Neap:

Trial Examination 2007

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.

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2007 VCE Further Mathematics Units 3 & 4 Written Examination 1.

SECTION A – DATA ANALYSIS – CORE MATERIAL

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.

The following information relates to Questions 1 and 2.

Below is a list of earnings per day for a tradesman over a period of 7 days:

Day	1	2	3	4	5	6	7
Amount	\$250	\$300	\$225	\$400	\$195	\$260	\$420

Question 1

The average earnings per day is closest to

A. \$80
B. \$195
C. \$260
D. \$293
E. \$420

Question 2

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

A. Over the 7 day period the minimum earnings per day was \$195.
B. The median earnings per day was \$260.
C. Over the 7 day period the maximum earnings per day was \$420.
D. The range of earnings per day is \$215.
E. The interquartile range of earnings per day is \$175.

The following information relates to Questions 3 and 4.

The marks obtained by students who sat for a test are displayed as an ordered stemplot as shown below.

0	8
1	5 9
2	2 4 5 5 8 9
3	0 1 2 2 4 5 6 7 9
4	3 4 4 6 7 9
5	0

Key:
0 | 8 = 8

Question 3

The number of students who sat the test is

A. 7
B. 24
C. 25
D. 32
E. 50

Question 4

The interquartile range of these test marks is closest to

A. 19
B. 25
C. 32
D. 42
E. 44

Question 5

A student's standard mark on a class test is $z = 2.4$.

Assuming the test results follow a normal distribution, it can be concluded that the student's test mark was

A. in the bottom 2.5% of marks in the class but not in the bottom 0.15%.
B. in the bottom 2.5% of marks in the class.
C. in the bottom 16% of marks in the class.
D. in the top 16% of marks in the class but not in the top 2.5%.
E. in the top 2.5% of marks in the class but not in the top 0.15%.

Question 6

A student's standardised mark on a class test is $z = -1.3$. The mean mark for the class is 62 and the standard deviation is 3.95. The student's mark on the test is closest to

A. 56
B. 57
C. 62
D. 65
E. 67

Question 7

A student wants to construct a box plot with outliers for the following set of data.

1, 3, 9, 17, 23, 24, 24, 24, 27, 28, 29, 29, 32 33, 33, 34, 35, 39, 40, 42, 44

She first obtains the following five-number summary.

minimum value = 1

$Q_1 = 23.5$

median = 29

$Q_3 = 34.5$

maximum value = 44

For this set of data, which of the following values from the data set would be displayed as outliers in the box plot?

A. 1 only.

B. 1 and 3.

C. 36 and 38.

D. 42 and 44.

E. 44 only.

Question 8

Given that, for a set of bivariate data, $r = 0.865$, $s_x = 4.76$ and $s_y = 17.42$, the slope of the corresponding least squares regression line $y = a + bx$ is closest to

A. 0.24

B. 3.16

C. 3.17

D. 3.65

E. 31.57

Question 9

When monitoring the fuel consumption of a particular model of car we notice that the data collected is normally distributed with a mean of 9.8 km per litre and a standard deviation of 1.9 km per litre.

The percentage of the results that have a fuel consumption less than 11.7 km per litre is closest to

A. 2.5%

B. 5%

C. 16%

D. 68%

E. 84%

The following information relates to Questions 10 and 11.

The temperature range (in degrees Celsius) and average rainfall (in cm) at several different locations in a particular region of the world are displayed in the table below:

Temperature range (°C)	3.5	4.5	8.0	10.5	14.7	17
Average rainfall (cm)	160	145	150	85	28	30

Question 10

Correct to four decimal places, the value of Pearson's product–moment correlation coefficient for this data is

A. –0.9553
B. –0.9552
C. –0.9124
D. 0.9124
E. 0.9552

Question 11

The equation of the least squares regression line for this data is:

$$\text{average rainfall} = 203.32 - 10.69 \times \text{temperature range}$$

From this equation it can be concluded that for this region, the average rainfall

A. decreases by 192.63 cm with each one degree Celsius increase in the temperature range.
B. increases by 10.69 cm with each one degree Celsius increase in the temperature range.
C. decreases by 10.69 cm with each one degree Celsius increase in the temperature range.
D. increases by 203.32 cm with each one degree Celsius increase in the temperature range.
E. decreases by 203.32 cm with each one degree Celsius increase in the temperature range.

Question 12

The data below gives the number of accidents recorded to have occurred at a particular intersection each year from 1997 to 2006.

Year	Number of accidents
1997	5
1998	8
1999	6
2000	11
2001	9
2002	10
2003	5
2004	12
2005	9
2006	13

Using a **four**-point moving average (mean) with centring, the smoothed value of the number of accidents in 1999 is

A. 7.5
B. 8
C. 8.5
D. 8.75
E. 9

Question 13

A trend line that can be used to forecast **deseasonalised** quarterly sales (in thousands of dollars) for a store is given by

$$\text{sales} = 185 + 38.9 \times \text{quarter number}$$

where quarter 1 is the summer of 2006, quarter 2 is the autumn of 2006 and so on.

The seasonal indices for summer, autumn, winter and spring are shown in the table below.

Summer	Autumn	Winter	Spring
1.18	0.93	0.87	1.02

Using the above equation and the table of seasonal indices, the **seasonalised** sales for **spring 2007** are forecast to be closest to

A. \$340 600
B. \$347 412
C. \$486 471
D. \$496 200
E. \$506 124

END OF SECTION A – DATA ANALYSIS – CORE MATERIAL

SECTION B – MODULES

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.
Marks will **not** be deducted for incorrect answers.
No mark will be given if more than one answer is completed for any question.

Module **Page**

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 numbers 7, 3, –1, ... form

A. a geometric sequence with a positive common ratio.
B. a geometric sequence with a negative common ratio.
C. an arithmetic sequence with a positive common difference.
D. an arithmetic sequence with a negative common difference.
E. neither an arithmetic nor a geometric sequence.

Question 2

James is recording the growth of a certain tree each month from the moment that its seed is planted and records the monthly height increase. The first three such results are 32, 24 and 18 cm. If this pattern continues indefinitely, the maximum tree height would be

A. 0
B. 13.5
C. 74
D. 87.5
E. 128

Question 3

A biologist is trying to determine the effectiveness of a particular chemical agent in killing bacteria. Initially there are 2 million bacteria, but every minute 80% are killed. If t_1 is the initial number in millions and t_2 gives the number of bacteria 1 minute later, then

A. $t_n = 2(0.8)^n$
B. $t_n = 1.6(0.8)^n$
C. $t_n = 2.5(0.8)^n$
D. $t_n = 2(0.2)^n$
E. $t_n = 2(0.2)^{n-1}$

Question 4

The second and fourth terms of a geometric sequence are 36 and 16 respectively. The third term could be

A. –24
B. 10
C. 20
D. 26
E. 36

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Question 5

A difference equation is defined by

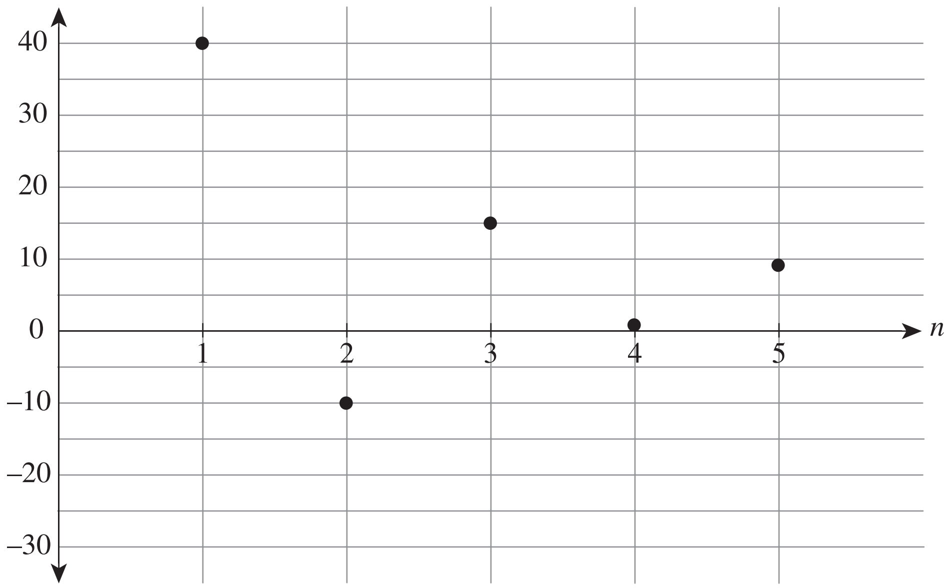
$f_{n+1} - 2f_n = -3$ where: $f_1 = 2$

The first three terms are

A. 1, –1, –5
B. 2, 1, –1
C. –3, –9, –21
D. 2, 1, 0
E. 2, –7, 11

Question 6

The first five terms of a sequence are plotted below:



The first-order difference equation that applies is

A. $t_{n+1} = t_n - 50$

B. $t_{n+1} = -t_n + 30$

C. $t_{n+1} = -2t_n + 70$

D. $t_{n+1} = \left(-\frac{1}{2}\right)t_n + 10$

E. $t_{n+1} = \left(-\frac{1}{4}\right)t_n$

Question 7

Claire and Jeremy play a game where they have to jump between numbered squares. A difference equation $t_{n+1} = t_n - t_{n-1} + 1$ gives the number of the square that they must jump to next. If $t_1 = 4$ and $t_2 = 2$ then the next three square numbers will be

A. 0, –2, –4
B. 3, 0, 4
C. –1, –2, 0
D. 7, 10, 18
E. 5, 3, 6

Question 8

The sum of the first five terms of an arithmetic sequence is equal to the third term. From this we know that

A. the third term is zero.
B. all terms are the same.
C. the first two terms are negative.
D. the third and fourth terms are negative.
E. positive and negative terms alternate.

Question 9

Jason is measuring the annual growth of a certain tree. During its first year it grows 40 cm. The next year it grows 30 cm to a height of 70 cm and 22.5 cm the next year, and so on in common ratio. The height of the tree after *n* years of growth will be given by the difference equation

A. $t_n = t_{n-1} \times \frac{3}{4}$

B. $t_n = t_{n-1} - \frac{1}{4}$

C. $t_n = t_{n-1} + 40\left(\frac{3}{4}\right)^{n-1}$

D. $t_n = t_{n-1}\left(\frac{3}{4}\right)^{n-1}$

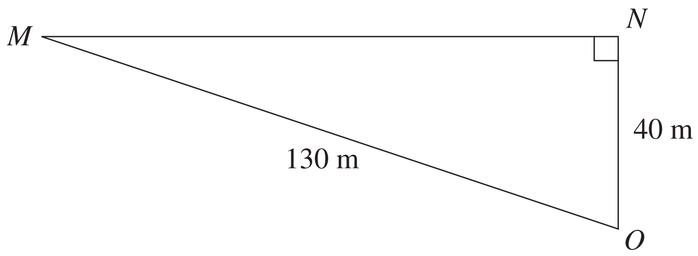
E. $t_n = t_{n-1} - \left(\frac{1}{4}\right)t_{n-1}$

END OF MODULE 1

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.

Questions 1 and 2 are based on the diagram below.



Question 1

In the right-angled triangle *MNO* above, the length of *MN* is

A. approximately equal to the length of *ON*.

B. approximately double the length of *ON*.

C. approximately double the length of *OM*.

D. approximately triple the length of *ON*.

E. less than the length of *ON*.

Question 2

In the right-angled triangle *MNO* above, the size of angle *NOM* is closest to

A. 17°

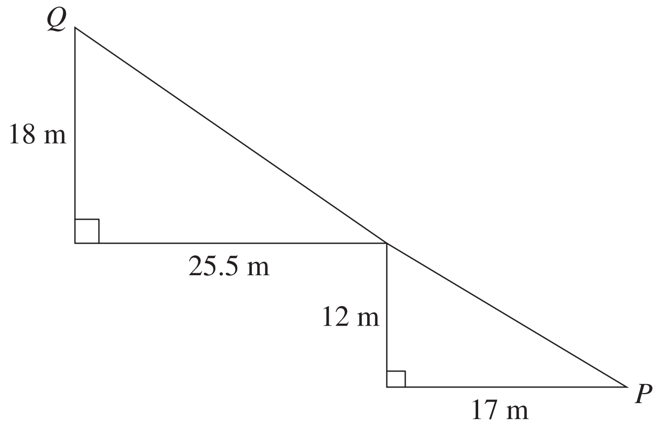
B. 18°

C. 72°

D. 74°

E. 76°

Question 3



The length of the straight line *QP* in the diagram above can be found by calculating

A. $\sqrt{(18 + 12)^2 + (25.5 + 17)^2}$

B. $\sqrt{(18 - 12)^2 + (25.5 - 17)^2}$

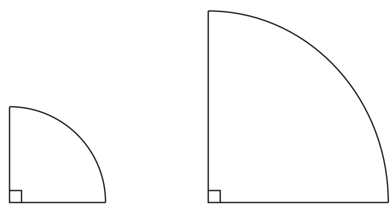
C. $\sqrt{(25.5^2 + 18^2)} - \sqrt{(17^2 + 12^2)}$

D. $\sqrt{(25.5^2 - 18^2)} + \sqrt{(17^2 - 12^2)}$

E. none of the above.

Question 4

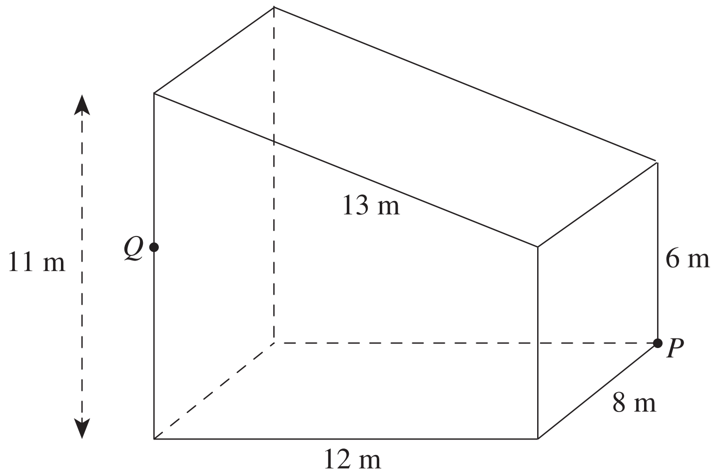
A planned section of an underground road tunnel is in the shape of a quarter circle. The original plan contains a radius of 8.2 metres. A new plan increases the size of the radius to 16.4 metres.



The area of the new plan is

A. the same as the area of the original plan.
B. twice the area of the original plan.
C. three times the area of the original plan.
D. four times the area of the original plan.
E. eight times the area of the original plan.

Questions 5 and 6 are based on the diagram below.



Point Q is 6 m above the base of the container.

Question 5

The storage container above is a prism with a cross-section in the shape of a trapezium. The volume of the storage container is

A. 104 m^3

B. 132 m^3

C. 576 m^3

D. 816 m^3

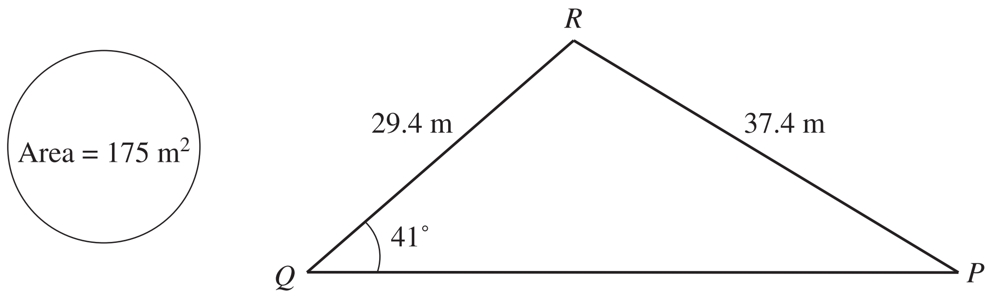
E. 1056 m^3

Question 6

A cable is to connect directly from point P to point Q. The length of the cable is closest to

A. 15.6 m
B. 18.1 m
C. 23.1 m
D. 26.0 m
E. 31.0 m

Questions 7 and 8 are based on the diagram below.



Question 7

In triangle PQR, angle QPR is approximately

A. 10° larger than angle PQR.
B. 5° larger than angle PQR.
C. equal to angle PQR.
D. 5° smaller than angle PQR.
E. 10° smaller than angle PQR.

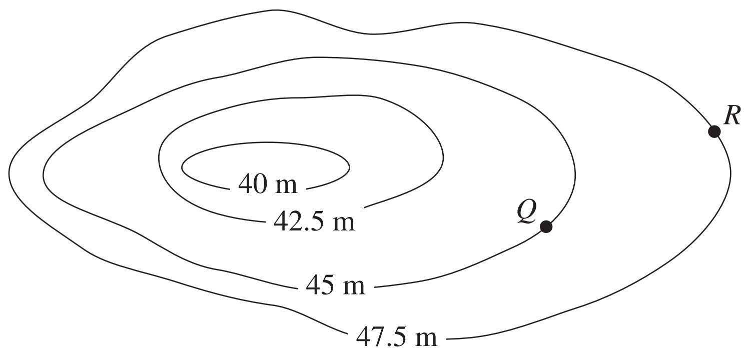
Question 8

The area of triangle PQR above is

A. approximately equal to the area of the circle.
B. approximately twice the area of the circle.
C. approximately three times the area of the circle.
D. approximately half the area of the circle.
E. not enough information is provided to determine the area of triangle PQR.

Question 9

The land between point Q and point R on the contour map below has a constant slope. The direct distance between point Q and point R is 118.4 metres.



The average slope between point Q and point R is closest to

A. 1.2°
B. 1.3°
C. 12.0°
D. 88.7°
E. 88.8°

END OF MODULE 2

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 line $2x - 3y = 6$ includes the points

A. $(3, 0)$ and $(0, 2)$.

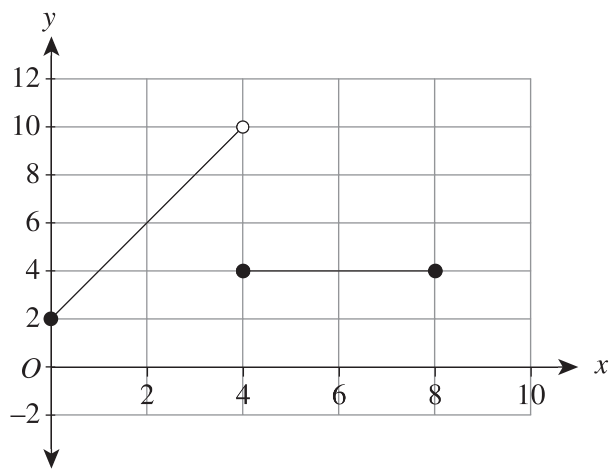
B. $(1, 2)$ and $(6, 2)$.

C. $(6, 2)$ and $(-3, -4)$.

D. $(2, 0)$ and $(0, -3)$.

E. $(0, 2)$ and $(-3, 0)$.

Question 2



The graph shown above is that of

A. $y = \begin{cases} 2x + 2 & 0 \le x \le 4 \\ 4 & 4 \le x \le 8 \end{cases}$

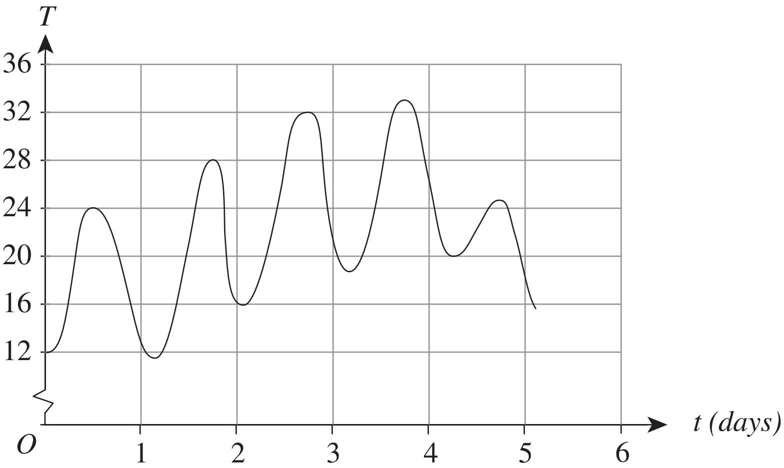
B. $y = \begin{cases} 2x + 2 & 0 \le x \le 4 \\ 4 & 4 < x \le 8 \end{cases}$

C. $y = \begin{cases} 2x + 2 & 0 < x \le 4 \\ 4 & 4 < x < 8 \end{cases}$

D. $y = \begin{cases} 2x + 2 & 0 \le x < 4 \\ 4 & 4 \le x \le 8 \end{cases}$

E. $y = \begin{cases} 2x + 2 & 0 < x < 4 \\ 4 & 4 \le x \le 8 \end{cases}$

Question 3



The above graph shows temperature variations in a certain location over a 5-day period. During this time, the temperature is exactly 30°C on

A. no occasion.
B. one occasion.
C. two occasions.
D. three occasions.
E. four occasions.

Question 4

The lines $2x - 5y = 3$ and $-4x + 10y = -6$

A. are separate parallel lines.
B. intersect at $(6, 1.2)$.
C. intersect at two points.
D. are identical lines.
E. do not intersect.

Question 5

A stationery company has determined that they are able to make *n* pen sets at a cost of $3n + 2000$ dollars. They sell each pen set for \$5. To find the break-even point they must solve the equation

A. $3n + 2000 = 5$
B. $3n + 2000 > 5n$
C. $5n = 3n + 2000$
D. $5n > 3n + 2000$
E. $5n + 2000 = 3n$

Neap:

Trial Examination 2007

VCE Further Mathematics Units 3 & 4

Written Examination 1

Formula Sheet

Detach this formula sheet during reading time. This formula sheet is provided for your reference.

FURTHER MATHEMATICS FORMULAS

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:	residual value = actual value – predicted value
seasonal index:	seasonal index = $\dfrac{\text{actual figure}}{\text{deseasonalised figure}}$

Module 1: Number patterns

arithmetic series:	$a + (a + d) + \ldots + (a + (n - 1)d) = \dfrac{n}{2}[2a + (n - 1)d] = \dfrac{n}{2}(a + l)$
geometric series:	$a + ar + ar^2 + \ldots + ar^{n-1} = \dfrac{a(1 - r^n)}{1 - r},\ r \neq 1$
infinite geometric series:	$a + ar + ar^2 + ar^3 + \ldots = \dfrac{a}{1 - r},\ \lvert r\rvert < 1$

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 $s = \dfrac{1}{2}(a + b + c)$
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:	area of base $\times$ height
volume of a pyramid:	$\dfrac{1}{3}$ area of base $\times$ height

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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): $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

equation: $y = mx + c$

Module 4: Business-related mathematics

simple interest: $I = \dfrac{PrT}{100}$

compound interest: $A = PR^n$ where $R = 1 + \dfrac{r}{100}$

hire purchase: effective rate of interest $\approx \dfrac{2n}{n+1} \times$ flat rate

Module 5: Networks and decision mathematics

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

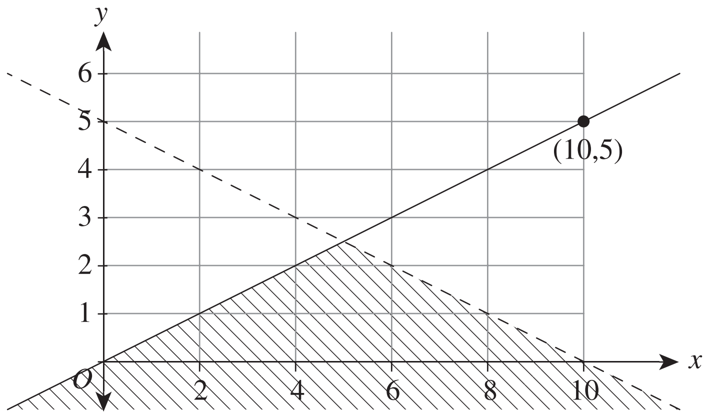
Module 6: Matrices

determinant of a 2×2 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 2×2 matrix: $A^{-1} = \dfrac{1}{\det A}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ where $\det A \neq 0$

END OF FORMULA SHEET

Question 6



The above region, shown shaded, has been formed by two separate constraints. One of these is

A. $x + 2y \leq 10$

B. $2x + y < 10$

C. $x + 2y > 10$

D. $y \leq \dfrac{x}{2}$

E. $y \geq \dfrac{x}{2}$

Question 7

Which of these statements about the line $6x - 8y = 12$ is **not** true?

A. The line has the same slope as $3x - 4y = 6$.

B. The line has the same slope as $3x - 4y = 8$.

C. The line does not pass through the origin.

D. The line has a slope of $\dfrac{3}{4}$.

E. The y intercept of this line is 12.

Question 8

x	1	3	5	7
y	40	56	88	136

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 9

Two different brands of fuel are being blended for use in a certain type of rocket engine. Their characteristics (per kilogram) are shown below.

	Energy	**Emissions**
P	40	20
Q	30	10

x kg of P and y kg of Q will be used. It is required that energy of at least 500 units be achieved and that total emissions do not exceed 250 units. Two of the constraints are $x \ge 0$ and $y \ge 0$. The other constraints are:

A. $40x + 30y \ge 500$
$20x + 10y \ge 250$

B. $40x + 30y \le 500$
$20x + 10y \le 250$

C. $4x + 3y \ge 50$
$2x + y \le 25$

D. $40x + 30y \le 500$
$20x + 10y \ge 250$

E. $40x + 30y \ge 250$
$20x + 10y \ge 500$

END OF MODULE 3

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

The average annual return over three years for an international share fund is reported as 9.5% per annum, compound. The total interest that would have been earned on an investment of $40 000 over that period is closest to

A. $3800
B. $11 400
C. $12 500
D. $13 000
E. $52 500

Question 2

If a loan of $21 500, repaid in monthly instalments, incurs simple interest of $8700 after 10 years, the effective interest rate charged is closest to

A. 4%
B. 7.5%
C. 8%
D. 15%
E. 16.5%

Question 3

Melanie stopped making contributions to her superannuation fund. If the estimate of the fund's long term interest rate is 7% per annum, then the number of years that it would take for her account balance to triple in value is closest to

A. 5 years.
B. 10 years.
C. 14 years.
D. 16 years.
E. 29 years.

Question 4

Bridgid makes monthly payments of $248 on a personal loan of $12 000 borrowed at a rate of 8.82% per annum compounding monthly. After 18 months the total amount owing (to the nearest cent) will be

A. $4464.00
B. $7536.00
C. $8936.65
D. $9061.08
E. $9123.60

Question 5

A travelling salesman buys a car for \$35 000. He is able to claim depreciation of 22 cents per kilometre that he travels. If he travels 31 000 kilometres in the first year and 34 000 kilometres in the second year, then the book value of the car at the end of the second year would be closest to

A. \$20 700
B. \$22 000
C. \$27 500
D. \$27 800
E. \$28 200

Question 6

A computer is purchased for \$5350 and depreciates at a flat rate of 17.5% per annum. If its scrap value is \$1000, the number of years before the computer will be written off is closest to

A. 4 years.
B. 5 years.
C. 7 years.
D. 8 years.
E. 9 years.

Question 7

To complete the renovations on their home, Tom and Sue take out a mortgage of \$142 000, at 7.52% per annum compounding monthly. If they make monthly repayments of \$1500 then the loan will be repaid in 12 years. If after 12 months the interest rate is increased to 8.02%, and Tom and Sue do not change the amount of their monthly repayments, the additional time that they would need to repay the loan is closest to

A. 5 months.
B. 6 months.
C. 7 months.
D. 11 months.
E. 12 months.

Question 8

The following is an extract from a bank account that shows all transactions that occurred for the period 1 July 2007 to 30 September 2007.

Date	Credit	Debit	Interest	Balance
1 July 2007				\$1970
29 July 2007	\$5280			\$7250
8 August 2007		\$1653		\$5597
28 August 2007		\$1380		\$4217
21 September 2007	\$1730			\$5947
1 October 2007				

Interest is calculated at a rate of 2.75% per annum of the minimum monthly balance and is paid into the account quarterly. Interest for the July, August, September quarter is paid on 1 October.

The amount of interest paid on 1 October is closest to

A. \$23.84
B. \$23.98
C. \$30.79
D. \$39.90
E. \$286.11

Question 9

Lisa owns a clothing store. She buys garments from a manufacturer and puts them in her store at a 100% mark-up from the purchase price. She manages to sell half of her stock at the marked price but the remainder is marked for sale at a 25% discount to the marked price. If Lisa then manages to sell all of the garments the percentage profit that she makes on the stock is

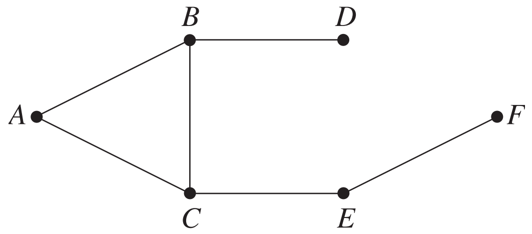
A. 25%
B. 37.5%
C. 50%
D. 75%
E. 100%

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.

Questions 1 and 2 are based on the network below.



Question 1

The sum of the degrees of all of the vertices in the network shown that have an odd degree is

A. 6
B. 7
C. 8
D. 10
E. 12

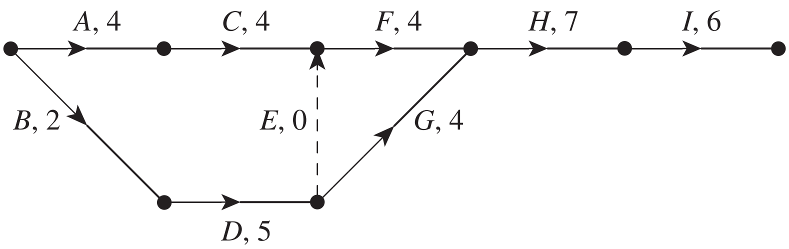
Question 2

It is possible to convert the network above into an Euler circuit by

A. adding a new edge that connects *D* with *F*.
B. adding a new edge that connects *D* with *E*.
C. removing the edge that connects *B* with *C*.
D. adding a new edge that connects *C* with *D* and adding a new edge that connects *A* with *B*.
E. adding a new edge that connects *C* with *D* and adding a new edge that connects *B* with *F*.

Question 3

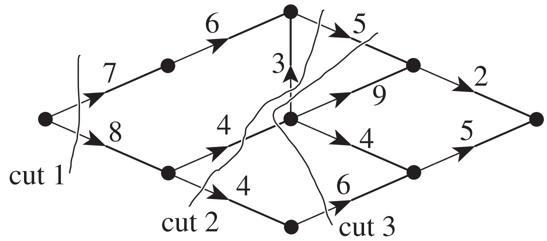
The network below shows a layout of pipes and the capacity of each pipe (in litres).



The maximum flow through the network shown is

A. 2 litres.
B. 6 litres.
C. 8 litres.
D. 9 litres.
E. 24 litres.

Question 4



In the directed graph above, **it is true to say that**

A. the capacity of cut 1 is equal to the capacity of cut 3.

B. the capacity of cut 1 is equal to the capacity of cut 2.

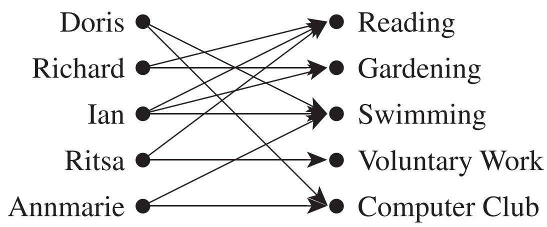
C. the capacity of cut 3 is even.

D. the capacity of cut 2 is larger than the capacity of cut 3.

E. cut 1 is the only cut to completely prevent the flow from the source to the sink.

Question 5

A group of five students elected various combinations of extra-curricular activities offered by their school. The information representing their choices is displayed on the bipartite graph below.



From the bipartite graph, it can be concluded that

A. Doris and Richard joined more activities between them than Ian.

B. Ian and Ritsa joined the same number of activities.

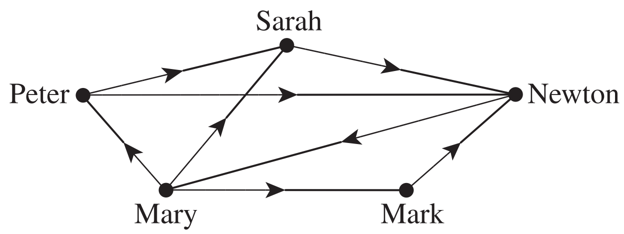
C. Annmarie participated in fewer activities than everyone else.

D. Ritsa and Annmarie participated in the same activities.

E. Participating in the Computer Club was the most popular activity.

Question 6

The dominance graph below represents the results of a round-robin tennis tournament.



From the dominance graph it can be concluded that

A. Mary has a two-step dominance over Mark.

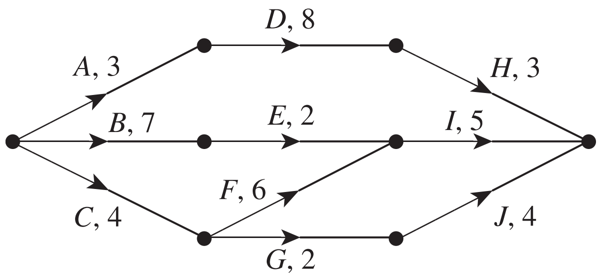
B. Mary has a two-step dominance over Newton.

C. Mary defeated Peter, Peter defeated Sarah and Sarah defeated Mary.

D. there have been 10 tennis matches.

E. Mary defeated every other player.

Questions 7 and 8 are based on the network below.



Question 7

The network above shows the activities that are needed to finish a project and their completion times (in hours).

The minimum project completion time is

A. 3 hours.
B. 13 hours.
C. 14 hours.
D. 15 hours.
E. 40 hours.

Question 8

The project can be completed in less time because the company has decided to employ more staff. The completion times of activity *H* and activity *I* will be reduced by three hours in total. For example:

- the completion time of activity *H* can be reduced by three hours, while the completion time of activity *I* is unchanged

  or

- the completion time of activity *H* can be reduced by one hour, while the completion time of activity *I* is reduced by two hours

  and so on.

The minimum project completion time after the reduction of the completion time of activity *H* and/or activity *I* is

A. 3 hours.
B. 13 hours.
C. 14 hours.
D. 15 hours.
E. 40 hours.

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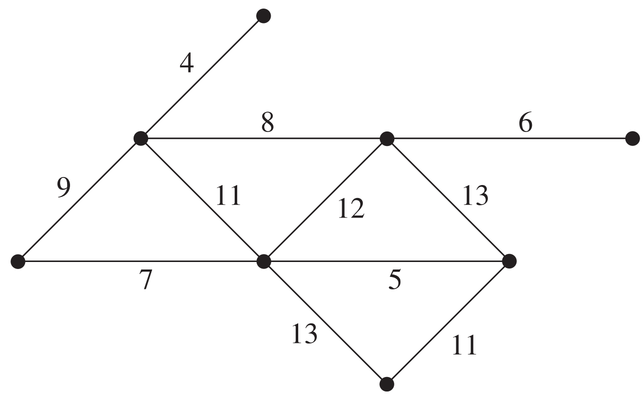
Question 9

A region in western Victoria was badly affected by bushfires so that all towns were left isolated. The network below describes the layout of the towns and the distances between towns, in kilometres.



Emergency services wish to clear some roads to ensure that no town is isolated.

What is the smallest 'total length of roads' that is required to be cleared?

A. 4 km
B. 50 km
C. 55 km
D. 75 km
E. 99 km

END OF MODULE 5

Module 6: Matrices

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

The following information applies to Questions 1 and 2.

$$A = \begin{bmatrix} 2 & 1 & -2 \\ -1 & 3 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} 2 & 1 \\ -1 & 0 \\ 1 & 3 \end{bmatrix}$$

Question 1

The matrix product *BA* is

A. $\begin{bmatrix} 1 & -4 \\ -4 & 2 \end{bmatrix}$

B. $\begin{bmatrix} 3 & 5 & -3 \\ -2 & -1 & 2 \\ -1 & 10 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 4 & 2 & -2 \\ -2 & 3 & 1 \\ 1 & 3 & 0 \end{bmatrix}$

D. undefined since *A* and *B* are not of the same order.

E. undefined since *A* and *B* have different numbers of rows.

Question 2

The equation $AX = B$

A. is impossible regardless of the format of matrix *X*.

B. could be a series of solvable simultaneous equations.

C. requires *X* to be a 3×3 matrix but can't represent a set of simultaneous equations.

D. represents a set of simultaneous equations with no solution.

E. requires *X* to be a 2×2 matrix but can't represent a set of simultaneous equations.

Question 3

If $R = \begin{bmatrix} 3 & 1 \\ 2 & -1 \end{bmatrix}$ then the scalar multiple $-2R$ will be

A. –5

B. –1

C. 10

D. $\begin{bmatrix} -6 & -2 \\ -4 & 2 \end{bmatrix}$

E. $\begin{bmatrix} 6 & 4 \\ 5 & 2 \end{bmatrix}$

Question 4

Which of the following is a singular matrix?

A. $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

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

C. $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 0 \\ 3 & 5 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & -2 & 1 \\ 2 & 3 & 3 \\ 4 & -1 & 5 \end{bmatrix}$

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

Question 5

A company makes small, medium and large T-shirts. Each size can be in either a standard form or a monogrammed form. The price of each style, in dollars, is given by the matrix *P*.

$$P = \begin{array}{c} \begin{matrix} S & M & L \end{matrix} \\ \begin{bmatrix} 15 & 17 & 18 \\ 25 & 28 & 30 \end{bmatrix} \end{array} \begin{array}{l} \\ \text{standard} \\ \text{monogrammed} \end{array}$$

The company wants to increase the price of all T-shirts. The price of standard T-shirts is to increase by 12% and the price of monogrammed T-shirts is to increase by 8%. The new price matrix will be

A. MP where $M = \begin{bmatrix} 0.12 & 0 \\ 0 & 0.08 \end{bmatrix}$

B. MP where $M = \begin{bmatrix} 1.12 & 1.12 \\ 1.08 & 1.08 \end{bmatrix}$

C. MP where $M = \begin{bmatrix} 1.12 & 1.08 \\ 1.12 & 1.08 \end{bmatrix}$

D. MP where $M = \begin{bmatrix} 1.12 & 0 \\ 0 & 1.08 \end{bmatrix}$

E. MP where $M = \begin{bmatrix} 1.12 & 1.08 \\ 1.08 & 1.12 \end{bmatrix}$

Question 6

A certain company is responsible for importing Asian-style decorations. They have two 3×3 matrices. Each is organised in such a way that columns 1, 2 and 3 represent the years 2004, 2005 and 2006, respectively. Rows 1, 2, and 3 represent paintings, tapestries and silk screens, respectively. Matrix *V* gives the prices of the items to import. Matrix *W* gives the prices charged to customers for the same items. No costs exist other than those in these matrices. Calculating $W - V$ would find

A. the total profit per item in each of the three years.

B. the total loss per item in each of the three years.

C. the profit on each of the three items totalled across all three years.

D. the profit for each of the three years, totalled for all three items.

E. the percentage profit on each of the three items in each of the three years.

Question 7

How many of the following four sets of simultaneous equations have a unique solution?

$$\begin{array}{cccc} 2x + 3y = 7 & x + 2y = 5 & x + 2y = 5 & x = 3 \\ x + 2y = 5 & 2x + 4y = 7 & 2x + 4y = 10 & 2x + y = 7 \end{array}$$

A. 0

B. 1

C. 2

D. 3

E. 4

Question 8

Bettersea City Council have analysed their annual roadwork projects.

Of the roads requiring work in any year, 12% require further work in the following year.

Of the roads not requiring work in any year, 20% do require work in the following year.

A possible transition matrix to describe this situation would be

A. $\begin{bmatrix} 0.12 \\ 0.20 \end{bmatrix}$

B. $\begin{bmatrix} 0.12 \\ 0.88 \end{bmatrix} + \begin{bmatrix} 0.20 \\ 0.80 \end{bmatrix}$

C. $\begin{bmatrix} 0.12 \\ 0.88 \end{bmatrix} + \begin{bmatrix} 0.80 \\ 0.20 \end{bmatrix}$

D. $\begin{bmatrix} 0.12 & 0.20 \\ 0.88 & 0.80 \end{bmatrix}$

E. $\begin{bmatrix} 0.12 & 0.80 \\ 0.88 & 0.20 \end{bmatrix}$

Question 9

Damien is investigating the market share of three companies, *P*, *Q* and *R*, on a monthly basis. During the first month, the market shares of all three were equal. The monthly changes after this time are described by the transition matrix

$$\begin{array}{cc} & \begin{array}{ccc} P & Q & R \end{array} \\ \begin{array}{c} P \\ Q \\ R \end{array} & \begin{bmatrix} 0.4 & 0.1 & 0.1 \\ 0.3 & 0.8 & 0.2 \\ 0.3 & 0.1 & 0.7 \end{bmatrix} \end{array}$$

It is evident from the matrix that

A. companies other than *P*, *Q* or *R* influence the market share of the three companies.

B. *P* will retain its market share in the long term.

C. *P* will increase its market share in the long term.

D. *Q* will increase its market share at the expense of *P*.

E. *Q* will eventually settle at about 80% of market share.

END OF MULTIPLE-CHOICE QUESTION BOOKLET