The Mathematical Association of Victoria

FURTHER MATHEMATICS

Trial written examination 1
(Facts, skills and applications)

2008

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

Student's Name: .....

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

These questions have been written and published to assist students in their preparations for the 2008 Further Mathematics Examination 1. The questions and associated answers and solutions do not necessarily reflect the views of the Victorian Curriculum and Assessment Authority. The Association gratefully acknowledges the permission of the Authority to reproduce the formula sheet.

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SECTION A

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Core: Data analysis

Multiple-choice questions (13 questions)

Question 1

Which one of the following **pairs of** measure of centre and spread is **not affected** by outliers?

A. mean & standard deviation
B. mean & range
C. median & range
D. median & interquartile range
E. mode & range

Question 2

Hewey Weyton has a 70% chance of winning a tennis match. Use the following association table and set of 20 random numbers to answer the question.

Numbers	Result
0,1,2,3,4,5,6	WIN (70%chance)
7,8,9	LOSE (30% chance)

Random Number Table	
9 9 1 5 4	7 0 3 9 2
7 9 2 3 0	9 1 0 5 8

The above simulation of twenty Hewey Weyton's tennis matches results in

A. 9 wins
B. 11 wins
C. 12 wins
D. 14 wins
E. 16 wins

Question 3

Which one of the following is an example of discrete numerical data?

A. number of wickets taken by a bowler
B. your favourite television station
C. speed of a car captured by a speed camera
D. weight of a car
E. finishing place in a 100 metre sprint

The following information relates to questions 4 and 5

The scores of 25 ten pin bowlers at a recent weekday competition are recorded in the following stem and leaf plot.

stem	leaf
11	1 2 9
12	0 3 3 4 5 9
13	1 4 5 8 9
14	0 3 5 9
15	2 9
16	3
17	2 8 9
18	4

16 | 3 = 163

Question 4

Which of the following frequency tables is the best representation of the above stem and leaf plot?

A.

Score x	Frequency f
11-	2
12-	5
13-	4
14-	3
15-	1
16-	1
17-	2
18-	1

B.

Score x	Frequency f
110-	3
120-	6
130-	5
140-	4
150-	2
160-	1
170-	3
180-	1

C.

Score x	Frequency f
11-	3
12-	6
13-	5
14-	4
15-	2
16-	1
17-	3
18-	1

D.

Score x	Frequency f
110-119	1
120-129	3
130-139	6
140-149	7
150-159	6
160-169	1
170-179	0
180-189	1
190-199	1

E.

Score x	Frequency f
110-119	3
120-129	6
130-139	5
140-149	4
150-159	2
160-169	1
170-179	3
180-189	1

Question 5

From the above stem and leaf plot, the median, interquartile range and range respectively are

A. 141.08, 38, 73

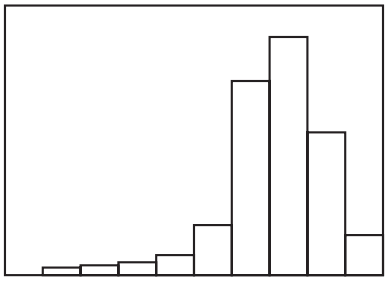
B. 138, 32, 73

C. 138, 38, 73

D. 13.8, 3.2, 7.3

E. 13.8, 3.8, 7.3

Question 6



For the histogram shown above the distribution of the data could best be described as

A. negatively skewed

B. negatively skewed with one outlier

C. positively skewed

D. positively skewed with one outlier

E. symmetrical

Question 7

The following set of data is the number of console games owned by twenty Year 8 students.

9	6	10	7	8	15	5	8	9	8
11	8	7	9	12	7	10	9	8	9

Using a suitable test for outliers, the finding is best represented by

A. three outliers of 5, 12 and 15 as they are not within the accepted range of 5.5 to 11.5

B. two outliers of 5 and 15 as they are not within the accepted range of 6 to 12

C. one outlier of 5 as it is not within the accepted range of 5.5 to 15.5

D. one outlier of 15 as it is not within the accepted range of 4.5 to 12.5

E. no outliers as all data values are within the accepted range of 1.5 to 15.5

Question 8

In a study to find the relationship between the weights of watermelons and hours of daylight, the following summary statistics were obtained.
Mean weight of watermelons = 3.0 kg
Mean hours of daylight = 6 hours
Standard deviation of watermelon weights = 0.4 kg
Standard deviation of daylight hours = 1.0 hours
Pearson's correlation coefficient = 0.8
The most appropriate regression equation is

A. *weight of watermelon* (*kg*) = 0.6 + 0.4 × *hours of daylight*

B. *weight of watermelon* (*kg*) = 2 × *hours of daylight*

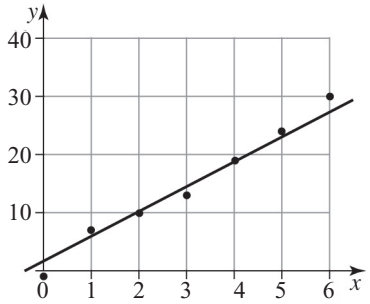
C. *weight of watermelon* (*kg*) = 1.08 + 0.32 × *hours of daylight*

D. *hours of daylight* = 2 × *weight of watermelon* (*kg*)

E. *hours of daylight* = 1.08 + 0.32 × *weight of watermelon* (*kg*)

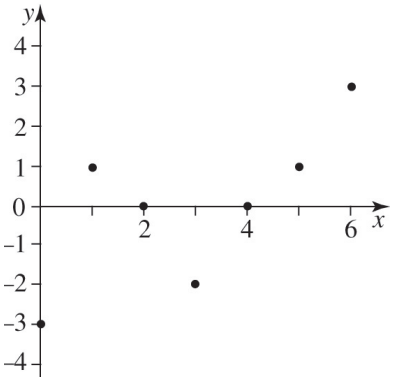
Question 9

A least squares regression line is fitted to the scatterplot shown below.



Which of the following looks most similar to the plot of residuals?

A.



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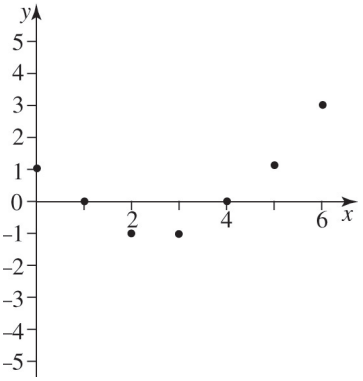
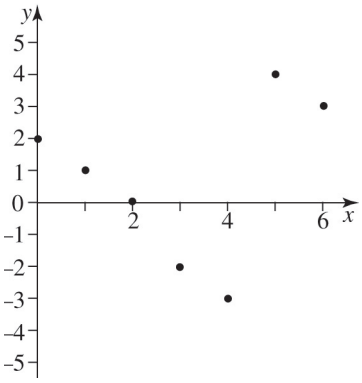
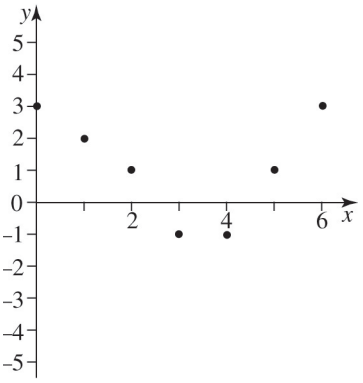


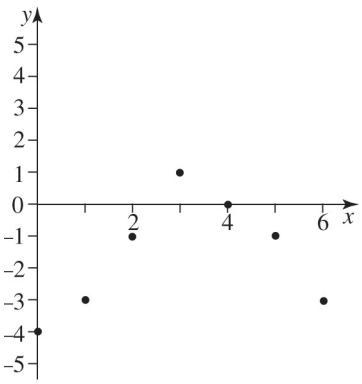
C.



D.



E.



Question 10

The following data represents the number of students attending karate lessons each week in the southern district for the past ten-week period.

Week	1	2	3	4	5	6	7	8	9	10
No. of students	550	572	586	585	630	570	620	680	660	720

The data is smoothed using a 5-point moving median. The last two points in the smoothed trend line are

A. 620 and 680

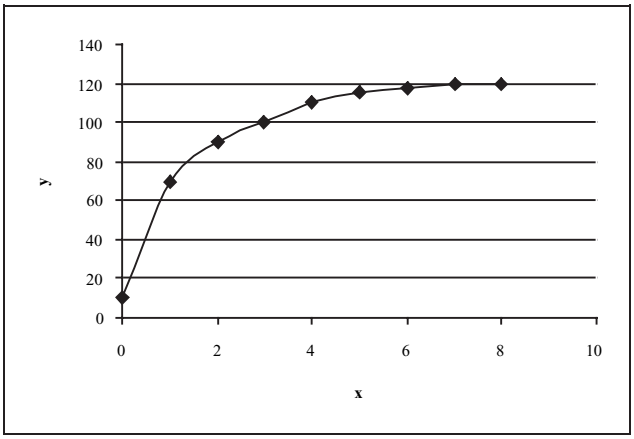
B. 660 and 680

C. 660 and 720

D. 630 and 660

E. 632 and 650

Question 11



For the above scatterplot, the most suitable transformations in either of the two variables x and y is

A. x^2 and y^2

B. $\frac{1}{x}$ and y^2

C. x^2 and $\frac{1}{y}$

D. $\log x$ and $\frac{1}{y}$

E. $\log x$ and $\log y$

The following information relates to questions 12 and 13

After extensive research of the top 1000 dog breeders and using the least squares regression, the relationship between the amount of dog food in grams and weight of dog in kilograms is given as

$$\text{Amount of dog food (grams)} = \frac{-6000}{\text{Weight of dog (kg)}} + 1800$$

The correlation coefficient is r = 0.9381

Question 12

If a dog is to be fed 1200 grams of pet food then weight of dog is closest to

A. 10 kg

B. 3 kg

C. 5.4 kg

D. 0.1 kg

E. 6.6 kg

Question 13

Using the correlation coefficient value given above, the best statement of the relationship between the two variables is

A. 93.8% of variation in amount of dog food (in grams) can be explained by its relationship with the reciprocal of weight of dog, the other 6.2% of variation in dog food can be explained by other factors such as breed.

B. 0.9381 of variation in amount of dog food (in grams) can be explained by its relationship with the reciprocal of weight of dog, the other 0.0619 of variation in dog food can be explained by other factors such as breed.

C. 93.8% of variation in weight of dog (in kg) can be explained by its relationship with the reciprocal of the amount of food (in grams), the other 6.2% of variation in weight of dog can be explained by other factors such as breed.

D. 88% of variation in weight of dog (in kg) can be explained by its relationship with the amount of food (in grams), the other 12% of variation in weight of dog can be explained by other factors such as breed.

E. 88% of variation in amount of dog food (in grams) can be explained by its relationship with the reciprocal of weight of dog, the remaining 12% of variation in dog food can be explained by other factors such as breed.

END OF SECTION A

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.

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**

Module 1: Number patterns

Instructions

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

Question 1

If the first term of an arithmetic sequence is 125 and the common difference is -2, then the 50^{th} term of this sequence is

A. 25
B. 27
C. 29
D. 223
E. 225

Question 2

If the 1^{st} term of a geometric sequence is 5, and the 3^{rd} term is 20, then the 4^{th} term could be

A. –40
B. 10
C. 27.5
D. 100
E. 320

Question 3

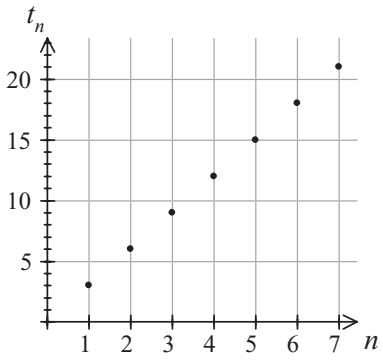
The difference equation $t_{n+1} = 1.5t_n + b$; $t_1 = 10$
generates the sequence 10, 12, 15, 19.5, ...
The value of b is

A. –5
B. –3
C. –2
D. 3
E. 5

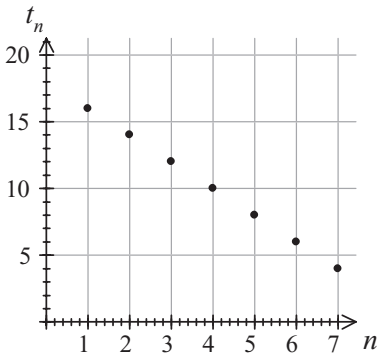
Question 4

The first 7 terms of five sequences are graphed below. Which one of the sequences represents a sequence whose sum to infinity is a finite amount?

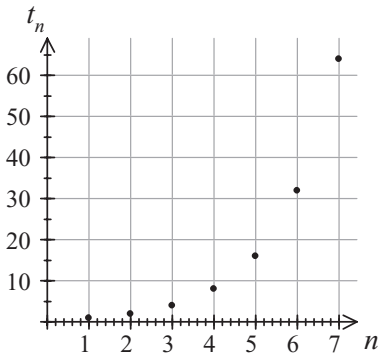
A.



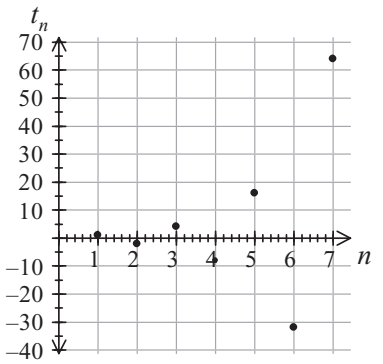
B.



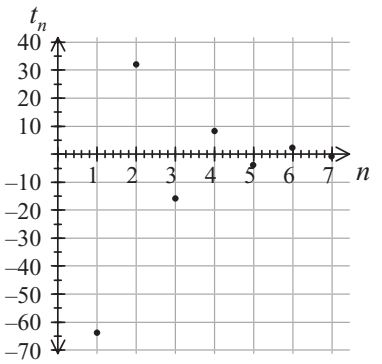
C.



D.



E.



Question 5

The difference equation $t_{n+2} = 3t_{n+1} + t_n - 6$; $t_1 = 5$; $t_2 = 10$ defines a sequence.

The fourth term of this sequence is

A. 29

B. 56

C. 61

D. 86

E. 91

Question 6

The first row of a section of seating contains 12 seats, the second row contains 14 seats, the third row 16 seats ...and so on... until the last row which contains 52 seats. The total number of seats in this section of seating is

A. 546

B. 640

C. 672

D. 704

E. 800

Question 7

Sam was employed by a company on a salary of $42 000 in his first year and then each year he received an increase of 6% of the previous year's salary. In the eight years of his employment with this company Sam has earned, to the nearest dollar, a total of

A. $352 541

B. $353 640

C. $356 160

D. $394 541

E. $415 694

Question 8

A sequence is defined by the difference equation $t_{n+1} = 1.2t_n - 20$ where $t_1 = 75$
The first term of this sequence that is a negative number is term

A. 8

B. 9

C. 10

D. 11

E. 12

Question 9

A dairy farmer has 100 cows and finds that if he kept all the female calves then the herd would increase by 45% each year. If H_n is the size of the herd after n years, the difference equation that produces a herd of approximately 160 cows after 5 years is given by

A. $H_n = 1.45H_{n-1} - 40$; $H_0 = 100$

B. $H_n = 1.45H_{n-1} - 33$; $H_0 = 100$

C. $H_n = 0.45H_{n-1} + 100$; $H_0 = 100$

D. $H_n = 1.45(H_{n-1} - 33)$; $H_0 = 100$

E. $H_n = 1.45(H_{n-1} - 40)$; $H_0 = 100$

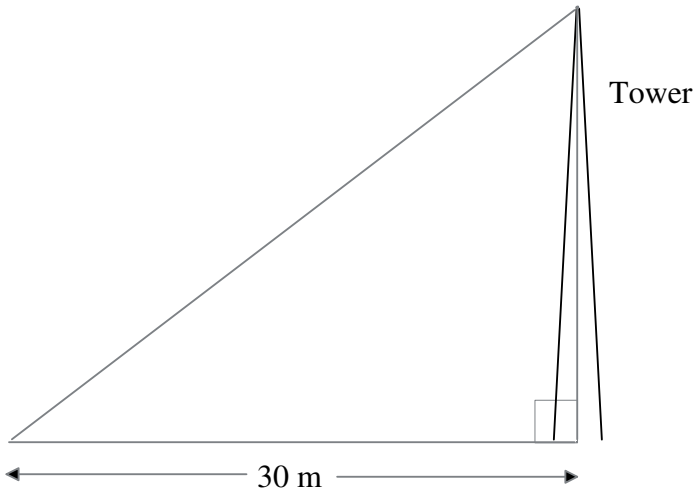
Module 2: Geometry and trigonometry

Instructions

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

Question 1

The angle of elevation, from a point 30 m from the base of a vertical tower, is 48°.



The height of the tower, to the nearest metre, is

A. 20

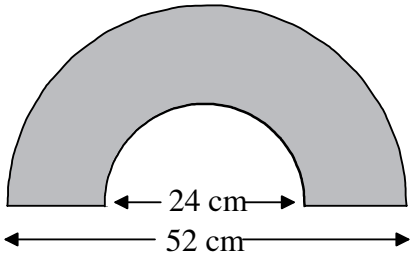
B. 22

C. 27

D. 33

E. 36

Question 2



Illustrated above is a closed figure drawn by joining two semicircles and two line segments. The large semicircle has a diameter of 52 cm and the smaller semicircle has a diameter of 24 cm.
The shaded area, correct to the nearest square centimetre, is

A. 39

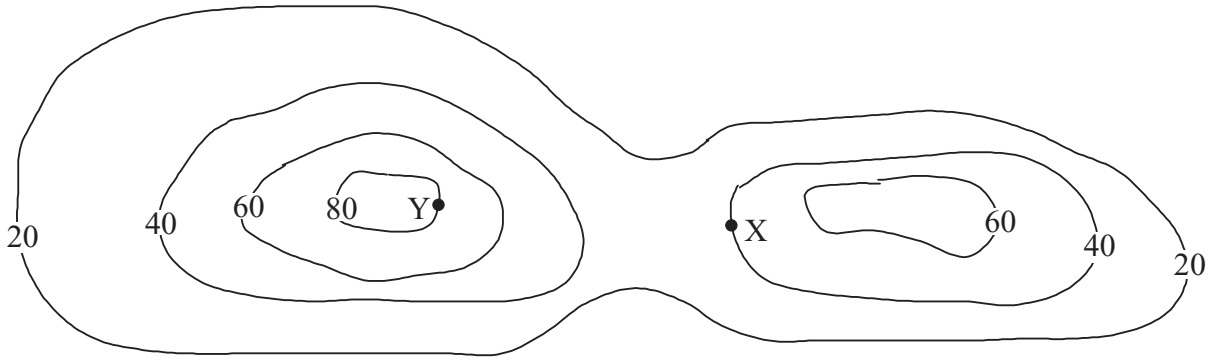
B. 305

C. 836

D. 1671

E. 3343

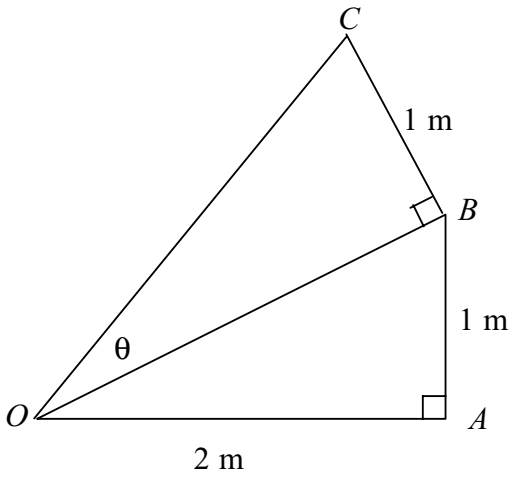
Question 3



A contour map of a region is shown above. The contour interval is 20 metres.
The actual horizontal distance between points X and Y is 2 kilometres.
The average slope from point X to point Y is

A. 0.002
B. 0.01
C. 0.02
D. 0.1
E. 0.2

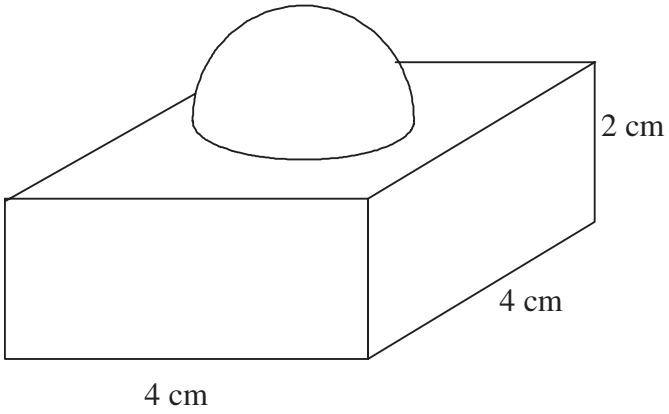
Question 4



For the triangles in the diagram above the magnitude of angle θ would be found by solving the equation

A. $\tan\theta = \frac{1}{2}$
B. $\tan\theta = 2$
C. $\tan\theta = \frac{1}{\sqrt{3}}$
D. $\sin\theta = \frac{2}{3}$
E. $\tan\theta = \frac{1}{\sqrt{5}}$

Question 5



A solid is constructed by attaching a hemisphere to the top of a box. The hemisphere has a radius of r cm where $0 < r < 2$ cm.
The box has rectangular faces and dimensions: length 4 cm, width 4 cm and height 2 cm.
The total surface area of the solid is

A. $64 + \pi r^2$

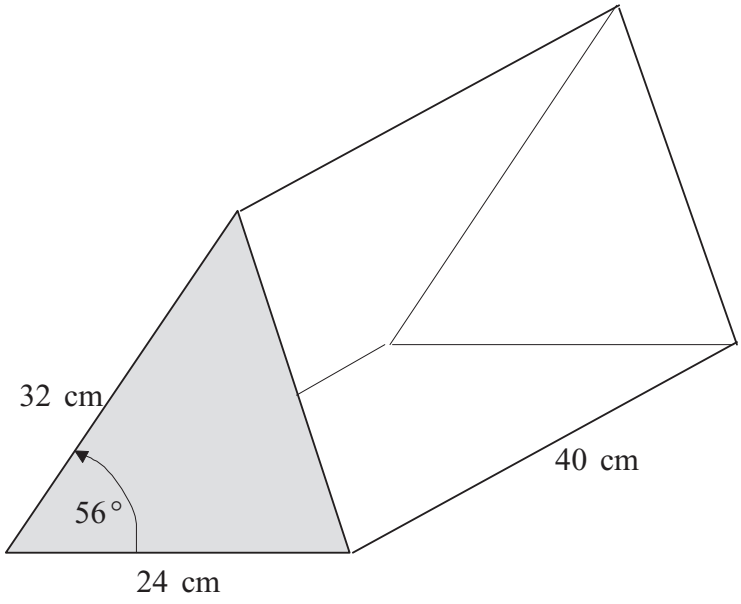
B. $64 + 2\pi r^2$

C. $64 + 3\pi r^2$

D. $64 + 4\pi r^2$

E. $64 + \frac{2}{3}\pi r^2$

Question 6



The solid, illustrated above, is a prism with length 40 cm. The prism has a triangular cross-section with one side of length 32 cm, another of length 24 cm and an included angle of 56°.
The volume of this solid, correct to the nearest cubic centimetre, is

A. 378

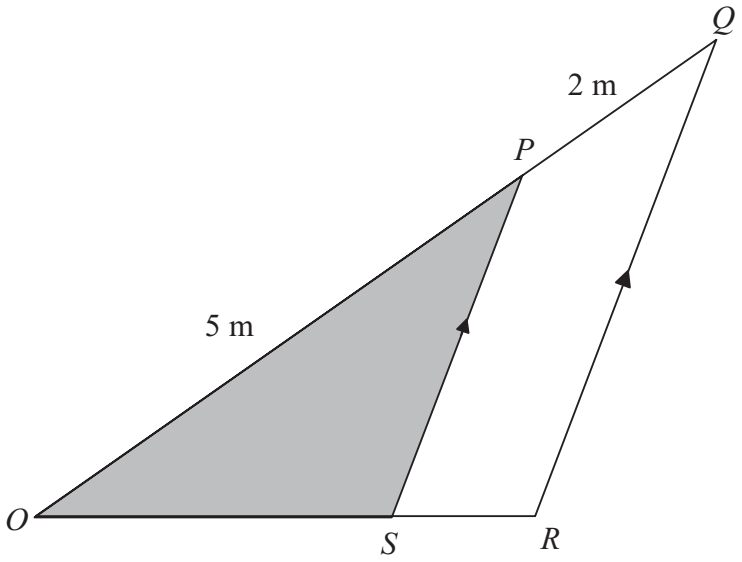
B. 8539

C. 8589

D. 12 734

E. 15 360

Question 7



In the diagram, $OP = 5$ metres and $PQ = 2$ metres.
Line segments SP and RQ are parallel.
If the area of triangle OQR is 7.5 m^2 then the shaded area, in square metres correct to two decimal places, is

A. 2.53

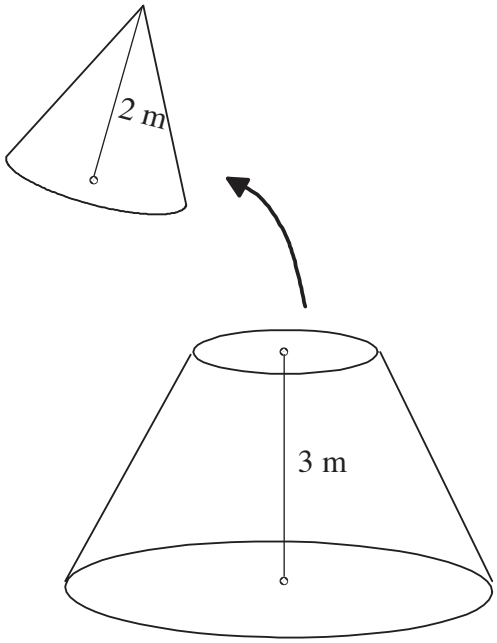
B. 3.13

C. 3.83

D. 5.36

E. 6.47

Question 8



The top two metre section of a five metre high cone is removed.
After the top is removed, the percentage of the total volume of the remaining part is closest to

A. 60%

B. 67%

C. 70%

D. 84%

E. 94%

Question 9

Point F is 16 km, on a bearing of 220°, from point G.
Point H is 12 km, on a bearing of 125°, from point G.
The distance between points F and H, in kilometres correct to two decimal places, is closest to

A. 5.39

B. 20.82

C. 24.90

D. 26.35

E. 27.77

Module 3: Graphs and relations

Instructions

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

Question 1

A straight line has a y-intercept of -3 and passes through the point (5, 2).
The gradient of this line is

A. -1

B. $-\frac{1}{5}$

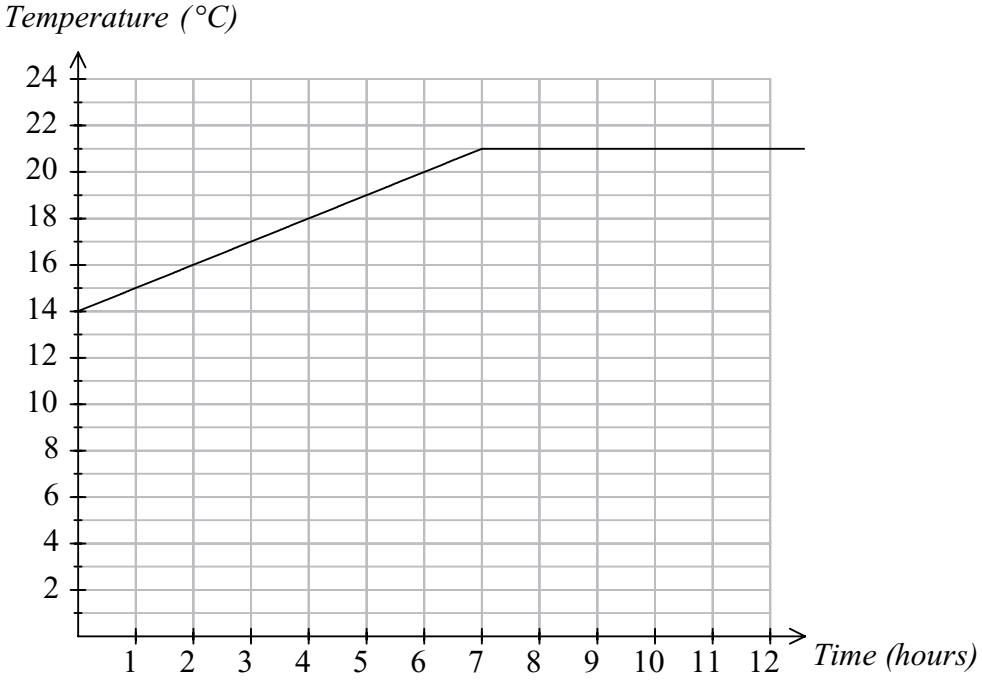
C. $\frac{1}{4}$

D. 1

E. 4

The following information relates to questions 2 and 3.

The graph below shows the temperature in a house over a period of 12 hours.



Question 2

Which one of the following is **true** about the rate at which the temperature is increasing over the first seven hours?

A. The temperature is increasing at a constant rate

B. The temperature is increasing at an increasing rate

C. The temperature is increasing at a variable rate

D. The temperature is increasing at 14 °C/hour

E. The temperature is increasing at more than 14 °C/hour

Question 3

The average rate of change, in °C/hour, of the temperature over the 12-hour period is closest to

A. 0.6

B. 1

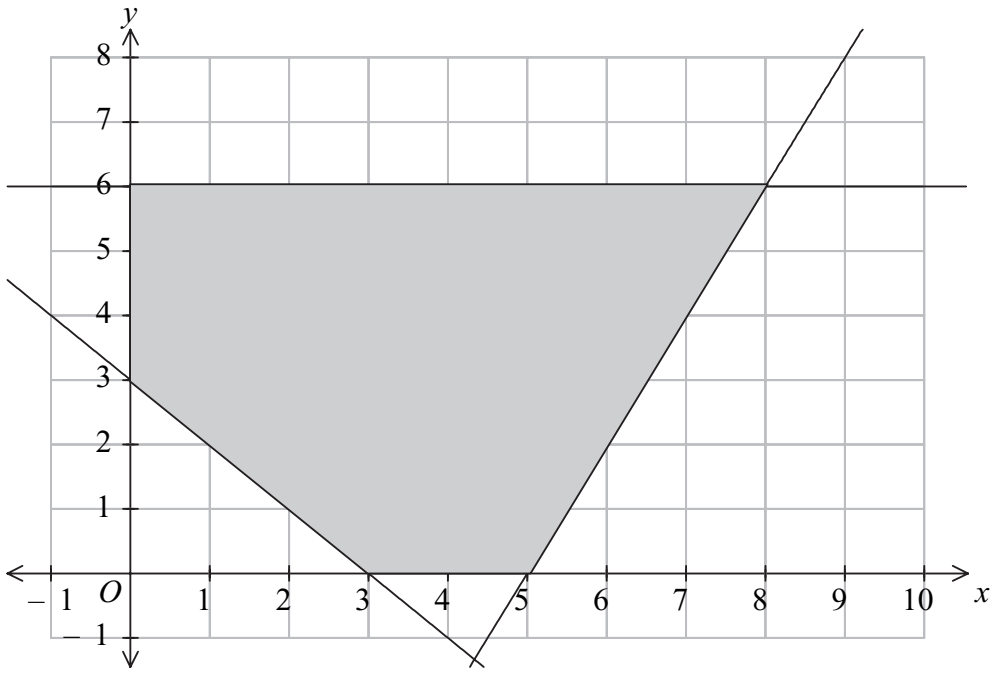
C. 1.2

D. 1.8

E. 3

Question 4

In the diagram below, the shaded region (with boundaries included) represents the feasible region for a linear programming problem.



Which one of the following constraints does **not** apply to the linear programming problem?

A. $x \geq 0$

B. $y \geq 0$

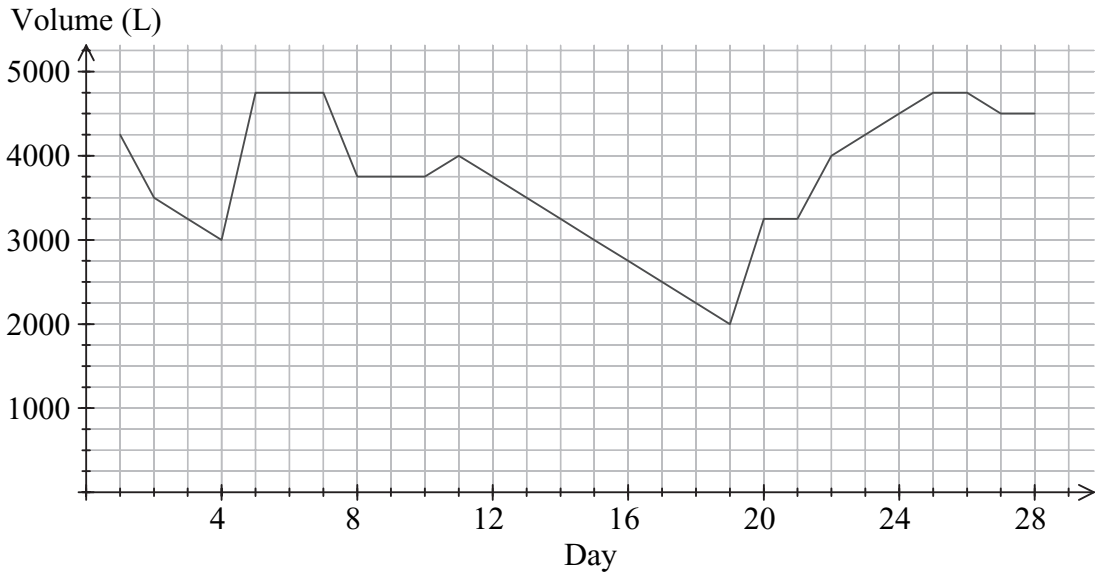
C. $y \geq 3 - x$

D. $y \leq 6$

E. $y \geq 2x$

Question 5

The daily volume of water in a 5000 L rainwater tank, over a period of four weeks, is graphed below.



From the graph it can be seen that the number of days that rain fell during this four week period was

A. 5

B. 6

C. 7

D. 8

E. 9

Question 6

The cost ($\$C$) to a manufacturer of producing x articles is given by the expression $C = 7250 + 6.4x$. The manufacturer sells these articles for $15 each.

The number of articles he needs to produce and sell if he is to make a profit is at least

A. 339

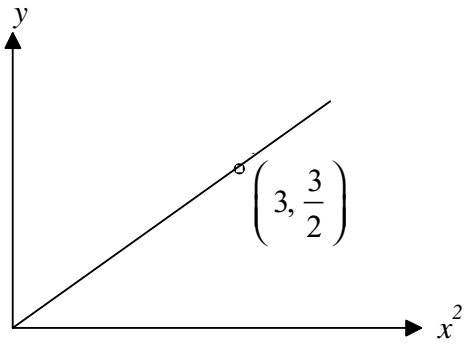
B. 484

C. 796

D. 844

E. 1133

Question 7

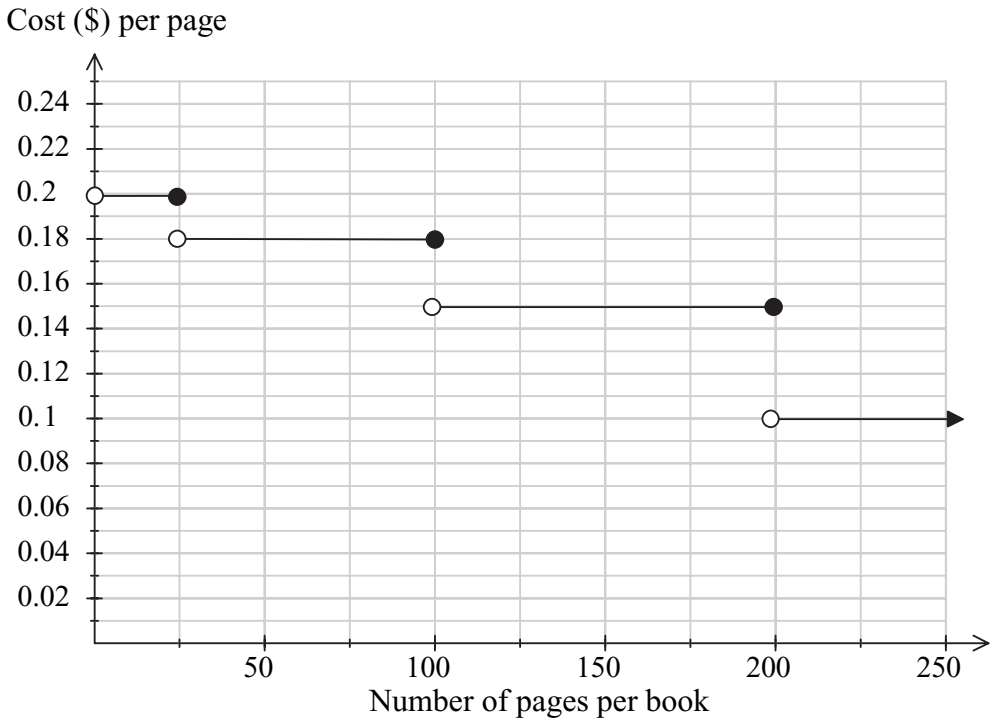


The graph above shows a relationship between y and x^2
For the same relationship, if $x = 4$ then y will have the value

A. 4
B. 8
C. 16
D. 32
E. 36

Question 8

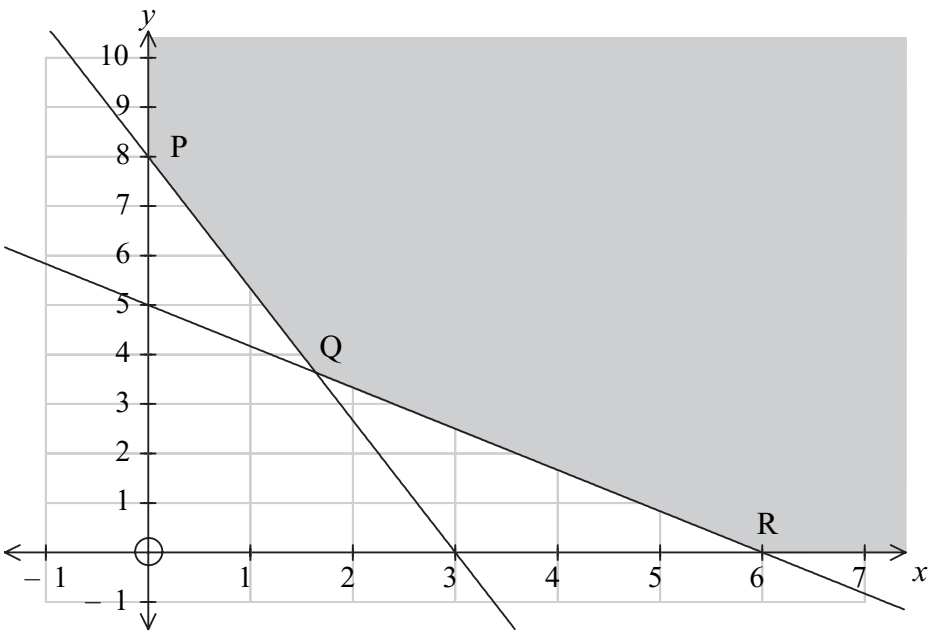
The cost per page of printing booklets is shown on the graph below.



A company wants to print 100 booklets containing 25 pages each and 200 booklets containing 80 pages each. The total cost, in dollars, to the company will be

A. 2050
B. 2100
C. 2900
D. 3330
E. 3380

Question 9



The unbounded region, shaded on the graph above, is defined by the constraints

$x \geq 0$

$y \geq 0$

$5x + 6y \geq 30$

$8x + 3y \geq 24$

The minimum value for the objective function $Z = 10x + 3y$ will be found

A. at the point P

B. at the point Q

C. at the point R

D. at all the points along the line joining P and Q

E. at all the points along the line joining Q and R

Module 4: Business-related mathematics

Instructions

Before answering these questions you must **shade** the Business-related mathematics box on the answer sheet for multiple-choice questions.

Question 1

Lara bought a property for $250 000 in June 2008. Furthermore she had to pay a total of $10 000 in stamp duty and solicitor's fees. She plans to sell the property, which will cost her a total of $10 000 in solicitor's fees and agent's commission. Her Capital Gain, if she sells the property for $300 000 within the first twelve months is

A. $15 000
B. $30 000
C. $40 000
D. $45 000
E. $50 000

Question 2

A store offering a 10% sale, sells DVDs for $27. The price of DVDs was originally

A. $30.00
B. $29.70
C. $24.30
D. $27.27
E. $32.00

Question 3

Scott received $2.55 in interest for the month of July on his savings account. If the minimum balance for July was $564.00, the simple interest rate per annum was

A. 0.45%
B. 5.43%
C. 4.67%
D. 5.00%
E. 2.55%

Question 4

A college has set up a Year 11 perpetuity scholarship of $4000 a year. The deputy principal is able to get a financial institution to offer a long-term interest rate of 8% per annum. The amount that needs to be deposited into the scholarship fund is closest to

A. $20 000
B. $25 000
C. $32 000
D. $50 000
E. $100 000

Question 5

What is the difference in investing $5000 at 8% p.a. compounded yearly for 3 years, as compared with investing the $5000 at a flat rate of interest of 9% for 3 years?

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

Question 6

A photocopier was bought for $32 000 and the owner elected to depreciate it by the prime cost (flat rate) method. If the scrap value was $3200 in 10 years, the annual depreciation would be closest to

A. 3.2%
B. 6%
C. 9%
D. 10%
E. 21%

Question 7

Mr Ive Haddit aged 45 is planning to retire at 60 and estimates he needs $800 000 to provide for his retirement. His current super fund has a balance of $120 000 and is delivering 5.8% pa compounded monthly. The monthly contributions needed to meet his retirement lump sum is given by

A. $7064
B. $3798
C. $3603
D. $2100
E. $1798

Question 8

Cruise Autos at Autocity advertises a used car for $19 800. The terms are $5000 deposit plus $650 per month for 3 years. The effective rate of interest per annum is

A. 19.37%
B. 37.69%
C. 38.74%
D. 58.11%
E. 43.43%

Question 9

David wants to borrow $80 000 for a sports car and his bank offers him a personal loan for that amount at an interest rate of 12% pa, interest debited quarterly, with quarterly repayments of $4240 over 10 years. **After 5 years** he wants to calculate how much he still owes by using the annuities formula. Which of the following equations should he use?

A. $A = 80\,000 \times 1.03^{20} - \dfrac{4240(1.03^{20} - 1)}{1.03 - 1}$

B. $A = 80\,000 \times 1.12^{5} - \dfrac{4240(1.12^{5} - 1)}{1.12 - 1}$

C. $A = 4240 \times 1.03^{40} - \dfrac{80\,000(1.03^{40} - 1)}{1.04 - 1}$

D. $A = 4240 \times 1.12^{5} - \dfrac{80\,000(1.12^{5} - 1)}{1.12 - 1}$

E. $A = 80\,000 \times 1.04^{20} - \dfrac{4240(1.04^{20} - 1)}{1.04 - 1}$

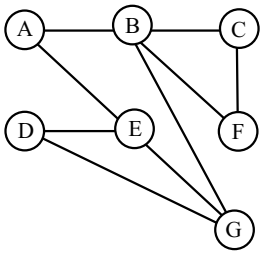
Module 5: Networks and decision mathematics

Instructions

Before answering these questions you must **shade** the Networks and decision mathematics box on the answer sheet for multiple-choice questions.

Question 1

The sum of the degrees of all the vertices of the network shown below is



A. 7
B. 9
C. 16
D. 18
E. 20

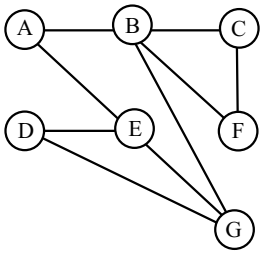
Question 2

A planar graph consists of 7 vertices and 10 edges. The number of faces in this graph is

A. 1
B. 3
C. 5
D. 7
E. 17

Question 3

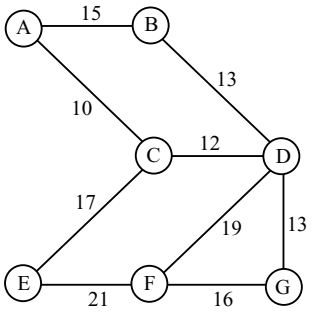
Consider the following network.



A possible Euler path for the network shown above is

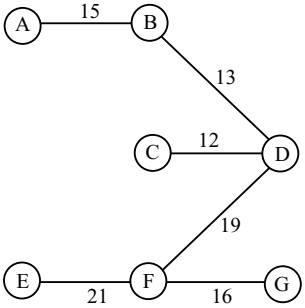
A. G – B – C – F – B – A – E – G – D – E
B. A – E – D – G – E – A – B – C – F – B – G
C. A – E – D – G – E – A – B – C – F – B
D. G – B – C – F – B – A – E – G – D
E. B – C – F – B – G – D – E – A – B

Question 4

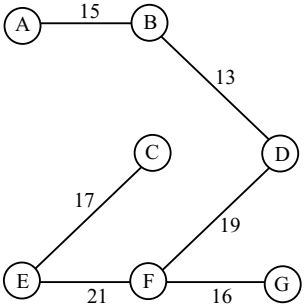


The maximum spanning tree for the above network is

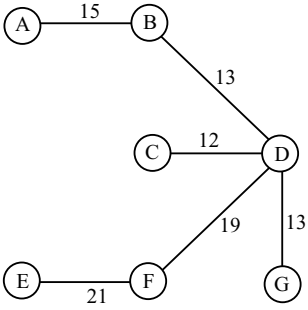
A.



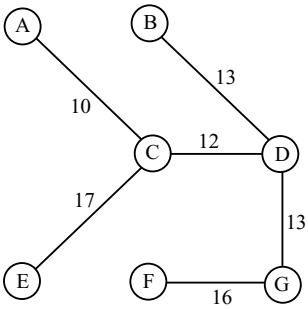
B.



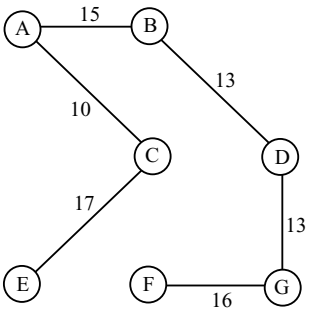
C.



D.

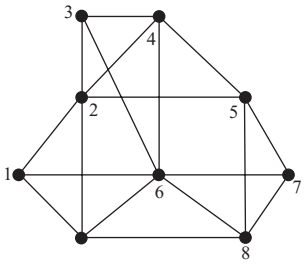


E.



Question 5

The network of electrical wires is shown in **Figure A**. **Figure B** is the same network but the electrical wiring is arranged so they do not cross each other.



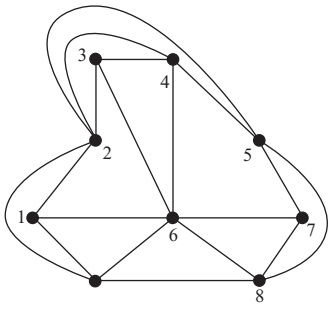


Figure A – Electrical Network **Figure B – redesigned Electrical Network**

The redesigned Electrical Network of **Figure B** is an example of a

A. A spanning tree

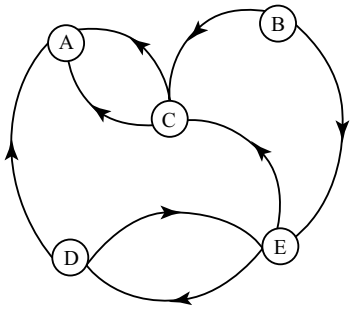
B. A bi-partite graph

C. A planar graph

D. A complete graph

E. A degenerate graph

Question 6



The one-stage adjacency matrix for the above network is

A.

From \ To	A	B	C	D	E
A	0	0	0	0	0
B	0	0	1	0	1
C	1	0	0	0	0
D	1	0	0	0	1
E	0	0	1	1	0

B.

From \ To	A	B	C	D	E
A	0	0	0	0	0
B	2	0	1	1	0
C	0	0	0	0	0
D	0	0	1	0	0
E	3	0	0	0	0

C.

From \ To	A	B	C	D	E
A	0	1	1	0	0
B	1	1	0	0	1
C	1	0	1	0	1
D	0	0	0	1	1
E	0	1	1	1	0

D.

From \ To	A	B	C	D	E
A	0	0	2	1	0
B	0	0	1	0	1
C	2	1	0	0	1
D	1	0	0	0	2
E	0	1	1	2	0

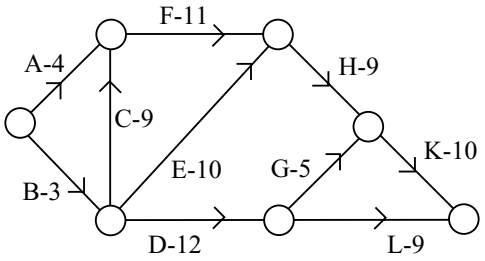
E.

From \ To	A	B	C	D	E
A	0	0	0	0	0
B	0	0	1	0	1
C	2	0	0	0	0
D	1	0	0	0	1
E	0	0	1	1	0

.

The following information relates to questions 7 to 9

The network diagram shown below is for the construction of a fashion exhibition stage. Activity times are shown in hours.



Question 7

The immediate predecessor(s) of activity E is/are

A. activity A
B. activity B
C. activity C
D. activity D
E. activities B and C

Question 8

The earliest time, after the start of the project, that activity H can begin is

A. 13 hours
B. 15 hours
C. 20 hours
D. 23 hours
E. 37 hours

Question 9

The critical path for the entire project is

A. B – C – F – H – K
B. B – D – G – K
C. A – F – H – K
D. A – F – H – G – L
E. B – D – L

Module 6: Matrices

Instructions

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

Question 1

$$\begin{bmatrix} 2 & 7 \\ 4 & 0 \\ -1 & 5 \end{bmatrix}$$

For the matrix above, the order of matrix is

A. 2×2

B. 2×3

C. 3×3

D. 3×2

E. 6×1

Question 2

Which one of the following matrices is a diagonal matrix?

A.
$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

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

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

D.
$$\begin{bmatrix} 1 & & \\ & 1 & \\ & & 1 \end{bmatrix}$$

E.
$$\begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

Question 3

Given the following matrices

$$A = \begin{bmatrix} 5 & 3 \\ 2 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} -1 & 3 \\ 2 & -5 \end{bmatrix} \qquad I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad O = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Which of the following expressions is **false?**

A. $A + B = B + A$

B. $A - B = B - A$

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

D. $A \times B = I$

E. $AB = BA$

Question 4

In Australian rules football a goal is worth 6 points and a behind is worth 1 point. The following is a typical scoreboard.

Team	Goals	Behinds	Points
Drovers	12	15	
Hawkers	6	23	

So as to complete the above table, to find the points the correct matrix equation is

A. $\begin{bmatrix} 12 & 15 \\ 6 & 23 \end{bmatrix}\begin{bmatrix} 6 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} \text{Drovers' points} \\ \text{Hawkers' points} \end{bmatrix}$

B. $\begin{bmatrix} 12 & 6 \\ 15 & 23 \end{bmatrix}\begin{bmatrix} 1 \\ 6 \end{bmatrix} = \begin{bmatrix} \text{Drovers' points} \\ \text{Hawkers' points} \end{bmatrix}$

C. $\begin{bmatrix} 12 & 6 \\ 15 & 23 \end{bmatrix}\begin{bmatrix} 6 \\ 1 \end{bmatrix} = \begin{bmatrix} \text{Drovers' points} \\ \text{Hawkers' points} \end{bmatrix}$

D. $\begin{bmatrix} 12 & 15 \\ 6 & 23 \end{bmatrix}\begin{bmatrix} 1 \\ 6 \end{bmatrix} = \begin{bmatrix} \text{Drovers' points} \\ \text{Hawkers' points} \end{bmatrix}$

E. $\begin{bmatrix} 12 & 15 \\ 6 & 23 \end{bmatrix}\begin{bmatrix} 6 \\ 1 \end{bmatrix} = \begin{bmatrix} \text{Drovers' points} \\ \text{Hawkers' points} \end{bmatrix}$

Question 5

Given

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 5 & 3 & 7 \\ 1 & -4 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & -1 & 4 \\ 6 & 1 & 3 \\ -5 & 2 & 2 \end{bmatrix}$$

The evaluation of $\frac{1}{2}(2B - A)$ is

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

B.
$\begin{bmatrix} -9 & 1 & 7 \\ 2 & -1 & 13 \\ -7 & 7.5 & -5 \end{bmatrix}$

C.
$\begin{bmatrix} 2.5 & -2.0 & 2.5 \\ 3.5 & -0.5 & -0.5 \\ -5.5 & 4.0 & 2.0 \end{bmatrix}$

D.
$\begin{bmatrix} 5 & -4 & 5 \\ 7 & -1 & -1 \\ -11 & 8 & 4 \end{bmatrix}$

E.
Cannot be evaluated.

Question 6

The matrix representation of the network of roads between five country towns as shown in **Diagram 1** below is represented by the following matrix

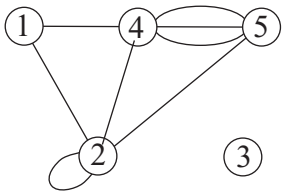
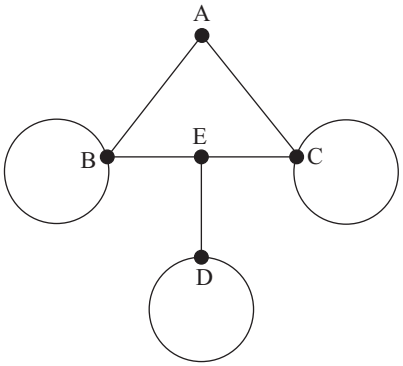


Diagram 1

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array}\begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 3 & 0 \end{bmatrix} \end{array}$$

Then a similar network as shown at right is best represented by



A.

$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

B.

$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 2 & 0 & 0 & 1 \\ 1 & 0 & 2 & 0 & 1 \\ 0 & 0 & 0 & 2 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

C.

$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 2 & 0 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 \\ 0 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 3 \end{bmatrix} \end{array}$$

D.

$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array}\begin{bmatrix} 2 & & & & \\ & 4 & & & \\ & & 4 & & \\ & & & 3 & \\ & & & & 3 \end{bmatrix}$$

E.

$$\begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{bmatrix} 2 & 4 & 4 & 3 & 2 \end{bmatrix} \end{array}$$

Question 7

For the following simultaneous equations

$$2x + y + 4z = 17$$
$$3x - 2y = -3$$
$$x + 4y + 5z = 7$$

The solution is

A. $x = 5 \quad y = 3 \quad z = 1$

B. $x = 8 \quad y = 1 \quad z = -1$

C. $x = -7 \quad y = -9 \quad z = 10$

D. $x = 59 \quad y = 57 \quad z = 40$

E. All lines are parallel thus there is NO solution

Question 8

For $T = \begin{bmatrix} 0.5 & 0.2 & 0.3 \\ 0.3 & 0.8 & 0.3 \\ 0.2 & 0 & 0.4 \end{bmatrix}$ and $S_0 = \begin{bmatrix} 100 \\ 50 \\ 80 \end{bmatrix}$ the steady state is

A. $\begin{bmatrix} 0.3 \\ 0.6 \\ 0.1 \end{bmatrix}$ **B.** $\begin{bmatrix} 69 \\ 138 \\ 23 \end{bmatrix}$ **C.** $\begin{bmatrix} 30 \\ 60 \\ 100 \end{bmatrix}$ **D.** $\begin{bmatrix} 70 \\ 135 \\ 25 \end{bmatrix}$ **E.** $\begin{bmatrix} 100 \\ 50 \\ 80 \end{bmatrix}$

Question 9

For Darwin during the monsoonal season, the probability of wet or dry days is given in the following table.

		From	
		Dry	**Wet**
To	**Dry**	0.15	0.25
	Wet	0.85	0.75

Given on the first day it is wet, the probability of the fourth day being dry is

A. 22.75%

B. 77.25%

C. 25.00%

D. 77.27%

E. 22.73%

END OF MULTIPLE-CHOICE QUESTION BOOK

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			

FURTHER MATHEMATICS

Trial written examinations 1 and 2

FORMULA SHEET

Directions to students

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

Module 1: Number patterns

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

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

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

Module 2: Geometry and trigonometry

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

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

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 × height

volume of a pyramid: $\dfrac{1}{3}$ 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