NSW GOVERNMENT

NSW Education Standards Authority

Centre Number

Student Number

2025 **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 2–7)

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

Section II – 85 marks (pages 9–40)

- Attempt Questions 16–40
- Allow about 2 hours and 5 minutes for this section

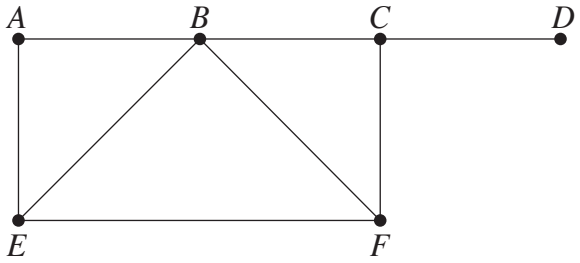
Section I

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

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

---

1 Consider the network diagram.



Which vertex has degree 4?

A. *A*

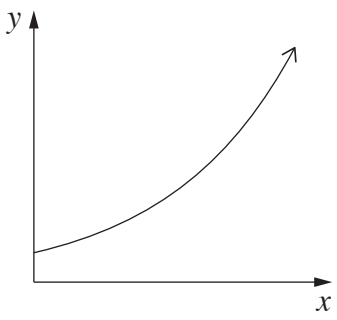
B. *B*

C. *C*

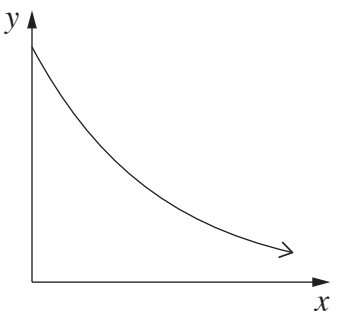
D. *D*

2 Which graph could represent $y = 4^x$?

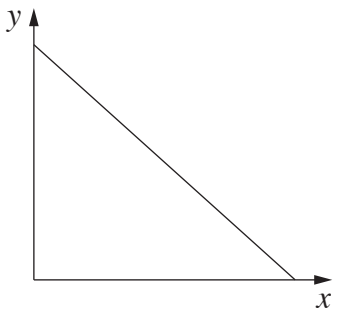
A.



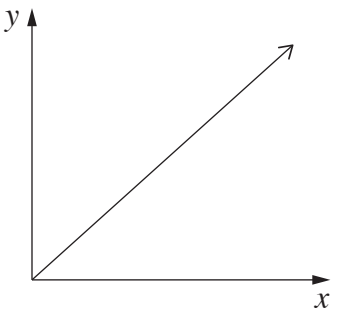
B.



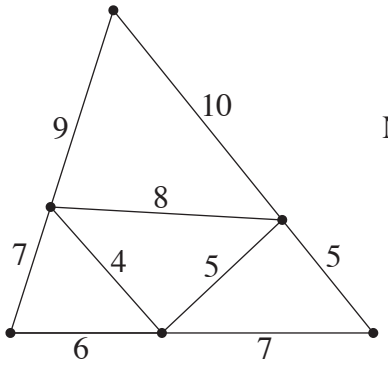
C.



D.



3 The network shows the distances, in kilometres, along a series of roads that connect towns.



NOT TO SCALE

What is the value of the largest weighted edge included in the minimum spanning tree for this network?

A. 7

B. 8

C. 9

D. 10

4 Frankie takes four weeks of annual leave. His weekly pay is $350 and his annual leave loading is $17\frac{1}{2}\%$ of four weeks pay.

What is Frankie's total pay for this period of annual leave?

A. $245.00

B. $411.25

C. $1461.25

D. $1645.00

5 Which of the following is arranged from largest to smallest?

A. 6.2×10^{-3}, 4.5×10^{-4}, 3.2×10^{-1}

B. 4.5×10^{-4}, 6.2×10^{-3}, 3.2×10^{-1}

C. 3.2×10^{-1}, 4.5×10^{-4}, 6.2×10^{-3}

D. 3.2×10^{-1}, 6.2×10^{-3}, 4.5×10^{-4}

6 Consider the formula $n = \dfrac{m - p}{q}$.

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

A. $p = nq - m$

B. $p = m - nq$

C. $p = n + q - m$

D. $p = m - n - q$

7 There are 960 students at a high school.

Using stratified sampling, 240 students from the whole school are to be chosen for a survey.

If there are 200 students in Year 12, how many Year 12 students should be chosen?

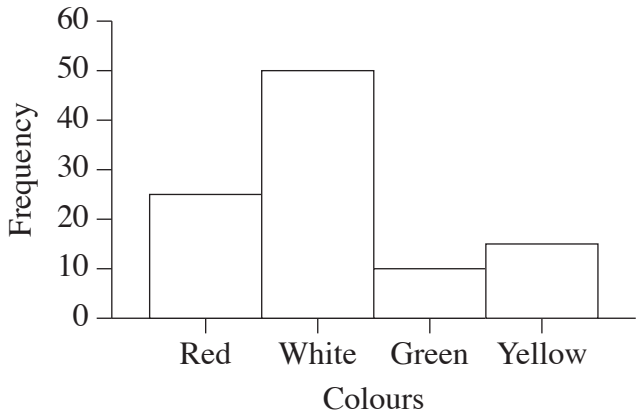
A. 4

B. 5

C. 50

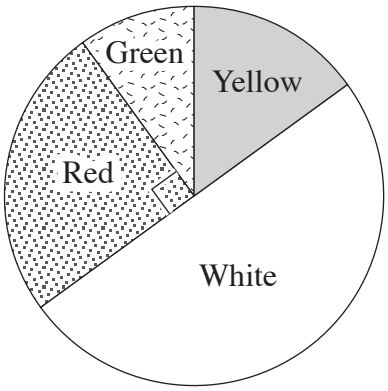
D. 60

8 A spinner made up of 4 colours is spun 100 times. The frequency histogram shows the results.

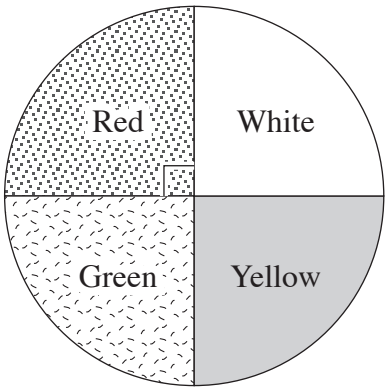


Which of these spinners is most likely to give the results shown?

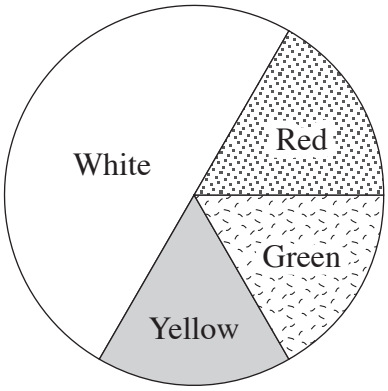
A.



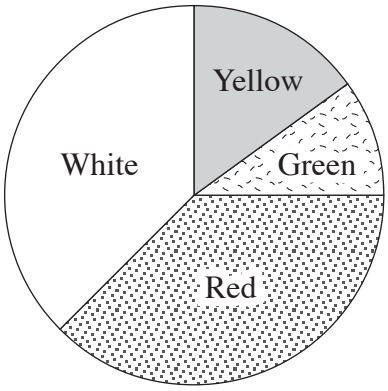
B.



C.



D.



9 The ratio of the dimensions of a model car to the dimensions of an actual car is 1 : 64. The actual car has a length of 4.9 m.

What is the length of the model car in cm, correct to 1 decimal place?

A. 3.1

B. 7.7

C. 13.1

D. 59.1

10 An electricity company charges customers 37 cents per kWh for electricity used, U, and pays customers 5 cents per kWh for electricity produced, P.

The electricity company also charges customers a fee of 71 cents per day.

Which formula should be used to calculate a customer's daily cost of electricity, C, in cents?

A. $C = 71 + 37U - 5P$

B. $C = 71 + 37U + 5P$

C. $C = 71 - 37U - 5P$

D. $C = 71 - 37U + 5P$

11 The thickness of the skin of a spherical balloon varies inversely with the surface area of the balloon.

What would be the effect on the thickness of the skin if the radius of the balloon is doubled?

A. Divided by 2

B. Multiplied by 2

C. Divided by 4

D. Multiplied by 4

12 A football game is being played in Quito (UTC −5) starting at 3:40 pm on Tuesday.

What is the time in Sydney (UTC +10) when the game starts in Quito?

A. 10:40 am Tuesday

B. 8:40 pm Tuesday

C. 12:40 am Wednesday

D. 6:40 am Wednesday

13 A ten-sided die has faces numbered 1 to 10.

The die is constructed so that the probability of obtaining the number 1 is greater than the probability of obtaining any of the other numbers. The numbers 2 to 10 are equally likely to occur.

When the die is rolled 153 times, a 1 is obtained 72 times.

By using the relative frequency of rolling a 1, which of the following is the best estimate for the probability of rolling a 10?

A. $\frac{1}{17}$

B. $\frac{1}{11}$

C. $\frac{1}{10}$

D. $\frac{1}{9}$

14 Points M and P are the same distance from a third point R.

The bearing of M from R is 017° and the bearing of P from R is 107°.

Which of the following best describes the bearing of P from M?

A. Between 000° and 090°

B. Exactly 090°

C. Between 090° and 180°

D. Exactly 180°

15 The minimum daily temperature, in degrees, of a town each year follows a normal distribution with its mean equal to its standard deviation. The minimum daily temperature was recorded over one year.

What percentage of the recorded minimum daily temperatures was above zero degrees?

A. 16%

B. 50%

C. 68%

D. 84%

BLANK PAGE

2025 HIGHER SCHOOL CERTIFICATE EXAMINATION

Centre Number

Student Number

Mathematics Standard 2

Section II Answer Booklet

85 marks
Attempt Questions 16–40
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

Office Use Only – Do NOT write anything, or make any marks below this line.

7178310434

1101 15236

Do NOT write in this area.

Question 16 (2 marks)

Paint is sold in two sizes at a local shop. **2**

- Four-litre cans at $90 per can
- Ten-litre cans at $205 per can

Mina needs to purchase 80 litres of paint.

Calculate the amount of money Mina will save by purchasing only ten-litre cans of paint rather than only four-litre cans of paint.

.....

.....

.....

.....

.....

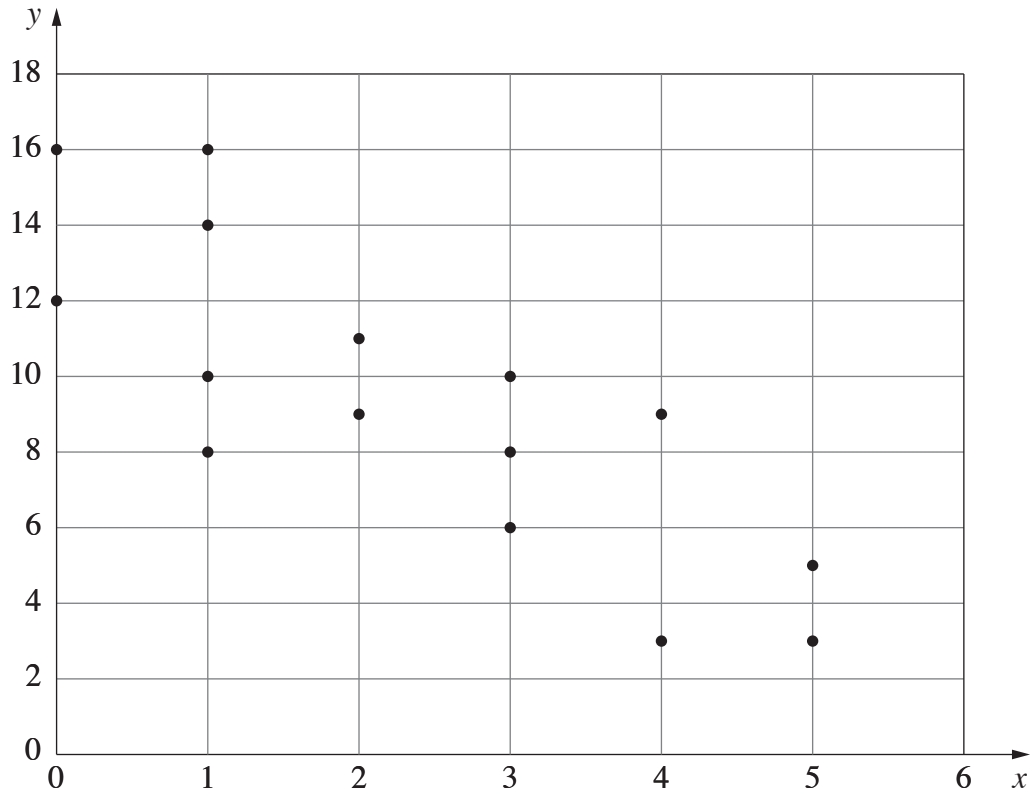
.....

.....

Do NOT write in this area.

Question 17 (3 marks)

The scatter plot shows a bivariate dataset, where x is the independent variable and y is the dependent variable. **3**



The points $(0, 14)$ and $(5, 4)$ lie on the line of best fit.

Plot the points $(0, 14)$ and $(5, 4)$ on the graph and hence find the equation of the line of best fit.

.....

.....

.....

.....

.....

.....

Question 18 (2 marks)

A table of future value interest factors for an annuity of $1 is shown. **2**

Rate / *Period*	*1.5%*	*3%*	*4.5%*	*6%*
5	5.152	5.309	5.471	5.637
10	10.703	11.464	12.288	13.181
20	23.124	26.870	31.371	36.786
40	54.268	75.401	107.030	154.762

The prize in a lottery is an annuity of $5000 a year for 10 years, invested at 4.5% per annum compounding annually.

What will be the value of the prize at the end of 10 years?

.....

.....

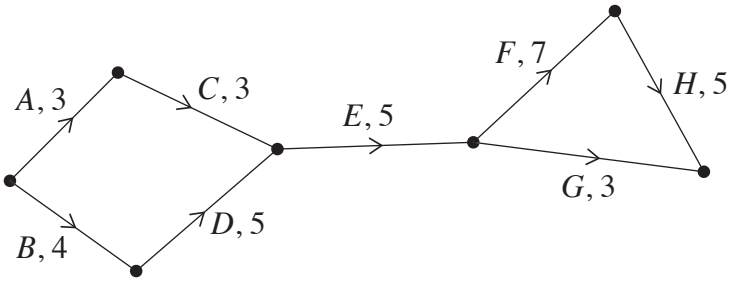
.....

.....

Do NOT write in this area.

Question 19 (5 marks)

The activities and corresponding durations in days for a project are shown in the network diagram.



(a) Complete the table showing the immediate prerequisites for each activity. Indicate with an × any activities without any immediate prerequisites. **2**

Activity	*Immediate prerequisite(s)*
B	
E	
F	

(b) Find the critical path for this project AND state the minimum duration for the project. **2**

.....

.....

.....

.....

(c) The duration of activity *A* is increased by 2. Does this affect the critical path for the project? Give a reason for your answer. **1**

.....

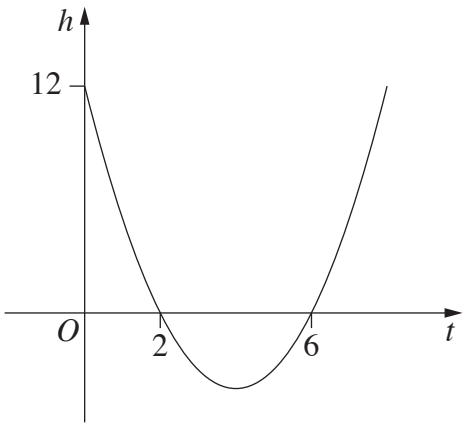
.....

.....

.....

Question 20 (3 marks)

The graph of a quadratic function represented by the equation $h = t^2 - 8t + 12$ is shown.



(a) Find the values of t and h at the turning point of the graph. **2**

.....

.....

.....

.....

.....

.....

(b) The graph shows $h = 12$ when $t = 0$. **1**

What is the other value of t for which $h = 12$?

.....

.....

Question 21 (3 marks)

A house has a reverse-cycle air conditioner which uses 2.5 kW of power for cooling and 3.2 kW of power for heating. The cost of electricity is 29 cents per kWh.

(a) Find the cost, in dollars and cents, of cooling the house for 6 hours. **1**

.....

.....

.....

.....

.....

(b) The cost of operating the air conditioner to heat the house during winter last year was $640. There are 92 days in winter. **2**

Find the number of hours, to 1 decimal place, that the air conditioner was used on average per day.

.....

.....

.....

.....

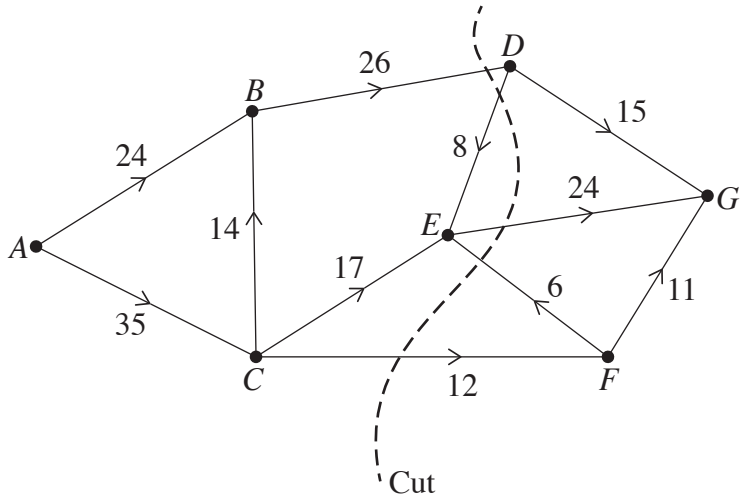
.....

.....

.....

Question 22 (5 marks)

A network of pipes with one cut is shown. The number on each edge gives the capacity of that pipe in L/min.



(a) What is the capacity of the cut shown? **1**

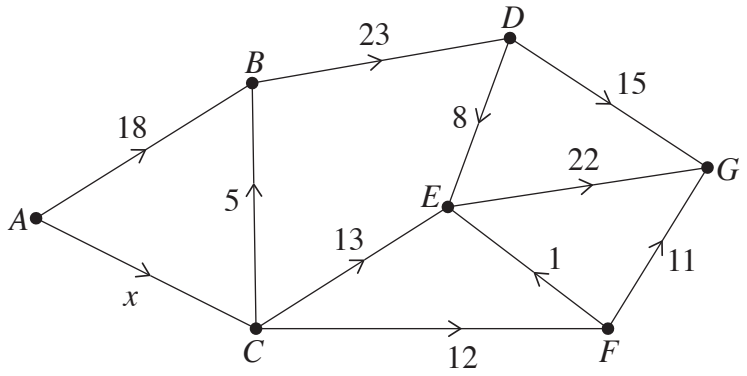
.....

.....

Question 22 continues on page 17

Question 22 (continued)

(b) The diagram shows a possible flow for this network of pipes.



(i) What is the value of x? Give a reason for your answer. **2**

.....

.....

.....

.....

(ii) Which of the pipes in the flow are at full capacity? **1**

.....

.....

(iii) The maximum flow for this network is 50 L/min. **1**

Which path of pipes could have an increase in flow of 2 L/min to achieve the maximum flow?

.....

.....

End of Question 22

Question 23 (2 marks)

Company A and Company B both issue an annual dividend per share as shown in the table. **2**

Company	*Current share price*	*Annual dividend per share*
A	$25.43	$4.92
B	$2.13	45c

Based on the dividend yield, which company would be better to invest in?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 24 (2 marks)

The population of snails in a garden is approximately 90. **2**

One night Bobbie collected 18 snails from the garden. He tagged each snail and released it back into the garden.

The next night 20 snails were captured from the garden.

Approximately how many of the snails in the second sample are expected to have a tag?

.....

.....

.....

.....

.....

.....

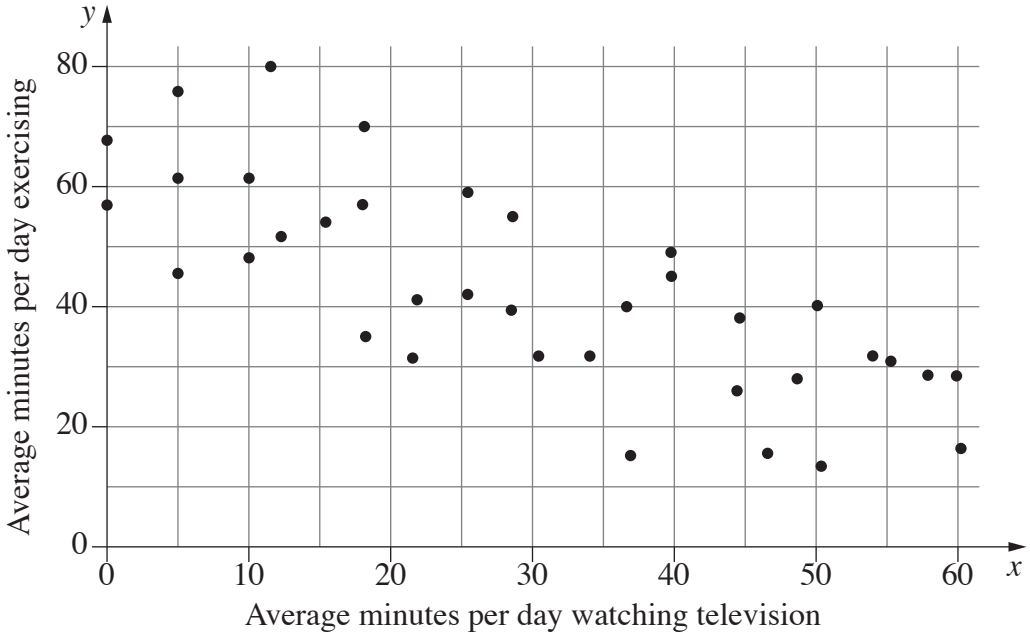
.....

.....

Please turn over

Question 25 (6 marks)

In a research study, participants were asked to record the number of minutes they spent watching television and the number of minutes they spent exercising each day over a period of 3 months. The averages for each participant were recorded and graphed.



(a) Describe the bivariate dataset in terms of its form and direction. **2**

Form: .....

Direction: .....

Question 25 continues on page 21

Question 25 (continued)

The equation of the least-squares regression line for this dataset is

$$y = 64.3 - 0.7x.$$

(b) Interpret the values of the slope and y-intercept of the regression line in the context of this dataset. **2**

.....

.....

.....

.....

.....

.....

(c) Jo spends an average of 42 minutes per day watching television. **1**

Use the equation of the regression line to determine how many minutes on average Jo is expected to exercise each day.

.....

.....

.....

.....

(d) Explain why it is NOT appropriate to extrapolate the regression line to predict the average number of minutes of exercise per day for someone who watches an average of 2 hours of television per day. **1**

.....

.....

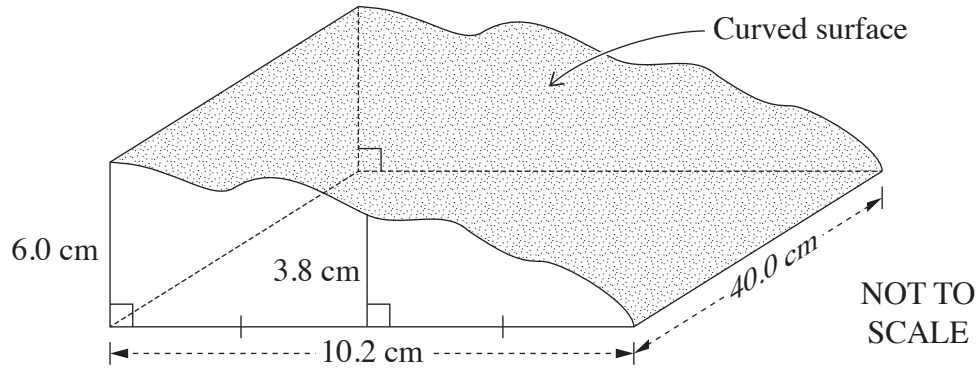
.....

.....

End of Question 25

Question 26 (6 marks)

A toy has a curved surface on the top which has been shaded as shown. The toy has a uniform cross-section and a rectangular base.



(a) Use two applications of the trapezoidal rule to find an approximate area of the cross-section of the toy. **2**

.....

.....

.....

.....

.....

.....

(b) The total surface area of the plastic toy is 1300 cm^2. **2**

What is the approximate area of the curved surface?

.....

.....

.....

.....

.....

.....

Question 26 continues on page 23

Question 26 (continued)

(c) The measurements shown on the diagram are given to the nearest millimetre. **2**

What is the percentage error of the measurement of 10.2 cm? Give your answer correct to 3 significant figures.

.....

.....

.....

.....

.....

.....

End of Question 26

Questions 16–26 are worth 39 marks in total

Please turn over

Question 27 (3 marks)

A credit card has an interest-free period of 45 days from and including the date of purchase. Interest is charged on purchases made, compounding daily at a rate of 13.74% per annum, from and including the day following the interest-free period. **3**

Concert tickets were purchased for a total of $392 using this credit card.

Full payment was made on the 68th day from the date of purchase. There were no other purchases on this credit card.

What was the total interest charged when the account was paid in full?

.....

.....

.....

.....

.....

.....

.....

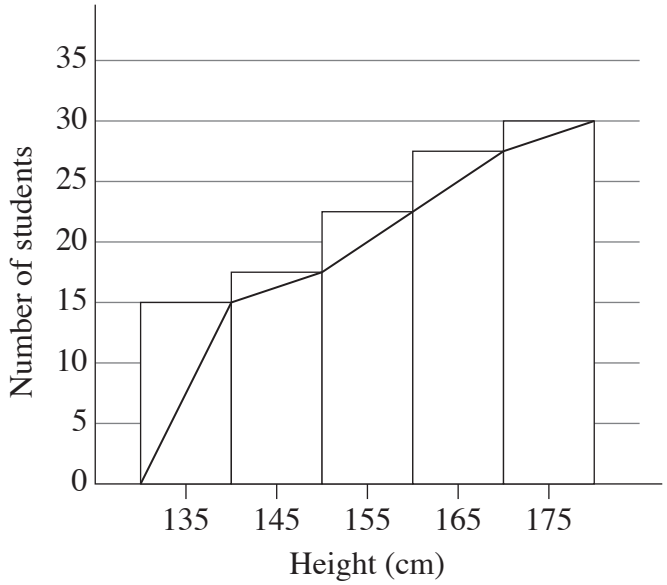
.....

Do NOT write in this area.

Question 28 (3 marks)

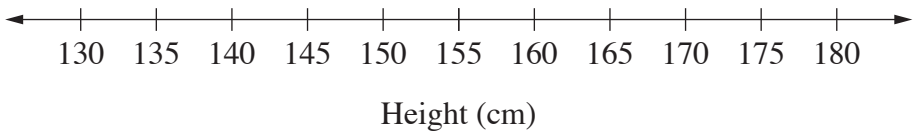
The heights of students in a class were recorded. **3**

The results for this class are displayed in the cumulative frequency graph shown.



The shortest student in this class is 130 cm and the tallest student is 180 cm.

Construct a box-plot for this class in the space below.



Question 29 (2 marks)

A bag contains 7 blue lollies and 9 yellow lollies. One lolly is selected at random and eaten. A second lolly is then selected from the remaining lollies in the bag. **2**

Find the probability that the two lollies selected are the same colour.

.....

.....

.....

.....

.....

.....

.....

Question 30 (2 marks)

It costs \$465 to register a passenger car and \$350 to register a motorcycle. **2**

Let P = the number of passenger cars, and

B = the number of motorcycles.

Write TWO linear equations that represent the relationships below.

- There are 11 times as many passenger cars as motorcycles.
- The total registration fees for passenger cars and motorcycles is \$494 million.

.....

.....

.....

.....

.....

.....

.....

.....

Question 31 (3 marks)

The table shows the income tax rate for Australian residents for the 2024–2025 financial year. **3**

Taxable income	*Tax on this income*
0 – $18 200	Nil
$18 201 – $45 000	16 cents for each $1 over $18 200
$45 001 – $135 000	$4288 plus 30 cents for each $1 over $45 000
$135 001 – $190 000	$31 288 plus 37 cents for each $1 over $135 000
$190 001 and over	$51 638 plus 45 cents for each $1 over $190 000

At the end of the 2024–2025 financial year, Alex's tax payable was $47 420, excluding the Medicare levy.

What was Alex's taxable income?

.....

.....

.....

.....

.....

.....

.....

.....

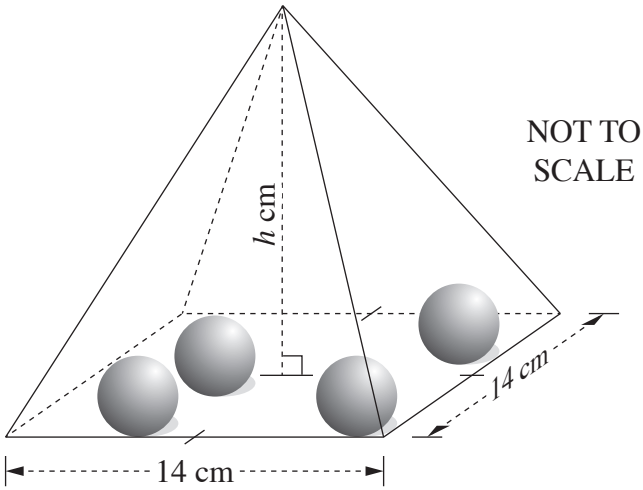
.....

.....

Do NOT write in this area.

Question 32 (3 marks)

Solid spheres are placed inside a square-based pyramid as shown. **3**



The base of the pyramid has side lengths of 14 cm. The height of the pyramid is h cm. The radius of each sphere is 1.5 cm.

The amount of empty space remaining inside the pyramid after 30 spheres have been placed inside the pyramid is 634 cm^3.

What is the height, h, of the pyramid? Give your answer correct to the nearest centimetre.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 33 (5 marks)

A used car has a sale price of $24 200. In addition to the sale price, the following costs are charged: **5**

- transfer of registration $50
- stamp duty which is calculated at $3 for every $100, or part thereof, of the sale price.

Kat borrows the total amount to be paid for the car, including transfer of registration and stamp duty. Simple interest at the rate of 6.8% per annum is charged on the loan. The loan is to be repaid in equal monthly repayments over 3 years.

Calculate Kat's monthly repayment.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 34 (3 marks)

The table shows future value interest factors for an annuity of $1. **3**

Rate (*r*) / *Period* (*n*)	*0.005*	*0.01*	*0.015*	*0.02*	*0.03*	*0.06*
7	7.10588	7.21354	7.32300	7.43428	7.66246	8.39384
28	29.97452	32.12910	34.48148	37.05121	42.93092	68.52811
56	64.44140	74.58098	86.79754	101.55826	141.15377	418.82235
84	104.07393	130.67227	166.17264	213.86661	365.88054	2209.41674

Lin invests a lump sum of $21 000 for 7 years at an interest rate of 6% per annum, compounding monthly.

Yemi wants to achieve the same future value as Lin by using an annuity. Yemi plans to deposit a fixed amount into an investment account at the end of each month for 7 years. The investment account pays 6% per annum, compounding monthly.

Using the table provided, determine how much Yemi needs to deposit each month.

.....

.....

.....

.....

.....

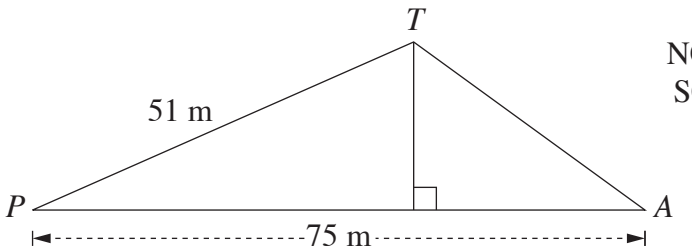
.....

Do NOT write in this area.

Question 35 (3 marks)

The triangle *PTA* is shown. The length of *PA* is 75 m and the length of *PT* is 51 m. **3**

The angle of depression from *T* to *A* is 36°, and the angle *PTA* is obtuse.



Find the length of *TA*. Give your answer correct to 2 decimal places.

.....

.....

.....

.....

.....

.....

.....

.....

.....

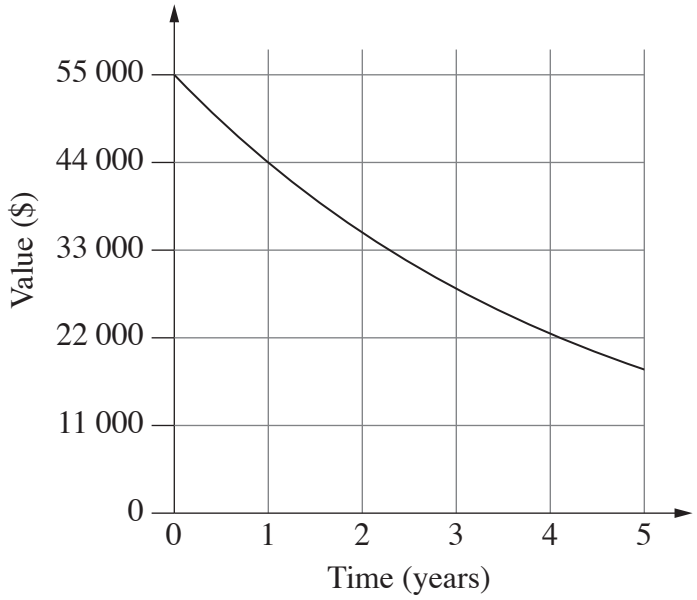
.....

.....

.....

Question 36 (4 marks)

The graph shows the salvage value of a car over 5 years. **4**



The salvage values are based on the declining-balance method.

By what amount will the car's value depreciate during the 10th year?

.....

.....

.....

.....

.....

.....

.....

.....

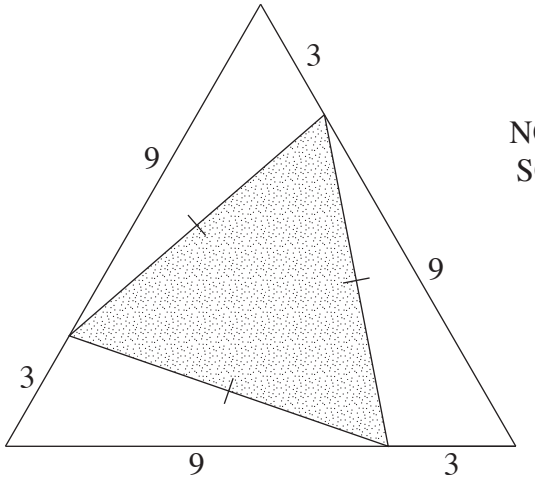
.....

.....

.....

Question 37 (4 marks)

The diagram shows a park consisting of two equilateral triangles. The shaded triangle is a grassed section. All measurements on the diagram are in metres. **4**



NOT TO SCALE

How long will it take to mow the grassed section if it takes 5 minutes to mow 20 m^2? Give your answer to the nearest minute.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Do NOT write in this area.

Question 38 (3 marks)

A car's fuel efficiency is 30 miles per US gallon. **3**

1 US gallon = 3.8 litres	(correct to 2 significant figures)
1 mile = 1.6 km	(correct to 2 significant figures)

Calculate the car's fuel efficiency in litres per 100 km, correct to 1 decimal place.

.....

.....

.....

.....

.....

.....

.....

.....

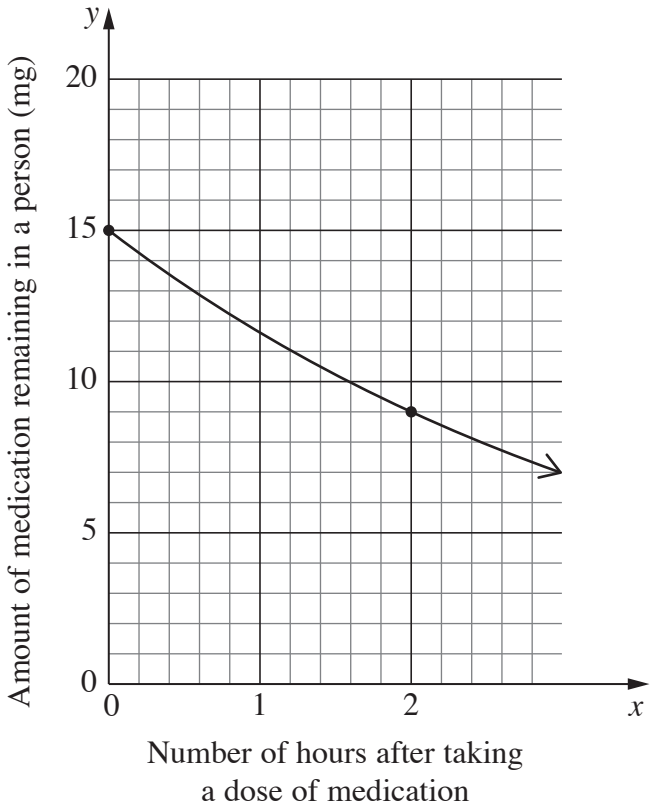
.....

.....

Question 39 (3 marks)

After a dose of a medication, the amount of the medication remaining in a person can be modelled by the equation $y = ka^x$, where x is the number of hours after taking the dose, and y is the amount remaining in milligrams (mg). **3**

The graph shows the amount of the medication remaining in a person after x hours. Two points are also shown on the graph.



Using the information provided, find the amount of medication that remains in a person when $x = 4$.

.....

.....

.....

.....

.....

.....

.....

.....

Question 40 (5 marks)

(a) In a flock of 12 600 sheep, the ratio of males to females is 1 : 20. **4**

The weights of the male sheep are normally distributed with a mean of 76.2 kg and a standard deviation of 6.8 kg.

In the flock, 15 of the male sheep each weigh more than x kg.

Find the value of x.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) The weights of the female sheep are also normally distributed but have a smaller mean and smaller standard deviation than the weights of male sheep. **1**

Explain whether it could be expected that 300 of the females from the flock each weigh more than x kg, where x is the value found in part (a).

.....

.....

.....

.....

.....

.....

.....

.....

End of paper

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.

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.

Office Use Only – Do NOT write anything, or make any marks below this line.

6054310436

Do NOT write in this area.

NSW Education Standards Authority

2025 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Mathematics Standard 1
Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

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

Upper bound = measurement + absolute error

Lower bound = measurement – absolute error

Length

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

Area

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

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

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

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

$$FV = PV\left(1 + r\right)^n$$

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

$$S = V_0\left(1 - r\right)^n$$

Statistical Analysis

An outlier is a score

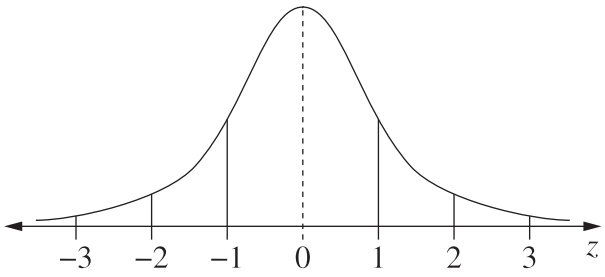
less than $Q_1 - 1.5 \times IQR$

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