Neap:

Trial Examination 2011

# VCE Further Mathematics Units 3 & 4

## Written Examination 1

## Multiple-choice Question Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

**Structure of Booklet**

| Section | Number of questions | Number of questions to be answered | Number of modules | Number of modules to be answered | Marks |
|---|---|---|---|---|---|
| A – Core | 13 | 13 | | | 13 |
| B – Modules | 54 | 27 | 6 | 3 | 27 |
| | | | | | Total 40 |

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

**Materials supplied**
Question booklet of 29 pages with a detachable sheet of miscellaneous formulas in the centrefold.
Answer sheet for multiple-choice questions.
Working space is provided throughout the booklet.

**Instructions**
Detach the formula sheet from the centre of this booklet during reading time.
Please ensure that you write your **name** and your **teacher's name** in the space provided on this page and on the answer sheet for multiple-choice questions.
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

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

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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 mark will be given if more than one answer is completed for any question.

### Core: Data analysis

*The following information relates to Questions 1 to 3.*

The back to back frequency chart below shows how many hours Jacob and Nick spend playing various computer games over the school holidays.

| Nick time (hours) | Game | Jacob time (hours) |
|---|---|---|
| 3 | Super Maria | 6 |
| 7 | Guitar Superstar | 8 |
| 12 | Call of Mum for Tea | 9 |
| 8 | Hack Man | 2 |
| 4 | Singhero | 7 |

**Question 1**

The total number of hours spent playing computer games by the boys was

**A.** 2
**B.** 10
**C.** 32
**D.** 34
**E.** 66

**Question 2**

The difference between the standard deviation for the two boys is

**A.** 0.22
**B.** 0.77 with Nick having a greater spread.
**C.** 0.77 with Jacob having a greater spread.
**D.** 0.86 with Nick having a greater spread.
**E.** 0.86 with Jacob having a greater spread.

**Question 3**

Which of the following statements is completely false?

**A.** The mode for Nick is 12
**B.** The IQR for Nick is 6.5
**C.** The mean for Jacob is 6.4
**D.** The range for Jacob is 7
**E.** The mean for Nick is 6.8


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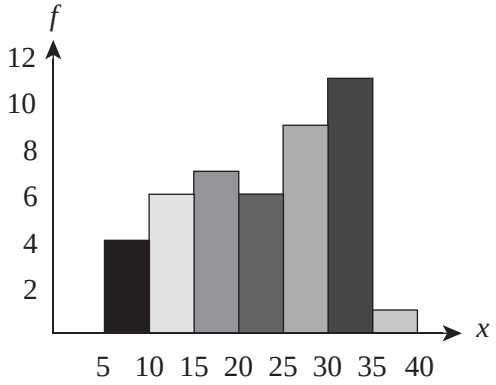
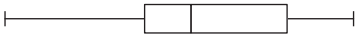
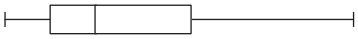
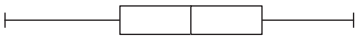
**Question 4**

Which of the following could represent a box plot for the information contained in the Histogram below?

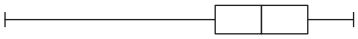



**A.** 

**B.** 

**C.** 

**D.**

**E.** 

**Question 5**

For the following set of data the 5-point moving average for the point 17.3 is

12.8 15.2 13.1 16.4 17.3 14.7 18.9 21.5 16.8

**A.** 16.08
**B.** 16.13
**C.** 16.30
**D.** 16.73
**E.** 29.34

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*The following data set applies to Questions 6 and 7.*

| Stem | Leaf |
|---|---|
| 0 | 4 4 6 6 6 7 8 8 |
| 1 | 3 8 |
| 2 | 3 |
| 3 | 5 |

**Question 6**

The data set is best described as

**A.** symmetrical with a median of 7.5 and mean of 11.5

**B.** negatively skewed with a median of 7.5 and an IQR of 9.5

**C.** negatively skewed with a median of 7.5 and an IQR of 11.5

**D.** positively skewed with a mode of 6 and an IQR of 11.5

**E.** positively skewed with a mode of 6 and an IQR of 9.5

**Question 7**

A mistake is found in the data set and the recorded figure of 35 was meant to be 25.

Changing this figure would

**A.** make no difference to the IQR, median and mode.

**B.** decrease the standard deviation, mean and mode.

**C.** decrease the mean, IQR and standard deviation.

**D.** make no difference to the mode, median and mean.

**E.** make no difference to the standard deviation but would decrease the IQR.

**Question 8**

The regression line $x$ on $y$ for the following summarised data is closest to

$$n = 5,\ \Sigma_x = 30\ \ S_x = 3.2\ \ \ \Sigma_y = 350\ \ S_y = 23 \text{ and } r = 0.95.$$

**A.** $y = 29 + 6.83x$

**B.** $y = 29 – 6.83x$

**C.** $y = 6.83 + 29x$

**D.** $y = 5 – 70x$

**E.** $y = 70 + 5x$


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**Question 9**

An experiment is undertaken to find the absorption of dye at different concentrations. The results are summarised in the table below.

| **Concentration** | 5 | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|---|
| **Absorption** | 26 | 35 | 48 | 62 | 70 | 75 |

Given the regression equation is Absorption = 16.3 + 2.1 × Concentration, the residual for a concentration of 15 is closest to

**A.** – 0.2
**B.** 0.2
**C.** 16.3
**D.** 31.5
**E.** 47.8

**Question 10**

The 5-figure summary for the data set shown below in the frequency table is

| $x$ | $f$ |
|---|---|
| 10 | 4 |
| 20 | 7 |
| 30 | 5 |
| 40 | 2 |

**A.** 10, 10, 20, 30, 40
**B.** 10, 20, 20, 30, 40
**C.** 10, 20, 30, 30, 40
**D.** 10, 20, 20, 30, 30
**E.** 20, 20, 20, 30, 40

**Question 11**

Using the information provided in the table, the seasonally adjusted figure for sales in Winter 2010 is closest to

| **Year** | **Summer** | **Autumn** | **Winter** | **Spring** |
|---|---|---|---|---|
| **2009** | \$2560 | \$3400 | \$4440 | \$1600 |
| **2010** | \$1250 | \$2900 | \$4750 | \$2100 |
| **Seasonal index** | 0.65 | 1.1 | $x$ | 0.65 |

**A.** 1.6
**B.** 2775
**C.** 2969
**D.** 7104
**E.** 7600

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**Question 12**

Watching the Australian Open Tennis, Stan the statistician becomes fascinated with the relationship between variables others don't notice. Two such relationships he compares are the maximum speed of a man's first service with his shoe size and a player's career prize money with the number of matches they have won.

The respective values for $r$ that Stan finds are most likely to be

**A.** 0.3 and 0.9
**B.** 0 and 0.4
**C.** –0.2 and 0.9
**D.** 0.6 and 0.7
**E.** 0 and 1

**Question 13**

The number of cars passing through a busy intersection per minute is recorded. The figures are normally distributed with a mean of 35 and a standard deviation of 3.8.

81.5% of the numbers recorded must be between

**A.** 35 and 116.5
**B.** 31.2 and 38.8
**C.** 31.2 and 42.6
**D.** 31.2 and 46.4
**E.** 27.4 and 46.4

**END OF SECTION A**


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## SECTION B

**Instructions for Section B**

Select **three** modules and answer **all** questions within the modules selected in pencil on the answer sheet provided for multiple-choice questions.

Show 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.

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

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**Module** **Page**

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## Module 1: Number patterns

Before answering these questions you must **shade** the "Number patterns" box on the answer sheet for multiple-choice questions.

**Question 1**

The first and third terms of an arithmetic sequence are 18 and 2 respectively.

The second term must be

**A.** –14
**B.** –6
**C.** 6
**D.** either 6 or –6
**E.** 10

**Question 2**

If left unattended, Swahilo Orchids reduce in size 20% each year. In year 1, a certain orchid is 15 cm wide.

In year 4, its width should be closest to

**A.** 3.00 cm
**B.** 6.00 cm
**C.** 6.14 cm
**D.** 7.68 cm
**E.** 12.00 cm

**Question 3**

The sum of the first three terms of an arithmetic sequence is 27.

The second term is

**A.** 4.5
**B.** 6
**C.** 9
**D.** 13.5
**E.** impossible to determine from the information given.

**Question 4**

A certain sequence obeys the difference equation $t_{n+1} = 3t_n - 2$.

Which of the following statements is true?

**A.** Each term is distinct.
**B.** The sequence is geometric.
**C.** It is either an arithmetic or geometric series, not an arithmetic or geometric sequence.
**D.** The sequence is neither arithmetic nor geometric.
**E.** The type of sequence depends on the value of the first term.


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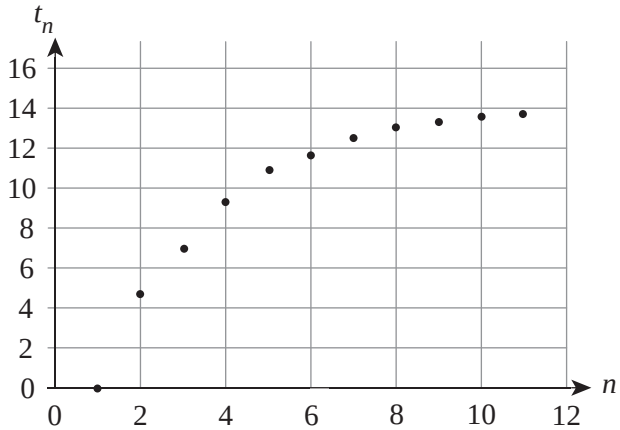
**Question 5**

The sequence shown graphically below




**A.** could be arithmetic.

**B.** could be geometric.

**C.** could have difference equation $t_{n+1} = a.t_n + b(a > b)$.

**D.** could have difference equation $t_{n+1} = a.t_n + b(0 < a < 1)$.

**E.** could have difference equation $t_{n+1} = a.t_n + b(a < -1)$.

**Question 6**

The sum of the first three terms of a geometric series is 57 while the infinite sum is 81.

The common ratio is

**A.** $\frac{1}{3}$

**B.** $\frac{2}{3}$

**C.** 1

**D.** $\frac{3}{2}$

**E.** 12

**Question 7**

The sum of the first four terms in a arithmetic series is 14 whilst the sum of terms 2 to 5 is 18.

The common difference is

**A.** $\frac{1}{3}$

**B.** 1

**C.** 2

**D.** 3

**E.** 4

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**Question 8**

The number of frogs in Riverside park is found to follow a difference equation $F_{n+1} = 0.8F_n + 15$.

This is consistent with

**A.** 20% dying each year and then 15 frogs being hatched.
**B.** 80% dying each year and then 15 frogs being hatched.
**C.** 15 frogs hatching and then 20% of all frogs dying out.
**D.** 15 frogs hatching and then 80% of all frogs dying out.
**E.** 15 frogs dying each year.

**Question 9**

Jason is a sprinter. He competes twice a week, Wednesday and Saturday, at his club. He performs better on Saturday than Wednesday. On the first Wednesday in 2012 he finishes his preferred distance in 27.0 seconds but improves by 4.0 seconds on the following Saturday. He takes 3.0 secs more on the following Wednesday but loses 2.25 seconds by the second Saturday.

If this pattern continues, Jason's times, to 2 decimal places, will be approaching a regular value of

**A.** 2.29
**B.** 11.00
**C.** 16.00
**D.** 23.75
**E.** 24.71

**END OF MODULE 1**


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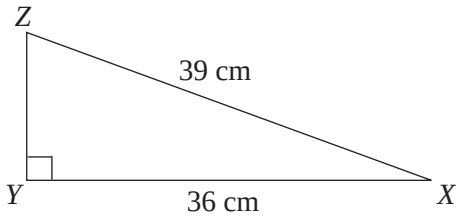
## Module 2: Geometry and trigonometry

Before answering these questions you must **shade** the "Geometry and trigonometry" box on the answer sheet for multiple-choice questions.

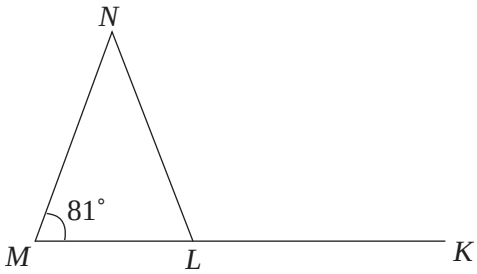
**Question 1**




For the right angled triangle *XYZ*, the distance *YZ* is

**A.** 5 cm
**B.** 15 cm
**C.** 25 cm
**D.** 35 cm
**E.** 39 cm

**Question 2**

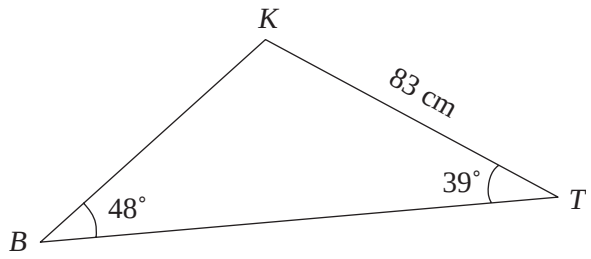



Triangle *LMN* is an isosceles triangle.

The size of the angle *MNL* is

**A.** 10°
**B.** 18°
**C.** 81°
**D.** 99°
**E.** 180°

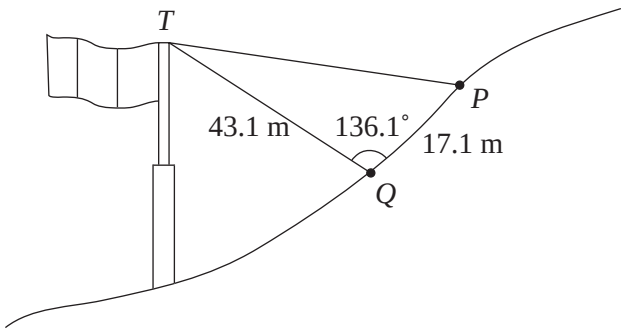
**Question 3**




In the triangle shown above, length *BK* is closest to

**A.** 70 cm
**B.** 71 cm
**C.** 80 cm
**D.** 83 cm
**E.** 91 cm

**Question 4**




A vertical flagpole, point *P*, and point *Q* are situated on a hill, shown above.

To calculate the distance between *T* and point *P*, the most useful method would be the

**A.** use of Heron's formula.
**B.** angle of depression.
**C.** sine rule.
**D.** cosine rule.
**E.** tangent rule.

**Question 5**

An equilateral triangle has a perimeter of 95.1 cm.

The area of the triangle is closest to

**A.** 335.1 $cm^2$
**B.** 335.9 $cm^2$
**C.** 435.1 $cm^2$
**D.** 435.9 $cm^2$
**E.** 502.4 $cm^2$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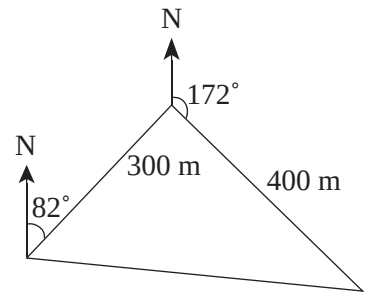
**Question 6**




Hal jogs for 300 metres on a bearing of 82°.

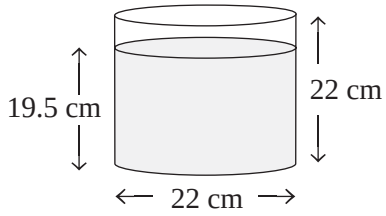
He then changes direction and jogs for 400 metres on a bearing of 172°.

He then jogs in a straight line to the point where he started jogging, to complete a triangle.

The total distance (in km) jogged by Hal is

**A.** 0.9
**B.** 1.0
**C.** 1.1
**D.** 1.2
**E.** 1.3

**Question 7**




An open cylinder is 22 cm high and has a diameter of 22 cm.

The cylinder is filled with water to a depth of 19.5 cm.

The internal surface area of the cylinder above the water is closest to

**A.** 86 $cm^2$
**B.** 96 $cm^2$
**C.** 173 $cm^2$
**D.** 183 $cm^2$
**E.** 553 $cm^2$

**Question 8**

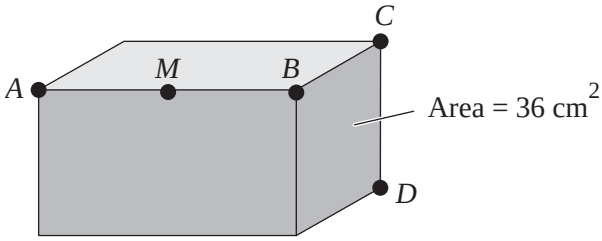
The side of a building has an area of 3600 $m^2$.

A scale drawing used by engineers shows that the area of the same side of the building is 36 $cm^2$.

The linear ratio of the scale drawing to the actual building is

**A.** 1 : 3
**B.** 1 : 30
**C.** 1 : 36
**D.** 1 : 100
**E.** 1 : 1000

**Question 9**




The rectangular prism shown above has a square end with an area of 36 cm$^2$.

The length of the prism is twice the width of the prism. Point *M* is the midpoint of *AB*.

Angle *CMD* is closest to

**A.** 25.3°

**B.** 35.2°

**C.** 35.3°

**D.** 45.2°

**E.** 45.3°

**END OF MODULE 2**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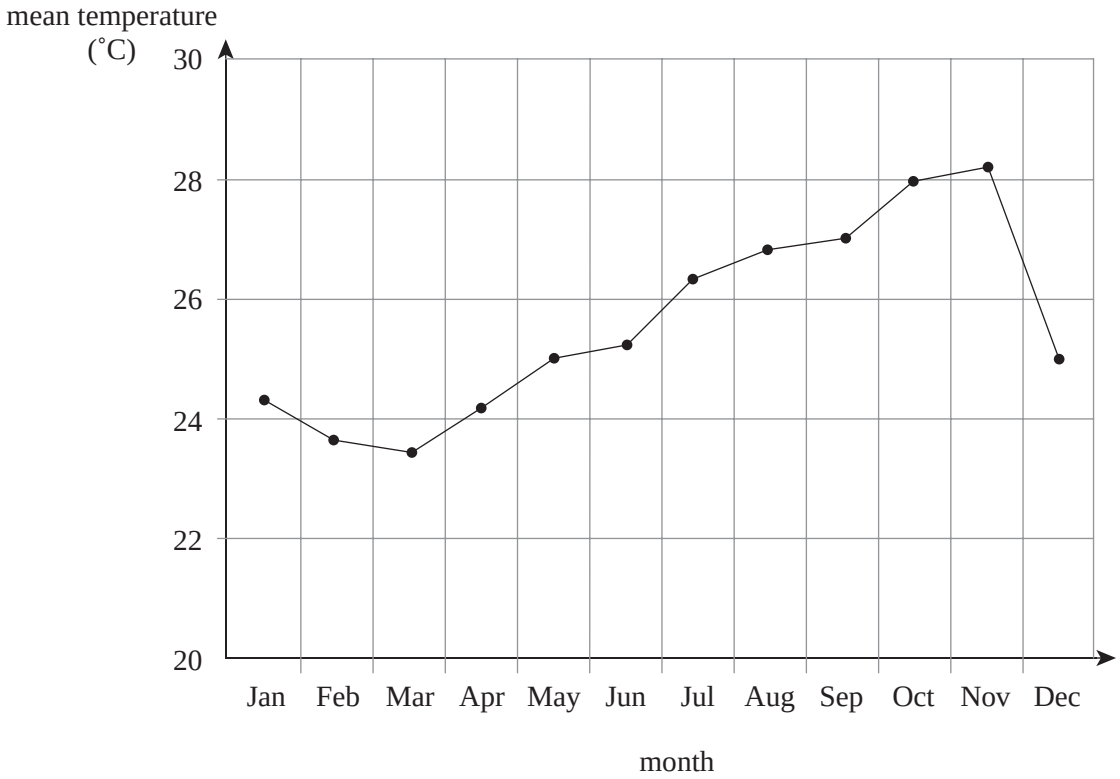
## Module 3: Graphs and relations

Before answering these questions you must **shade** the "Graphs and relations" box on the answer sheet for multiple-choice questions.

**Question 1**

The graph below shows the monthly mean temperature for Ormod City.




The one month period in which the temperature was changing fastest was

**A.** June to July.
**B.** March to November.
**C.** November.
**D.** November to December.
**E.** November to March.

**Question 2**

An equation for the straight line through the points $A(-2,1)$ and $B(3,4)$ is

**A.** $5x + 3y = 8$
**B.** $5x - 3y = 8$
**C.** $5y - 3x = 11$
**D.** $3x - 5y = 11$
**E.** $3x + 5y = 29$

**Question 3**

The cost of making a certain type of device is \$3 each but there is also a \$100 daily charge for rental of equipment. The devices can be sold for \$5 each.

The correct equation for the daily profit from making and selling $n$ such devices is

**A.** $P = 3n + 100$
**B.** $P = 5n$
**C.** $P = 2n + 100$
**D.** $P = 2n - 100$
**E.** $P = 100 - 2n$

**Question 4**

The unshaded region in the graph below satisfies a series of inequations from the set listed here:

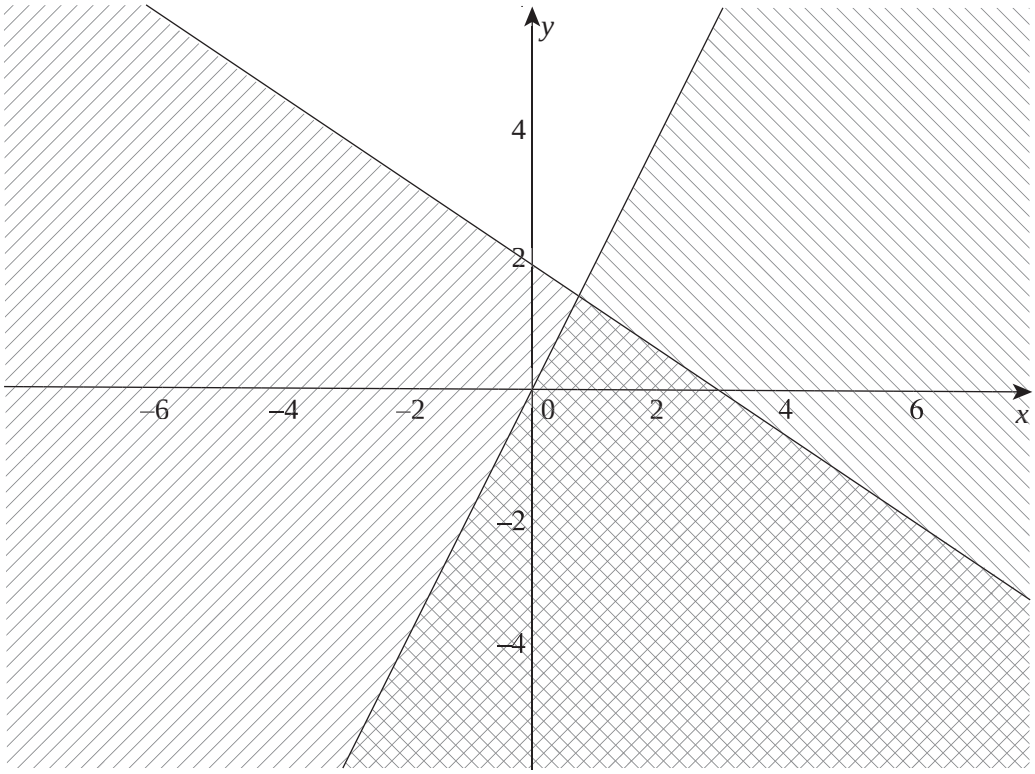
I $2x + 3y \geq 6$

II $3x + 2y \geq 6$

III $y \leq 2x$

IV $y \geq 2x$

V $y > 0$




Which of I to V could be constraints governing the unshaded region?

**A.** I and III
**B.** I, IV and V
**C.** II and III
**D.** I and IV
**E.** II and III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**Question 5**

Each of Clive's geese requires at least 15 grams of protein each day. A pili nut contains 2 grams of protein while a peanut contains 3 grams of protein. Clive will buy $x$ pili nuts and $y$ peanuts per day to feed his geese.

If Clive has 5 geese, an inequation expressing these constraints on protein is

**A.** $2x + 3y \geq 75$

**B.** $2x + 3y \leq 75$

**C.** $2x + 3y \geq 15$

**D.** $2x + 3y \leq 15$

**E.** $\frac{x}{2} + \frac{y}{3} = 15$

**Question 6**

The straight lines $3x + 4y = 11$ and $y = 2 - \frac{3x}{4}$

**A.** meet at (1, 2).
**B.** meet at (4, –1).
**C.** meet at (4, –0.25).
**D.** are the same line.
**E.** never meet.

**Question 7**

| ***x*** | 2 | 4 | 6 | 8 |
|---|---|---|---|---|
| ***y*** | 160 | 40 | 17.78 | 10 |

The data in the above table would best be plotted as a linear graph by plotting $y$ against

**A.** $x$

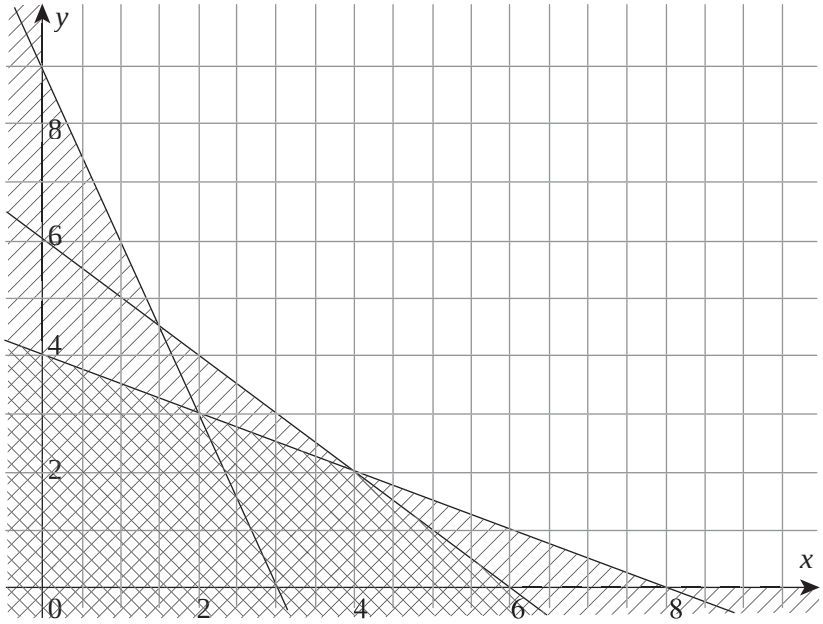
**B.** $x^2$

**C.** $x^3$

**D.** $\frac{1}{x}$

**E.** $\frac{1}{x^2}$

**Question 8**



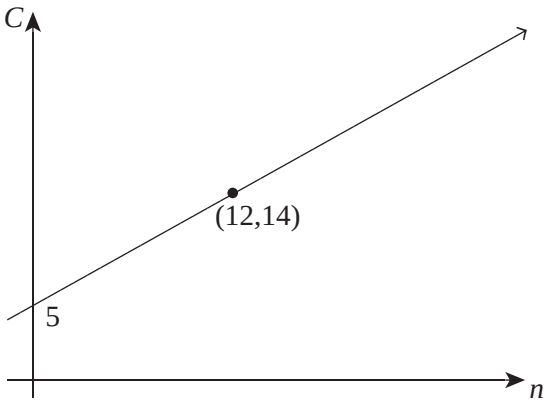

The feasible region in the scenario is shown unshaded in the diagram above.

If the objective function is $C = 6x + 5y$, then the minimum value of $C$ will occur at the point

**A.** (0, 9)
**B.** (1.5, 4.5)
**C.** (2, 4)
**D.** (4, 2)
**E.** (8, 0)

**Question 9**

The graph below shows the cost, $C$ (in dollars), of making $n$ key rings.




Assuming each key ring can be sold for \$3, in order to achieve a profit of at least \$40, the minimum number of key rings made and sold must be

**A.** 12
**B.** 14
**C.** 20
**D.** 21
**E.** 24

**END OF MODULE 3**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## 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.

**Question 1**

'Jeans for Everyone' is having a 20% off sale. Employees of the store also get an extra 5% discount after the first discount is applied.

How much would an employee pay for a pair of jeans originally marked at $87?

**A.** $20.88
**B.** $21.75
**C.** $62.00
**D.** $65.25
**E.** $66.12

*The following information relates to Questions 2 and 3.*

The interest charged on a 'Maxi-spend' credit card is calculated at 0.09% per day on the outstanding balance. The minimum repayment for the month is either 5% of the original outstanding amount or $40, whichever is larger. The outstanding balance every day at the end of June is $1500.

**Question 2**

The interest charged at the start of July is closest to

**A.** $1.35
**B.** $40.00
**C.** $40.50
**D.** $135.00
**E.** $4050.00

**Question 3**

The minimum repayment required for June is closest to

**A.** $40
**B.** $75
**C.** $77
**D.** $135
**E.** $1541

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**Question 4**

Jason wishes to purchase a block of land and is required to save a deposit of $35 000. His financial institution is offering an interest rate of 5% per annum calculated monthly.

Which of the following equations need to be solved in order to calculate how much Jason needs to deposit each month to reach his deposit target in 2 years?

**A.** $\dfrac{35000 \times 5 \times 2}{100}$

**B.** $\dfrac{35000(5-1)}{5^2-1}$

**C.** $35000 \times \left(\dfrac{5}{12}\right)^{24}$

**D.** $\dfrac{35000(0.00417)}{(1.00417^{24}-1)}$

**E.** $\dfrac{35000(0.00417)}{(1.00417^{2}-1)}$

**Question 5**

The trade-in value of a new car drops by 25% in the first year and then depreciates at 15% p.a. of its existing book value for each of the next nine years.

For a car with a purchase price of $25 000, the trade-in value after four years is closest to

**A.** $4343
**B.** $5109
**C.** $9788
**D.** $11 515
**E.** $18 750

**Question 6**

For a certain bank, the interest at the end of the month is calculated on the minimum monthly balance at 4% per annum and added monthly.

| Date | Withdrawal | Deposit | Balance $ |
|---|---|---|---|
| 1 May | | | 5400 |
| 12 May | 2300 | | |
| 18 May | | 4000 | |
| 25 May | 1300 | | |
| 31 May | | | ? |

The balance at the end of the day on May 31 is closest to

**A.** $10.33
**B.** $19.33
**C.** $3110.33
**D.** $5810.33
**E.** $5819.33


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**Question 7**

Belinda has taken out a $200 000 loan to purchase an investment property. She takes a loan at 7.25% per annum compounding monthly over a 10 year period. She makes the required payments regularly but decides to sell the home and pay out the loan after 3 years.

How much does she still owe on the loan after 3 years?

**A.** $1433.57
**B.** $2348.00
**C.** $45 679.11
**D.** $154 320.89
**E.** $189 470.28

*The following information relates to Questions 8 to 9.*

An electrical store is offering a home theatre package for $4560 cash or a 20% deposit and the outstanding amount to be paid in 36 monthly payments of $138.

**Question 8**

The amount saved by paying cash is

**A.** $408
**B.** $912
**C.** $1320
**D.** $4968
**E.** $5880

**Question 9**

The effective interest rate is

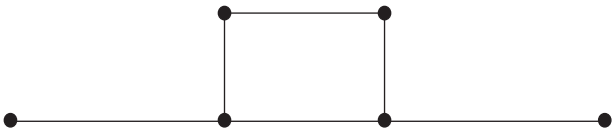
**A.** 1.67%
**B.** 12.06%
**C.** 23.47%
**D.** 36.18%
**E.** 70.41%

**END OF MODULE 4**

## 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.

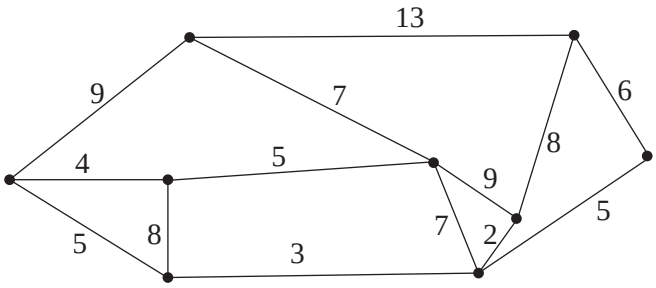
**Question 1**



The number of vertices with an odd degree in the network above is

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

**Question 2**




The length of the minimum spanning tree for the network above is

**A.** 28
**B.** 30
**C.** 33
**D.** 36
**E.** 37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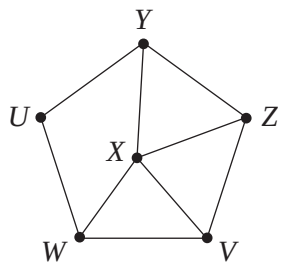
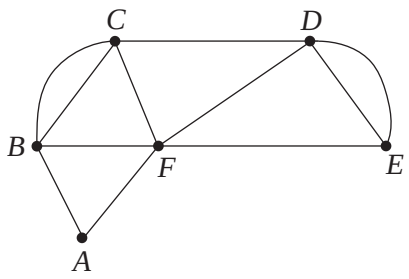
**Question 3**




A Hamiltonian circuit for the network above is

**A.** *WVZXYU*
**B.** *YXZVXWUY*
**C.** *UYXZVWU*
**D.** *VWUYZVX*
**E.** *ZVWUYZ*

**Question 4**




In the network graph above, an Euler path currently exists.

Adding which one of the following edges will result in the network still containing an Euler Path?

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

**Question 5**

A courier is employed to collect mail for a company from thirteen offices across a city. The courier must start and finish the journey at the same office.

To find the shortest distance travelled, the courier must use the

**A.** shortest Hamiltonian circuit.
**B.** minimum spanning tree.
**C.** shortest Eulerian circuit.
**D.** minimum flow.
**E.** critical path.

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**Question 6**

A connected planar graph has nine vertices and five faces.

Which one of the following statements is correct?

**A.** The graph contains one loop.

**B.** An Euler circuit must exist.

**C.** The graph is a tree.

**D.** There are more faces than edges.

**E.** There are more edges than vertices.

**Question 7**

$$\begin{array}{c} \\ F \\ G \\ H \\ I \end{array} \begin{array}{c} \begin{array}{cccc} F & G & H & I \end{array} \\ \begin{bmatrix} - & 5 & - & 8 \\ 5 & - & 9 & 2 \\ - & 9 & - & 4 \\ 8 & 2 & 4 & - \end{bmatrix} \end{array}$$

The matrix above shows the distance, in kilometres, between four towns connected by roads. Some towns have no direct road between them.

The shortest path from $F$ to $H$, in kilometres, is

**A.** 11

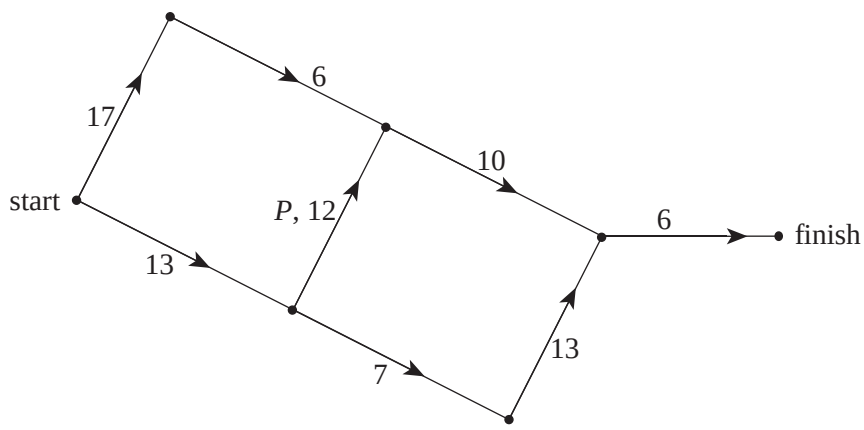
**B.** 12

**C.** 15

**D.** 18

**E.** 28

**Question 8**




The activities and their completion times, in minutes, that are required to complete a project are shown in the network above. For this project, only one activity, activity $P$, can be ‘crashed’.

The maximum time that activity $P$ can be ‘crashed’ before further crashing has no benefit is

**A.** 1 minute.

**B.** 2 minutes.

**C.** 3 minutes.

**D.** 4 minutes.

**E.** 5 minutes.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**Question 9**

A complete graph contains fewer than sixteen vertices and more than sixty edges. It contains an odd number of vertices and an odd number of edges.

Which one of the following statements is correct?

**A.** There are exactly twice as many edges as vertices.

**B.** There are exactly twice as many edges as faces.

**C.** There must be 78 edges.

**D.** There must be 14 vertices.

**E.** There must be 105 edges.

**END OF MODULE 5**

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## Module 6: Matrices

Before answering these questions you must **shade** the "Matrices" box on the answer sheet for multiple-choice questions.

### Question 1

The matrix $\begin{bmatrix} a & 1 \\ 2 & 3 \end{bmatrix}$ is singular.

Thus $a$ equals

**A.** $-3$

**B.** $\frac{-3}{2}$

**C.** $0$

**D.** $\frac{2}{3}$

**E.** $3$

### Question 2

The solution to the equations:

$2x - 3y = 7$

$3x + 2y = 11$

can be found by calculating

**A.** $\begin{bmatrix} 2 & -3 \\ 3 & 2 \end{bmatrix}\begin{bmatrix} 7 \\ 11 \end{bmatrix}$

**B.** $\frac{1}{13}\begin{bmatrix} 2 & 3 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} 7 \\ 11 \end{bmatrix}$

**C.** $\begin{bmatrix} 2 & 3 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} 7 \\ 11 \end{bmatrix}$

**D.** $\frac{1}{13}\begin{bmatrix} 2 & -3 \\ 3 & 2 \end{bmatrix}\begin{bmatrix} 7 \\ 11 \end{bmatrix}$

**E.** $\frac{-1}{5}\begin{bmatrix} 2 & 3 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} 7 \\ 11 \end{bmatrix}$


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**Question 3**

$A$ is a matrix with order $2 \times 3$. $C$ is a matrix with order $m \times 4$

If $AB = C$ then $B$ must have order

**A.** $3 \times 4$

**B.** $2 \times 4$

**C.** $2 \times 3$

**D.** $3 \times 3$

**E.** $4 \times 2$

**Question 4**

Andrea needs to buy many light globes of two types, Bayonet ($B$) and Screw-in ($S$), as part of her property management job.

The matrix $A = \begin{array}{cc} J & F \\ \end{array}$ $\begin{array}{c} \begin{bmatrix} 3 & 4 \\ 4 & 5 \end{bmatrix} \end{array} \begin{array}{c} B \\ S \end{array}$ shows the price of each globe purchased in January ($J$) and February ($F$).

The matrix $C = \begin{array}{cc} K & L \\ \end{array}$ $\begin{array}{c} \begin{bmatrix} 7 & 8 \\ 9 & 9 \end{bmatrix} \end{array} \begin{array}{c} J \\ F \end{array}$ shows the cost of globes installed at each of factories $K$ and $L$ during January and February this year.

The product $AC$ would determine

**A.** the total cost of globes at both factories combined.

**B.** the cost of each type of globe, totalled across both factories, with one row per type.

**C.** the cost of each type at each factory, one row per type, one column per factory.

**D.** the cost of each type in each month, one row per type, one column per month.

**E.** the cost of each factory in each month.

**Question 5**

For the matrix $A = \begin{bmatrix} 2 & 1 & 3 & -1 \\ 4 & 2 & 3 & -3 \\ 3 & 3 & 3 & 4 \end{bmatrix}$, it is **not** true that

**A.** element $A_{2,4}$ has a unique value.

**B.** $A_{2,1} + A_{3,2} = 7$

**C.** $A_{2,2}$ is a $2 \times 2$ matrix.

**D.** $A_{4,3}$ is undefined.

**E.** $A_{2,2} - A_{3,2} = -1$

**Question 6**

Matrix $B$ is a transition matrix. $A$ is a $5 \times 3$ matrix.

If it is true that $P = A(BC)$, then it could also be true that

**A.** $B$ is $5 \times 3$.

**B.** $P$ and $C$ are both $3 \times 2$.

**C.** $P$ is $5 \times 4$ and $C$ is $3 \times 4$.

**D.** $P$, $B$ and $C$ are the same order.

**E.** $P$ and $C$ are the same order, but $B$ is a different order.

**Question 7**

The prices of small, medium and large dogs at a pet shop are to decrease by 2%, 5% and 8% respectively.

If current prices are in matrix format $P = \begin{bmatrix} s \\ m \\ l \end{bmatrix}$, where $s$, $m$ and $l$ represent small, medium and large dog prices, then the new prices would be

**A.** $M - P$ where $M = \begin{bmatrix} 0.02 \\ 0.05 \\ 0.08 \end{bmatrix}$

**B.** $M + P$ where $M = \begin{bmatrix} 0.98 \\ 0.95 \\ 0.08 \end{bmatrix}$

**C.** $MP$ where $M = \begin{bmatrix} 0.02 & 0 & 0 \\ 0 & 0.05 & 0 \\ 0 & 0 & 0.08 \end{bmatrix}$

**D.** $MP$ where $M = \begin{bmatrix} 0.98 & 0 & 0 \\ 0 & 0.95 & 0 \\ 0 & 0 & 0.92 \end{bmatrix}$

**E.** $MP$ where $M = \begin{bmatrix} -0.02 & 0 & 0 \\ 0 & -0.05 & 0 \\ 0 & 0 & -0.08 \end{bmatrix}$


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**Question 8**

For transition matrix $T = \begin{bmatrix} 0.6 & 0.2 & 0.1 \\ 0.1 & 0.7 & 0.2 \\ 0.3 & 0.1 & 0.7 \end{bmatrix}$, when applied to initial state $\begin{bmatrix} a \\ b \\ c \end{bmatrix}$ there is

**A.** no steady state.

**B.** a steady state of $\begin{bmatrix} 0.269 \\ 0.346 \\ 0.385 \end{bmatrix}$

**C.** a steady state of $\begin{bmatrix} 0.269a \\ 0.346b \\ 0.385c \end{bmatrix}$

**D.** a steady state of $\begin{bmatrix} 0.269(a+b+c) \\ 0.346(a+b+c) \\ 0.385(a+b+c) \end{bmatrix}$

**E.** a possible steady state but not for all initial states.

**Question 9**

Every year, Miriam's store reduces prices for autumn sales but then later increases them again for winter according to the matrices $R = \begin{bmatrix} 0.90 & 0 & 0 \\ 0 & 0.85 & 0 \\ 0 & 0.05 & 0.80 \end{bmatrix}$ and $I = \begin{bmatrix} 1.10 & 0 & 0.1 \\ 0 & 1.06 & 0 \\ 0.1 & 0 & 1.05 \end{bmatrix}$ respectively, where prices are in $\begin{bmatrix} toys \\ hardware \\ books \end{bmatrix}$ format.

From this, we can conclude that the every year

**A.** the price of hardware decreases 9.9% regardless of the prices of other items.

**B.** the price of hardware decreases 9.9% but is increased by the prices of both toys and books.

**C.** the price of toys falls 1% but is increased by 9% of the books price.

**D.** the price of toys falls 1% regardless of the price of other items.

**E.** the price of hardware is affected by the previous price of all three items.

**END OF MULTIPLE-CHOICE QUESTION BOOKLET**