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Student Name……

FURTHER MATHEMATICS

TRIAL EXAMINATION 1

2017

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

Instructions to students

This exam consists of Section A and Section B.
Section A contains 24 multiple-choice questions from the core.
Section A is compulsory and is worth 24 marks.
Section B begins on page 13 and consists of 4 modules each containing 8 multiple-choice questions. You should choose 2 of these modules and answer every question in each of your chosen modules. Each of the modules is worth 8 marks.
Section B is worth 16 marks.
There are a total of 40 marks available for this exam.
Students may bring one bound reference into the exam.
Students may bring into the exam one approved technology (calculator or software) and, if desired, one scientific calculator. Calculator memory does not need to be cleared. For approved computer-based CAS, full functionality may be used.
Unless otherwise stated, the diagrams in this exam are not drawn to scale.
Formula sheets can be found on pages 30 and 31 of this exam.
An answer sheet appears on page 32 of this exam.

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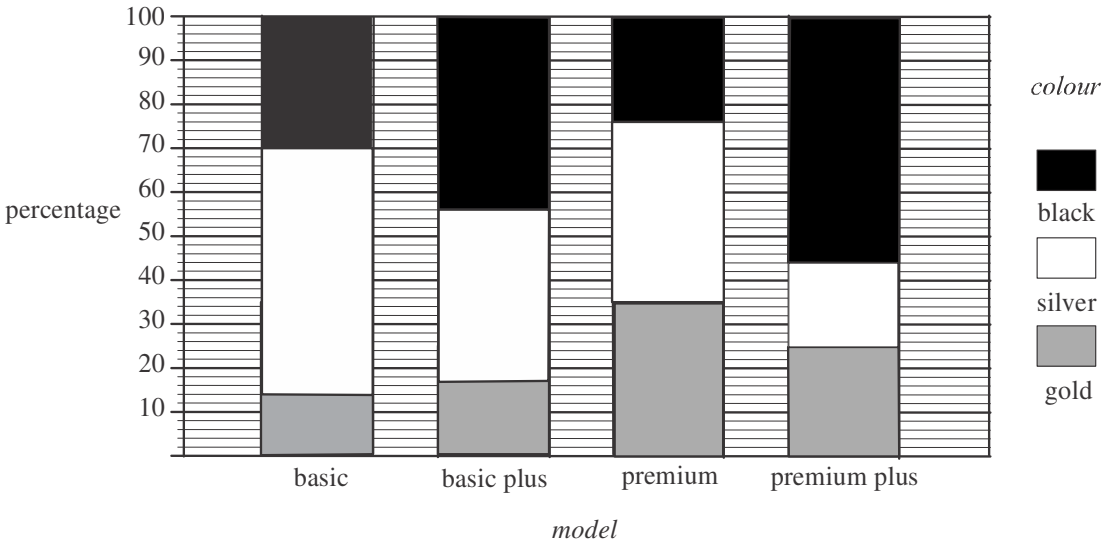
SECTION A - Core

Data analysis

This section is compulsory.

Use the following information to answer Questions 1 and 2.

The segmented bar chart below shows the distribution of the *colour* selected by purchasers when purchasing a particular *model* of a popular brand of laptop.



Question 1

The percentage of basic plus laptops purchased which were black is

A. 17%
B. 24%
C. 30%
D. 39%
E. 44%

Question 2

The variables *model* (basic, basic plus, premium, premium plus) and colour (black, silver, gold) are

A. both ordinal variables
B. both nominal variables
C. an ordinal variable and a nominal variable respectively
D. a nominal variable and an ordinal variable respectively
E. a categorical and a numerical variable respectively.

Use the following information to answer Questions 3 and 4.

The back-to-back ordered stem plot below shows the female and male participation rates, expressed as a percentage, of sixty year olds engaged in full-time work in 20 countries.

female					participation rate (%)	male							Key
			9	7	2								
		8	5	0	3								
8	6	6	5	2	4								6|4=64%
	2	2	2	0	5								
		7	5	1	6	3	4	7					
			6	2	7	0	3	5	8	8	8	9	
				3	8	1	1	2	4	5	5	7	
					9	2	3	3					

Question 3

For these 20 countries, the interquartile range (IQR) of female participation rates is

A. 3
B. 10
C. 11
D. 23
E. 27

Question 4

For these 20 countries, the participation rates for sixty year old females engaged in full-time work are generally

A. lower and less variable than the participation rates for males.
B. higher and less variable than the participation rates for males.
C. about the same as the participation rates for males.
D. higher and more variable than the participation rates for males.
E. lower and more variable than the participation rates for males.

Use the following information to answer Questions 5 and 6.

The waist measurements of the 386 women who attend a gym are approximately normally distributed with a mean of 78.2 cm and a standard deviation of 3.4 cm.

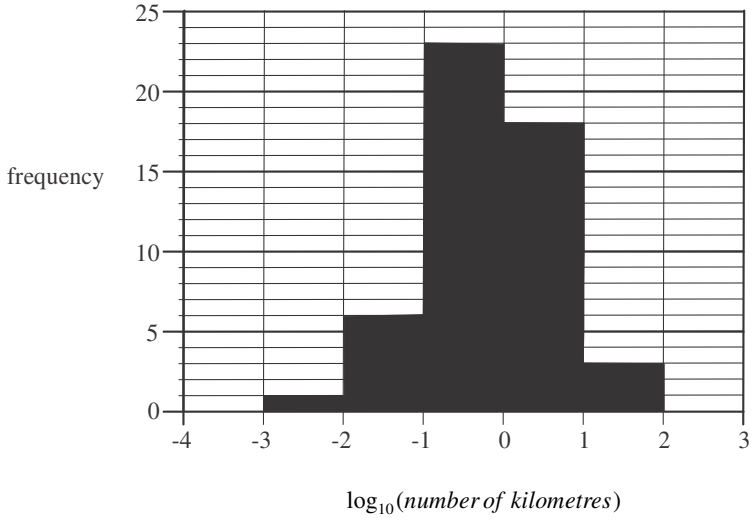
Question 5
The expected number of these women who have a waist measurement less than 85 cm is closest to

A. 19
B. 262
C. 367
D. 376
E. 385

Question 6
Two women, Jane and Marita, both attend this gym. Comparing waist measurements of all the women who attend the gym, Jane has a standard waist measurement of $z = -2.1$ and Marita's waist measurement is 10 cm more than Jane's.
Which one of the following statements is **not** true?

A. Jane's waist measurement is less than the mean waist measurement of all the women who attend the gym.
B. Jane's waist measurement is greater than 70 cm.
C. Marita's waist measurement is more than the mean waist measurement of all the women who attend the gym.
D. Marita has a standard waist measurement (z value) greater than 0.8.
E. less than 50% of all the women at the gym have a waist measurement less than Marita's.

Question 7
The histogram below shows the distribution of the *number of kilometres* walked or run by the 51 people who used a particular treadmill at a gym one day. The distribution has been plotted using a $\log_{10}$ scale.



The number of people who walked or ran less than 0.1 kilometre is

A. 6
B. 7
C. 23
D. 30
E. 32

Use the following information to answer Questions 8 and 9.

The table below shows the average weekly takings, in dollars, at 11 stores (A – K) of a clothing company in 2015 and 2016.

Store	Average weekly takings ($)	
	2015	**2016**
A	7 100	8 200
B	9 300	10 400
C	8 700	7 900
D	11 400	12 000
E	15 800	14 900
F	12 600	13 200
G	13 800	14 100
H	11 900	10 800
I	9 300	10 300
J	8 500	7 900
K	10 200	11 500

Question 8

The mean and standard deviation respectively of the average weekly takings, in dollars, at these 11 stores in 2016 was closest to

A. 10 800 and 2 313
B. 10 781 and 2 469
C. 10 781 and 2 589
D. 11 018 and 2 313
E. 11 018 and 2 426

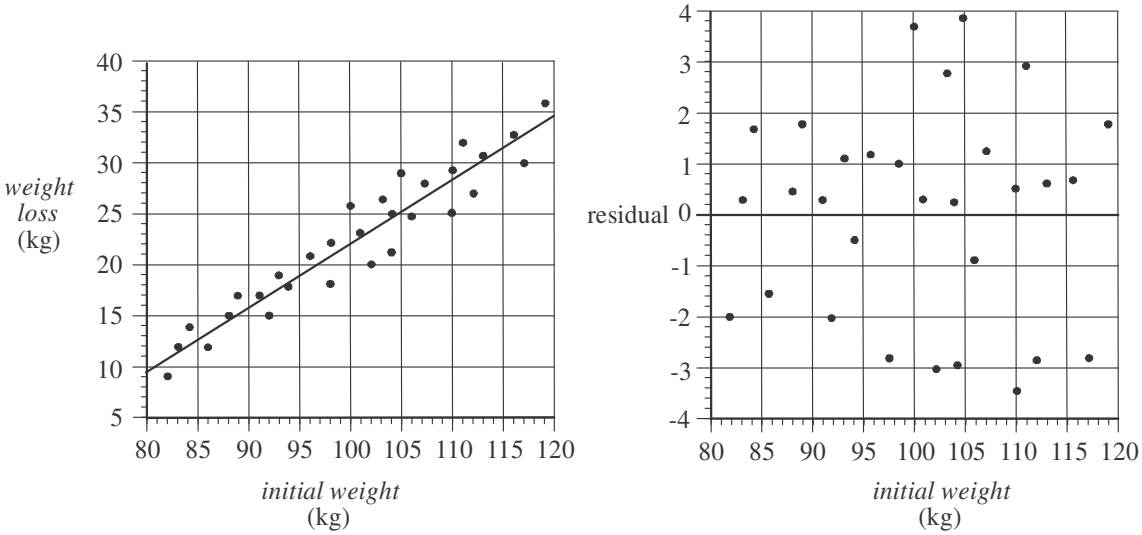
Question 9

The value of the correlation coefficient, *r*, for this set of data is closest to

A. 0.8758
B. 0.8768
C. 0.9359
D. 0.9742
E. 0.9989

Question 10

The scatterplot below shows the weight loss, in kilograms, plotted against the initial weight, in kilograms, for a group of people who followed a weight loss program.
In order to investigate the association between the variables *weight loss* and *initial weight*, a least squares regression line has been fitted to the data and the resulting residual plot is shown.



For this group of people, the equation of the least squares regression line is given by

$$weight\ loss = -40.12 + 0.62 \times initial\ weight\ .$$

Jess followed the same weight loss program. She had an initial weight of 95 kg and her weight loss was 14 kg.
When the least squares regression line is used to predict Jess' weight loss, the residual is closest to

A. – 18.8
B. – 4.8
C. 4.0
D. 4.8
E. 18.8

Question 11

For a set of bivariate data involving the variables x and y,

$$\bar{x} = 43.6,\ \ s_x = 11.6,\ \ \bar{y} = 75.2,\ \ s_y = 6.7 \text{ and } r = 0.95\ .$$

The least squares regression line that predicts y from x, is obtained using this information and is closest to

A. $y = 51.3 + 0.55x$
B. $y = 2.3 + 0.55x$
C. $y = 3.5 + 1.6x$
D. $y = 0.55 + 51.3x$
E. $y = 1.6 + 3.5x$

Question 12

A reciprocal transformation is used to linearise the relationship between the *annual rainfall*, in millimeters, recorded at a number of weather stations and *distance*, in kilometres, of these weather stations from the coast.

The least squares regression line equation for the transformed data is

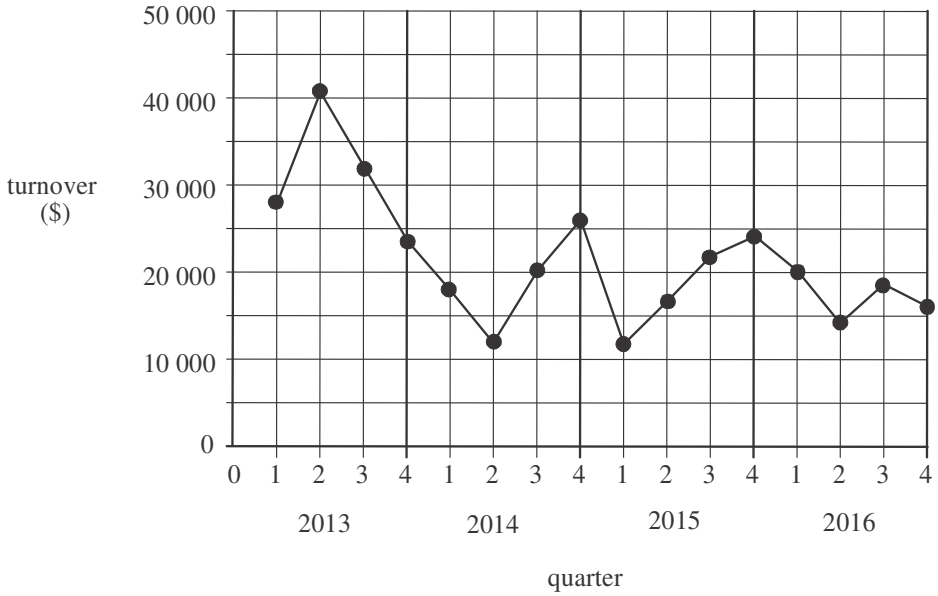
$$\frac{1}{annual\ rainfall} = 0.016 + 0.004 \times distance$$

It is predicted by this equation that the annual rainfall, in millimeters, recorded 10 kilometres from the coast would be closest to

A. 0.056
B. 5.6
C. 10.4
D. 17.9
E. 27.8

Use the following information to answer Questions 13 and 14.

The time series plot below shows the quarterly turnover, in dollars, of a retail business for the period 2013 – 2016.



Question 13

The pattern in this time series plot can be best described as having

A. seasonality and irregular fluctuations.
B. a decreasing trend and irregular fluctuations
C. seasonality, a decreasing trend and irregular fluctuations
D. an increasing trend and irregular fluctuations
E. irregular fluctuations only.

Question 14

The table below shows the data from the time series plot for the years 2015 and 2016.

Quarter	Turnover ($)
1 (2015)	12 000
2 (2105)	17 000
3 (2015)	22 000
4 (2015)	24 000
1 (2016)	20 000
2 (2016)	14 000
3 (2016)	18 000
4 (2016)	16 000

When four-mean smoothing with centring is used, the smoothed turnover for quarter 2 (2016) is closest to

A. $14 000
B. $16 500
C. $17 000
D. $18 000
E. $19 000

Question 15

A business owner wants to determine quarterly seasonal indices for the tax his business pays to the tax office. The table below shows the quarterly tax payments made by the business to the tax office for the years 2015 and 2016.

	Quarter			
	March	June	September	December
2015 tax paid ($)	8 240	6 920	10 360	12 180
2016 tax paid ($)	9 030	8 450	9 910	12 490

Using the data for these two years, the quarterly seasonal index for the tax the business pays to the tax office in the June quarter is closest to

A. 0.73
B. 0.79
C. 0.82
D. 0.85
E. 1.22

Question 16

A least squares regression line is fitted to a set of deseasonalised quarterly sales data in 2016. The equation of the line is given by

$$deseasonalised\ sales = 430\,600 + 59\,100 \times quarter\ number\ .$$

The table below shows the quarterly seasonal indices for sales for quarters 1, 2 and 4.

Quarter number	1	2	3	4
Quarterly seasonal index	0.92	1.13		1.01

Using the equation, the actual sales in quarter 3 of 2016 are predicted to be

A. $571 426
B. $593 827
C. $607 900
D. $621 845
E. $646 700

Recursion and financial modelling

Question 17

$$C_0 = 1, \qquad C_{n+1} = 2C_n - 3$$

The first five terms of the recurrence relation shown above are

A. $1, -4, -11, -25, -53, \ldots$
B. $1, -1, -5, -13, -29, \ldots$
C. $1, -1, -5, -7, -11, \ldots$
D. $2, 1, -1, -5, -13, \ldots$
E. $2, -2, -1, -5, -7, \ldots$

Question 18

Marcia's photography equipment was purchased for \$4 000. It is to be depreciated using the flat rate method at the rate of \$800 per year.
A recurrence relation that can be used to model the value V_n of this equipment n years after it was purchased is

A. $V_0 = 4\,000, \quad V_{n+1} = V_n - 800$
B. $V_0 = 4\,000, \quad V_{n+1} = V_n + 800$
C. $V_0 = 4\,000, \quad V_{n+1} = 0.2V_n$
D. $V_0 = 4\,000, \quad V_{n+1} = 0.8V_n$
E. $V_0 = 4\,000, \quad V_{n+1} = 0.92V_n$

Question 19

Helena makes an initial deposit of \$10 000 in an annuity investment which has an interest rate of 5.2% per annum compounding quarterly.
Helena deposits \$500 to the account each quarter immediately after interest has been added.
The first four lines of the table below show the growth of the investment.

Payment number	Payment made	Interest earned	Increase in principal	Balance of investment
0	0	0	0	10 000
1	500	130	630	10 630
2	500	138.19	638.19	11 268.19
3	500			

The balance of the investment after payment number 3 has been made and the interest added is

A. \$11 414.68
B. \$11 768.19
C. \$11 854.14
D. \$11 914.68
E. \$12 354.13

Question 20

Consider the recurrence relation $V_0 = 125\,000, \quad V_{n+1} = 1.02V_n - 2\,500$.
This recurrence relation could be used to model

A. an annuity investment with periodic amounts of \$2 500 added to the investment.
B. a reducing balance depreciation of an asset purchased for \$125 000.
C. a compound interest loan of \$125 000.
D. a simple interest loan of \$125 000.
E. a perpetuity with periodic payments of \$2 500 paid out of the annuity.

Question 21

Jane invests \$6 000 at an annual interest rate of 2.4% compounding quarterly. After interest has been added each quarter, Jane adds an additional \$450 to the investment.
Let V_n be the value of the investment at the end of each quarter.
A recurrence relation that can be used to model Jane's investment is

A. $V_0 = 6\,000, \; V_{n+1} = 1.24V_n$
B. $V_0 = 6\,000, \; V_{n+1} = 0.024V_n + 450$
C. $V_0 = 6\,000, \; V_{n+1} = 1.006V_n + 450$
D. $V_0 = 6\,000, \; V_{n+1} = 1.06V_n + 450$
E. $V_0 = 6\,000, \; V_{n+1} = 1.024V_n + 450$

Question 22

Hong invests \$16 000 in an account that pays interest at the rate of 4.8% per annum compounding monthly. Hong deposits the same amount to the account at the end of every month after interest has been calculated.
After two years the balance of the account is \$25 000.
The amount Hong deposited each month is closest to

A. \$294.04
B. \$368.23
C. \$1 695.06
D. \$4 427.02
E. \$4 493.92

Question 23

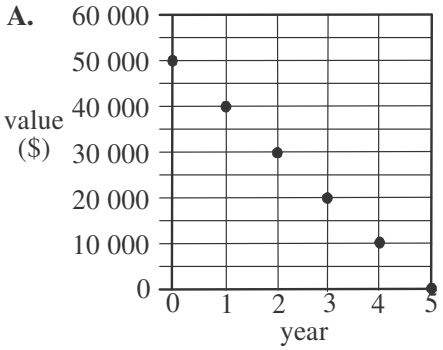
Tony takes out a reducing balance loan of \$270 000 to purchase a home. Interest is charged at the rate of I % per annum compounding monthly.
Tony makes monthly repayments of \$3 200.
After three years, the amount owing on the loan is \$211 602.44.
After five years, the amount owing on the loan is \$164 377.62.
The value of I is closest to

A. 5.7
B. 6.3
C. 7.8
D. 11.9
E. 15.1

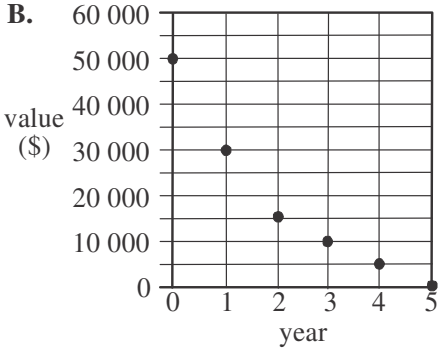
Question 24

Gerry invests $50 000 in an annuity that earns annual compound interest and pays him a constant yearly sum for a finite number of years. The graph showing the value of the investment for the first five years could be

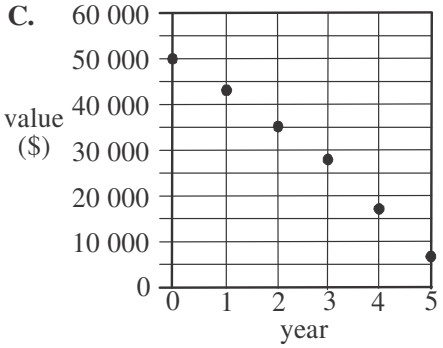
A.



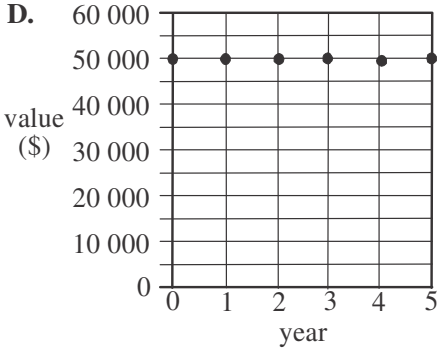
B.



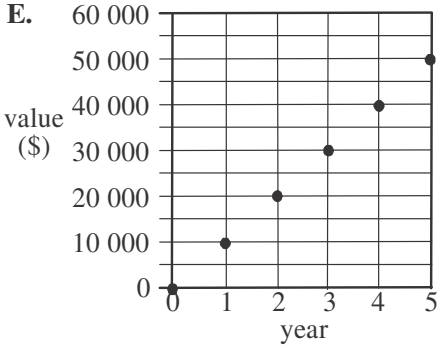
C.



D.



E.



SECTION B - Modules

Module 1 - Matrices

If you choose this module all questions must be answered.

Question 1

The matrix $\begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 3 \end{bmatrix}$ is an example of

A. a diagonal matrix
B. a unit matrix
C. a triangular matrix
D. a binary matrix
E. a permutation matrix.

Question 2

When simplified, the matrix expression $\begin{bmatrix} 3 & 4 \\ 1 & 2 \end{bmatrix}^2 \times 4 \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ is equal to

A. $\begin{bmatrix} 16 \\ 8 \end{bmatrix}$

B. $\begin{bmatrix} 20 \\ 8 \end{bmatrix}$

C. $\begin{bmatrix} 80 \\ 32 \end{bmatrix}$

D. $\begin{bmatrix} 13 & 24 \\ 9 & 16 \end{bmatrix}$

E. $\begin{bmatrix} 13 & 20 \\ 9 & 12 \end{bmatrix}$

Question 3

Consider the following four pairs of matrices.

$$\begin{bmatrix}1 & 2\end{bmatrix} \text{ and } \begin{bmatrix}2\\1\end{bmatrix}$$

$$\begin{bmatrix}3 & 8\\1 & -2\end{bmatrix} \text{ and } \begin{bmatrix}3 & 1\\8 & -2\end{bmatrix}$$

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

$$\begin{bmatrix}1\\3\\9\end{bmatrix} \text{ and } \begin{bmatrix}9\\3\\1\end{bmatrix}$$

The number of these pairs of matrices which are the transpose of each other is

A. 0
B. 1
C. 2
D. 3
E. 4

Question 4

A pair of simultaneous linear equations is represented by the matrix equation below.

$$\begin{bmatrix}4.2 & k\\2.1 & 2.5\end{bmatrix}\begin{bmatrix}x\\y\end{bmatrix} = \begin{bmatrix}3\\7\end{bmatrix}$$

The simultaneous equations have no solution when k is equal to

A. – 5
B. – 0.2
C. 0
D. 0.2
E. 5

Question 5

The table below shows the number of hours worked by each member of staff last week and their hourly pay rate.

Employee	Hours worked	Hourly pay rate
Janine	22	\$25
Hala	31	\$28
Anna	27	\$24
Linda	15	\$30
John	29	\$23

The matrix product that shows the total number of hours worked and the total amount paid to these employees is

A. $\begin{bmatrix}22 & 31 & 27 & 15 & 29\end{bmatrix}\begin{bmatrix}25\\28\\24\\30\\23\end{bmatrix}$

B. $\begin{bmatrix}25 & 28 & 24 & 30 & 23\end{bmatrix}\begin{bmatrix}22\\31\\27\\15\\29\end{bmatrix}$

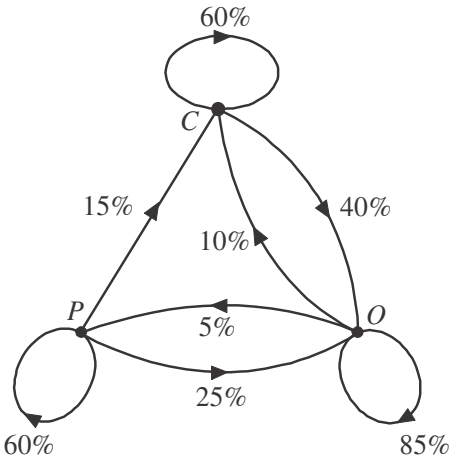
C. $\begin{bmatrix}22 & 31 & 27 & 15 & 29\\25 & 28 & 24 & 30 & 23\end{bmatrix}\begin{bmatrix}1\\1\\1\\1\\1\end{bmatrix}$

D. $\begin{bmatrix}1 & 1 & 1 & 1 & 1\\25 & 28 & 24 & 30 & 23\end{bmatrix}\begin{bmatrix}22\\31\\27\\15\\29\end{bmatrix}$

E. $\begin{bmatrix}1 & 1 & 1 & 1 & 1\end{bmatrix}\begin{bmatrix}22 & 25\\31 & 28\\27 & 24\\15 & 30\\29 & 23\end{bmatrix}$

Question 6

Council rates must be paid annually. Ratepayers in a particular municipality can choose to pay their rates online (O), by post (P) or by paying in person at the council offices (C).
The way in which these ratepayers change their method of payment from one year to the next is shown in the transition diagram below.



The same information can be represented by the transition matrix given by

A.

this year

$$\begin{array}{c} \\ C \\ O \\ P \end{array}\begin{array}{c} \begin{array}{ccc} C & O & P \end{array} \\ \begin{bmatrix} 0.6 & 0.4 & 0 \\ 0.1 & 0.85 & 0.05 \\ 0.15 & 0.25 & 0.6 \end{bmatrix} \end{array}$$

this year, next year

B.

this year

$$\begin{array}{c} \\ C \\ O \\ P \end{array}\begin{array}{c} \begin{array}{ccc} C & O & P \end{array} \\ \begin{bmatrix} 0.6 & 0.1 & 0.15 \\ 0.4 & 0.85 & 0.25 \\ 0 & 0.05 & 0.6 \end{bmatrix} \end{array}$$

this year, next year

C.

this year

$$\begin{array}{c} \\ C \\ O \\ P \end{array}\begin{array}{c} \begin{array}{ccc} C & O & P \end{array} \\ \begin{bmatrix} 0.6 & 0.05 & 0.15 \\ 0.25 & 0.85 & 0.25 \\ 0.15 & 0.1 & 0.6 \end{bmatrix} \end{array}$$

this year, next year

D.

this year

$$\begin{array}{c} \\ C \\ O \\ P \end{array}\begin{array}{c} \begin{array}{ccc} C & O & P \end{array} \\ \begin{bmatrix} 0.4 & 0.6 & 0.15 \\ 0.15 & 0 & 0 \\ 0.45 & 0.4 & 0.85 \end{bmatrix} \end{array}$$

this year, next year

E.

$$\begin{array}{c} \\ C \\ O \\ P \end{array}\begin{array}{c} \begin{array}{ccc} C & O & P \end{array} \\ \begin{bmatrix} 0.6 & 0.1 & 0.1 \\ 0.4 & 0.85 & 0.3 \\ 0 & 0.05 & 0.6 \end{bmatrix} \end{array}$$

this year, next year

Question 7

The element in row i and column j of matrix A is a_{ij} where $A = \begin{bmatrix} 3 & 6 \\ 4 & 7 \\ 5 & 8 \end{bmatrix}$

A rule that determines the elements of A is

A. $a_{ij} = i - j + 3$

B. $a_{ij} = i + j + 3$

C. $a_{ij} = 3i - j + 1$

D. $a_{ij} = 3i + j - 1$

E. $a_{ij} = i + 3j - 1$

Question 8

At a senior citizens club, the 90 members can choose each month to go to the movies (M), listen to a speaker (S) or sit and chat (C).
The transition matrix below shows how the choices of the members change from one month to the next.

$$T = \begin{array}{c} \\ M \\ S \\ C \end{array} \begin{array}{c} \begin{array}{ccc} M & S & C \end{array} \\ \begin{bmatrix} 0.4 & 0.5 & 0.2 \\ 0.1 & 0.2 & 0.6 \\ 0.5 & 0.3 & 0.2 \end{bmatrix} \end{array} \begin{array}{l} \text{this month} \\ \\ \\ \text{next month} \end{array}$$

Over the long term, we know for sure from this information that

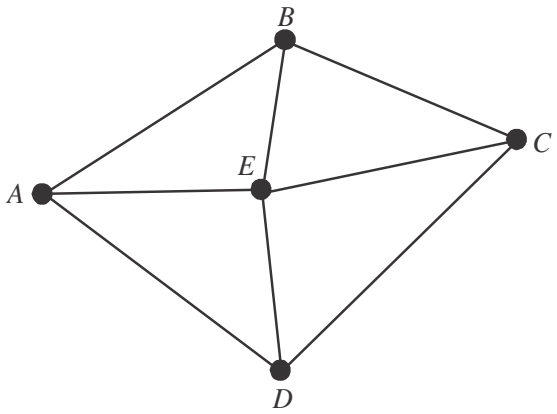
A. all members will try the three different activities at least once.
B. more members will choose to sit and chat rather than go to the movies.
C. no members will choose to listen to a speaker.
D. fewer members will choose to listen to a speaker then choose to do either of the other two activities.
E. the same number of members will choose the same activity each month.

Module 2 - Networks and decision mathematics

If you choose this module all questions must be answered.

Question 1

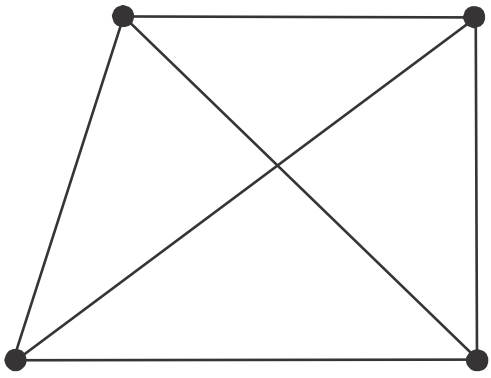
The graph below shows the paths connecting five park benches located at *A*, *B*, *C*, *D* and *E*.



Jean starts at *B* then walks to *C*, *D* and *E* before finishing at *A*. This route can be described mathematically as

A. an Eulerian trail
B. a Hamiltonian path
C. a network
D. a Hamiltonian cycle
E. an Eulerian circuit.

Question 2

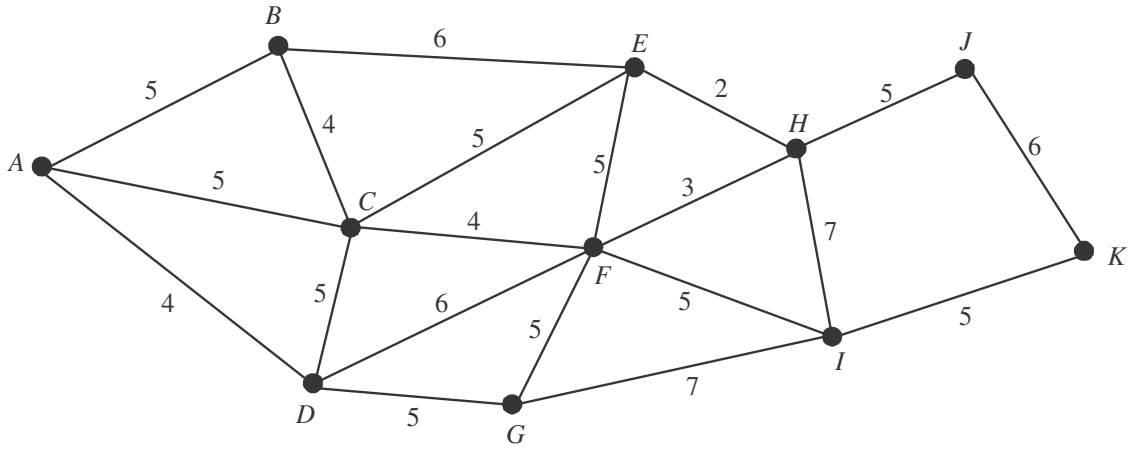


The graph shown above is

A. complete but not planar
B. planar but not complete
C. degenerate
D. both complete and planar
E. neither complete nor planar.

Question 3

The network below shows the distances in metres along the edges connecting vertices $A - K$.



The shortest distance, in metres, between vertices A and K is

A. 17
B. 18
C. 19
D. 20
E. 21

Question 4

A graph has six vertices, **one** of which is isolated.
The minimum number of edges that this graph can have is

A. 3
B. 4
C. 5
D. 6
E. 7

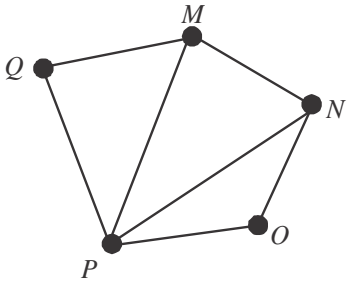
Question 5

Consider the adjacency matrix below.

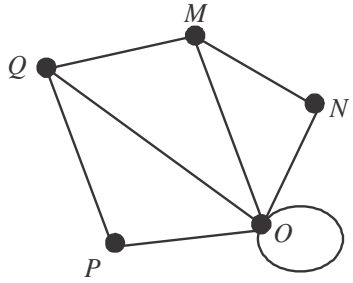
$$\begin{array}{c} \begin{matrix} M & N & O & P & Q \end{matrix} \\ \begin{bmatrix} 0 & 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \end{bmatrix} \begin{matrix} M \\ N \\ O \\ P \\ Q \end{matrix} \end{array}$$

A graph that can be drawn from this matrix is

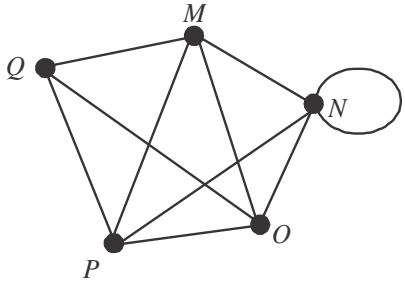
A.



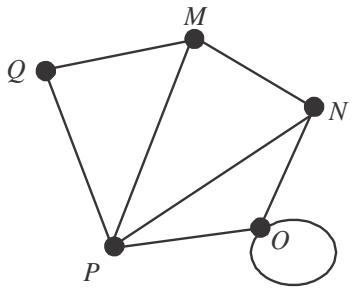
B.



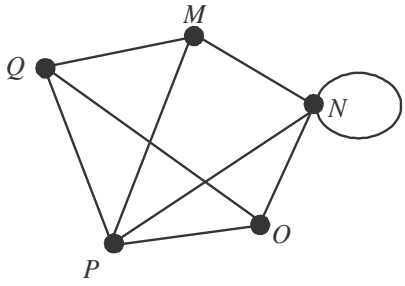
C.



D.

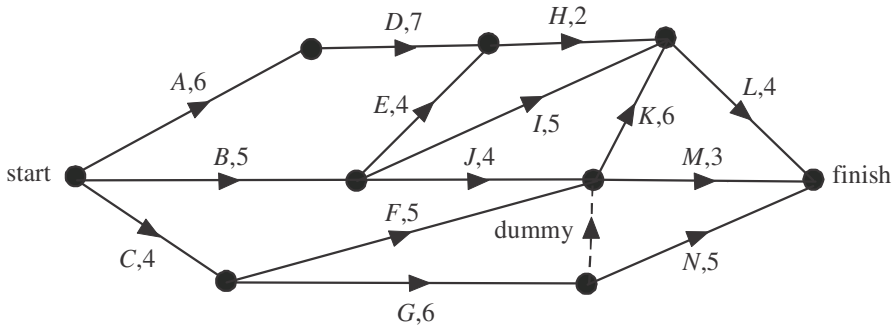


E.



Use the information below to answer Questions 6 and 7.

The directed graph below shows a sequence of activities required to complete a project.



The time, in weeks, required to complete each activity is also shown.

Question 6

The earliest start time, in weeks, for activity *L* is

A. 4
B. 10
C. 11
D. 15
E. 16

Question 7

The immediate predecessor(s) of activity *M* is/are

A. activity *J* only
B. activity *K* only
C. activity *J* and *F* only
D. activities *J*, *F* and *G* only
E. activities *B*, *C*, *J* and *F* only.

Question 8

Five consultants, Viv, Will, Xavier, Yani and Zac are each to be assigned a different task by a business. The table below shows the number of days required by each of the consultants to complete each of the tasks A - E.

	Viv	Will	Xavier	Yani	Zac
Task A	4	5	4	4	5
Task B	7	8	9	5	6
Task C	10	11	9	8	12
Task D	9	7	7	8	9
Task E	6	5	5	7	6

The business must allocate the tasks so that they can all be completed in the minimum time possible. When this is done, the consultants start their allocated task at the same time.
The second consultant to finish their task could be

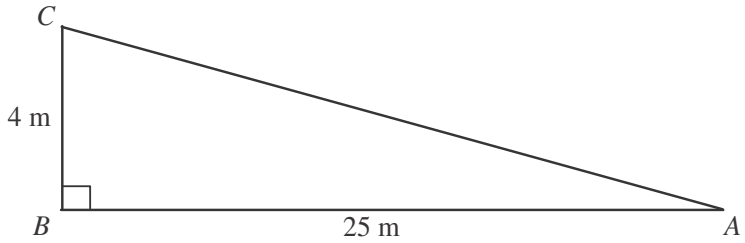
A. Viv or Will
B. Xavier or Will
C. Xavier or Yani
D. Zac or Yani
E. Viv or Zac

Module 3 - Geometry and measurement

If you choose this module all questions must be answered.

Question 1

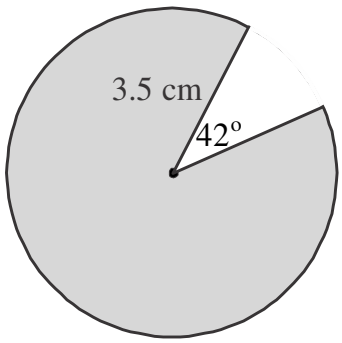
In the right-angled triangle ABC, $AB = 25\,\text{m}$, $BC = 4\,\text{m}$ and AB is horizontal.



The angle of depression of point A from point C is closest to

A. 9.0°
B. 9.1°
C. 9.2°
D. 81.0°
E. 81.8°

Question 2

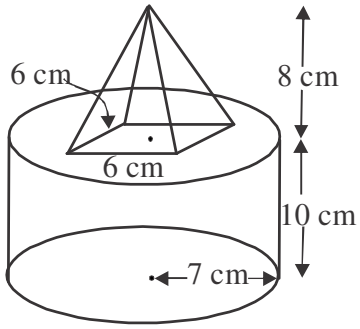


A circle of radius 3.5 cm has a sector that subtends an angle of 318° at the centre of the circle. The area of the sector, in square centimetres, is closest to

A. 3
B. 4
C. 10
D. 19
E. 34

Question 3

A square based pyramid with base side lengths of 6 cm has a height of 8 cm.
This pyramid sits on top of a cylinder with height 10 cm and radius 7 cm.

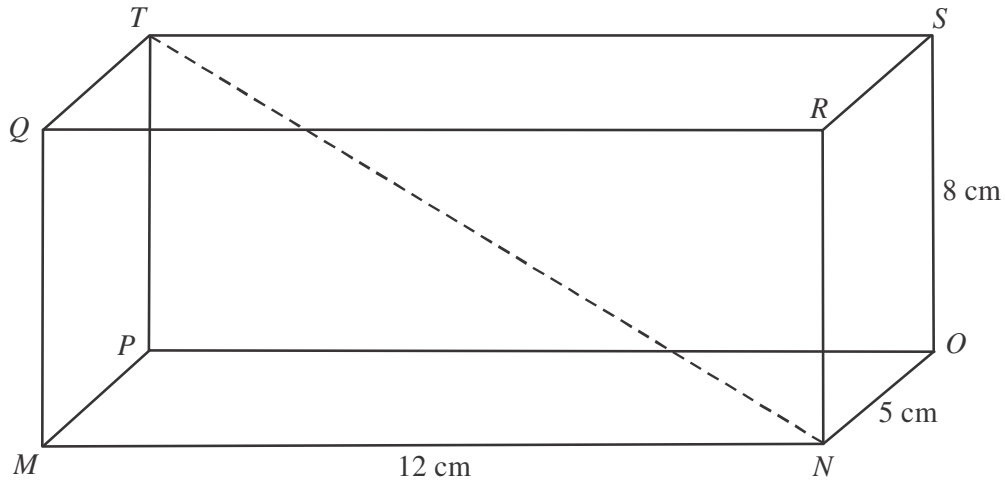


The total volume of the shapes in cubic centimetres, is closest to

A. 1 352
B. 1 555
C. 1 608
D. 1 635
E. 1 670

Question 4

A right rectangular prism with base *MNOP* is shown below.

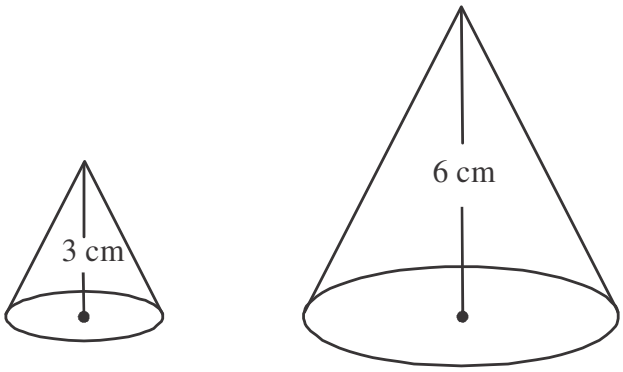


The height of the prism *OS* is 8 cm, $MN = 12$ cm and $NO = 5$ cm.
The length of the diagonal of the prism *NT*, in centimetres, is closest to

A. 13.0
B. 14.6
C. 15.3
D. 16.1
E. 16.2

Question 5

Two cones that are similar in shape are shown below.

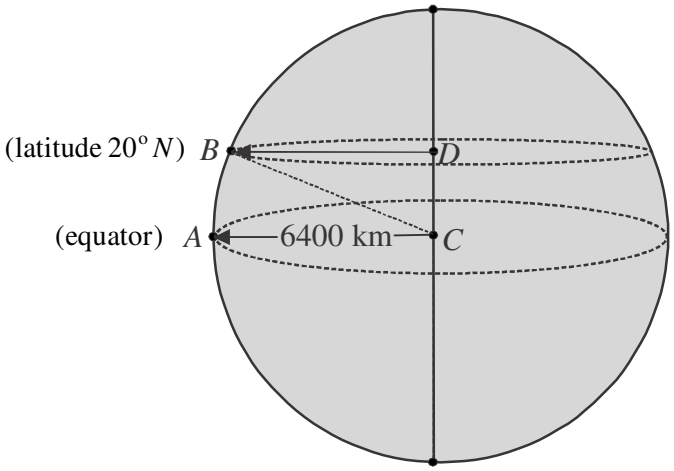


The height of the smaller cone is 3 cm and the height of the larger cone is 6 cm.
The base of the smaller cone has an area of 38.5 square centimetres. The base of the larger cone has an area, in cm^2, of

A. 6.2
B. 77
C. 154
D. 308
E. 346.5

Question 6

The Earth can be assumed to be a sphere with radius 6 400 km. The diagram below shows the earth with centre at *C*.
Point *B* has latitude 20°N and lies on a small circle of Earth with centre at *D*.
Point *A* lies on the equator on the same line of longitude as point *B*.

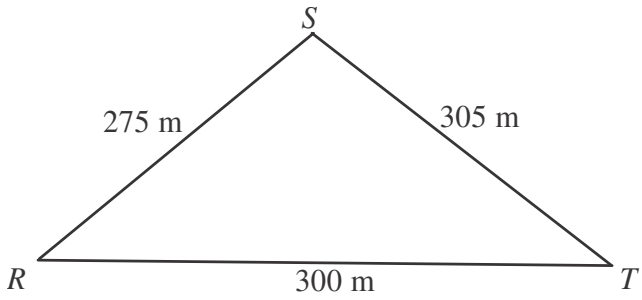


The distance from point *B* to point *D*, in kilometres, is closest to

A. 2 189
B. 3 624
C. 5 739
D. 6 014
E. 6 810

Use the following information to answer Questions 7 and 8.

Three fence posts located at points *R*, *S* and *T* form the corner points of a triangular paddock as shown below.



The distance from *R* to *S* is 275 m.
The distance from *S* to *T* is 305 m.
The distance from *R* to *T* is 300 m.
The post at point *R* is due west of the post at point *T*.

Question 7

The area of the paddock, in square metres, is closest to

A. 37 042
B. 41 938
C. 45 750
D. 396 827
E. 421 373

Question 8

The bearing of the post at point *S* from the post at point *T* is closest to

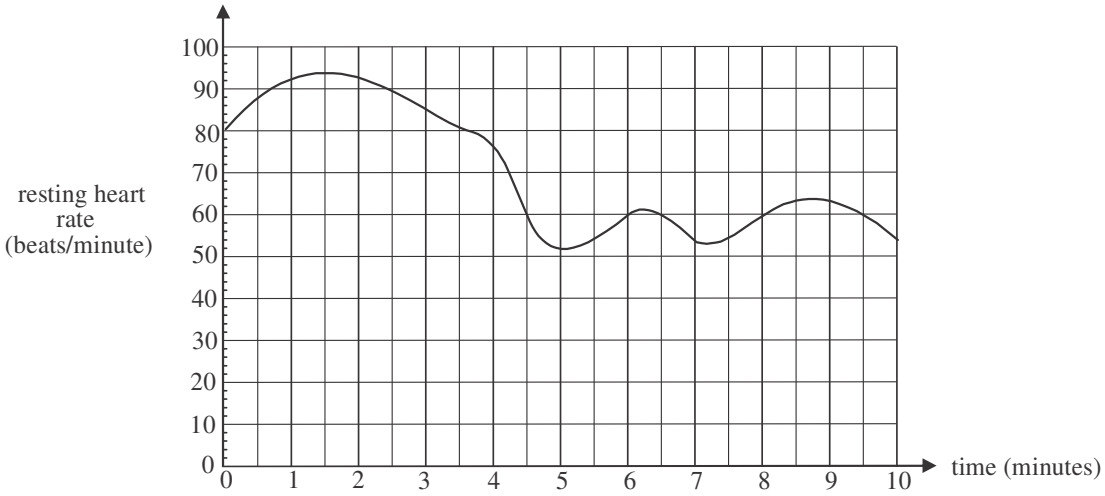
A. 234°
B. 306°
C. 312°
D. 318°
E. 324°

Module 4 - Graphs and relations

If you choose this module all questions must be answered.

Question 1

The graph below shows the resting heart rate, in beats per minute, of a patient over a ten-minute period.



Over this ten-minute period, the total amount of time, in minutes, when the patient's resting heart rate was less than 60 beats per minute, was

A. 3
B. 3.5
C. 5
D. 5.5
E. 6.5

Question 2

A horizontal line that passes through the point (4,1) has the equation

A. $x = 1$
B. $y = 1$
C. $x = 4$
D. $y = 4$
E. $x + y = 5$

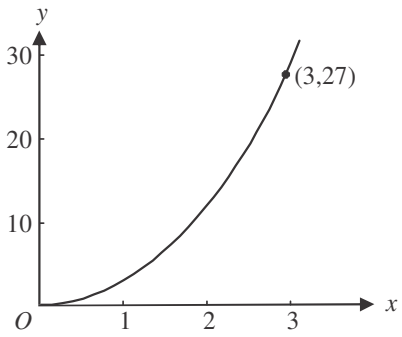
Question 3

At a canteen, Hugh pays $13.90 for five dim sims and three hotdogs. Will pays $16.20 for two dim sims and five hotdogs.
The cost of one dim sim and one hotdog at this canteen is

A. $1.10
B. $1.90
C. $2.80
D. $3.00
E. $3.90

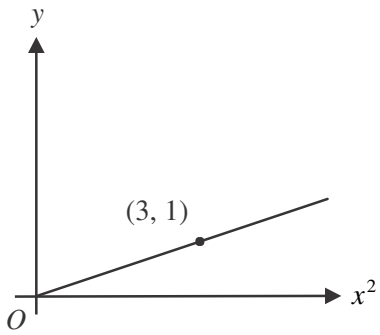
Question 4

The graph of $y = kx^n$ is shown below. The point (3, 27) lies on this graph.

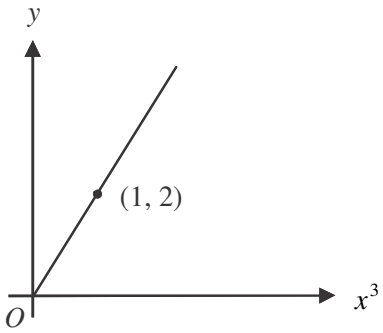


A graph that represents the same relationship between the variables y and x could be

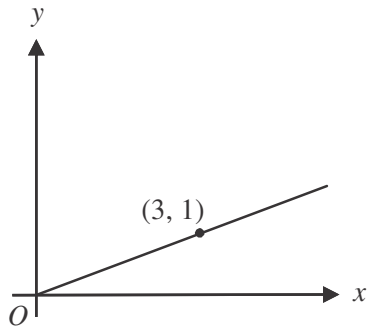
A.



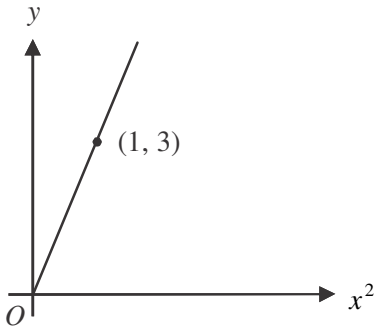
B.



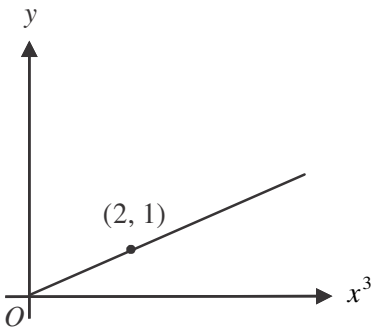
C.



D.



E.



Question 5

The cost C, in dollars, of producing n bottles of tomato relish is given by $C = 85 + 1.5n$.
A profit will be made if

A. 40 bottles are sold at \$3.60 each.
B. 50 bottles are sold at \$3.20 each.
C. 60 bottles are sold at \$2.90 each.
D. 80 bottles are sold at \$2.60 each.
E. 100 bottles are sold at \$2.30 each.

Question 6

Joan waters her garden using up the last 200 litres of water in her tank.
The relationship between the volume of water, in litres, Joan has sprayed on her garden t minutes after she begins watering is

$$\text{volume} = \begin{cases} 10t & 0 \le t \le 10 \\ k & 10 < t \le p \\ 5t & p < t \le 40 \end{cases}$$

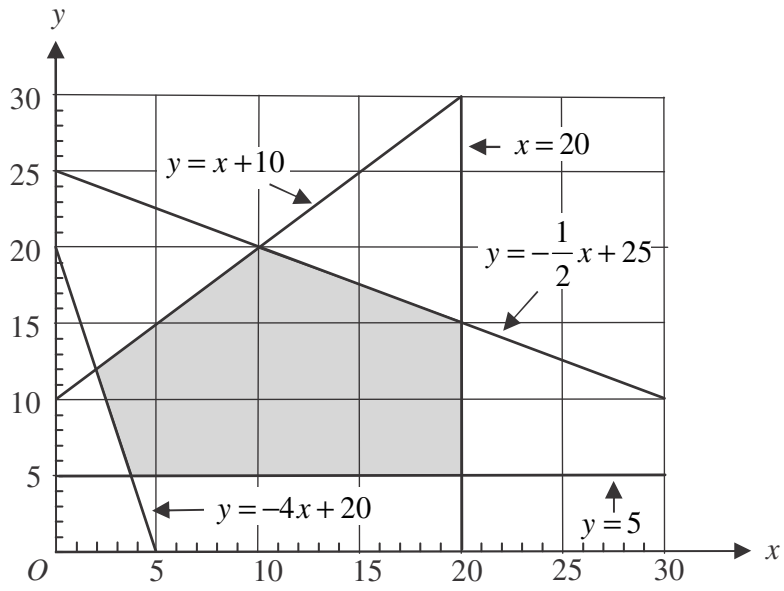
where k and p are positive constants.

Forty minutes after Joan begins watering the tank is empty. The value of p is

A. 10
B. 15
C. 20
D. 25
E. 30

Use the following information to answer Questions 7 and 8.

The graph below shows a shaded region, including boundaries, that represents the feasible region in a linear programming problem.



The equations of the lines that represent the boundaries of the feasible region are also shown.

Question 7

One of the constraints that defines the feasible region is

A. $y \leq -4x + 20$
B. $x \geq 20$
C. $y \geq -\frac{1}{2}x + 25$
D. $y \leq 5$
E. $y \leq x + 10$

Question 8

In this linear programming problem, the objective function representing cost is given by $C = 4x + 2y$. The minimum cost, in dollars, is

A. 25
B. 32
C. 80
D. 90
E. 110

Further Mathematics formulas

Core - Data analysis

standardised score	$z = \dfrac{x - \bar{x}}{s_x}$
lower and upper fence in a boxplot	lower $Q_1 - 1.5 \times IQR$ upper $Q_3 + 1.5 \times IQR$
least squares line of best fit	$y = a + bx,$ 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 $= \dfrac{\text{actual figure}}{\text{deseasonalised figure}}$

Core – Recursion and financial modelling

first-order linear recurrence relation	$u_0 = a, \quad u_{n+1} = bu_n + c$
effective rate of interest for a compound interest loan or investment	$r_{effective} = \left[\left(1 + \dfrac{r}{100n}\right)^n - 1\right] \times 100\%$

Module 1 - Matrices

determinant of a 2×2 matrix	$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, \quad \det A = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$
inverse of a 2×2 matrix	$A^{-1} = \dfrac{1}{\det A}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$, where $\det A \neq 0$
recurrence relation	$S_0 = \text{initial state}, \quad S_{n+1} = TS_n + B$

Module 2 - Networks and decision mathematics

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

Module 3 – Geometry and measurement

area of a triangle	$A = \frac{1}{2}bc\sin(\theta°)$
Heron's formula	$A = \sqrt{s(s-a)(s-b)(s-c)}$, where $s = \frac{1}{2}(a+b+c)$
sine rule	$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$
cosine rule	$a^2 = b^2 + c^2 - 2bc\cos(A)$
circumference of a circle	$2\pi r$
length of an arc	$r \times \frac{\pi}{180} \times \theta°$
area of a circle	πr^2
area of a sector	$\pi r^2 \times \frac{\theta°}{360}$
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 prism	area of base $\times$ height
volume of a pyramid	$\frac{1}{3} \times$ area of base $\times$ height

Module 4 – Graphs and relations

gradient (slope) of a straight line	$m = \frac{y_2 - y_1}{x_2 - x_1}$
equation of a straight line	$y = mx + c$

END OF FORMULA SHEET

FURTHER MATHEMATICS

TRIAL EXAMINATION 1

MULTIPLE- CHOICE ANSWER SHEET

STUDENT NAME:.....

INSTRUCTIONS

Fill in the letter that corresponds to your choice. Example: (A) ■ (C) (D) (E)

The answer selected is B. Only one answer should be selected.

Section A - Core

1.	(A)	(B)	(C)	(D)	(E)	13.	(A)	(B)	(C)	(D)	(E)			
2.	(A)	(B)	(C)	(D)	(E)	14.	(A)	(B)	(C)	(D)	(E)			
3.	(A)	(B)	(C)	(D)	(E)	15.	(A)	(B)	(C)	(D)	(E)			
4.	(A)	(B)	(C)	(D)	(E)	16.	(A)	(B)	(C)	(D)	(E)			
5.	(A)	(B)	(C)	(D)	(E)	17.	(A)	(B)	(C)	(D)	(E)			
6.	(A)	(B)	(C)	(D)	(E)	18.	(A)	(B)	(C)	(D)	(E)			
7.	(A)	(B)	(C)	(D)	(E)	19.	(A)	(B)	(C)	(D)	(E)			
8.	(A)	(B)	(C)	(D)	(E)	20.	(A)	(B)	(C)	(D)	(E)			
9.	(A)	(B)	(C)	(D)	(E)	21.	(A)	(B)	(C)	(D)	(E)			
10.	(A)	(B)	(C)	(D)	(E)	22.	(A)	(B)	(C)	(D)	(E)			
11.	(A)	(B)	(C)	(D)	(E)	23.	(A)	(B)	(C)	(D)	(E)			
12.	(A)	(B)	(C)	(D)	(E)	24.	(A)	(B)	(C)	(D)	(E)			

Section B - Modules

Module Number ___

1.	(A)	(B)	(C)	(D)	(E)
2.	(A)	(B)	(C)	(D)	(E)
3.	(A)	(B)	(C)	(D)	(E)
4.	(A)	(B)	(C)	(D)	(E)
5.	(A)	(B)	(C)	(D)	(E)
6.	(A)	(B)	(C)	(D)	(E)
7.	(A)	(B)	(C)	(D)	(E)
8.	(A)	(B)	(C)	(D)	(E)

Module Number ___

1.	(A)	(B)	(C)	(D)	(E)
2.	(A)	(B)	(C)	(D)	(E)
3.	(A)	(B)	(C)	(D)	(E)
4.	(A)	(B)	(C)	(D)	(E)
5.	(A)	(B)	(C)	(D)	(E)
6.	(A)	(B)	(C)	(D)	(E)
7.	(A)	(B)	(C)	(D)	(E)
8.	(A)	(B)	(C)	(D)	(E)