



NSW Education Standards Authority

--	--	--	--	--

Centre Number

--	--	--	--	--	--	--	--	--

Student Number

2024 HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- For questions in Section II, show relevant mathematical reasoning and/or calculations
- Write your Centre Number and Student Number at the top of this page

Total marks: 100

Section I – 15 marks (pages 2–8)

- Attempt Questions 1–15
- Allow about 25 minutes for this section

Section II – 85 marks (pages 9–39)

- Attempt Questions 16–41
- Allow about 2 hours and 5 minutes for this section

Section I

15 marks

Attempt Questions 1–15

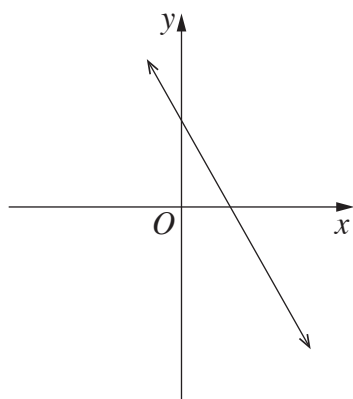
Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1–15.

1 If $x = -2.531$, what is the value of x^2 rounded to 2 decimal places?

- A. -6.41
- B. -6.40
- C. 6.40
- D. 6.41

2 Consider the function shown.



NOT TO
SCALE

Which of the following could be the equation of this function?

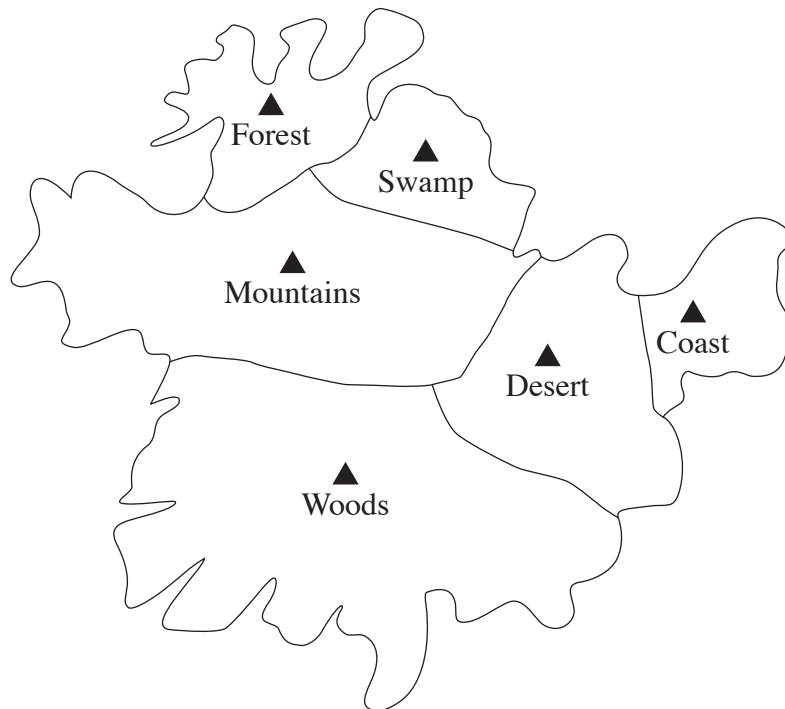
- A. $y = 2x + 3$
- B. $y = 2x - 3$
- C. $y = -2x + 3$
- D. $y = -2x - 3$

- 3 Shoppers are invited to complete an online survey.

What type of sampling is this?

- A. Self-selecting
- B. Simple random
- C. Stratified
- D. Systematic

- 4 The map shows regions within a country.



A network diagram is to be drawn to represent this map. Vertices will be used to indicate each region and edges will be used to represent a border shared between two regions.

How many edges will there be in the network diagram?

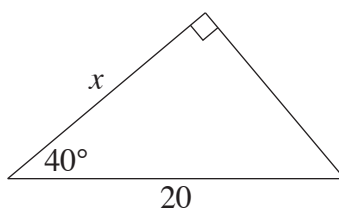
- A. 8
- B. 7
- C. 6
- D. 5

- 5 Pia's marks in Year 10 assessments are shown. The scores for each subject were normally distributed.

	<i>Pia's mark</i>	<i>Year 10 mean</i>	<i>Year 10 standard deviation</i>
English	78	66	6
Mathematics	80	71	10
Science	77	70	15
History	85	72	9

In which subject did Pia perform best in comparison with the rest of Year 10?

- A. English
 - B. Mathematics
 - C. Science
 - D. History
- 6 Consider the diagram shown.



Which of the following is the correct expression for the length of x ?

- A. $20 \cos 40^\circ$
- B. $20 \sin 40^\circ$
- C. $\frac{20}{\cos 40^\circ}$
- D. $\frac{20}{\sin 40^\circ}$

- 7** Three years ago, the price of a uniform was \$180.

Due to inflation, the price increased annually by 2.5%.

What is the price of this uniform now?

- A. \$180.14
- B. \$181.35
- C. \$193.50
- D. \$193.84

- 8** A bill for servicing a car is made up of:

- \$242 for parts, which includes 10% GST
- \$100 for labour, excluding GST.

The mechanic needs to add 10% GST onto the labour charge.

How much GST does the customer pay in total?

- A. \$22.00
- B. \$24.20
- C. \$32.00
- D. \$34.20

- 9** The time taken to paint a school varies inversely with the number of painters completing the task.

It takes 6 painters a total of 20 days to paint a school.

How many days would it take 15 painters to paint the same school?

- A. 4.5
- B. 8
- C. 15.5
- D. 50

- 10** Consider the formula $s = wt + \frac{p}{2}$.

Which of the following correctly shows p as the subject of the formula?

- A. $p = 2wt - s$
- B. $p = 2wt - 2s$
- C. $p = 2s - wt$
- D. $p = 2s - 2wt$

- 11** A train left Richmond at 6:42 am and arrived at Central Station at 8:04 am. The distance travelled by the train from Richmond to Central was 61 km.

What was the average speed of this train, correct to the nearest km/h?

- A. 38
- B. 45
- C. 50
- D. 74

- 12** A survey of 370 people was conducted to investigate the association between watching *Anime* and the age of the person.

The two-way table shows the responses collected.

Age \ Watching	Watches <i>Anime</i>	Does not watch <i>Anime</i>	TOTAL
30 years old and under	152	61	213
Over 30 years old	34	123	157
TOTAL	186	184	370

Approximately what percentage of the over 30-year-olds watch *Anime*?

- A. 9%
 - B. 18%
 - C. 22%
 - D. 42%
- 13** José takes out a loan of \$9000. Simple interest is charged on the loan.

The loan and the interest charged will be repaid by making monthly repayments of \$300 over 4 years.

What simple interest rate per annum, to the nearest percent, is charged on the loan?

- A. 15%
- B. 38%
- C. 40%
- D. 60%

- 14** Year 11 is making pizzas to raise money for a charity.

The cost (C) and revenue (R) in dollars, when x pizzas are sold are represented by the equations

$$C = 2.5x + 6$$

$$R = 8x.$$

Enough pizzas are sold so that a profit is made.

By how much does the profit increase for each additional pizza sold?

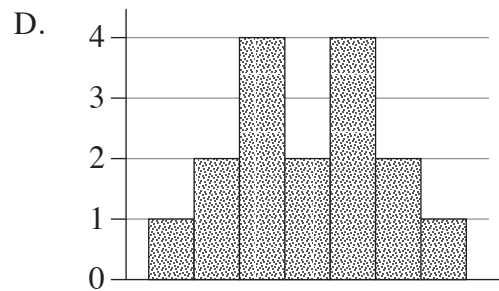
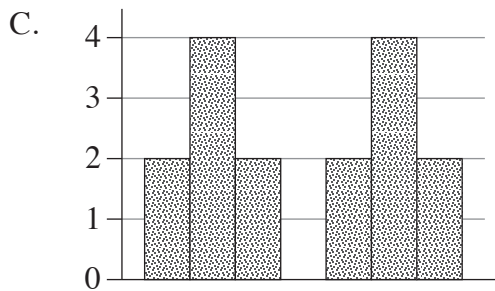
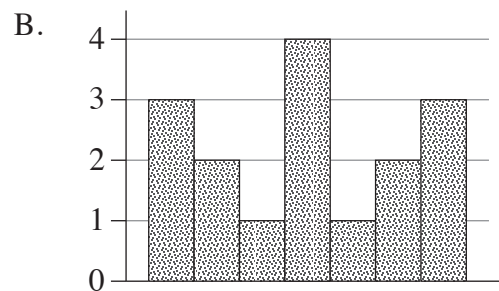
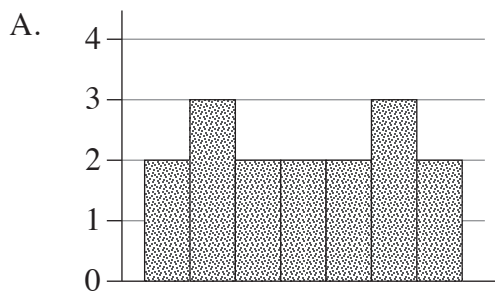
- A. \$2.50
- B. \$5.50
- C. \$6.00
- D. \$8.00

- 15** Some data are used to create a box plot shown.



A histogram is created from the same set of data.

Which of these histograms is NOT possible for the given box plot?



--	--	--	--	--

Centre Number

Mathematics Standard 2

Section II Answer Booklet

--	--	--	--	--	--	--	--	--

Student Number

85 marks**Attempt Questions 16–41****Allow about 2 hours and 5 minutes for this section**

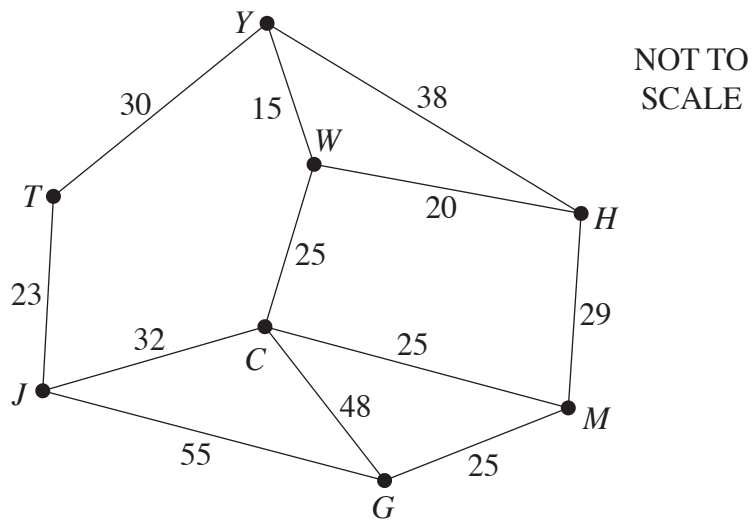
Instructions

- Write your Centre Number and Student Number at the top of this page.
 - Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
 - Your responses should include relevant mathematical reasoning and/or calculations.
 - Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.
-

Please turn over

Question 16 (4 marks)

A network of towns and the distances between them in kilometres is shown.



- (a) What is the shortest path from T to H ?

2

.....

.....

- (b) A truck driver needs to travel from Y to G but knows that the road from C to G is closed.

2

What is the length of the shortest path the truck driver can take from Y to G after the road closure?

.....

.....

.....

.....

Question 17 (2 marks)

The cost of electricity is 30.13 cents per kWh.

2

Calculate the cost of using a 650 W air conditioner for 6 hours.

.....

.....

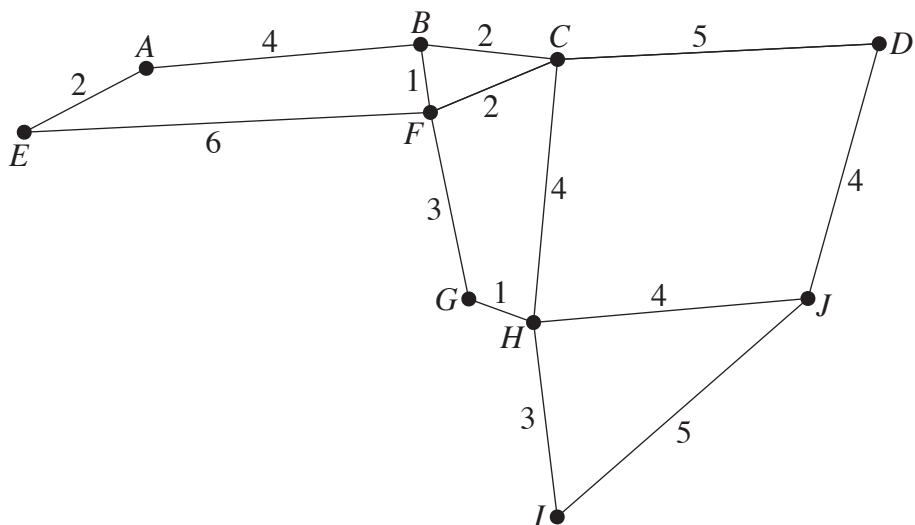
.....

.....

Please turn over

Question 18 (3 marks)

The diagram shows a network with weighted edges.



- (a) Draw a minimum spanning tree for this network and determine its weight.

2

A
•

B
•

C
•

D
•

E
•

F
•

G
•

H
•

I
•

J
•

Weight =

- (b) Is it possible to find another spanning tree with the same weight? Give a reason for your answer.

1

.....

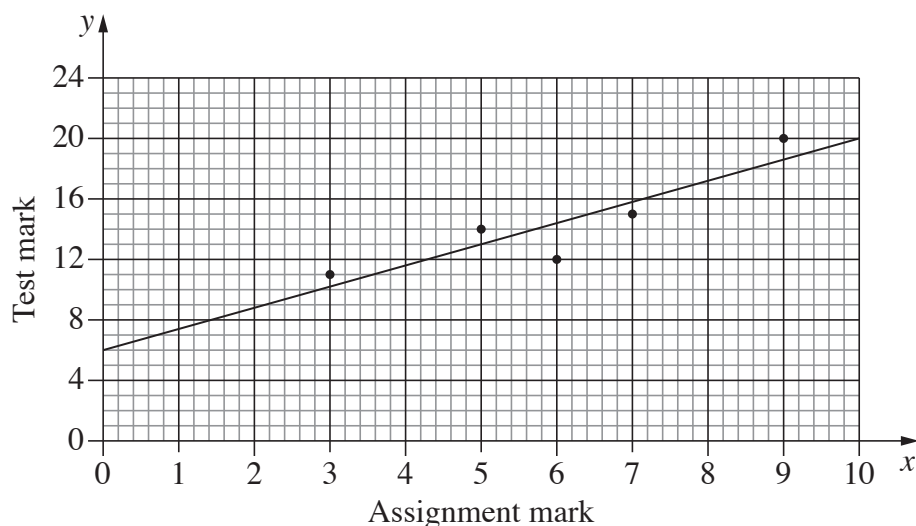
.....

.....

Question 19 (3 marks)

A teacher was exploring the relationship between students' marks for an assignment and their marks for a test. The data for five different students are shown on the graph.

The least-squares regression line is also shown.



- (a) What is the equation of the least-squares regression line for this dataset?

2

.....

.....

.....

.....

- (b) Another student, whose marks are not on the graph, scored 5 for the assignment and 12 on the test.

1

Did this student do better or worse on the test than the regression line predicts?
Provide a reason for your answer.

.....

.....

.....

.....

Question 20 (3 marks)

The table shows the future value for an annuity of \$1 for varying interest rates and time periods.

<i>Period \ Rate</i>	<i>1%</i>	<i>2%</i>	<i>3%</i>	<i>4%</i>	<i>5%</i>
1	1.0100	1.0200	1.0300	1.0400	1.0500
2	2.0301	2.0604	2.0909	2.1216	2.1525
3	3.0604	3.1216	3.1836	3.2465	3.3101
4	4.1010	4.2040	4.3091	4.4163	4.5256
5	5.1520	5.3081	5.4684	5.6330	5.8019
6	6.2135	6.4343	6.6625	6.8983	7.1420
7	7.2857	7.5830	7.8923	8.2142	8.5491
8	8.3685	8.7546	9.1591	9.5828	10.0266

- (a) Ken invests \$200 at the start of each year for eight years, at an interest rate of 5% per annum. **1**

Calculate the future value of Ken's investment.

.....

.....

- (b) Shay is planning to take a holiday in three years. She needs \$4500 for this holiday and will make regular six-monthly payments into an account that earns interest at the rate of 4% per annum, compounded 6 monthly. **2**

What is the minimum amount Shay needs to pay into this account every 6 months? Give your answer to the nearest \$10. Support your answer with calculations.

.....

.....

.....

.....

.....

.....

.....

Question 21 (3 marks)

William has a reducing balance loan on which he owes \$5590. He makes monthly repayments of \$110.

The loan company charges interest at 24% per annum, compounded monthly.

The spreadsheet shows some of the information for the next two months of the loan.

- (a) Complete the entries in the spreadsheet to show the balance owing on the loan at the end of two months. 2

	A	B	C	D	E
1	Month	Principal	Interest charged	Amount repaid	Balance owing
2	1	\$5590.00	\$111.80	\$110.00	
3	2			\$110.00	

- (b) Explain why the loan will never be repaid if William continues to make repayments of \$110 per month. 1

.....

.....

.....

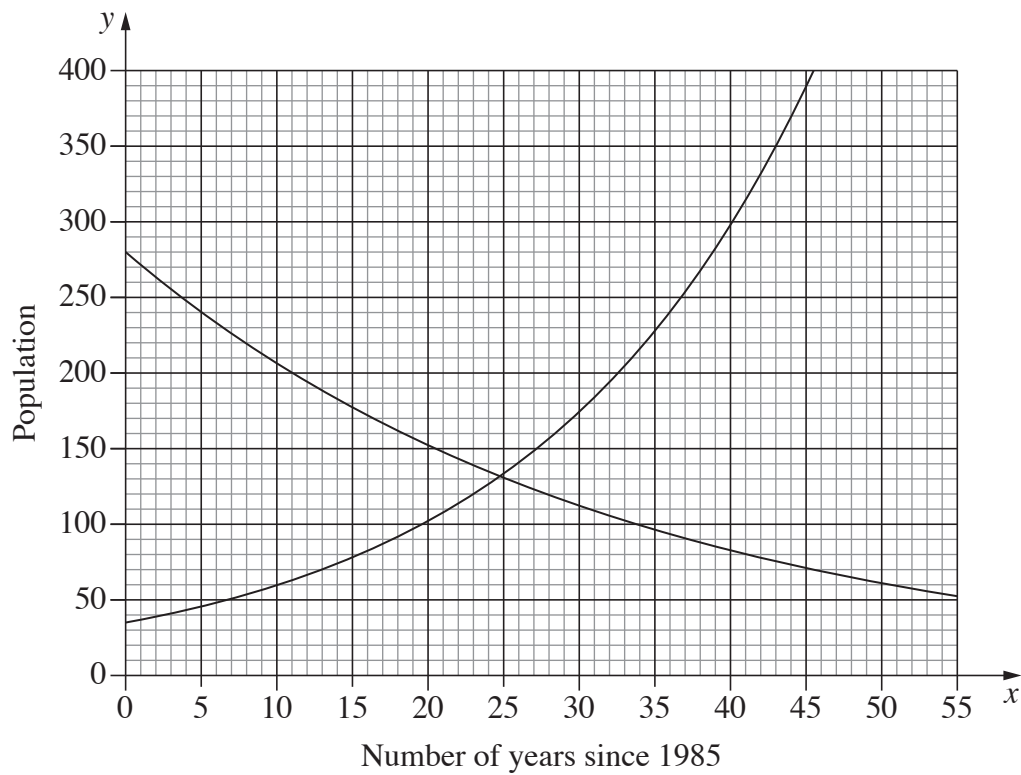
Question 22 (3 marks)

The graph shows the populations of two different animals, W and K , in a conservation park over time. The y -axis is the size of the population and the x -axis is the number of years since 1985.

3

Population W is modelled by the equation $y = A \times (1.055)^x$.

Population K is modelled by the equation $y = B \times (0.97)^x$.



Complete the table using the information provided.

	Population W	Population K
Population in 1985	$A = 34$	$B =$
Percentage yearly change in the population		
Predicted population when $x = 50$		61

Question 23 (3 marks)

Zazu works a 38-hour week and is paid at an hourly rate of \$45. Any overtime hours worked are paid at time-and-a-half.

3

In a particular week, Zazu worked the regular 38 hours and some overtime hours. In that week Zazu earned \$2790.

How many hours of overtime did Zazu work in that week?

.....

.....

.....

.....

.....

.....

Please turn over

Question 24 (4 marks)

Sarah, a 60 kg female, consumes 3 glasses of wine at a family dinner over 2.5 hours.

Note: there are 1.2 standard drinks in one glass of wine.

The blood alcohol content (BAC) for females can be estimated by

$$BAC_{\text{female}} = \frac{10N - 7.5H}{5.5M},$$

where N = number of standard drinks

H = number of hours drinking

M = mass in kilograms.

- (a) Calculate Sarah's BAC at the end of the dinner, correct to 3 decimal places. 2

.....

.....

.....

.....

- (b) The time it takes a person's BAC to reach zero is given by 2

$$\text{Time} = \frac{BAC}{0.015}.$$

Calculate the time it takes for Sarah's BAC to return to zero, assuming she stopped drinking after 2.5 hours. Give your answer to the nearest minute.

.....

.....

.....

Do NOT write in this area.

Question 25 (3 marks)

Alex and Jun each invest \$1800 for 5 years.

3

- Alex's investment earns simple interest at a rate of 7.5% per annum.
- Jun's investment earns interest at a rate of 6.0% per annum, compounding quarterly.

By calculating the interest earned over the 5 years, determine who will have the greater amount.

.....

.....

.....

.....

.....

.....

.....

.....

.....

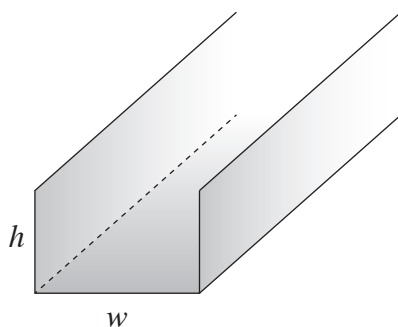
.....

Please turn over

Question 26 (3 marks)

A sheet of metal is folded to make a gutter, as shown. The cross-section of the gutter is a rectangle of width w cm and height h cm.

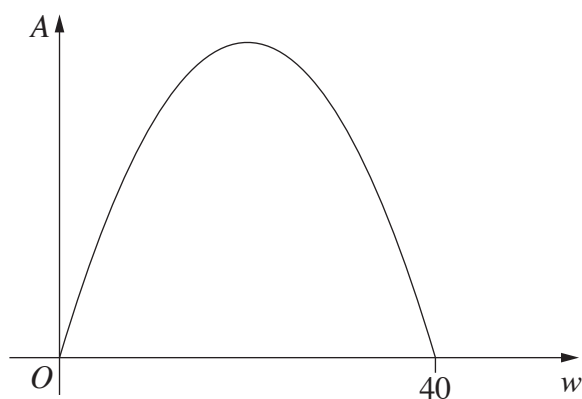
3



The area, $A \text{ cm}^2$, of the cross-section can be modelled by the quadratic formula

$$A = -0.5w^2 + 20w.$$

A graph of this model is shown.



Find the width and height of the rectangle which will give the greatest possible area of the cross-section.

.....

.....

.....

.....

.....

.....

.....

.....

Question 27 (3 marks)

A couple borrows \$30 000 to be repaid in equal monthly repayments of \$280 over 10 years.

3

After following this repayment plan for 5 years, they decide to decrease their monthly repayment to \$250. As a result, it will take them an additional two years to pay off their loan.

How much more will they repay in total by making this change?

.....

.....

.....

.....

.....

.....

Please turn over

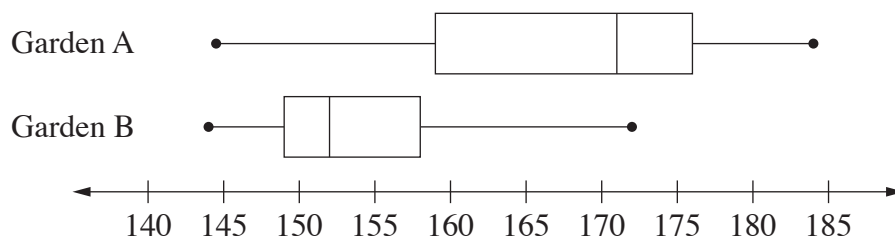
Question 28 (3 marks)

Flowers were planted in two gardens (Garden A and Garden B).

3

On a particular day, 25 flowers were randomly selected from each garden and their heights measured in millimetres.

The data are represented in parallel box-plots.



Compare the two datasets by examining the skewness of the distributions, and the measures of central tendency and spread.

.....

.....

.....

.....

.....

.....

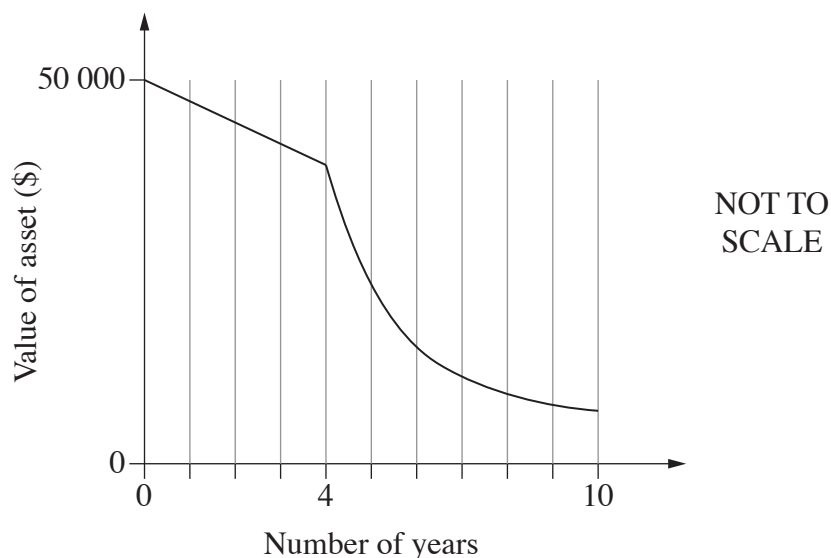
.....

Do NOT write in this area.

Question 29 (4 marks)

The graph shows the decreasing value of an asset.

4



For the first 4 years, the value of the asset depreciated by \$1500 per year, using a straight-line method of depreciation.

After the end of the 4th year, the method of depreciation changed to the declining-balance method at the rate of 35% per annum.

What is the total depreciation at the end of 10 years?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Questions 16–29 are worth 44 marks in total

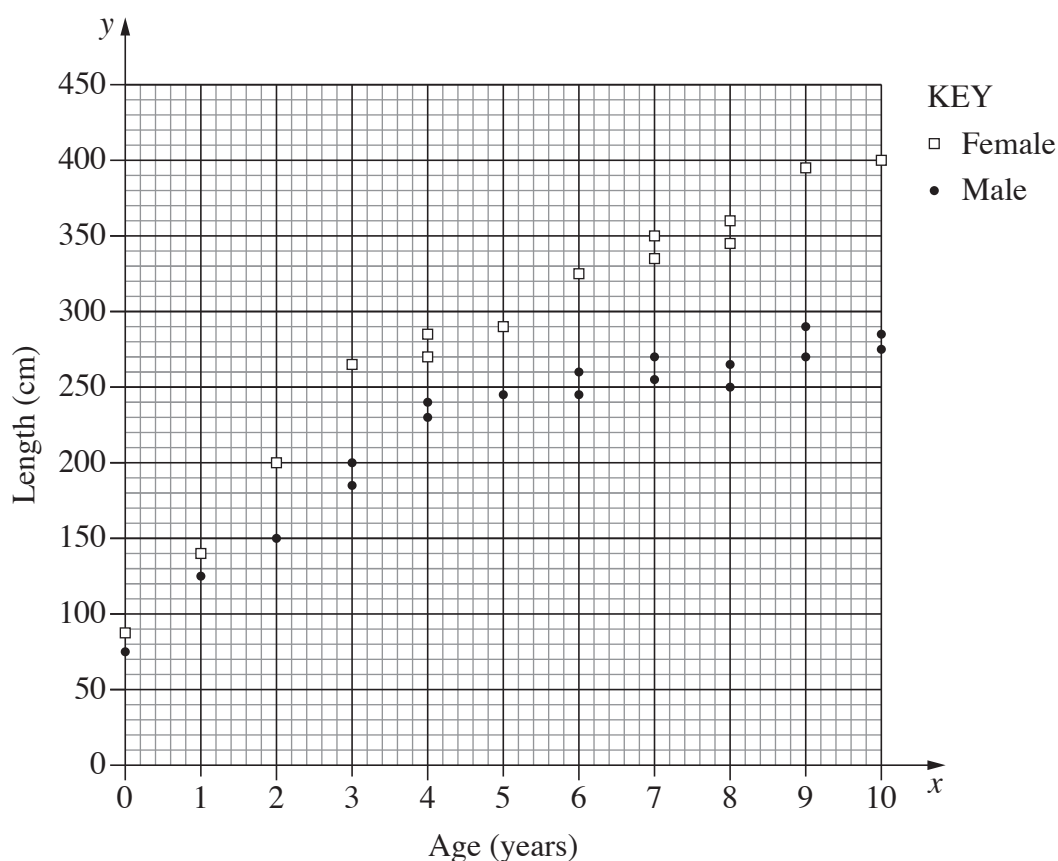
Question 30 (3 marks)

A researcher is studying anacondas (a type of snake).

3

A dataset recording the age (in years) and length (in cm) of female and male anacondas is displayed on the graph.

Anacondas reach maturity at about 4 years of age.



Write THREE observations about anacondas that may be made from the scatterplot. (Note: No calculations are required.)

.....

.....

.....

.....

.....

.....

Question 31 (3 marks)

A coin is biased so that it is twice as likely to show a head than a tail.

- (a) What is the probability of obtaining a head with one throw of this coin? **1**

.....

- (b) In two throws of this coin, what is the probability of obtaining at least one head? **2**

.....

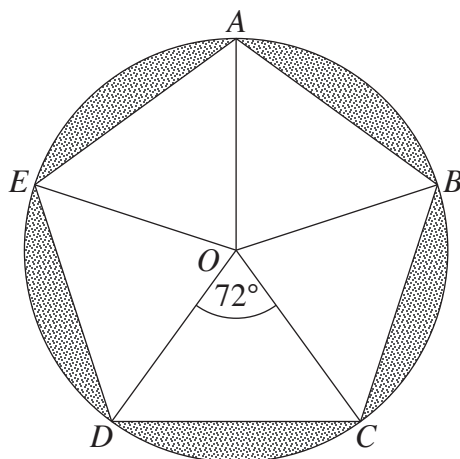
Please turn over

Question 32 (4 marks)

A regular pentagon $ABCDE$ is drawn inside a circle with a radius of 30 cm.

4

O is the centre of the circle.



What is the area of the shaded region of the circle? Answer correct to 2 significant figures.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Do NOT write in this area.

Question 33 (3 marks)

Wombats can run at a speed of 40 km/h over short distances.

3

At this speed, how many seconds would it take a wombat to run 150 metres?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Please turn over

Question 34 (4 marks)

A container for soccer balls is made using two half spheres joined to each end of a cylindrical body.

4



Three soccer balls fit exactly inside the container. Each ball has a diameter of 23 cm.

The hemispherical ends of the container just touch the surface of the soccer balls.

What is the total surface area of the container? Give your answer in square metres correct to 1 decimal place.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

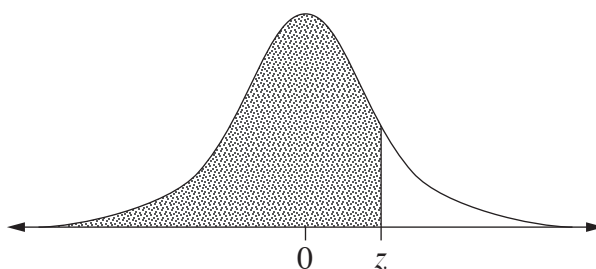
Do NOT write in this area.

Question 35 (5 marks)

A random variable is normally distributed with mean 0 and standard deviation 1. The table gives the probability that this random variable is less than z .

z	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4
<i>Probability</i>	0.7257	0.7580	0.7881	0.8159	0.8413	0.8643	0.8849	0.9032	0.9192

The probability values given in the table for different values of z are represented by the shaded area in the following diagram.



The scores in a university examination with a large number of candidates are normally distributed with mean 58 and standard deviation 15.

- (a) By calculating a z -score, find the percentage of scores that are between 58 and 70. 2

.....

.....

.....

.....

- (b) Explain why the percentage of scores between 46 and 70 is twice your answer to part (a). 1

.....

.....

- (c) By using the values in the table above, find an approximate minimum score that a candidate would need to be placed in the top 10% of the candidates. 2

.....

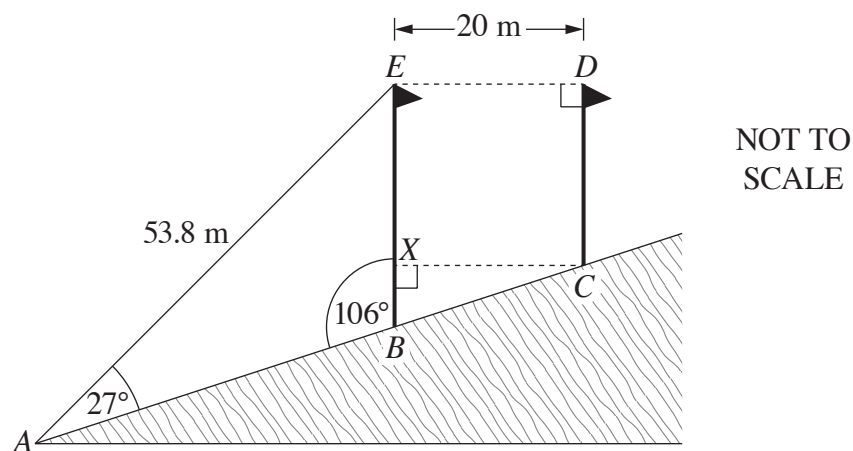
.....

.....

.....

Question 36 (4 marks)

The diagram shows two vertical flagpoles, BE and CD , set on sloping ground.



- (a) What is the height of the flagpole BE , correct to 1 decimal place?

2

.....

.....

.....

.....

.....

.....

- (b) What is the height of the flagpole CD , correct to 1 decimal place?

2

.....

.....

.....

.....

.....

.....

Do NOT write in this area.

Question 37 (2 marks)

Sakura will travel from Sydney (UTC +10) to Rio de Janeiro (UTC –3).

2

The flight from Sydney to Rio de Janeiro will take 20 hours.

The flight will arrive in Rio de Janeiro at 3 pm on Wednesday 20 July.

On what day and at what time will Sakura leave Sydney?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

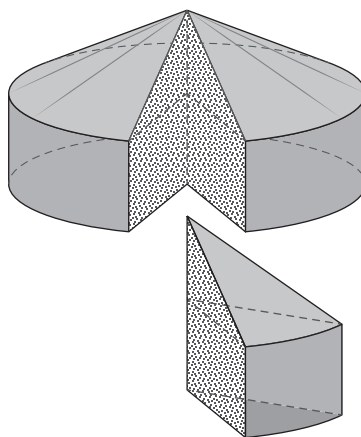
.....

.....

Question 38 (3 marks)

A cake is constructed using a cylinder and a cone-shaped top. The cylinder has diameter 30 cm and height 6 cm.

3



The ratio of the volume of the cylinder to the volume of the cone-shaped top is 5 : 1.

The cake is to be cut into equal slices with volume 212 cm^3 .

How many equal slices can be cut from the cake?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

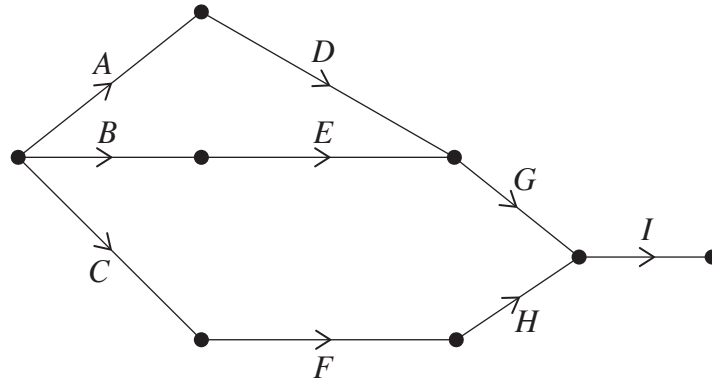
.....

Do NOT write in this area.

Question 39 (3 marks)

A project involving nine activities is shown in the network diagram.

The duration of each activity is not yet known.



The following table gives the earliest start time (EST) and latest start time (LST) for three of the activities. All times are in hours.

Activity	EST	LST
A	0	2
C	0	1
I	12	12

- (a) What is the critical path? 1

.....

- (b) The minimum time required for this project to be completed is 19 hours. 1

What is the duration of activity *I*?

.....

- (c) The duration of activity *C* is 3 hours. 1

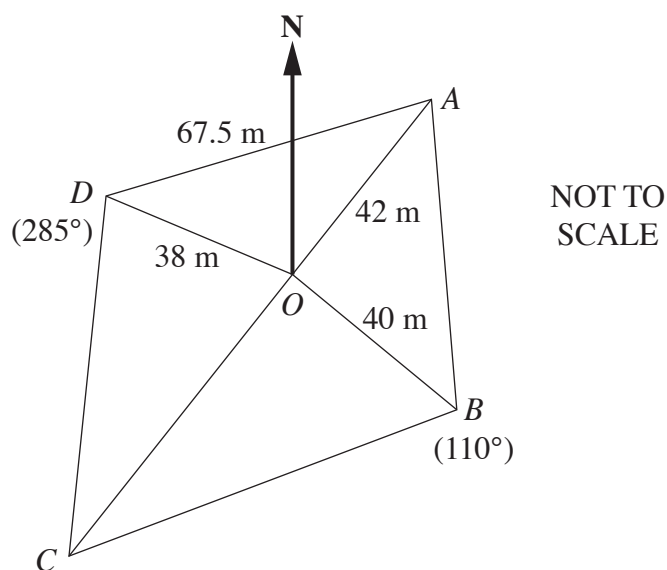
What is the maximum amount of time that could occur between the start of activity *F* and the end of activity *H*?

.....

Question 40 (3 marks)

A compass radial survey is shown.

3



Given that AC is a straight line, find the bearing of C from O , correct to the nearest degree.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Do NOT write in this area.

Question 41 (4 marks)

Twenty-five years ago, Phoenix deposited a single sum of money into a new bank account, earning 2.4% interest per annum compounding monthly.

4

Present value interest factors for an annuity of \$1 for various interest rates (r) and numbers of periods (n) are given in the table.

<i>Rate (r)</i> <i>Period (n)</i>	<i>0.001</i>	<i>0.002</i>	<i>0.003</i>	<i>0.004</i>
60	58.207	56.487	54.835	53.249
120	113.026	106.592	100.649	95.156
180	164.655	151.036	138.927	128.137
240	213.278	190.460	170.908	154.093
300	259.071	225.430	197.627	174.521

Phoenix made the following withdrawals from this account.

- \$2000 at the end of each month for the first 15 years, starting at the end of the first month.
- \$1200 at the end of each month for the next 10 years, starting at the end of the 181st month after the account was opened.

Calculate the minimum sum that Phoenix could have deposited in order to make these withdrawals.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of paper

– 35 –

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Do NOT write in this area.

Do NOT write in this area.

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Do NOT write in this area.

Do NOT write in this area.

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

BLANK PAGE

Do NOT write in this area.

Mathematics Standard 1

Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

$$\text{Absolute error} = \frac{1}{2} \times \text{precision}$$

$$\text{Upper bound} = \text{measurement} + \text{absolute error}$$

$$\text{Lower bound} = \text{measurement} - \text{absolute error}$$

Length

$$l = \frac{\theta}{360} \times 2\pi r$$

Area

$$A = \frac{\theta}{360} \times \pi r^2$$

$$A = \frac{h}{2}(a + b)$$

$$A \approx \frac{h}{2}(d_f + d_l)$$

Surface area

$$A = 2\pi r^2 + 2\pi rh$$

$$A = 4\pi r^2$$

Volume

$$V = \frac{1}{3}Ah$$

$$V = \frac{4}{3}\pi r^3$$

Trigonometry

$$\sin A = \frac{\text{opp}}{\text{hyp}}, \quad \cos A = \frac{\text{adj}}{\text{hyp}}, \quad \tan A = \frac{\text{opp}}{\text{adj}}$$

$$A = \frac{1}{2}ab \sin C$$

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

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

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Financial Mathematics

$$FV = PV(1 + r)^n$$

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

$$S = V_0(1 - r)^n$$

Statistical Analysis

An outlier is a score

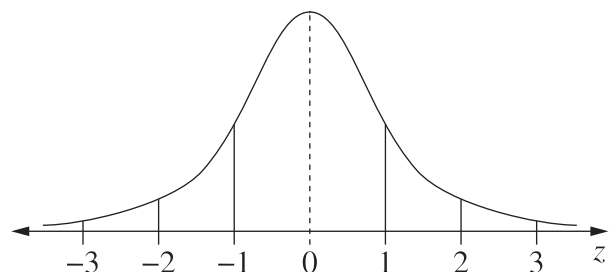
less than $Q_1 - 1.5 \times IQR$

or

more than $Q_3 + 1.5 \times IQR$

$$z = \frac{x - \mu}{\sigma}$$

Normal distribution



- approximately 68% of scores have z -scores between -1 and 1
- approximately 95% of scores have z -scores between -2 and 2
- approximately 99.7% of scores have z -scores between -3 and 3

BLANK PAGE

2024 HSC Mathematics Standard 2 Marking Guidelines

Section I

Multiple-choice Answer Key

Question	Answer
1	D
2	C
3	A
4	B
5	A
6	A
7	D
8	C
9	B
10	D
11	B
12	C
13	A
14	B
15	D

Section II

Question 16 (a)

Criteria	Marks
• Provides the correct path	2
• Provides a continuous path from T to H	1

Sample answer:

$TYWH$

Question 16 (b)

Criteria	Marks
• Provides correct solution	2
• Provides a continuous path from Y to G , without C to G	1

Sample answer:

$YWHMG$ is 89 km

Question 17

Criteria	Marks
• Provides correct answer	2
• Performs an appropriate conversion, or equivalent merit	1

Sample answer:

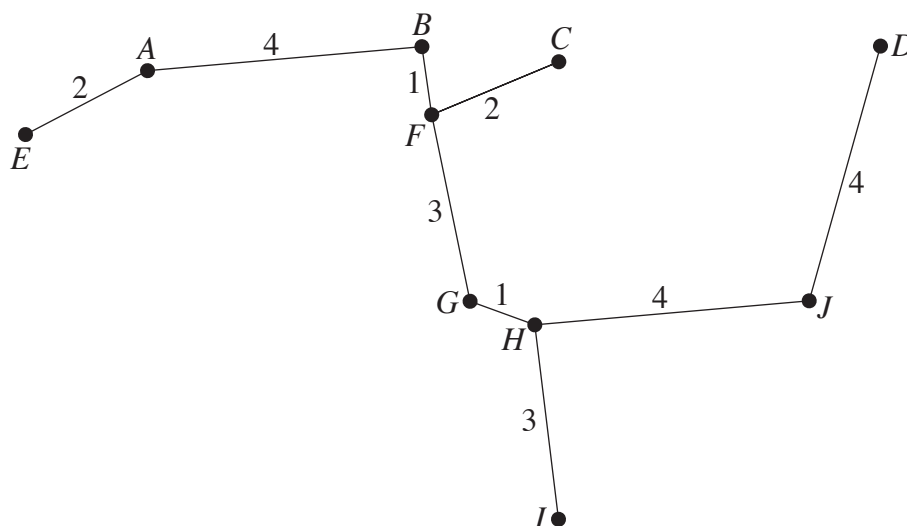
$$\frac{650}{1000} \times 6 \times \$0.3013$$

$$= \$1.18$$

Question 18 (a)

Criteria	Marks
• Provides correct solution	2
• Draws a spanning tree, or equivalent merit	1

Sample answer:



Weight = 24

Question 18 (b)

Criteria	Marks
• Provides a correct reason for why it is possible to find another spanning tree with the same weight	1

Sample answer:

Yes, use BC instead of FC as the weight of BC is the same as the weight of FC .

Question 19 (a)

Criteria	Marks
• Provides correct solution	2
• Finds the y-intercept or gradient, or equivalent merit	1

Sample answer:

$$m = \frac{14}{10}$$

$$= 1.4$$

$$y = 1.4x + 6$$

Question 19 (b)

Criteria	Marks
• Provides correct reason	1

Sample answer:

Worse as the predicted test mark was 13 instead of 12.

Question 20 (a)

Criteria	Marks
Provides correct answer	1

Sample answer:

$$\$200 \times 10.0266$$

$$= \$2005.32$$

Question 20 (b)

Criteria	Marks
Provides correct solution	2
Finds the correct rate, or equivalent merit	1

Sample answer:

$$r = \frac{4}{2}\%$$

$$= 2\%$$

$$n = 3 \times 2$$

$$= 6$$

$$\begin{aligned} \text{Investment per 6 months} &= \frac{4500}{6.4343} \\ &= 699.37\ldots \end{aligned}$$

$$= \$700 \quad \text{rounded to nearest \$10}$$

Question 21 (a)

Criteria	Marks
• Provides correct solution	2
• Provides one correct entry in the table	1

Sample answer:

	A	B	C	D	E
1	Month	Principal	Interest charged	Amount repaid	Balance owing
2	1	\$5590.00	\$111.80	\$110.00	\$5591.80
3	2	\$5591.80	\$111.84	\$110.00	\$5593.64

$\therefore$ Balance owing = \$5593.64

Question 21 (b)

Criteria	Marks
• Provides a correct reason	1

Sample answer:

Loan will never be repaid as the interest charged per month is more than the monthly repayment of \$110.

Answers could include:

The balance owing on the loan is increasing.

Question 22

Criteria	Marks
• Completes the table correctly	3
• Provides two correct entries	2
• Provides one correct entry	1

Sample answer:

	<i>Population W</i>	<i>Population K</i>
Population in 1985	$A = 34$	$B = \mathbf{280}$
Percentage yearly change in the population	5.5%	-3%
Population when $x = 50$	494	61

$$\begin{aligned}
 & \uparrow \\
 & 34(1.055)^{50} \\
 & = 494.426... \\
 & = 494
 \end{aligned}$$

Question 23

Criteria	Marks
• Provides correct solution	3
• Finds Zazu's normal time earnings and overtime hourly rate, or equivalent merit	2
• Finds Zazu's normal time earnings, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Normal time earnings} &= 38 \times 45 \\
 &= 1710
 \end{aligned}$$

$$\begin{aligned}
 \text{Overtime paid} &= 2790 - 1710 \\
 &= 1080
 \end{aligned}$$

$$\begin{aligned}
 \text{Overtime hours} &= \frac{\$1080}{(45 \times 1.5)} \\
 &= 16 \text{ hours}
 \end{aligned}$$

Therefore 16 hours overtime.

Question 24 (a)

Criteria	Marks
• Provides correct answer	2
• Attempts to use the <i>BAC</i> formula	1

Sample answer:

$$\begin{aligned}
 BAC &= \frac{10(1.2 \times 3) - 7.5 \times 2.5}{5.5 \times 60} \\
 &= 0.0522... \\
 &= 0.052 \quad (\text{to 3 decimal places})
 \end{aligned}$$

Question 24 (b)

Criteria	Marks
• Provides correct answer in hours and minutes	2
• Correct substitution of previous answer, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Time} &= \frac{0.052}{0.015} \\
 &= 3 \text{ hours } 28 \text{ minutes}
 \end{aligned}$$

Question 25

Criteria	Marks
• Provides correct solution	3
• Calculates Jun's interest, or equivalent merit	2
• Calculates Alex's interest, or equivalent merit	1

Sample answer:

$$\begin{aligned}\text{Alex's interest after 5 years} &= 1800 \times 7.5\% \times 5 \\ &= \$675\end{aligned}$$

$$\begin{aligned}\text{Jun's investment at 5 years} &= 1800 \times \left(1 + \frac{6}{4}\%\right)^{4 \times 5} \\ &= 2424.339\dots\end{aligned}$$

$$\begin{aligned}\text{Interest} &= 2424.34 - 1800 \\ &= \$624.34\end{aligned}$$

$\therefore$ Alex earns more interest.

Question 26

Criteria	Marks
• Provides correct solution	3
• Finds correct maximum area, or equivalent merit	2
• Finds the width corresponding to maximum area, or equivalent merit	1

Sample answer:

$$A = -0.5w^2 + 20w$$

Maximum area when width = 20

$$\begin{aligned}A &= -0.5(20)^2 + 20(20) \\ &= 200 \text{ cm}^2\end{aligned}$$

$$A = h \times w$$

$$200 = h \times 20$$

$$h = 10$$

$\therefore$ width = 20 cm, height = 10 cm

Question 27

Criteria	Marks
• Provides correct answer	3
• Finds two of the repayments required, or equivalent merit	2
• Finds a relevant repayment amount, or equivalent merit	1

Sample answer:

$$\begin{aligned}\text{Repayments for 5 years at 280} &= 280 \times 12 \times 5 \\ &= 16\,800\end{aligned}$$

$$\text{Repayments for 7 years at 250} = 21\,000$$

$$\begin{aligned}\text{Total repayment} &= 16\,800 + 21\,000 \\ &= 37\,800\end{aligned}$$

$$\text{Repayment for 10 years at 280} = 33\,600$$

$$\begin{aligned}\therefore \text{Difference} &= \$37\,800 - \$33\,600 \\ &= \$4\,200\end{aligned}$$

Question 28

Criteria	Marks
• Compares the two datasets on skewness, central tendency and spread	3
• Compares two of the measures of centre and spread and skewness for the two gardens, or equivalent merit	2
• Compares skewness, measures of centre or spread for the two gardens, or equivalent merit	1

Sample answer:

The dataset for Garden A is negatively skewed while the dataset for Garden B is positively skewed.

The median for Garden A is higher than the median for Garden B.

The *IQR* of Garden A is larger than the *IQR* of Garden B.

Answers could include:

The range of Garden A is larger than the range of Garden B.

Question 29

Criteria	Marks
• Provides correct solution	4
• Uses the declining-balance method with correct values for r , n and V_0 , or equivalent merit	3
• Attempts to use the declining-balance method with an initial value from the straight-line method, or equivalent merit	2
• Attempts to use straight-line method, or equivalent merit	1

Sample answer:

Value after 4 years:

$$\begin{aligned}\text{Using straight-line method} &= 50\,000 - 1500 \times 4 \\ &= 44\,000\end{aligned}$$

Value after the next 6 years:

$$\begin{aligned}\text{Using declining-balance method} &= 44\,000(1 - 35\%)^6 \\ &= 3318.43\dots\end{aligned}$$

$$\begin{aligned}\text{Total depreciation} &= 50\,000 - 3318.43 \\ &= \$46\,681.57\end{aligned}$$

Question 30

Criteria	Marks
• Provides three correct observations	3
• Provides two correct observations	2
• Provides one correct observation	1

Sample answer:

- Female anacondas grow at a faster rate than males.
- Both females and males continue to grow after 4 years.
- Females are longer than males.

Question 31 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$\frac{2}{3}$$

Question 31 (b)

Criteria	Marks
• Provides correct solution	2
• Finds probability of no heads, or equivalent merit	1

Sample answer:

$$\begin{aligned}P(\text{no heads}) &= \frac{1}{3} \times \frac{1}{3} \\&= \frac{1}{9}\end{aligned}$$

$$\begin{aligned}\therefore P(\text{at least 1 head}) &= 1 - \frac{1}{9} \\&= \frac{8}{9}\end{aligned}$$

Question 32

Criteria	Marks
• Provides correct solution to 2 significant figures	4
• Finds the shaded area, or equivalent merit	3
• Finds the area of both the circle and a triangle, or equivalent merit	2
• Finds the area of the circle or a triangle, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 A_{\text{circle}} &= \pi r^2 \\
 &= \pi \times 30^2 \\
 &= 2827.433\dots
 \end{aligned}$$

$$\begin{aligned}
 A_{\Delta} &= \frac{1}{2}ab \sin C \\
 &= \frac{1}{2} \times 30 \times 30 \sin 72^\circ \\
 &= 427.975\dots
 \end{aligned}$$

$$\begin{aligned}
 A_{\text{pentagon}} &= 5 \times 427.975\dots \\
 &= 2139.877\dots
 \end{aligned}$$

$$\begin{aligned}
 \text{Shaded area} &= 2827.433 - 2139.877 \\
 &= 687.5\dots \\
 &= 690 \text{ cm}^2 \quad (2 \text{ significant figures})
 \end{aligned}$$

Question 33

Criteria	Marks
• Provides correct solution	3
• Provides correct calculations in hours, or equivalent merit	2
• Provides correct distance conversion, or equivalent merit	1

Sample answer:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$40 \text{ km/h} = \frac{0.15 \text{ km}}{T}$$

$$T = \frac{0.15}{40}$$

$$T = 0.00375 \text{ hours}$$

$$T = 0.00375 \times 3600 \text{ seconds}$$

$$= 13.5 \text{ seconds}$$

Question 34

Criteria	Marks
• Provides correct solution in square metres	4
• Finds the total surface area, or equivalent merit	3
• Finds the surface area of the cylinder or sphere	2
• Attempts to find surface area of sphere, or equivalent merit	1

Sample answer:

$$\text{Surface area of sphere} = 4 \times \pi \times \left(\frac{23}{2}\right)^2$$

$$\text{Surface area curved cylindrical body} = 2 \times \pi \times \frac{23}{2} \times (23 \times 2)$$

$$\begin{aligned} \therefore \text{Total surface area} &= \left(4 \times \pi \times \left(\frac{23}{2}\right)^2\right) + \left(2 \times \pi \times \frac{23}{2} \times 46\right) \\ &= 4985.707... \\ &= 4985.7 \text{ cm}^2 \\ &= 0.5 \text{ m}^2 \quad (\text{correct to 1 decimal place}) \end{aligned}$$

Question 35 (a)

Criteria	Marks
• Provides correct solution, including a correct z-score	2
• Finds z-score corresponding to 70, or equivalent merit	1

Sample answer:

$$z = \frac{70 - 58}{15}$$

$$= 0.8$$

$$P \text{ from table} = 0.7881$$

$$P \text{ required} = 0.7881 - 0.5 = 0.2881$$

$$\therefore 28.81\%$$

Question 35 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

The z-score for 46 is -0.8 .

By symmetry the area between 46 and 58 is equal to the area between 58 and 70.

So, the percentage of scores between 46 and 70 is twice 28.81%.

Question 35 (c)

Criteria	Marks
• Provides correct solution, with evidence of using the table	2
• Finds the z-score corresponding to 90th percentile, or equivalent merit	1

Sample answer:

$$1.3 = \frac{x - 58}{15}$$

$$x = 77.5$$

$\therefore$ Approximate minimum score = 77

Answers could include:

78

Question 36 (a)

Criteria	Marks
• Provides correct answer	2
• Attempts to use sine rule, or equivalent merit	1

Sample answer:

$$\frac{BE}{\sin 27^\circ} = \frac{53.8}{\sin 106^\circ}$$

$$BE = \frac{53.8}{\sin 106^\circ} \times \sin 27^\circ$$

$$= 25.408\dots$$

$$= 25.4 \text{ m}$$

Question 36 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the length of BX , or equivalent merit	1

Sample answer:

$$\angle EBC = 180^\circ - 106^\circ$$

$$= 74^\circ$$

$$\tan 74^\circ = \frac{20}{BX}$$

$$BX = \frac{20}{\tan 74^\circ}$$

$$= 5.73\dots$$

$$\therefore CD = 25.4 - 5.73$$

$$= 19.7 \text{ m} \quad (1 \text{ decimal place})$$

Question 37

Criteria	Marks
• Provides correct solution	2
• Provides 7 pm Tuesday or 4 am Thursday, or equivalent merit	1

Sample answer:

Rio – flight time
 = 3 pm – 20 hours
 = 7 pm Tuesday 19th July
 + time difference 13 hours
 = 8 am Wednesday 20th July

Alternative:

Rio + time difference
 = 3 pm + 13 hours
 = 4 am Thursday 21st July
 – flight time
 = 8 am Wednesday 20th July

Question 38

Criteria	Marks
• Provides correct solution	3
• Calculates the volume of the cake, or equivalent merit	2
• Calculates the volume of the cylinder, or equivalent merit	1

Sample answer:

Volume of cylinder : volume of top = 5 : 1

$$\begin{aligned}
 \text{Volume of cylinder} &= \pi \times 15^2 \times 6 \\
 &= 4241.150\dots \\
 &= 5 \text{ parts}
 \end{aligned}$$

$$\begin{aligned}
 \text{Volume of cake} &= 6 \text{ parts} \\
 &= \frac{6}{5} \times 4241.150 \\
 &= 5089.38\dots
 \end{aligned}$$

Volume of each slice is 212 cm^3

$$\begin{aligned}
 \therefore \text{Number of slices} &= \frac{5089.38}{212} \\
 &= 24.0065\dots \\
 &= 24 \text{ slices} \quad (\text{to the nearest whole slice})
 \end{aligned}$$

Question 39 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

As there are float-times for A and C , the critical path is $BEGI$.

Question 39 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$19 - 12 = 7 \text{ hours}$$

Question 39 (c)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$12 - 3 = 9 \text{ hours}$$

$$9 - 1 = 8 \text{ hours}$$

Question 40

Criteria	Marks
• Provides correct solution	3
• Attempts to find bearing of C from O , or equivalent merit	2
• Uses cosine rule in $\triangle ODA$ to find an angle, or equivalent merit	1

Sample answer:

In $\triangle ODA$:

$$\begin{aligned}\cos \angle AOD &= \frac{38^2 + 42^2 - 67.5^2}{2 \times 38 \times 42} \\ &= -0.42238... \\ \angle AOD &= 114.985... \\ &\approx 115^\circ\end{aligned}$$

Bearing of D from O is 285°

$$\therefore \angle DON = 75^\circ$$

$$\angle AOD = \angle DON + \angle AON$$

$$\text{ie } 115^\circ = 75^\circ + \angle AON$$

$$\therefore \angle AON = 40^\circ$$

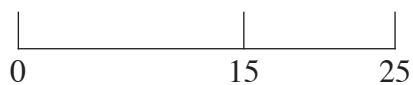
$$\begin{aligned}\text{Bearing of } C \text{ from } O &= 40^\circ + 180^\circ \quad (\text{as } AC \text{ is a straight line}) \\ &= 220^\circ \quad (\text{nearest degree})\end{aligned}$$

Question 41

Criteria	Marks
• Provides correct solution	4
• Makes substantial progress towards a solution	3
• Demonstrates in calculations understanding of importance of 15 years and 25 years	2
• Identifies the required interest rate, or equivalent merit	1

Sample answer:

$$r = \frac{2.4\%}{12} = 0.002$$



For 25 years need $1200 \times 225.430 = 270\,516$

For 15 years need extra $800 \times 151.036 = 120\,828.80$

Total = \$391 344.80

2024 HSC Mathematics Standard 2 Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	MS-M1 Application of Measurement	MS11-3
2	1	MS-A2 Linear Relationships	MS11-9
3	1	MS-S1 Data Analysis	MS11-10
4	1	MS-N2 Network Concepts	MS2-12-8
5	1	MS-S5 The Normal Distribution	MS2-12-7
6	1	MS-M6 Non-right-angled Trigonometry	MS2-12-3
7	1	MS-F1 Money Matters	MS11-6
8	1	MS-F1 Money Matters	MS11-5
9	1	MS-A4 Types of Relationships	MS2-12-6
10	1	MS-A1 Formulae and Equations	MS11-10
11	1	MS-M7 Rates and Ratios	MS2-12-3
12	1	MS-S2 Relative Frequency and Probability	MS11-10
13	1	MS-F1 Money Matters	MS11-6
14	1	MS-A4 Types of Relationships	MS2-12-6
15	1	MS-S1 Data Analysis	MS11-10

Section II

Question	Marks	Content	Syllabus outcomes
16 (a)	2	MS-N2 Network Concepts	MS2-12-8
16 (b)	2	MS-N2 Network Concepts	MS2-12-8
17	2	MS-M7 Rates and Ratios	MS2-12-3
18 (a)	2	MS-N2 Network Concepts	MS2-12-8
18 (b)	1	MS-N2 Network Concepts	MS2-12-10
19 (a)	2	MS-S4 Bivariate Data Analysis	MS2-12-7
19 (b)	1	MS-S4 Bivariate Data Analysis	MS2-12-2
20 (a)	1	MS-F5 Annuities	MS2-12-5
20 (b)	2	MS-F5 Annuities	MS2-12-5
21 (a)	2	MS-F4 Investments and Loans	MS2-12-5
21 (b)	1	MS-F4 Investments and Loans	MS2-12-10
22	3	MS-A4 Types of Relationships	MS2-12-6
23	3	MS-F1 Money Matters	MS11-6
24 (a)	2	MS-A1 Formulae and Equations	MS11-6
24 (b)	2	MS-A1 Formulae and Equations	MS11-10
25	3	MS-F4 Investments and Loans	MS2-12-10
26	3	MS-A4 Types of Relationships	MS2-12-6
27	3	MS-F4 Investments and Loans	MS2-12-10

Question	Marks	Content	Syllabus outcomes
28	3	MS-S1 Data Analysis	MS11-10
29	4	MS-F1 Money Matters MS-F4 Investments and Loans	MS11-10, MS2-12-10
30	3	MS-S4 Bivariate Data Analysis	MS2-12-10
31 (a)	1	MS-S2 Relative Frequency and Probability	MS11-10
31 (b)	2	MS-S2 Relative Frequency and Probability	MS11-10
32	4	MS-M6 Non-right-angled Trigonometry	MS2-12-9
33	3	MS-M7 Rates and Ratios	MS2-12-3
34	4	MS-M1 Applications of Measurement	MS11-10
35 (a)	2	MS-S5 The Normal Distribution	MS2-12-7
35 (b)	1	MS-S5 The Normal Distribution	MS2-12-7
35 (c)	2	MS-S5 The Normal Distribution	MS2-12-7
36 (a)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-9
36 (b)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-9
37	2	MS-M2 Working with Time	MS11-3
38	3	MS-M1 Applications of Measurement	MS11-4
39 (a)	1	MS-N3 Critical Path Analysis	MS2-12-10
39 (b)	1	MS-N3 Critical Path Analysis	MS2-12-10
39 (c)	1	MS-N3 Critical Path Analysis	MS2-12-10
40	3	MS-M6 Non-right-angled Trigonometry	MS2-12-4
41	4	MS-F5 Annuities	MS2-12-9