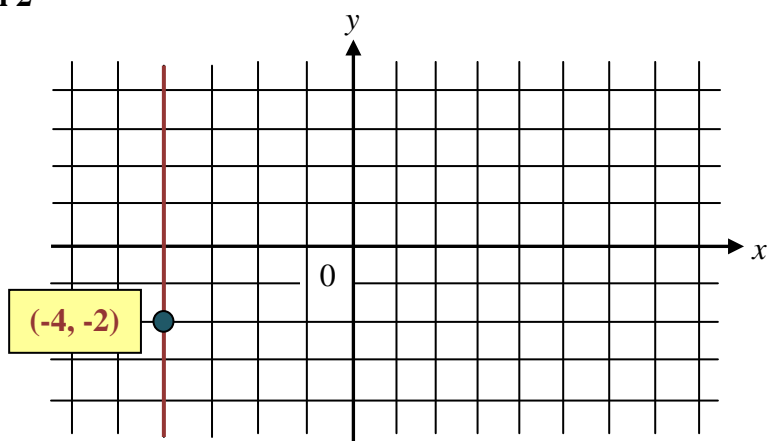
Module 3: Graphs and relations

Before answering these questions you must **shade** the Graphs and relations box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

The lines with equations $2x - 3y = 5$ and $x - 2y = 3$ both pass through the point

- A. (9, 1)
- B. (4, 1)
- C. (1, -1)
- D. (-2, -3)
- E. (2.5, 0)

Question 2

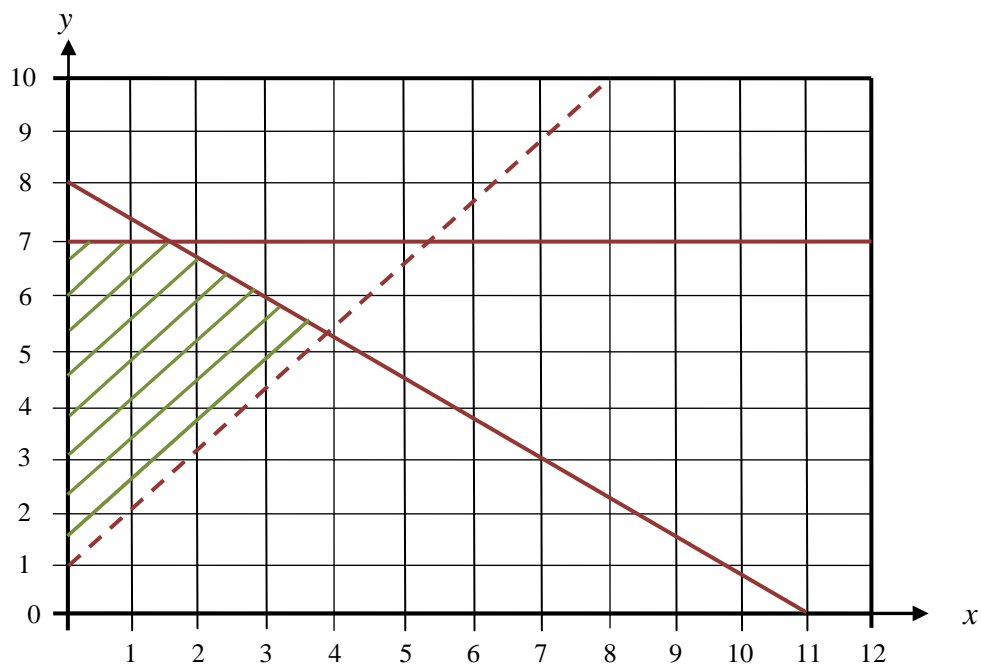
Which of the following is the equation of the line passing through the point $(-4, -2)$ on the graph above?

- A. $x = -4$
- B. $y = -4$
- C. $x = -2$
- D. $y = -2$
- E. $y = -2x - 4$

Question 3

A straight line has a y -intercept of -4 and passes through the point $(-1, 3)$. Which of the following is the x -intercept of this line?

- A. 1
- B. $\frac{2}{3}$
- C. -4
- D. -7
- E. $-\frac{4}{7}$

Question 4

The shaded region above has been formed by three separate constraints. Which of the following alternatives lists two of these constraints?

- A. $8y - 9x \geq 8$
 $8x + 11y < 88$
- B. $y \leq 7$
 $9x + 8y > 8$
- C. $8x + 11y \leq 88$
 $8y - 9x > 8$
- D. $x \leq 7$
 $9x - 8y < 8$
- E. $y < 7$
 $8x + 11y < 88$

Question 5

Which of the following pairs of simultaneous equations has a unique solution?

- A.** $3x + 8y = 12$
 $1.5x + 4y = 6$
- B.** $17x + 11y = 10$
 $85x + 55y = 50$
- C.** $3x + 2y = 6$
 $6x - 4y = 12$
- D.** $x + 2y = 5$
 $-7x - 14y = 7$
- E.** $4x - 3y = 3$
 $20x - 15y = 1$

Question 6

Mia can choose between three different tollways to get to different parts of the city: Powerlink, Quicklink and Speedway.

Powerlink charges fees according to the formula:

$$\text{fee} = \$3.20 \times \text{number of sections used}$$

The fee structure for Quicklink is as follows:

$$\text{fee} = \begin{cases} \$6.50, & 1 \leq \text{the number of sections used per day} < 3 \\ \$9.40, & 3 \leq \text{the number of sections used per day} < 5 \\ \$11.40, & 5 \leq \text{the number of sections used per day} \end{cases}$$

Speedway has a fixed daily charge of \$10.10 regardless of the number of sections used.

Mia wants to use four sections of the tollways on Saturday, eight sections on Sunday and two sections on Monday. Which of the following is the minimum total fee that she can pay for using the tollways for the three days?

- A.** \$44.80
- B.** \$30.30
- C.** \$27.30
- D.** \$25.90
- E.** \$19.50

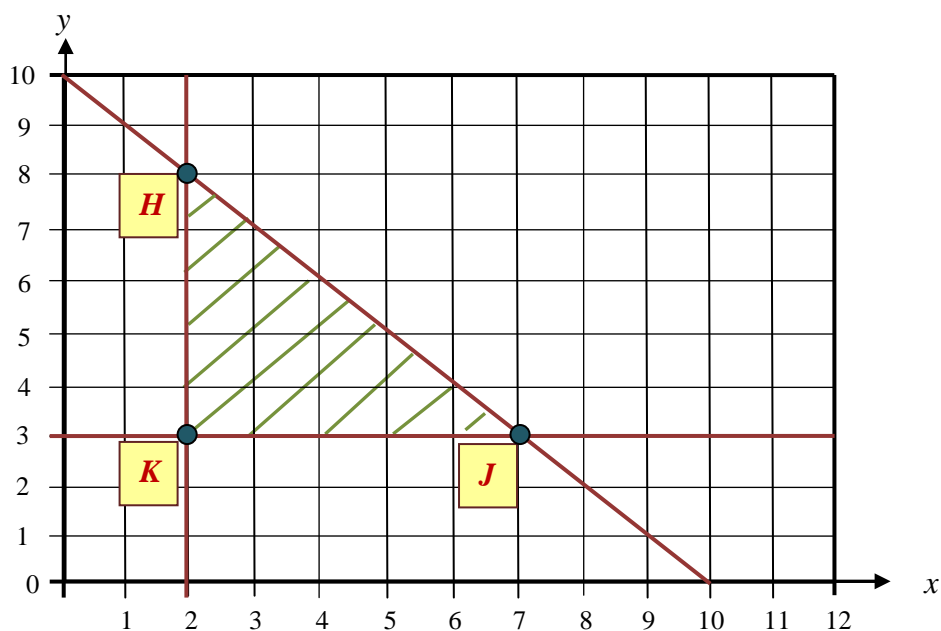
Question 7

A florist sells fresh roses and lilies every day. She prepares a maximum of 10 bouquets of roses and lilies to sell each day. She sells at least two bouquets of roses and three bouquets of lilies daily.

Let x be the number of rose bouquets the florist sells in a day.

Let y be the number of lily bouquets the florist sells in a day.

The constraints above define the feasible region shaded in the graph below.



The profit that the florist makes from selling a bouquet of lilies is \$3 and from a bouquet of roses is \$ a .

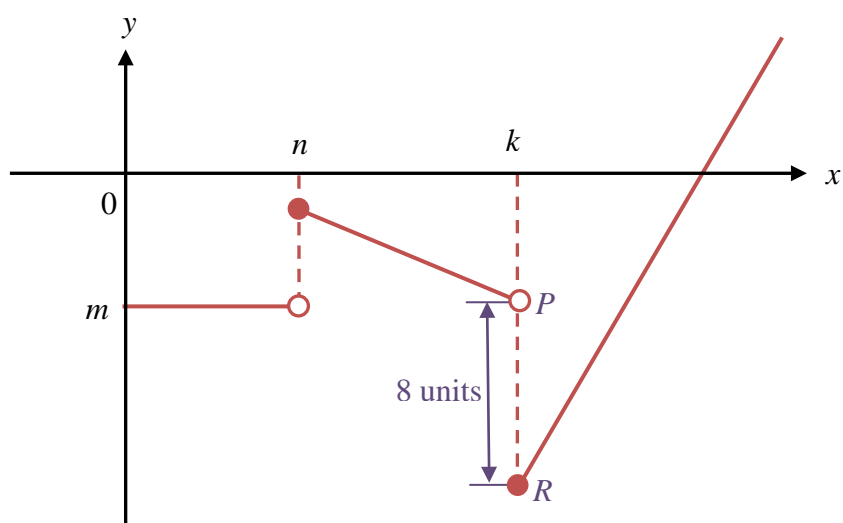
If the maximum profit occurs at every discrete point between the points H and J , and the points H and J are inclusive, then the value of a is

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

Question 8

Paul manufactures pillows in his factory. The cost of manufacturing pillows starts with a fixed cost of \$2400 plus a cost of \$10 per pillow. For Paul to make a profit, he must sell

- A. 40 pillows at \$70 each
- B. 60 pillows at \$50 each
- C. 70 pillows at \$45 each
- D. 50 pillows at \$55 each
- E. 100 pillows at \$33 each

Question 9

The rule for the graph above is given as:

$$y = \begin{cases} m, & 0 < x < n \\ -0.4x + 1, & n \leq x < k \\ 1.5x - 45, & k \leq x \end{cases}$$

Given that the vertical distance between the points P and R is 8 units, the value of k is

- A. 5
- B. 10
- C. 15
- D. 20
- E. 25

Module 4: Business-related mathematics

Before answering these questions you must **shade** the Business-related mathematics box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

\$60 000 is invested at a simple interest rate of 4.5% per annum. Assuming no deposits or withdrawals are made, the amount of money which will be in the bank after 3 years is

- A. \$62 700
- B. \$68 100
- C. \$72 600
- D. \$74 200
- E. \$78 100

Question 2

Joshua buys a freezer with a purchase price of \$3250. He first pays a deposit of \$515 and he agrees to make fortnightly payments of \$112 for one year. The total interest that he is going to pay in this hire-purchase agreement, and the effective rate of interest, are closest to

- A. \$112, 6.47%
- B. \$150, 10.65%
- C. \$150, 12.46%
- D. \$177, 12.46%
- E. \$177, 6.47%

Question 3

Zoe purchases a brand new car for \$52 000. The car depreciates at a rate of 32 cents per kilometre travelled. Which of the following will be the book value of the car after it has travelled a total distance of 70 000 km?

- A. \$46 200
- B. \$38 700
- C. \$29 600
- D. \$24 300
- E. \$22 400

Question 4

Grace invests \$20 000 at 5.2% per annum with interest compounding monthly for 4 years.

Ethan has the same amount of money and he invests it at a flat rate of interest with the same interest rate and for the same amount of time as Grace.

The difference in the interests that they will receive, correct to the nearest cent, is

- A. \$613.20
- B. \$305.30
- C. \$414.00
- D. \$524.75
- E. \$453.20

Question 5

Riley repaid a reducing balance loan of \$261 000 in nine years by weekly repayments and with interest charged weekly at 7.45% per annum on the outstanding balance.

The weekly repayment that Riley made to the nearest cent is

- A. \$765.78
- B. \$785.19
- C. \$686.77
- D. \$785.20
- E. \$765.80

Question 6

Lucas owns a shoe store. He buys shoes from a manufacturer and sells them in his store at a 90% mark-up on the purchase price. He manages to sell one-quarter of his stock at the marked price. To be able to sell the remainder of his stock, he has to make a 35% discount storewide.

If Lucas then manages to sell all of the shoes in his store, the percentage profit that he makes on the stock is closest to

- A. 20%
- B. 30%
- C. 40%
- D. 50%
- E. 60%

Question 7

The Victorian state government stamp duty schedule for the purchase of a home which will be used as a principal place of residence is shown in the table below.

Dutiable value range	Rate
\$0–\$25 000	1.4 per cent of the dutiable value of the property
>\$25 000–\$130 000	\$350 plus 2.4 per cent of the dutiable value in excess of \$25 000
>\$130 000–\$440 000	\$2870 plus 5 per cent of the dutiable value in excess of \$130 000
>\$440 000–\$550 000	\$18 370 plus 6 per cent of the dutiable value in excess of \$440 000
>\$550 000–\$960 000	\$2 870 plus 6 per cent of the dutiable value in excess of \$130 000
More than \$960 000	5.5 per cent of the dutiable value

The amount of stamp duty payable for a home with a value of \$480 000 is

- A. \$23 870
- B. \$6 720
- C. \$11 270
- D. \$20 770
- E. \$20 370

Question 8

Connor puts his \$32 000 in an account earning 6.1% interest per annum compounding fortnightly. The interest is charged at the end of every fortnight and right after that he regularly adds \$140 to his investment.

Which of the following is closest to the value of Connor's investment at the end of the fourteenth fortnight before he adds the \$140?

- A. \$35 057
- B. \$34 917
- C. \$36 814
- D. \$37 120
- E. \$37 153

Question 9

Liam borrowed \$43 000 to make renovations to his house. He will fully repay the loan in 8 years with equal monthly payments. Interest is charged at the rate of 8.3% per annum, calculated monthly, on the reducing balance.

The amount Liam will have paid off the principal immediately following the fifty-sixth repayment is closest to

- A. \$21 407
- B. \$20 509
- C. \$22 349
- D. \$21 593
- E. \$24 254

Module 5: Networks and decision mathematics

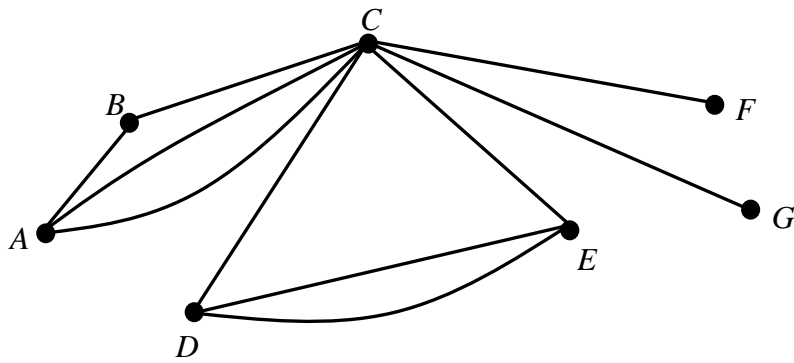
Before answering these questions you must **shade** the Networks and decision mathematics box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

A connected, planar graph has 11 vertices and 18 edges. The number of faces it has is

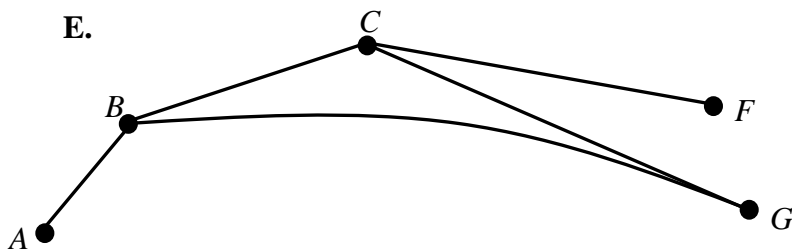
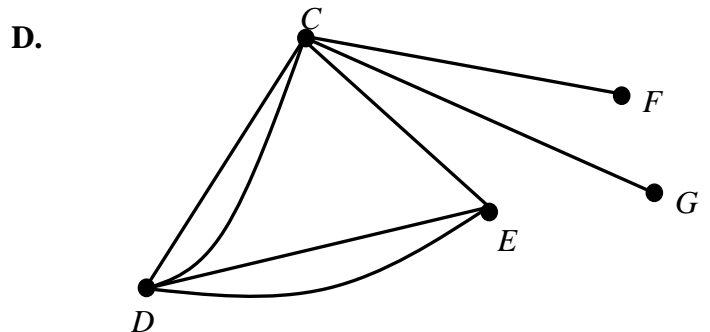
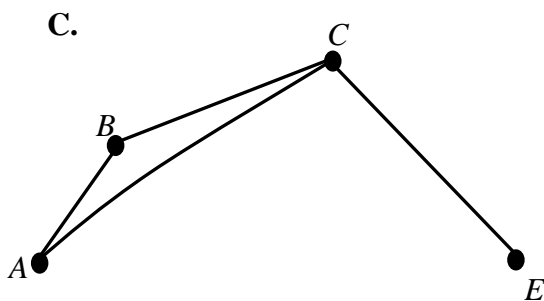
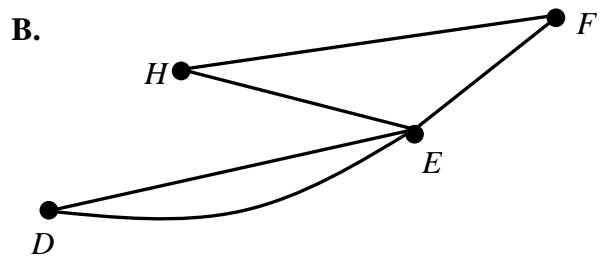
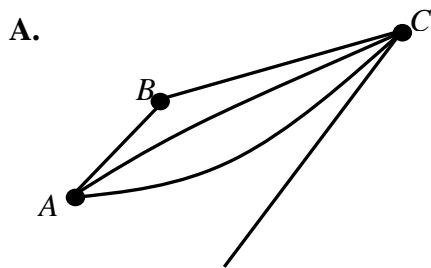
- A. 5
- B. 7
- C. 9
- D. 11
- E. 13

The following information relates to Questions 2 and 3.



Question 2

Which one of the following is a subgraph of the graph above?



SECTION B – continued
TURN OVER

Question 3

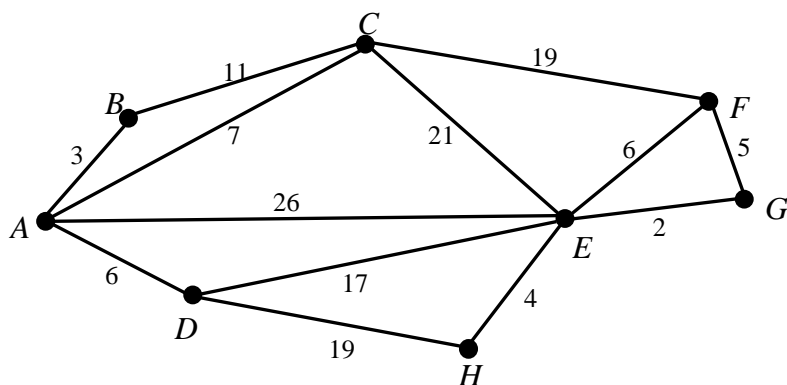
The adjacency matrix of the graph is shown below:

$$\begin{array}{c}
 A \ B \ C \ D \ E \ F \ G \\
 \begin{array}{l}
 A \ \begin{bmatrix} 0 & 1 & ? & 0 & 0 & 0 & 0 \end{bmatrix} \\
 B \ \begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix} \\
 C \ \begin{bmatrix} ? & 1 & 0 & ? & 1 & 1 & 1 \end{bmatrix} \\
 D \ \begin{bmatrix} 0 & 0 & ? & 0 & ? & 0 & 0 \end{bmatrix} \\
 E \ \begin{bmatrix} 0 & 0 & 1 & ? & 0 & 0 & 0 \end{bmatrix} \\
 F \ \begin{bmatrix} 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix} \\
 G \ \begin{bmatrix} 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}
 \end{array}
 \end{array}$$

Six of the entries in the adjacency matrix are missing.

The sum of the six missing entries is

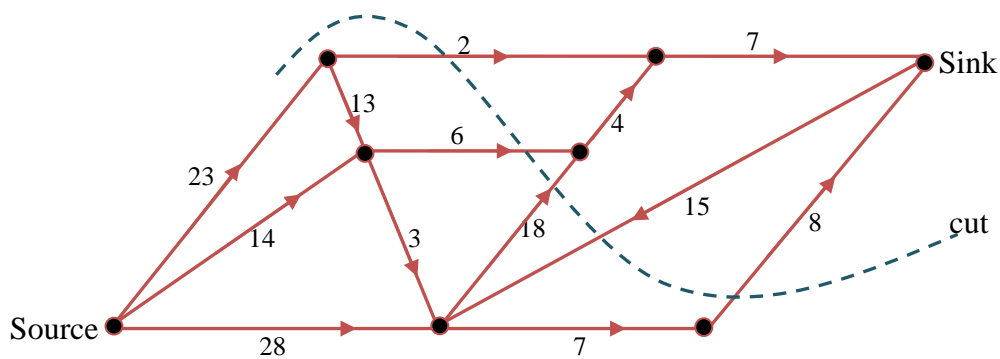
- A. 12
- B. 10
- C. 8
- D. 6
- E. 4

Question 4

The minimal spanning tree for the network above has a length of

- A. 69
- B. 56
- C. 48
- D. 44
- E. 38

The following information refers to Questions 5 and 6.



In the directed graph above the numbers on the edges give the maximum flow possible between each pair of vertices. A cut that separates the source from the sink is also shown.

Question 5

The cut shown in the network has a capacity of

- A. 34
- B. 39
- C. 49
- D. 52
- E. 58

Question 6

Using the 'minimum-cut, maximum-flow' theorem, the maximum flow possible between source and sink through the network is

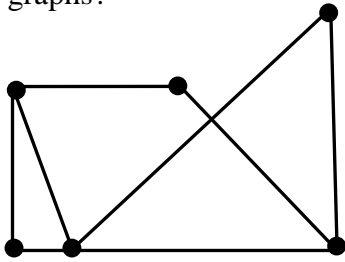
- A. 29
- B. 28
- C. 15
- D. 14
- E. 13

SECTION B – continued
TURN OVER

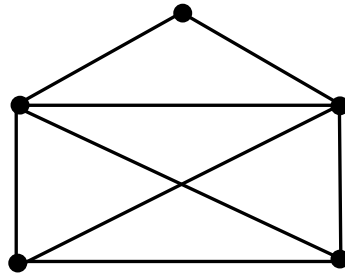
Question 7

Euler's formula, relating vertices, faces and edges, does **not** apply to which one of the following graphs?

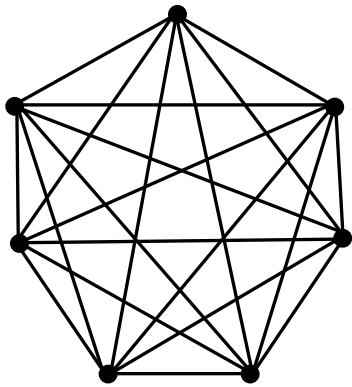
A.



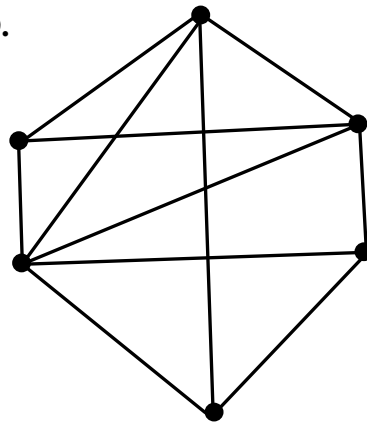
B.



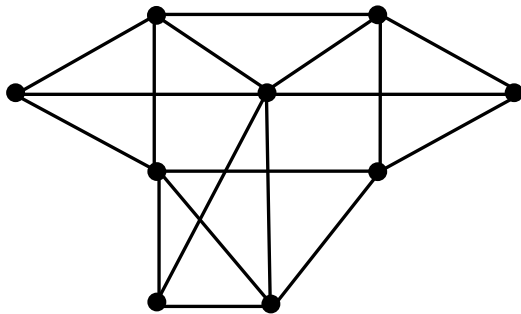
C.



D.



E.



Question 8

The table below shows the time (in minutes) that each of five cleaning company employees, Leonie, Luke, Anna, Simon and Felix, would take to complete each of the cleaning tasks: vacuuming, mopping, ironing, cleaning windows and dishwashing.

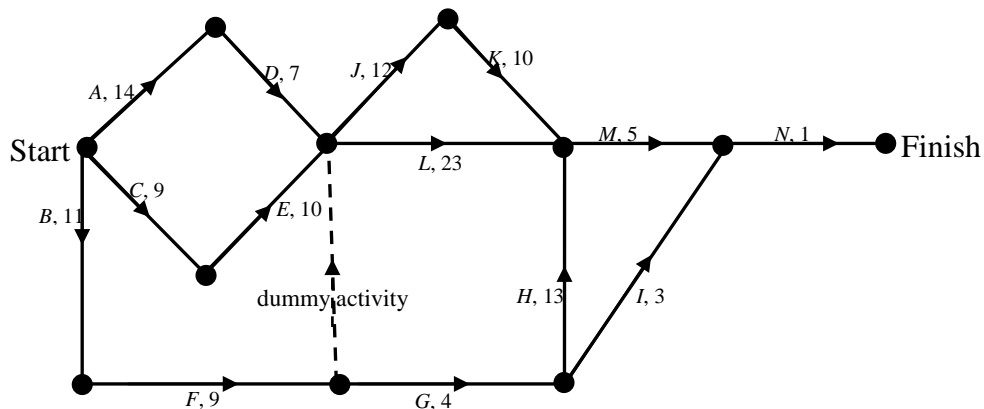
Cleaning company employee	Time to complete task (minutes)				
	Vacuuming	Mopping	Ironing	Window cleaning	Dishwashing
Leonie	30	15	31	41	15
Luke	15	12	38	32	25
Anna	27	25	42	38	16
Simon	35	22	21	18	19
Felix	28	23	30	25	22

If each person is allocated to one task only, the minimum total time in minutes for this group of people to complete all five tasks is

- A. 108
- B. 105
- C. 96
- D. 92
- E. 81

Question 9

A project has ten activities. The network below shows all these activities together with the time it takes, in days, to complete each activity.



The critical path for this project and its length is

- A. *ADJKMN*, 49
- B. *ADLMN*, 50
- C. *CELMN*, 48
- D. *BFGIN*, 28
- E. *CEJKMN*, 52

Module 6: Matrices

Before answering these questions you must **shade** the Matrices box on the answer sheet for multiple-choice questions and write the name of the module in the box provided.

Question 1

The matrix $\begin{bmatrix} 30 & 0 \\ 15 & 65 \\ 45 & 5 \\ 15 & 35 \\ 0 & 5 \end{bmatrix}$ can also be written as

A. $\begin{bmatrix} 30 \\ 15 \\ 45 \\ 15 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ 65 \\ 5 \\ 35 \\ 5 \end{bmatrix}$

B. $\frac{1}{5} \times \begin{bmatrix} 6 & 0 \\ 3 & 13 \\ 9 & 1 \\ 3 & 7 \\ 0 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 10 & 0 \\ 5 & 13 \\ 15 & 1 \\ 5 & 7 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 3 \\ 5 \end{bmatrix}$

D. $5 \times \begin{bmatrix} 6 & 0 \\ 3 & 13 \\ 9 & 1 \\ 3 & 7 \\ 0 & 1 \end{bmatrix}$

E. $[30 \ 0] + [15 \ 65] + [45 \ 5] + [15 \ 35] + [0 \ 5]$

Question 2

The matrix $12 \times \begin{bmatrix} -2 & 0 & -5 & 8 \\ 3 & 5 & -1 & 0 \\ 1 & 2 & 4 & 6 \end{bmatrix} - 4 \times \begin{bmatrix} 5 & 4 & -8 & 4 \\ 9 & 0 & 6 & 1 \\ 7 & 6 & 9 & 5 \end{bmatrix} + 6 \times \begin{bmatrix} 3 & 0 & 6 & 2 \\ 2 & 1 & 9 & 5 \\ 0 & 2 & -7 & 1 \end{bmatrix}$ equals

A. $0.5 \times \begin{bmatrix} -26 & -16 & 8 & 92 \\ 12 & 66 & 18 & 26 \\ -16 & 12 & -30 & 58 \end{bmatrix}$

B. $\begin{bmatrix} -2 & -2 & 4.5 & 3 \\ -2 & 3 & 1 & 2 \\ -3 & -1 & -6 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 24 & 0 & -60 & 96 \\ 36 & 60 & -12 & 0 \\ 12 & 24 & 48 & 72 \end{bmatrix}$

D. $2 \times \begin{bmatrix} -13 & -8 & 4 & 46 \\ 6 & 33 & 9 & 13 \\ -8 & 6 & -15 & 29 \end{bmatrix}$

E. $3 \times \begin{bmatrix} -2 & 0 & -5 & 8 \\ 3 & 5 & -1 & 0 \\ 1 & 2 & 4 & 6 \end{bmatrix}$

SECTION B – continued
TURN OVER

Question 3

Matrix **A** is of order $d \times e$.

Matrix **C** and matrix **X** are of order $e \times f$.

d , e and f are positive integers.

The set of linear equations defined by the matrix equation $\mathbf{AX} = \mathbf{C}$ has a unique solution for **X** when

- A. e is equal to f and matrix **C** is not singular
- B. e is greater than f and matrix **C** is singular
- C. e is less than f and matrix **C** is not singular
- D. d is greater than e and matrix **A** is singular
- E. d is equal to e and matrix **A** is not singular

Question 4

Ruby bought nine lollies and five chewing gums and paid \$19. Ruby's friend Charlie bought eleven lollies and six chewing gums and paid \$23.

Let x be the cost of a lolly and y be the cost of a chewing gum.

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

A. $\begin{bmatrix} 9 & 5 \\ 11 & 6 \end{bmatrix} \begin{bmatrix} 19 \\ 23 \end{bmatrix}$

B. $\begin{bmatrix} 9 & 11 \\ 5 & 6 \end{bmatrix} \begin{bmatrix} 19 \\ 23 \end{bmatrix}$

C. $\begin{bmatrix} -6 & 5 \\ 11 & -9 \end{bmatrix} \begin{bmatrix} 19 \\ 23 \end{bmatrix}$

D. $\begin{bmatrix} -6 & 11 \\ 5 & -9 \end{bmatrix} \begin{bmatrix} 19 \\ 23 \end{bmatrix}$

E. $\begin{bmatrix} 9 & 5 \\ 11 & 6 \end{bmatrix} \begin{bmatrix} 23 \\ 19 \end{bmatrix}$.

Question 5

The Diamond Milk factory makes skim milk (S), low-fat milk (L) and full-cream milk (F). Each type of milk comes in either 2-litre bottles or 3-litre bottles.

The price of each type of milk, in dollars, is listed in a price matrix, A :

$$A = \begin{array}{ccc} S & L & F \\ \begin{bmatrix} 3.50 & 3.20 & 2.80 \\ 4.80 & 4.50 & 3.90 \end{bmatrix} \end{array} \begin{array}{l} \text{2-litre bottles} \\ \text{3-litre bottles} \end{array}$$

Diamond Milk wants to increase the price of a 2-litre bottle of milk by 25% and decrease the price of a 3-litre bottle of milk by 10%.

The matrix equation used to calculate the new prices is best represented by

- A. $\begin{bmatrix} 3.50 & 3.20 & 2.80 \\ 4.80 & 4.50 & 3.90 \end{bmatrix} \times \begin{bmatrix} 1.25 \\ 0.9 \end{bmatrix}$ B. $\begin{bmatrix} 3.50 & 3.20 & 2.80 \\ 4.80 & 4.50 & 3.90 \end{bmatrix} \times \begin{bmatrix} 0.9 \\ 1.25 \end{bmatrix}$
- C. $\begin{bmatrix} 1.25 & 0.9 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \times \begin{bmatrix} 3.50 & 3.20 & 2.80 \\ 4.80 & 4.50 & 3.90 \end{bmatrix}$ D. $\begin{bmatrix} 3.50 & 3.20 & 2.80 \\ 4.80 & 4.50 & 3.90 \end{bmatrix} \times \begin{bmatrix} 1.25 & 0 \\ 0 & 0.9 \end{bmatrix}$
- E. $\begin{bmatrix} 1.25 & 0 \\ 0 & 0.9 \end{bmatrix} \times \begin{bmatrix} 3.50 & 3.20 & 2.80 \\ 4.80 & 4.50 & 3.90 \end{bmatrix}$

Question 6

$$T = \begin{bmatrix} 0.4 & 0.5 & 0.3 \\ 0.5 & 0.2 & 0.3 \\ 0.1 & 0.3 & 0.4 \end{bmatrix} \quad T \text{ is a transition matrix.}$$

$$S_{15} = \begin{bmatrix} 400 \\ 400 \\ 200 \end{bmatrix} \quad S_{15} \text{ is a state matrix.}$$

If $S_{15} = TS_{14}$, then S_{14} equals

- A. $\begin{bmatrix} 400 \\ 400 \\ 200 \end{bmatrix}$ B. $\begin{bmatrix} 300 \\ 300 \\ 400 \end{bmatrix}$
- C. $\begin{bmatrix} 900 \\ 100 \\ 200 \end{bmatrix}$ D. $\begin{bmatrix} 600 \\ 200 \\ 200 \end{bmatrix}$
- E. $\begin{bmatrix} 500 \\ 400 \\ 100 \end{bmatrix}$

Question 7

Emily sat for a multiple-choice test consisting of 40 questions. Each question had five alternative answers: A, B, C, D or E.

Emily randomly guessed the answer to the first question. She then determined her answers to the remaining 39 questions by following this transition matrix:

$$\mathbf{T} = \begin{array}{c} \text{This question} \\ \begin{array}{ccccc} \text{A} & \text{B} & \text{C} & \text{D} & \text{E} \end{array} \\ \left[\begin{array}{ccccc} 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \end{array} \right] \begin{array}{l} \text{A} \\ \text{B} \\ \text{C Next question} \\ \text{D} \\ \text{E} \end{array} \end{array}$$

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

- A. Emily would always give the same answer to the odd numbered questions.
- B. Emily would always give the same answer to the sixth and eighth questions.
- C. It's impossible for Emily to give the same answer to all forty questions.
- D. It's possible that Emily gave the same answer to exactly twenty of forty questions.
- E. Emily would always give the same answer to the even numbered questions.

The following information refers to Questions 8 and 9.

The Diamond Milk factory delivers milk to three different supermarkets: A, B and C.

In April, equal numbers of customers buy milk from supermarkets B and C and the number of customers who buy milk from supermarket A is twice as many as that who buy from supermarket B.

In each month after April, a percentage of customers changed the supermarket at which they bought milk. This movement of customers is described by this transition matrix:

$$\mathbf{T} = \begin{array}{c} \text{This month} \\ \begin{array}{ccc} \text{A} & \text{B} & \text{C} \end{array} \\ \left[\begin{array}{ccc} 0.5 & 0.7 & 0.5 \\ 0.3 & 0.3 & 0.5 \\ 0.2 & 0 & 0 \end{array} \right] \begin{array}{l} \text{A} \\ \text{B Next month} \\ \text{C} \end{array} \end{array}$$

Question 8

Assume the pattern of movement described by the transition matrix continues. Which of the following statements is **not true**?

- A. In the long term, more customers will buy milk from supermarket A than from supermarket C.
- B. 30% of customers who buy milk from supermarket A in a given month will buy milk from supermarket B the next month.
- C. There will be 14% more customers buying milk from supermarket A in June than there was in April.
- D. In the long term, no customers will be buying milk from supermarket C.
- E. There will be 40% more customers buying milk from supermarket B in May than there were in April.

Question 9

The number of customers buying milk from supermarket C in the long term will be

- A. approximately 55% less than the initial number in April.
- B. 0.
- C. equal to the initial number in April.
- D. approximately 29% more than the initial number in April.
- E. more than the number of people buying milk from supermarket B.

END OF MULTIPLE-CHOICE QUESTION BOOK