Mathematical Association of Victoria
Trial Examination 2010

STUDENT NAME _____

FURTHER MATHEMATICS

Written Examination 1

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

MULTIPLE-CHOICE QUESTION BOOK

Structure of book

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

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, 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 book of 34 pages with a detachable sheet of miscellaneous formulas at the back.
- Answer sheet for multiple-choice questions.
- Working space is provided throughout the book.

Instructions
- Detach the formula sheet from the back of this book during reading time.
- Check that your **name** is printed on your answer sheet for multiple-choice
- Unless otherwise indicated, the 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 and/or any other unauthorised electronic devices into the examination room.

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Working space

TURN OVER

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 that question.
A correct answer scores 1, and 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.

Core – Data Analysis

*The following table relates to questions **1** and **2**.*

The table gives the reaction of junior and senior students at a local boys secondary college to the idea of going co-educational.

Attitude	Senior students	Junior students	Total
For	72	38	110
Against	13	67	80
Total	85	105	190

Question 1

From the table above, we can conclude that the type of investigation is

A. Univariate analysis of the attitude to going co-educational
B. Univariate analysis of the distribution of junior and senior students
C. Bivariate analysis of the attitude to going co-educational **versus** age (junior/senior) group
D. Bivariate analysis of age (junior/senior) group **versus** the attitude to going co-educational
E. Time Series analysis of the attitude to going co-educational

Question 2

From the table above, we can conclude that

A. 20% of juniors are for going co-educational
B. 34.5% of juniors are for going co-educational
C. 36.2% of juniors are for going co-educational
D. 56.7% of juniors are for going co-educational
E. 63.8% of juniors are for going co-educational

Question 3

The amounts of money spent by 20 students at a recent school fete are shown in the stemplot below.

stem	Leaf
2	1
3	7 9
4	2 3 5 5 6 7 7 9
5	0 2 3 7 9
6	1 4 4
7	9

2|3= $23

The lower and upper limits for which outliers are identified for the above data set is

A. 21 and 79

B. 23 and 79

C. 37 and 64

D. 39 and 64

E. 44 and 58

Question 4

The 150 gram weight chocolate bars tested on the production line would be rejected if the weight of the bar was 145 grams or less as it would be in the bottom 2.5% of a normal distribution where the mean weight is 150 grams.

The percentage of chocolate bars that are between 147.5 and 155 grams is closest to

A. 2.5%

B. 34%

C. 68%

D. 81.5%

E. 95%

Question 5

A student received the following data about his performance in his recent chemistry and physics tests.

Subject	**Z score**	**Class Mean**	**Class standard deviation**
Physics	−1	82%	5%
Chemistry	1.5	62%	16%

Comparing **his physics test** to **his chemistry test** result it is found that

A. Chemistry test was 20% lower than Physics

B. Chemistry test was 9% lower than Physics

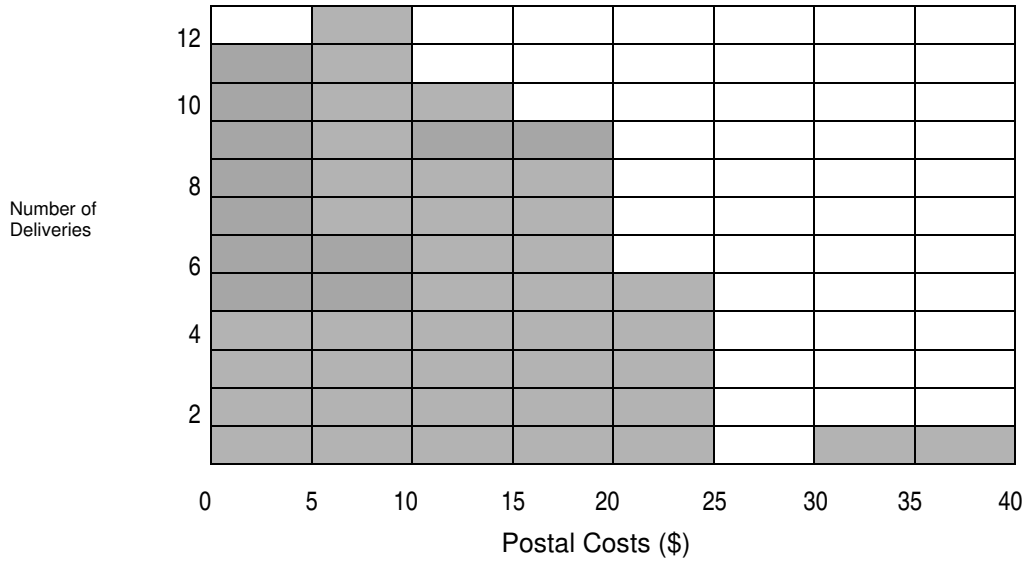
C. Chemistry test was 11% lower than Physics

D. Physics test was 9% lower than Chemistry

E. Physics test was 20% lower than Chemistry

Question 6

The distribution of postal costs for goods bought on ebay is displayed in the frequency histogram below:



The median for the postal costs is **best** stated as

A. $10

B. $11

C. $12.50

D. $15

E. $20

Question 7

Given that 92% of the variation in the number of speeding tickets issued, on average, to a driver can be explained by the variation in a driver's age, and the other 8% of variation in the number of speeding tickets issued, on average, to a driver can be explained by other factors, then the Pearson product-moment correlation coefficient is **best** given as

A. 92%

B. 0.92

C. - 0.92

D. 0.959

E. ± 0.959

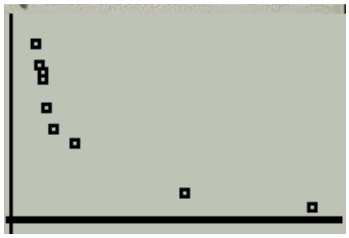
*The following table relates to questions **8** and **9**.*

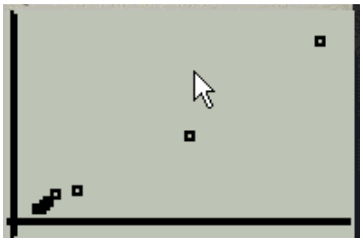
Competition	Number of Competitors (independent)	Winning time margins (seconds) (dependent)
Vancouver 2010	98	0.02
Tourin 2006	56	0.042
World Bobsleigh Cup 2009	21	0.11
World Luge Cup 2009	14	0.13
World Bobsleigh Cup 2008	12	0.16
World Luge Cup 2008	11	0.21
World Bobsleigh Cup 2007	9	0.22
USA Trials 2007	8	0.25
World Luge Cup 2007	10	0.20

The table above shows records of luge and bobsleigh winning margins (in seconds) at various winter Olympics and other major competitions.

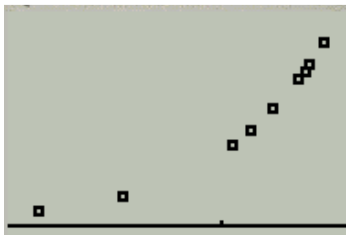
Question 8

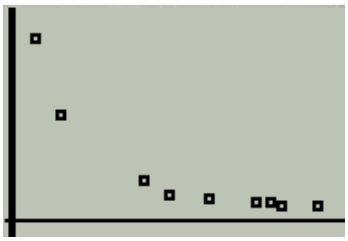
A suitable scatterplot of the above data with the dependent on the *y*-axis and independent on the *x*-axis is

A. 

B. 

C. 

D. 

E. 

Question 9

Using the *reciprocal transformation* of the **dependent** variable, the least squares regression equation is

A. $\dfrac{1}{\text{no. of competitors}} = -0.3222 + 0.4939 \times \text{winning margin}$

B. $\dfrac{1}{\text{winning margin}} = -0.3222 + 0.4939 \times \text{no. of competitors}$

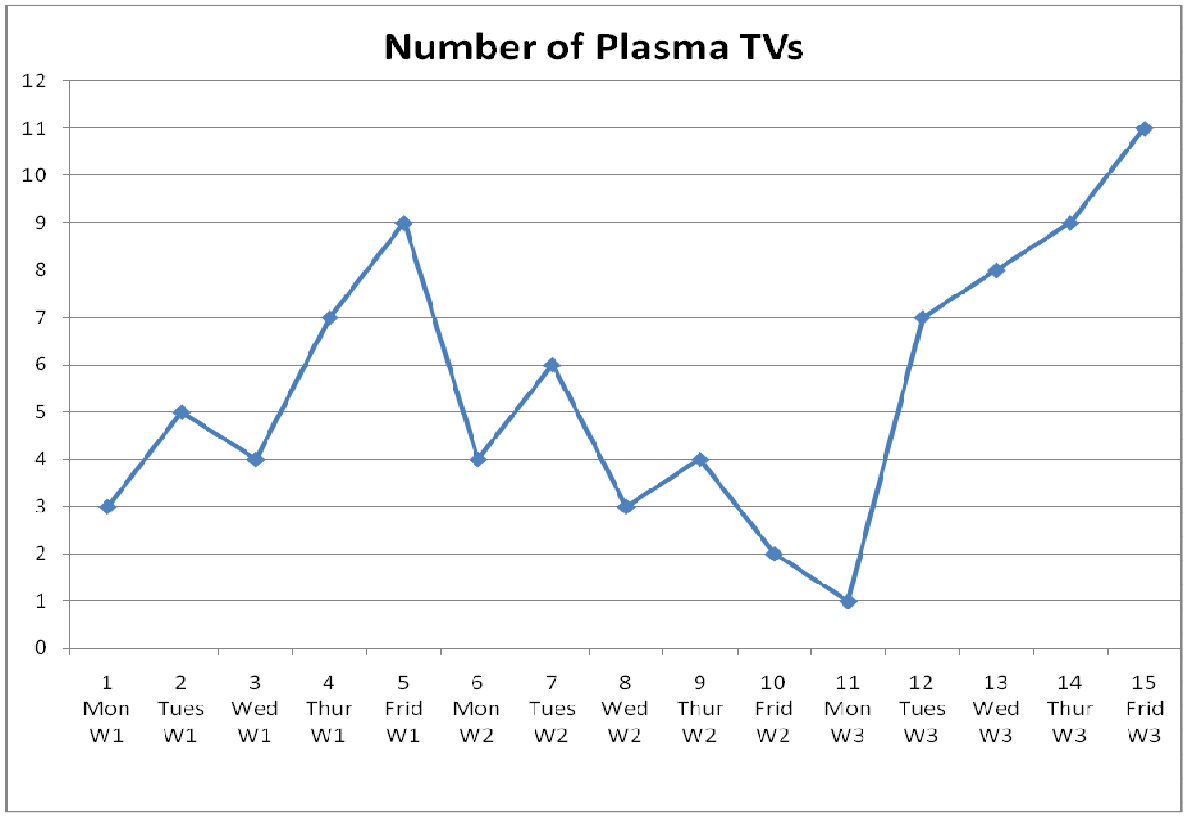
C. $\text{no. of competitors} = -0.3222 + \dfrac{0.4939}{\text{winning margin}}$

D. $\text{winning margin} = -0.3222 + \dfrac{0.4939}{\text{no. of competitors}}$

E. $\dfrac{1}{\text{winning margin}} = 0.2089 - 0.0023 \times \text{no. of competitors}$

The following information is related to Questions 10 and 11

The number of Plasma TVs sales for each of the **5 days** a week for a three week period that the store is open is recorded. To investigate the trend, a scatterplot is constructed as shown below.



Question 10

In the process of constructing a three median regression line, the three medians would be

A. (3,4) (8,3) (13,8)
B. (5,3) (4,8) (8,13)
C. (1,3) (8,3) (15,11)
D. (3.0, 5.6) (8.0, 3.8) (13.0, 7.2)
E. (3,5) (8,4) (13,8)

Question 11

To improve the modelling of the above data, an appropriate smoothing of the data is suggested. The most appropriate smoothing technique for the above data displayed is

A. 3 median regression
B. 3-point moving median smoothing
C. 4-point centred moving median smoothing
D. 5-point moving median smoothing
E. seasonal smoothing

The following information relates to Questions 12 and 13

Quarter	Summer	Autumn	Winter	Spring
Seasonal Index		0.8	0.35	

The table shows the seasonal indices for the quarterly sales figures of golf balls.

Question 12
Given that the seasonal indices for summer and spring are the same, then the value of the seasonal index for Spring is

A. 1.2
B. 1.425
C. 1.65
D. 2.85
E. Cannot be determined

Question 13
A trend line that can forecast the deseasonalised number of golf balls sold is given by

$$Deseasonalised\ number\ of\ golf\ balls = 2100 + 125 \times Quarter$$

where Quarter 1 is Summer 2008, Quarter 2 is Autumn 2008, and so on.

The **actual** number of golf balls predicted to be sold for Autumn 2010 is closest to

A. 2225
B. 2350
C. 2680
D. 3350
E. 4188

END OF SECTION A
TURN OVER

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 **and** writing the name of the module in the box provided.
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.

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 and write the name of the module in the box provided.

Question 1

The first four terms of a geometric sequence are $\frac{2}{3}, 1\frac{1}{3}, 2\frac{2}{3}, 5\frac{1}{3}, ...$

The sequence pattern is best summarised as

A. $d = 0.5$
B. $d = 2$
C. $a = 0.5$
D. $r = 0.5$
E. $r = 2$

Question 2

The sum of 4 terms of a geometric sequence is 6187. If the common ratio is 1.3, the 2nd term is

A. 1000
B. 1300
C. 2000
D. 1030.3
E. 3660.946

Question 3

The numbers 9, 2 and –5 form the first three terms of an arithmetic sequence. In this arithmetic sequence the term which is equal to –131 is the

A. 19^{th}
B. 20^{th}
C. 21^{st}
D. 22^{nd}
E. 23^{rd}

Question 4

Jade increases the size of her vegetable garden by 8% each year. The garden initially covered 6 square metres. The first order difference equation that would **best represent** the area after the *n*th year is

A. $A_n = 0.08 \times A_{n-1}$ where $A_0 = 6$

B. $A_n = 1.08 \times A_{n-1}$ where $A_1 = 6$

C. $A_n = 1.08 \times A_{n-1}$ where $A_0 = 6$

D. $A_n = 1.08 \times A_{n-1} + 6$ where $A_1 = 0$

E. $A_n = 1.08 \times A_{n-1} + 6$ where $A_0 = 0$

Question 5

The sequence defined by $t_n = -3n + 1$ where $n = 1, 2, 3, \ldots$ can be defined by the first order difference equation

A. $t_{n+1} = -2t_n - 6$, $t_1 = -5$

B. $t_{n+1} = 2.5t_n$, $t_1 = -2$

C. $t_{n+1} = t_n - 6$, $t_1 = -5$

D. $t_{n+1} = t_n - 3$, $t_1 = -2$

E. $t_{n+1} = t_n - 3$, $t_1 = 1$

Question 6

Given $t_5 = 6.25$ and $t_6 = -3.125$ and $S_\infty = 300$, then a is

A. 150

B. 100

C. −200

D. 450

E. −100

Question 7

Part of a Fibonacci sequence is given as …..,–3,–7, –10, –17, –27,….., the first two terms could be given as

A. $t_1 = -5$ and $t_2 = 1$

B. $t_1 = -4$ and $t_2 = -1$

C. $t_1 = 1$ and $t_2 = -5$

D. $t_1 = -5$ and $t_2 = 6$

E. $t_1 = -7$ and $t_2 = 4$

Question 8

The 8^{th} term of an arithmetic sequence is 32.5 and the sum of the first 10 terms of the sequence is 187.5. The value of the 10^{th} term of the sequence is

A. 187.5
B. 43.5
C. 42.5
D. 70
E. –6

Question 9

A number of timber beams support a ramp. The first of the beams is 0.5 metres long and each successive beam is 5% longer than the previous one. The beam that first exceeds a length of 2 metres is the

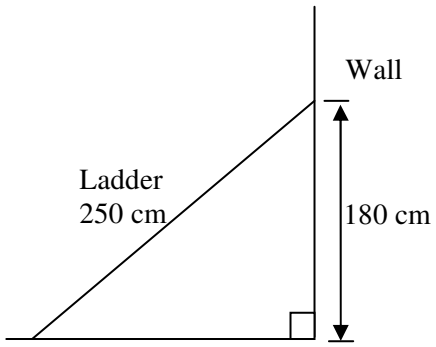
A. 30th
B. 29th
C. 28th
D. 27th
E. 4th

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 relates to Questions 1 and 2

A ladder 250 cm long leans on a vertical wall at a height of 180 cm as shown in the diagram.



Question 1

The distance, to the nearest cm, from the bottom of the ladder to the base of the wall is

A. 30
B. 70
C. 83
D. 164
E. 173

Question 2

The ladder slips 20cm down the wall.
The angle that the top of the ladder makes with the wall is given by

A. $\sin^{-1}\left(\frac{160}{250}\right)$

B. $\cos^{-1}\left(\frac{160}{250}\right)$

C. $\tan^{-1}\left(\frac{160}{250}\right)$

D. $\tan^{-1}\left(\frac{250}{160}\right)$

E. $\cos^{-1}\left(\frac{160}{230}\right)$

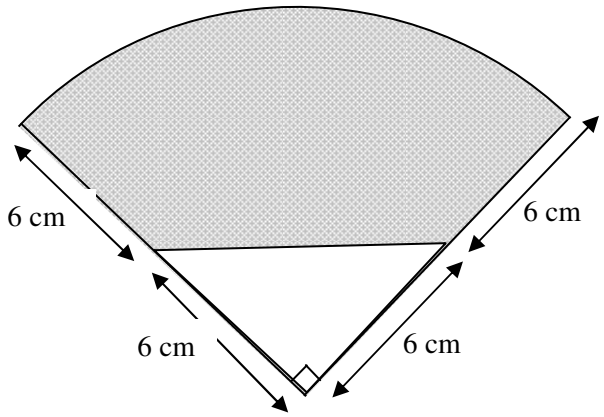
Question 3

A regular polygon that has an interior angle of 160^o has

A. 6 sides
B. 10 sides
C. 12 sides
D. 15 sides
E. 18 sides

The following information is relevant to Questions 4 and 5

The diagram below shows a fan made out of wire supports that frame the ***entire*** perimeter of material (shaded) and extend further to meet at a right angle.



Question 4

The total length of wire used to make the fan, to the nearest cm, is

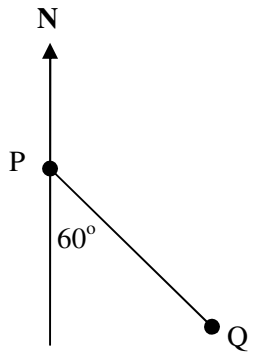
A. 24
B. 33
C. 42
D. 51
E. 61

Question 5

The area of material (shaded), in square centimetres, is given by

A. $9\pi - 18$
B. $18\pi - 18$
C. $24\pi - 18$
D. $36\pi - 18$
E. $72\pi - 18$

Question 6

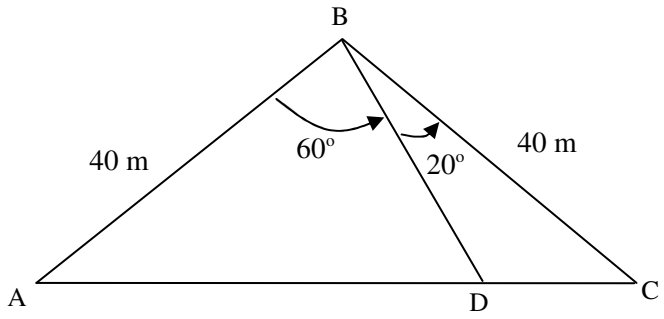


The bearing of P from Q is

A. 060°
B. 120°
C. 150°
D. 240°
E. 300°

Question 7

In the diagram, AB and BC are equal to 40 m

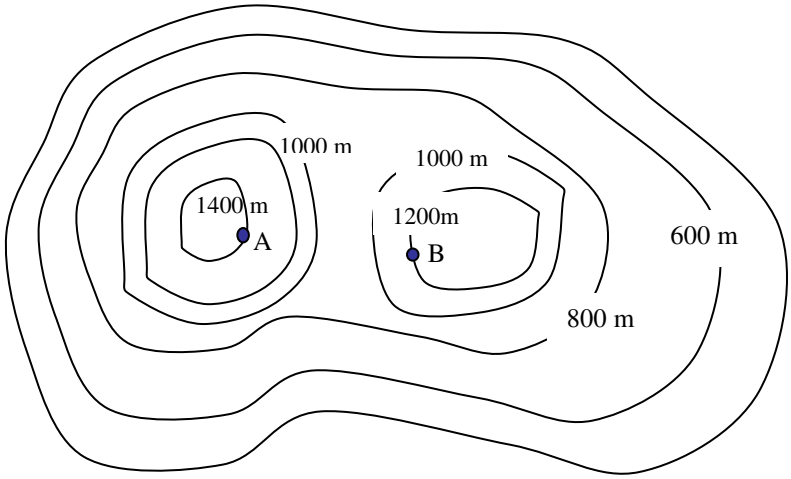


The length of AD, to the nearest metre, is

A. 35
B. 37
C. 43
D. 45
E. 51

Question 8

The contour map shown represents a mountain region. Two hikers are located at A and B as shown on the diagram. The intervals for the contour lines are 200 m and the map scale is 1: 50 000



1 : 50 000

The distance from A to B is measured to be 2.5 cm on the map.

To the nearest degree, the angle of depression from A to B is

A. 1^o
B. 6^o
C. 9^o
D. 15^o
E. 60^o

Question 9

The radius of a spherical exercise ball is increased by 20% to produce a larger spherical exercise ball.

The increase in surface area is

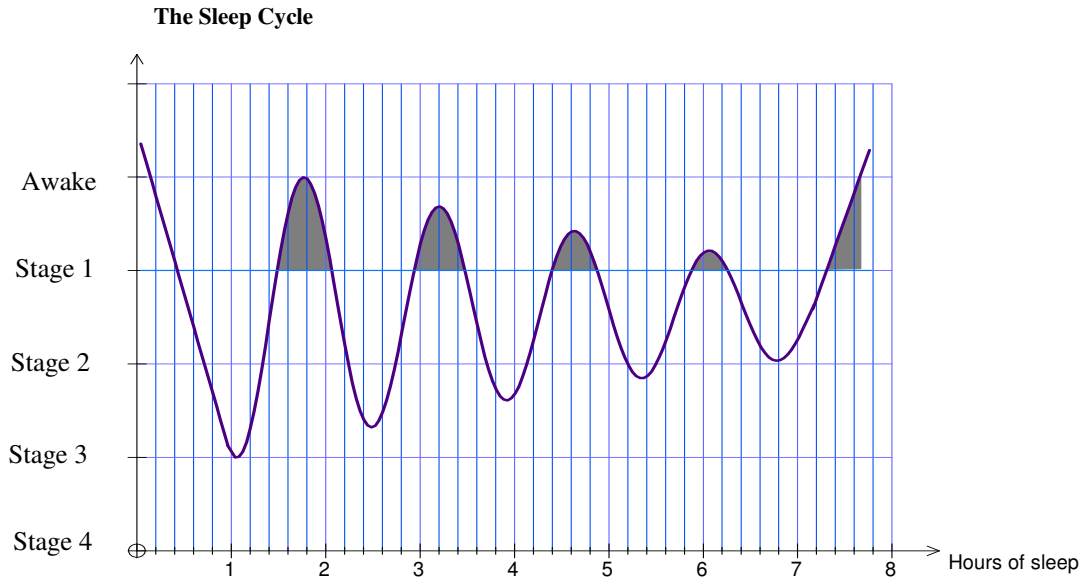
A. 20%
B. 40%
C. 44%
D. 380%
E. 400%

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 graph below shows a person's sleep cycle over an eight hour period. The Rapid Eye Movement (REM) is indicated in the dark sections and represents the times during which this person is dreaming.



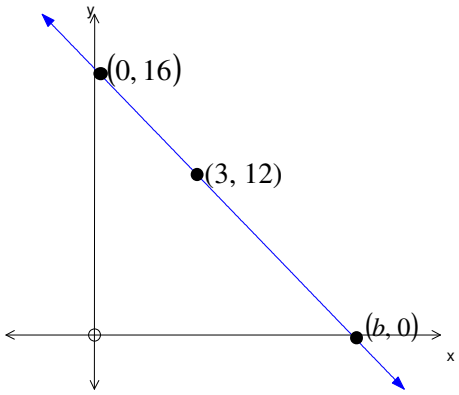
The total time spent on REM sleep is

A. less than an hour
B. between one and two hours
C. between two and three hours
D. between three and four hours
E. more than four hours

Question 2

For the straight line graph the value of b is

A. 32
B. 21
C. 16
D. 12
E. 4



Question 3

At the Easter stall Betty purchased a dozen Easter eggs and 4 hot cross buns for $16.60.
Ebony purchased three Easter eggs and half a dozen hot cross buns for $15.90.

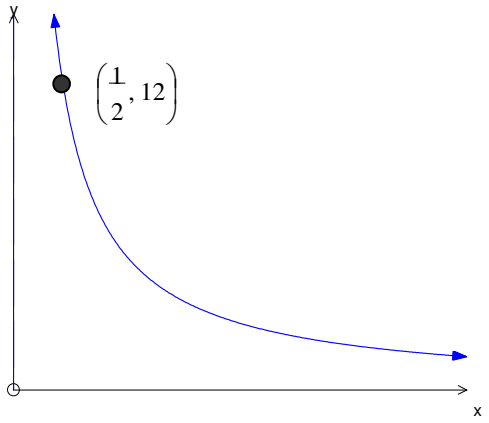
The cost of one hot cross bun and two Easter eggs is

A. $2.95
B. $3.55
C. $5.30
D. $5.90
E. $1.35

Question 4

A possible equation for the graph shown is

A. $y = \frac{3}{x^2}$
B. $y = \frac{6}{x^2}$
C. $y = \frac{3}{x}$
D. $y = \frac{1}{6x}$
E. $y = \frac{24}{x}$



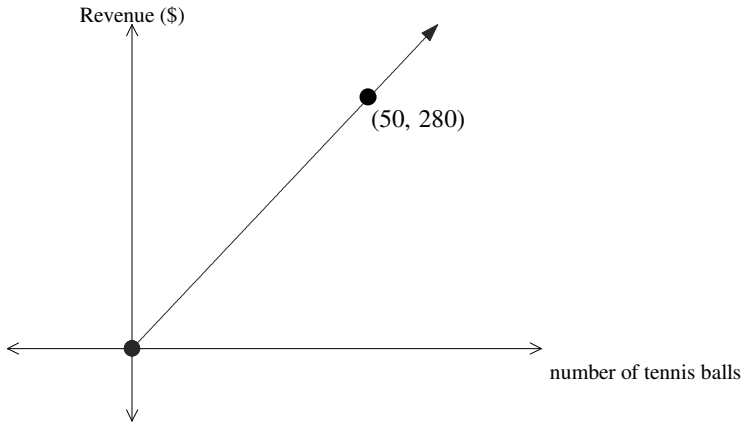
Question 5

For the linear relation $2x - 3y = -3$, it is true to say

A. as x increases y decreases
B. the gradient of the graph is 2
C. the y-intercept of the graph is -1
D. the x-intercept of the graph is greater than -2
E. the graph passes through the point (3, -3)

The following information relates to question 6 and 7

The graph below shows the revenue (in dollars) of selling tennis balls.



The profit on the sale of 250 tennis balls is $180.
The cost of producing these tennis balls consists of a fixed cost of $600 plus the cost of each tennis ball.

Question 6

Each tennis ball is sold for

A. $0.72
B. $2.48
C. $2.88
D. $4.88
E. $5.60

Question 7

The cost of each tennis ball is

A. $0.72
B. $2.48
C. $2.88
D. $4.88
E. $5.60

Question 8

Mel listens to music on her ipod.
Let x represent the number of rap songs she has stored on her ipod and y represent the number of R'n'B songs.

She has at least twice as many rap songs as R'n'B songs.
An inequality representing this situation is

A. $2y \geq x$

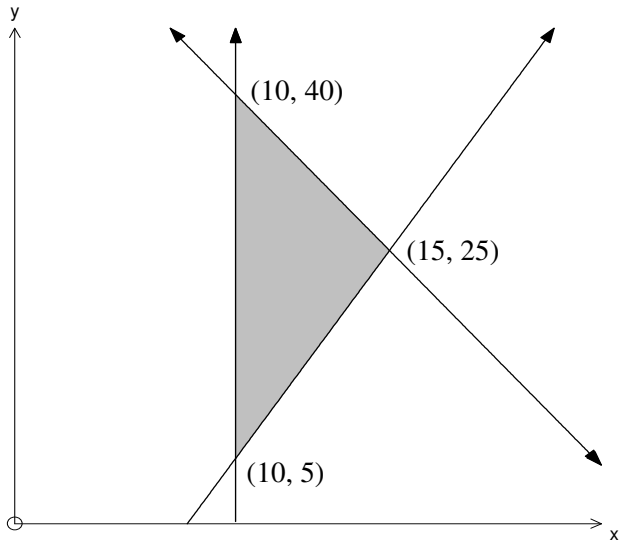
B. $2y \leq x$

C. $y \geq 2x$

D. $y \leq 2x$

E. $2 + y \geq x$

Question 9



For the shaded region above (with boundaries included), the value of the objective function $Z = 2kx + y$ is a maximum only at the point (15, 25).

A possible value for k is

A. 1

B. -1

C. 2

D. -2

E. 0

SECTION B– continued
TURN OVER

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

The number of interest bearing periods for an investment that is compounded monthly over 5 years is:

A. 5
B. 12
C. 50
D. 60
E. 72

Question 2

The table lists the bookvalue of an air-conditioning plant bought new for $260 000.

Time (years)	Bookvalue ($)
0	260 000
1	234 000
2	210 600
3	189 540
4	170 586

The depreciation model and percentage depreciation used is

A. straightline depreciation at 10% pa
B. straightline depreciation at 9% pa
C. reducing balance depreciation at 11% pa
D. reducing balance depreciation at 10% pa
E. reducing balance depreciation at 9% pa

Question 3

Date	Transaction	Debit $	Credit $	Balance $
5th May	Salary		420.50	841.00
12th May	ATM withdrawal	70.00		
23rd May	EFTPOS purchase	150.70		620.30
25th May	Salary		200.00	
31st May	ATM withdrawal	300.00		

For the above bank statement, complete the balance column. The minimum monthly balance for May is

A. $620.30
B. $520.30
C. $420.50
D. $420.30
E. $841.00

Question 4

A charity fund is to be setup with a large donation of $220 000. The charity is able to get a financial institution to offer perpetuity with a long-term interest rate of 5% per annum. The amount that can be offered every three-month period is closest to

A. $2200
B. $2750
C. $3667
D. $5500
E. $8000

Question 5

Wendy has two options for investing the sum of $5000. Option 1 is investing $5000 at 8% p.a. compounded yearly for 3 years. Option 2 is to invest the $5000 at a flat rate of interest of 9%p.a. for 3 years.
After 3 years, the **difference** in the interest earned by each option is

A. $44.51
B. $45.14
C. $51.44
D. $54.14
E. $54.41

Question 6

The Victorian State Government Vehicle Stamp Duty Schedule is shown.

Vehicle Ownership			
Dutiable Value of Vehicle	**New Vehicles**		**Used Vehicles**
	Commercial	Passenger	
Less than $57 009	**$5 per $200 or part thereof**	**$8 per $200 or part thereof**	**$8 per $200 or part thereof**
Exceeding $57 009	**$5 per $200 or part thereof**	**$10 per $200 or part thereof**	**$8 per $200 or part thereof**

The amount of stamp duty payable for a new passenger vehicle with a value of $38 900 car is

A. $975
B. $1556
C. $1560
D. $1945
E. $1950

Question 7

A reducing balance loan of $180 000 is taken out at 7.9% p.a. (adjusted monthly) to finance the purchase of a house. It is to be repaid with monthly instalments of $1500. The final payment will be

A. $1260.49
B. $1252.25
C. $1494.41
D. $239.51
E. $1500

Question 8

If the effective interest rate is 7.5% p.a. on a hire purchase with monthly repayments over 5 years, then the flat interest rate is closest to:

A. 3%
B. 3.8%
C. 3.75%
D. 14.8%
E. 15%

Question 9

Wendy is planning to retire in 12 years time. Her annual salary is $60 000 and her monthly employer contributions are 10% of her gross monthly income. The superannuation fund has been returning an interest rate of 7.3% p.a. compounded monthly. Wendy's current balance is $162 000 which she wants to grow to $800 000.

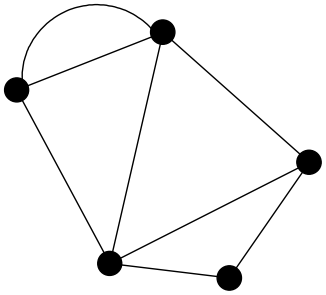
The extra amount that Wendy will have to contribute each month to ensure this final payout is achieved is closest to

A. $500
B. $1800
C. $2140
D. $5180
E. $1300

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

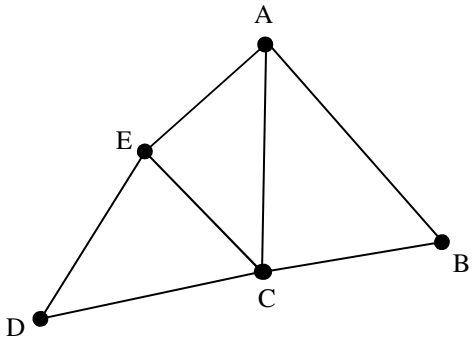


The graph shown above can be described as

A. connected and planar
B. complete and planar
C. planar with no circuits
D. a tree with three circuits
E. simple and connected

Question 2

For the graph shown, it is possible to form an Euler path that



A. starts at A and finishes at C
B. starts at E and finishes at B
C. starts at E and finishes at A
D. starts at B and finishes at D
E. starts at D and finishes at A

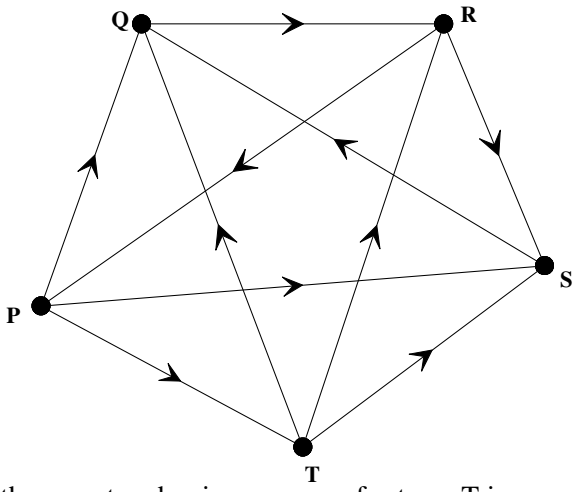
Question 3

A connected planar graph has 7 vertices.
This graph could have

A. 4 faces and 9 edges
B. 4 faces and 8 edges
C. 3 faces and 9 edges
D. 5 faces and 8 edges
E. 4 faces and 5 edges

The following information relates to Questions 4 and 5

Five teams P, Q, R, S and T play each other in a round robin competition. The results for the competition are represented in the digraph below.



Question 4

In this competition, the one-step dominance score for team T is

A. 2 and the ranking is 3rd place

B. 3 and the ranking is 2rd place

C. 3 and the ranking is equal 1st

D. 2 and the ranking is 2nd place

E. 1 and the ranking is 3rd place

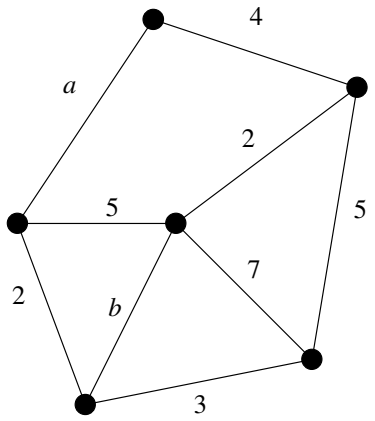
Question 5

The one-step and two-step dominance matrix is

A. $\begin{bmatrix} 0 & 2 & 2 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 2 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{bmatrix}$ **B.** $\begin{bmatrix} 0 & 3 & 2 & 2 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 2 & 0 & 2 & 1 \\ 0 & 1 & 1 & 0 & 0 \\ 1 & 2 & 2 & 2 & 0 \end{bmatrix}$ **C.** $\begin{bmatrix} 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$

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

Question 6
Consider the following network.



The minimum spanning tree has a length of 14 when the weighting for a and b are

A. $a = 2 \quad b = 3$
B. $a = 2 \quad b = 5$
C. $a = 1 \quad b = 6$
D. $a = 3 \quad b = 3$
E. $a = 3 \quad b = 4$

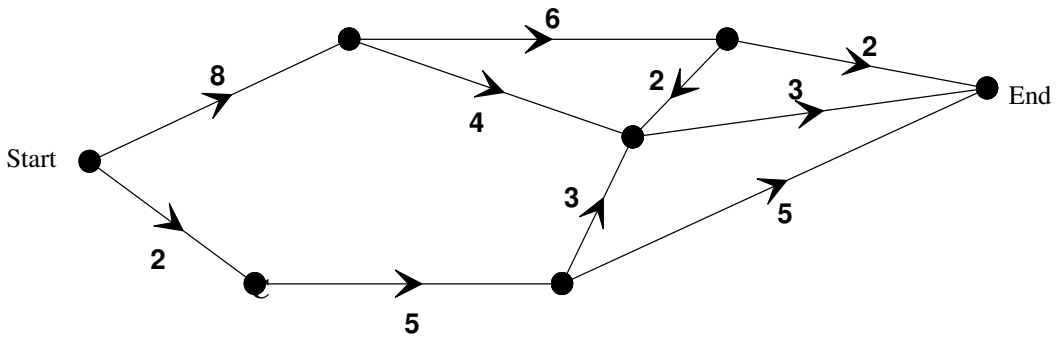
Question 7
The following table shows the fastest time (in minutes) each of the four team members can complete four different sporting events.

	hurdles	**400 m run**	**cycling**	**swim**
Anne	2	5	10	3
Brendan	4	3	8	9
Cindy	7	8	9	2
Dan	6	8	8	4

Each person in the team is to compete in only one event. The competition allows for only one event to be completed before another begins. All four events can be completed in the shortest possible time if

A. Anne hurdles, Brendan runs, Cindy cycles and Dan swims
B. Anne runs, Brendan hurdles, Cindy swims and Dan cycles
C. Anne swims, Brendan runs, Cindy cycles and Dan hurdles
D. Anne swims, Brendan hurdles, Cindy runs and Dan hurdles
E. Anne hurdles, Brendan runs, Cindy swims and Dan cycles

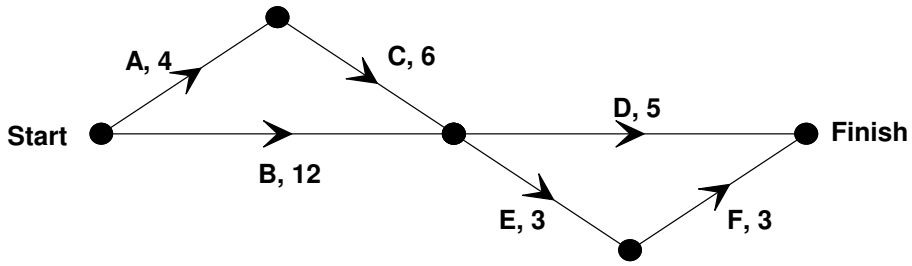
Question 8



The maximum flow in the network linking the start to finish is

A. 7
B. 10
C. 11
D. 13
E. 15

Question 9



The directed graph above shows the activities and their respective duration (in hours) for completing a project.

The latest time task C can start in order not to delay the project is

A. 4 hours after the start
B. 6 hours after the start
C. 7 hours after the start
D. 9 hours after the start
E. 12 hours after the start

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

Given the matrices $A = \begin{bmatrix} 1 & 4 \\ 2 & -3 \\ 0 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 1 & 3 \end{bmatrix}$, $C = \begin{bmatrix} 2 & 0 \\ 1 & -5 \end{bmatrix}$ and $D = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 5 & 3 \\ 4 & -1 & 2 \end{bmatrix}$

then the product matrix of the order 3×2 is a result of

A. $A \times B \times C \times D$

B. $C \times A$

C. $A \times D$

D. $D \times A$

E. $A \times A \times C$

Question 2

Given matrices $A = \begin{bmatrix} 2 & -9 \\ 1 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 4 \\ 2 & -3 \\ 0 & 2 \end{bmatrix}$ and $C = \begin{bmatrix} -3 & 2 \\ 0 & -1 \end{bmatrix}$ then

the answer when evaluating $B(A - C^2)$ is

A. $\begin{bmatrix} -3 & -5 \\ -17 & 1 \\ 2 & -2 \end{bmatrix}$

B. $\begin{bmatrix} 9 & -7 \\ 7 & -25 \\ 2 & 2 \end{bmatrix}$

C. $\begin{bmatrix} -7 & -11 \\ 1 & -11 \end{bmatrix}$

D. $\begin{bmatrix} 12 & -5 \\ 13 & -32 \\ 2 & 4 \end{bmatrix}$

E. No solution - undefined

Question 3

Given $\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \times \begin{bmatrix} 2 & 5 \\ 3 & 6 \end{bmatrix}$, the calculation would be represented by

A. $\begin{bmatrix} 2\times 2 & 3\times 5 \\ 1\times 3 & 4\times 6 \end{bmatrix}$

B. $\begin{bmatrix} 5\times 2+1\times 2 & 3\times 5+2\times 4 \\ 6\times 2+3\times 4 & 3\times 6+4\times 6 \end{bmatrix}$

C. $\begin{bmatrix} 2\times 2\times 3\times 3 & 2\times 5\times 3\times 6 \\ 1\times 2\times 3\times 4 & 1\times 5\times 4\times 6 \end{bmatrix}$

D. $\begin{bmatrix} 2\times 5 & 3\times 2 \\ 1\times 6 & 4\times 3 \end{bmatrix}$

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

Question 4

A computer supplies store has three types of inkjet cartridges priced at \$10, \$13 and \$23 and three types of laser toner cartridges priced at \$50, \$85 and \$125. The owner of the store wishes to mark down the prices of the inkjet cartridges by 8% and mark up the prices of the laser toner cartridges by 5%.

The **new prices** of **each of** the inkjet cartridges and **each of** the laser toner cartridges as a suitable matrix is **best calculated** using

A. $\begin{bmatrix} 10 & 50 \\ 13 & 85 \\ 23 & 125 \end{bmatrix} \times \begin{bmatrix} 0.92 \\ 1.05 \end{bmatrix}$

B. $\begin{bmatrix} 10 & 50 \\ 13 & 85 \\ 23 & 125 \end{bmatrix} \times \begin{bmatrix} 0.92 & 0 \\ 0 & 1.05 \end{bmatrix}$

C. $\begin{bmatrix} 10 & 13 & 23 \\ 50 & 85 & 125 \end{bmatrix} \times \begin{bmatrix} 0.92 & 0 \\ 0 & 1.05 \end{bmatrix}$

D. $\begin{bmatrix} 10 & 13 & 23 \\ 50 & 85 & 125 \end{bmatrix} \times \begin{bmatrix} 0.92 \\ 1.05 \end{bmatrix}$

E. $\begin{bmatrix} 10 & 50 \\ 13 & 85 \\ 23 & 125 \end{bmatrix} \times \begin{bmatrix} -8 \\ 5 \end{bmatrix}$

Question 5

Which of the following matrix equation statements is **false**?

A. $k(A-B)=kA-kB$

B. $A\times A^{-1}=A^{-1}\times A$

C. $A-B=B-A$

D. $A(B-C)=AB-AC$

E. $A+(B+C)=(A+B)+C$

Question 6

The weather for the next day for a tropical region of Northern Territory, from long-run data, suggests that there is a 65% chance that, if today is dry, then the next day will also be dry. Also, if today is wet, there is a 40% chance that the next day will also be wet. The transition matrix is **best** represented as a matrix by

A.
$$\begin{matrix} & Dry & Wet \\ Dry & 0.65 & 0.35 \\ Wet & 0.60 & 0.40 \end{matrix}$$

B.
$$\begin{matrix} & Dry & Wet \\ Dry & 0.65 & 0.60 \\ Wet & 0.40 & 0.35 \end{matrix}$$

C.
$$\begin{matrix} & Wet & Dry \\ Wet & 0.65 & 0.60 \\ Dry & 0.35 & 0.40 \end{matrix}$$

D.
$$\begin{matrix} & Wet & Dry \\ Wet & 0.40 & 0.35 \\ Dry & 0.60 & 0.65 \end{matrix}$$

E.
$$\begin{matrix} & Dry & Wet \\ Dry & 65 & 60 \\ Wet & 35 & 40 \end{matrix}$$

Question 7

Which one of the following statements is **not** true about **square matrices**?

A. A diagonal matrix has to be a square matrix.

B. Only square matrices can be raised to a power.

C. Finding the inverse of a matrix can only be applied to a square matrix.

D. When multiplying square matrices, order is not important.

E. All transition matrices are square matrices.

Question 8

A transition analysis for a Victorian State electorate of the voters' preference between the Labor Party and the Liberal Party is given by

$$S_n = \begin{bmatrix} 0.75 & 0.4 \\ 0.25 & 0.6 \end{bmatrix}^n \begin{bmatrix} 26000 \\ 78000 \end{bmatrix}.$$

The expected number of voters supporting each party in the long term, represented as a matrix, is:

A. $\begin{bmatrix} 26000 \\ 78000 \end{bmatrix}$

B. $\begin{bmatrix} 64000 \\ 40000 \end{bmatrix}$

C. $\begin{bmatrix} \frac{8}{13} \\ \frac{5}{13} \end{bmatrix}$

D. $\begin{bmatrix} 0.62 \\ 0.38 \end{bmatrix}$

E. $\begin{bmatrix} 59345 \\ 44655 \end{bmatrix}$

Question 9

The sum of two numbers is 87 and their difference is 27. To find the two numbers by solving two simultaneous equations, the appropriate matrix setup is

A. $\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 87 \\ 27 \end{bmatrix}$

B. $\begin{bmatrix} 87 & 0 \\ 0 & 27 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 87 \\ 27 \end{bmatrix}$

D. $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 87 \\ 27 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

E. $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} 87 \\ 27 \end{bmatrix}$

END OF MULTIPLE CHOICE QUESTION BOOK

Exam 1 & 2 Further Mathematics Formulas

Core: Data analysis

standardised score: $z = \frac{x - \bar{x}}{s_x}$

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

residual value: residual value = actual value – predicted value

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

Module 1: Number patterns

arithmetic series: $a + (a + d) + \ldots + (a + (n-1)d) = \frac{n}{2}\left[2a + (n-1)d\right] = \frac{n}{2}(a + l)$

geometric series: $a + ar + ar^2 + \ldots + ar^{n-1} = \frac{a(1 - r^n)}{1 - r}, r \neq 1$

infinite geometric series: $a + ar + ar^2 + ar^3 + \ldots = \frac{a}{1 - r}, |r| < 1$

Module 2: Geometry and trigonometry

area of a triangle: $\frac{1}{2}bc\sin A$

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

circumference of a circle: $2\pi r$

area of a circle: πr^2

volume of a sphere: $\frac{4}{3}\pi r^3$

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

volume of a cone: $\frac{1}{3}\pi r^2 h$

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

volume of a prism: area of base × height

volume of a pyramid: $\frac{1}{3}$ area of base × height

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

sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

Module 3: Graphs and relations

Straight line graphs

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

equation: $y = mx + c$

Module 4: Business-related mathematics

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

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

hire purchase: effective rate of interest $\approx \frac{2n}{n+1} \times$ 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: $A^{-1} = \frac{1}{\det A}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ where $\det A \neq 0$

END OF FORMULA SHEET

MULTIPLE CHOICE ANSWER SHEET

Student Name: .....

Circle the letter that corresponds to each correct answer

Section A	Section B		
Compulsory	Answer three different modules. Show each module selected by ticking the appropriate box.		
	Module:	Module:	Module:
	❑ Number patterns ❑ Geometry and trigonometry ❑ Graphs and relations ❑ Business related mathematics ❑ Networks and decision mathematics ❑ Matrices	❑ Number patterns ❑ Geometry and trigonometry ❑ Graphs and relations ❑ Business related mathematics ❑ Networks and decision mathematics ❑ Matrices	❑ Number patterns ❑ Geometry and trigonometry ❑ Graphs and relations ❑ Business related mathematics ❑ Networks and decision mathematics ❑ Matrices
1. A B C D E	1. A B C D E	1. A B C D E	1. A B C D E
2. A B C D E	2. A B C D E	2. A B C D E	2. A B C D E
3. A B C D E	3. A B C D E	3. A B C D E	3. A B C D E
4. A B C D E	4. A B C D E	4. A B C D E	4. A B C D E
5. A B C D E	5. A B C D E	5. A B C D E	5. A B C D E
6. A B C D E	6. A B C D E	6. A B C D E	6. A B C D E
7. A B C D E	7. A B C D E	7. A B C D E	7. A B C D E
8. A B C D E	8. A B C D E	8. A B C D E	8. A B C D E
9. A B C D E	9. A B C D E	9. A B C D E	9. A B C D E
10. A B C D E			
11. A B C D E			
12. A B C D E			
13. A B C D E			