NSW GOVERNMENT

NSW Education Standards Authority

Centre Number

Student Number

2023 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Mathematics Standard 1

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours
- 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: 80

Section I – 10 marks (pages 2–6)

- Attempt Questions 1–10
- Allow about 15 minutes for this section

Section II – 70 marks (pages 9–35)

- Attempt Questions 11–31
- Allow about 1 hour and 45 minutes for this section

Section I

10 marks
Attempt Questions 1–10
Allow about 15 minutes for this section

Use the multiple-choice answer sheet for Questions 1–10.

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1 What is 4.26819 when rounded to 3 decimal places?

A. 4.26

B. 4.27

C. 4.268

D. 4.269

2 An amount of $2500 is invested at a simple interest rate of 3% per annum.

How much interest is earned in the first two years?

A. $75

B. $150

C. $2575

D. $2652

3 Two towns are 5 cm apart on a map that uses a scale of 1 : 100 000.

What is the actual distance between the two towns?

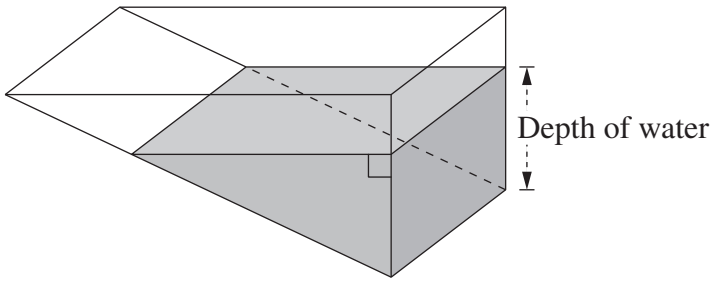
A. 5 km

B. 50 km

C. 500 km

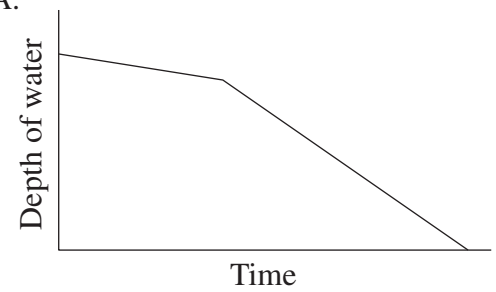
D. 5000 km

4 The diagram shows water in a pool which is in the shape of a triangular prism. The pool is being emptied of water at a constant rate.

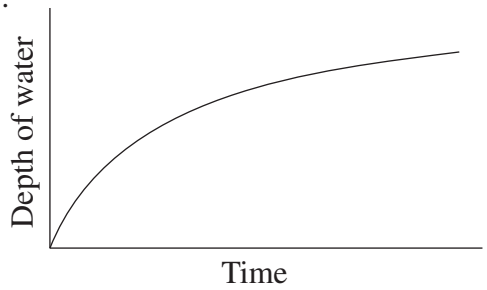


Which graph best illustrates the change in depth of water with time?

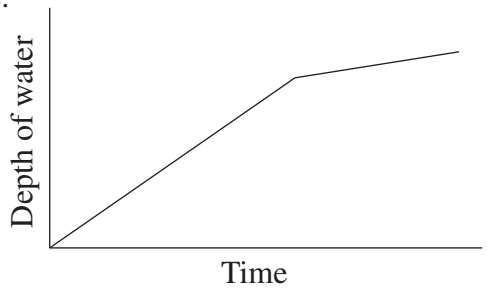
A.



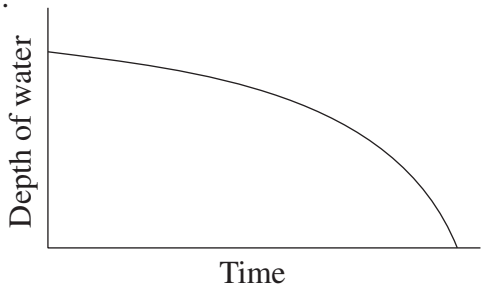
B.



C.



D.



5 The following is part of a credit card statement for August, with some figures missing.

Statement period: 1 August to 31 August

Opening balance		New charges		Payments		Closing balance
$506.05	+		−	$118.95	=	

1 August	Opening balance	506.05
18 August	Clothing	85.97
22 August	Payment	−18.95
23 August	Payment	−100.00
31 August	Interest	4.64

What are the amounts for 'New charges' and 'Closing balance'?

	New charges	*Closing balance*
A.	$85.97	$468.43
B.	$85.97	$596.66
C.	$90.61	$473.07
D.	$90.61	$477.71

6 A delivery truck was valued at $65 000 when new. The value of the truck depreciates at a rate of 22 cents per kilometre travelled.

What is the value of the truck after it has travelled a total distance of 132 600 km?

A. $35 828

B. $29 172

C. $14 872

D. $14 300

7 An item was purchased for a price of $880, including 10% GST.

What is the amount of GST included in the price?

A. $8.00

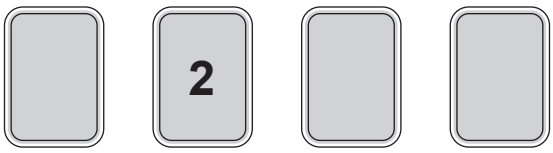
B. $8.80

C. $80.00

D. $88.00

8 Four cards marked with the numbers 1, 2, 3 and 4 are placed face down on a table.

One card is turned over as shown.



What is the probability that the next card turned over is marked with an odd number?

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

B. $\frac{1}{3}$

C. $\frac{2}{4}$

D. $\frac{2}{3}$

9 A bag contains 150 jelly beans. Some of them are red and the rest are blue. The ratio of red to blue jelly beans is 2 : 3.

Sophie eats 10 of each colour.

What is the new ratio of red to blue jelly beans?

A. 2 : 3

B. 4 : 9

C. 5 : 8

D. 11 : 17

10 A tap is dripping at the rate of 4 mL per minute.

Which expression shows how many litres this would amount to in one year?

A. $\dfrac{4 \times 1000}{60 \times 24 \times 365}$

B. $\dfrac{4 \times 60 \times 24 \times 365}{1000}$

C. $\dfrac{60 \times 24 \times 365}{4 \times 1000}$

D. $\dfrac{1000}{4 \times 60 \times 24 \times 365}$

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2023 HIGHER SCHOOL CERTIFICATE EXAMINATION

Centre Number

Student Number

Mathematics Standard 1

Section II Answer Booklet

70 marks
Attempt Questions 11–31
Allow about 1 hour and 45 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

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Question 11 (3 marks)

A company employs 50 people.

The annual income of the employees is shown in the grouped frequency distribution table.

Annual income ($)	*Class centre* (x)	*Number of employees* (f)	fx
40 000 – 49 999	45 000	12	540 000
50 000 – 59 999	55 000	13	715 000
60 000 – 69 999	65 000	15	***A***
70 000 – 79 999	75 000	7	525 000
80 000 – 89 999	85 000	3	255 000
		Total = 50	*Total* = ***B***

(a) What are the values of ***A*** and ***B***? **2**

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(b) Find the mean for this distribution. **1**

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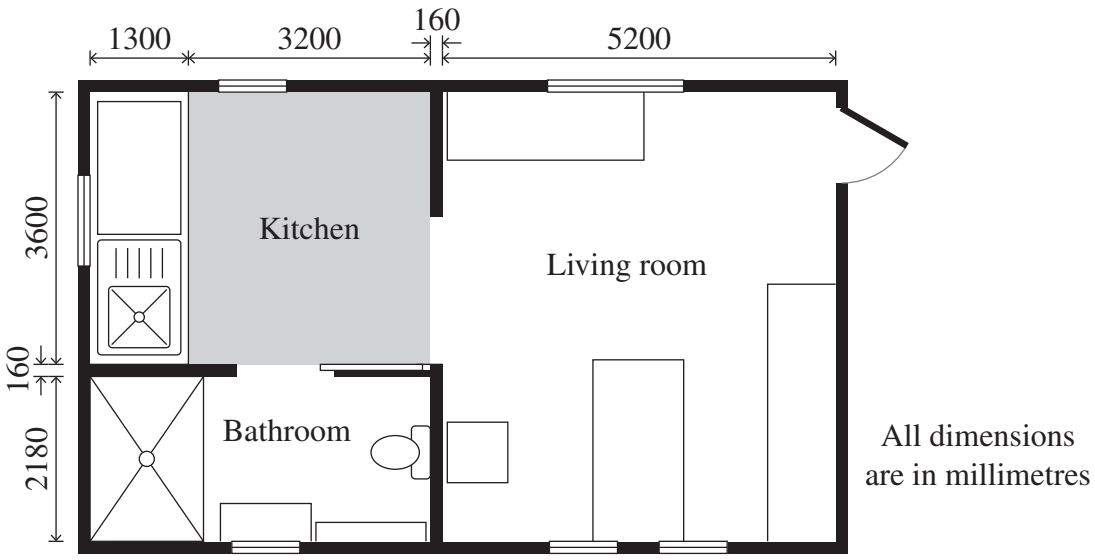
Question 12 (5 marks)

A floor plan is shown.



(a) What are the dimensions, in metres, of the living room? **2**

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(b) The shaded area of the kitchen floor is to be tiled. Each tile is 40 cm by 40 cm. **2**

How many tiles are needed to cover the kitchen floor?

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(c) The tiles are supplied in boxes of 10. Only full boxes can be purchased. **1**

How many boxes need to be purchased to tile the kitchen floor?

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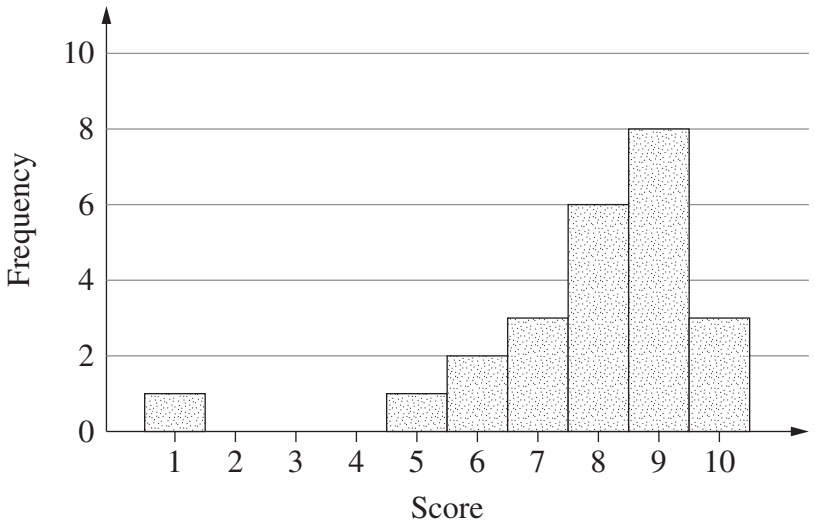
Question 13 (3 marks)

The graph shows the frequency of scores out of 10 awarded to a museum by visitors.



(a) What is the mode of these data? **1**

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(b) Describe TWO features of this graph. **2**

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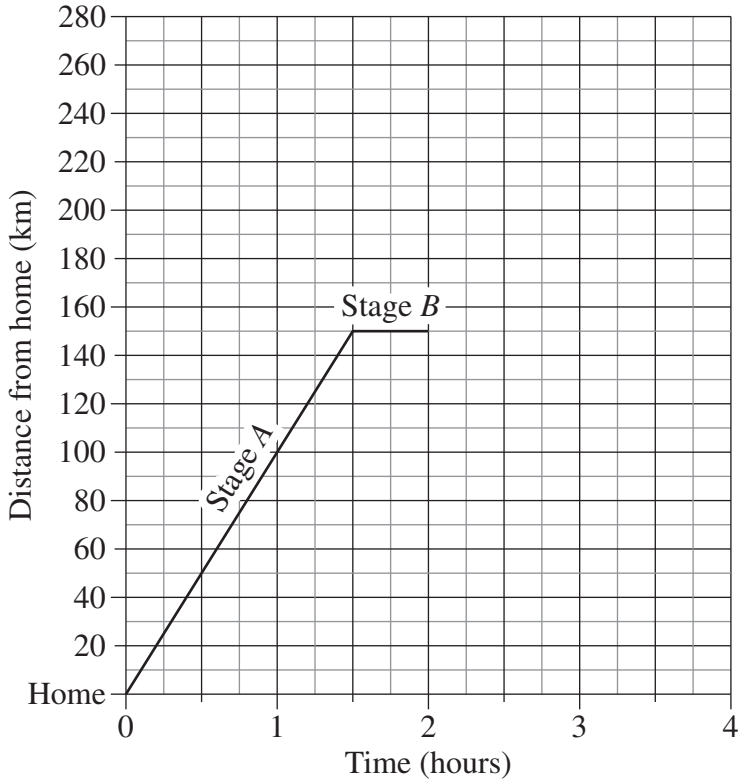
Question 14 (4 marks)

The distance–time graph shows the first two stages of a car journey from home to a holiday house.



(a) At what speed, in kilometres per hour, did the car travel during stage *A* of the journey? **1**

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(b) For how long did the car stop during stage *B* of the journey? **1**

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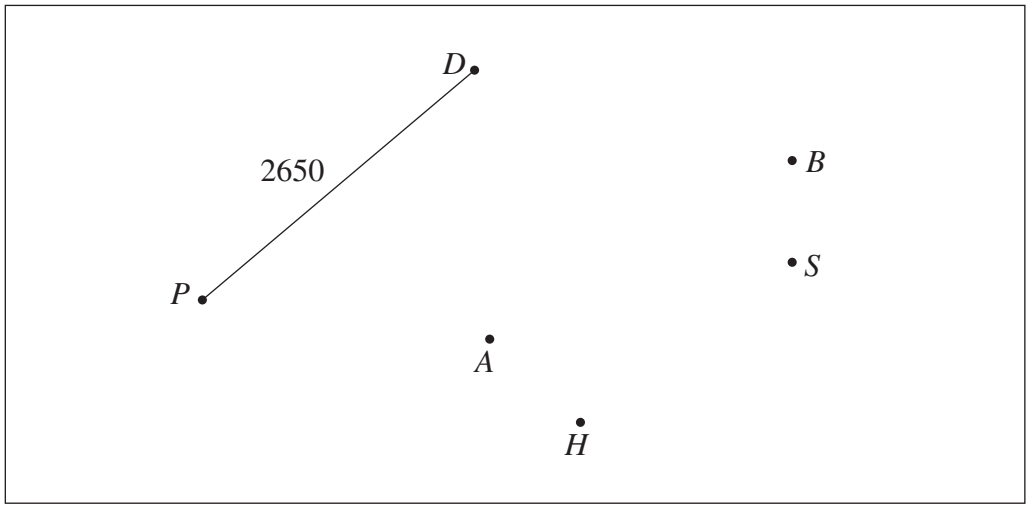
(c) After stage *B*, the car continues to travel towards the holiday house at a constant speed of 50 km/h for 2 hours. Graph this part of the journey on the grid above. **2**

Question 15 (3 marks)

The table shows some of the flight distances (rounded to the nearest 10 km) between various Australian cities.

City	Adelaide (*A*)	Brisbane (*B*)	Darwin (*D*)	Hobart (*H*)	Perth (*P*)	Sydney (*S*)
Adelaide		–	–	1170	2120	–
Brisbane	–		2850	–	–	750
Darwin	–	2850		–	2650	3150
Hobart	1170	–	–		–	1040
Perth	2120	–	2650	–		3270
Sydney	–	750	3150	1040	3270	

(a) Use the information in the table to complete the network diagram where the edges are labelled with distances. **2**



(b) Mahsa wants to travel from Hobart to Darwin. She wants to change planes only once. **1**

Using the network diagram, calculate how many kilometres she will travel by plane.

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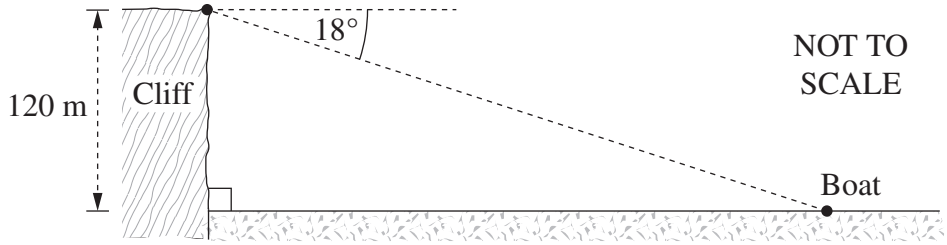
Question 16 (2 marks)

From the top of a vertical cliff 120 metres high, a boat is observed. The angle of depression of the boat from the top of the cliff is 18°, as shown in the diagram. **2**



Find the distance of the boat from the base of the cliff. Give your answer to the nearest metre.

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Question 17 (2 marks)

Consider the equation $P = \dfrac{10N - 7.5M}{9}$. **2**

Find the value of P when $N = 6$ and $M = 2$.

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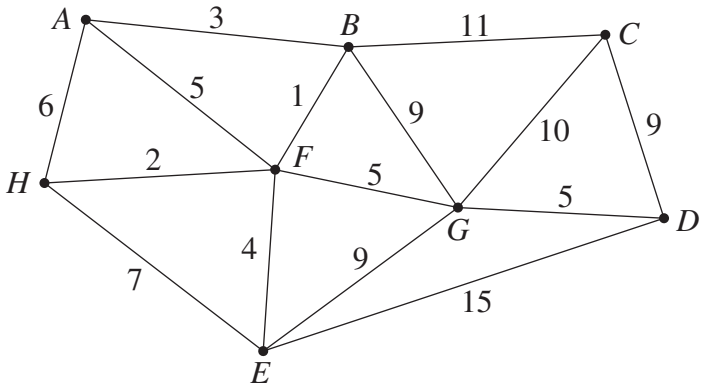
Please turn over

Question 18 (4 marks)

A network of running tracks connects the points A, B, C, D, E, F, G, H, as shown. The number on each edge represents the time, in minutes, that a typical runner should take to run along each track.



(a) Which path could a typical runner take to run from point A to point D in the shortest time? **2**

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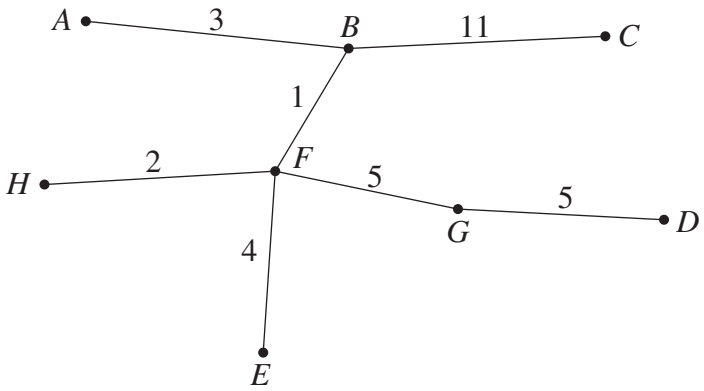
(b) A spanning tree of the network above is shown. **2**



Is it a minimum spanning tree? Give a reason for your answer.

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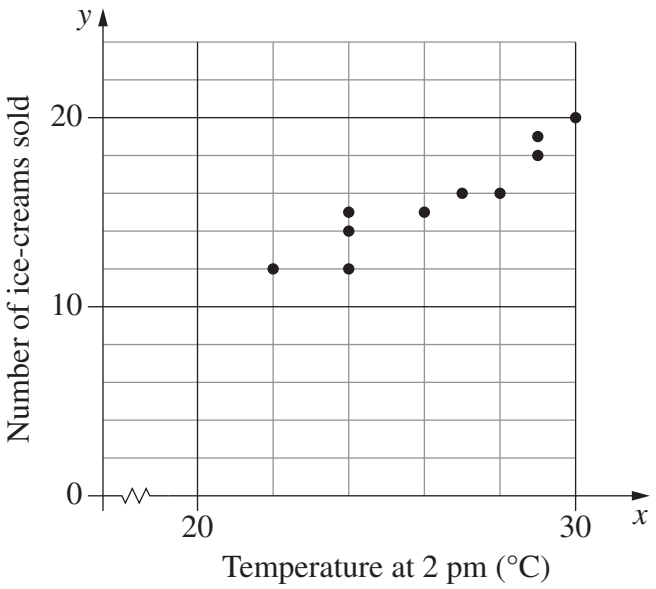
Question 19 (4 marks)

The scatterplot shows the number of ice-creams sold, y, at a shop over a ten-day period, and the temperature recorded at 2 pm on each of these days.



(a) The data are modelled by the equation of the line of best fit given below. **2**

$$y = 0.936x - 8.929, \text{ where } x \text{ is the temperature.}$$

Sam used a particular temperature with this equation and predicted that 23 ice-creams would be sold.

What was the temperature used by Sam, to the nearest degree?

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(b) In using the equation to make the prediction in part (a), was Sam interpolating or extrapolating? Justify your answer. **2**

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Question 20 (3 marks)

Consider the following dataset. **3**

22, 27, 29, 32, 36, 37, 39, 45, 47, 58

Is 58 an outlier in this dataset? Justify your answer with working.

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Question 21 (3 marks)

An amount of $12 000 is invested in an account that pays 1% interest per quarter, compounding quarterly for five years. **3**

What is the future value of this investment?

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Questions 11–21 are worth 36 marks in total

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Question 22 (4 marks)

The hours worked last week by Rose are shown. Her normal rate of pay per hour is $24.05 . **4**

Monday to Friday (normal rate)	8:30 am – 12:30 pm
Saturday (time-and-a-half)	9:00 am – 11:30 am
Sunday (double time)	9:00 am – noon

How much did Rose earn last week?

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Question 23 (3 marks)

The table compares the fuel costs of a petrol car with an electric car. **3**

	Petrol car	*Electric car*
Fuel consumption	8.6 L / 100 km	18 kWh / 100 km
Cost of fuel	$1.87 / L	$0.25 / kWh

Jun travels on average 35 000 km per year.

How much will he save on fuel costs in a year by using an electric car?

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Question 24 (4 marks)

Bobby invested $5000.

The table shows the progress of his investment over the first 4 months.

Amount invested $5000
Interest rate 0.6% per month, compounded monthly

Month	*Principal* (at start of month)	*Interest earned*	*Balance* (at end of month)
1	5000.00	30.00	5030.00
2	5030.00	30.18	5060.18
3	5060.18	30.36	5090.54
4	5090.54	***A***	***B***

(a) What are the values of ***A*** and ***B***? **2**

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(b) Bobby could have earned simple interest on the investment at 0.62% per month. **2**

How much interest would Bobby have earned over 4 months by choosing this option?

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Question 25 (2 marks)

An artwork is currently valued at $15 000. It appreciates at a rate of 5.3% per annum. **2**

What will the value of the artwork be in 8 years time?

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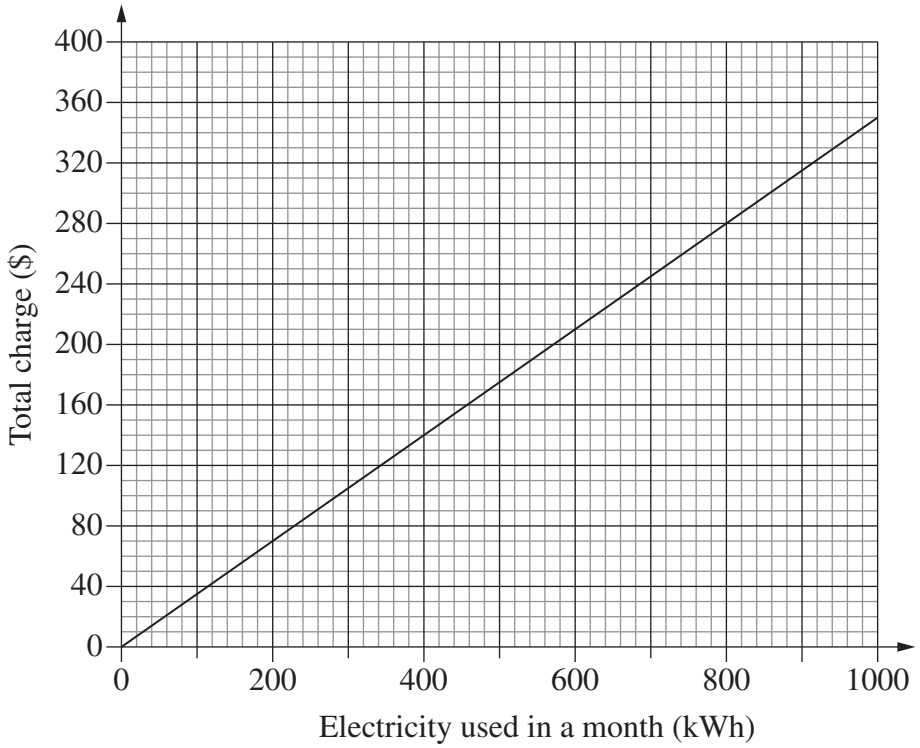
Question 26 (5 marks)

Electricity provider *A* charges 25 cents per kilowatt hour (kWh) for electricity, plus a fixed monthly charge of $40.

(a) Complete the table showing Provider *A*'s monthly charges for different levels of electricity usage. **1**

Electricity used in a month (kWh)	0	400	1000
Monthly charge ($)	40		290

Provider *B* charges 35 cents per kWh, with no fixed monthly charge. The graph shows how Provider *B*'s charges vary with the amount of electricity used in a month.



Question 26 continues on page 27

Question 26 (continued)

(b) On the grid on the previous page, graph Provider *A*'s charges from the table in part (a). **1**

(c) Use the two graphs to determine the number of kilowatt hours per month for which Provider *A* and Provider *B* charge the same amount. **1**

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(d) A customer uses an average of 800 kWh per month. **2**

Which provider, *A* or *B*, would be the cheaper option and by how much?

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End of Question 26

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Question 27 (2 marks)

When it is 10 am in Town *A*, the time in Town *B* is 2 pm on the same day. **2**

Joe lives in Town *A* and wishes to watch a live soccer game played in Town *B*. The game commences at 11:30 am, Town *B* local time, and lasts for 2 hours.

What time will it be in Town *A* when the game finishes?

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Question 28 (2 marks)

The nutrition label for a food item is shown. **2**

Nutrition information		
	Quantity per serving	% daily recommended intake per serving
Energy	420 kJ	5%
Protein	2.2 g	4%
Carbohydrates	19.1 g	6%
Fat, total	1.9 g	3%

Based on the information on this label, what is the daily recommended intake of carbohydrates, to the nearest gram?

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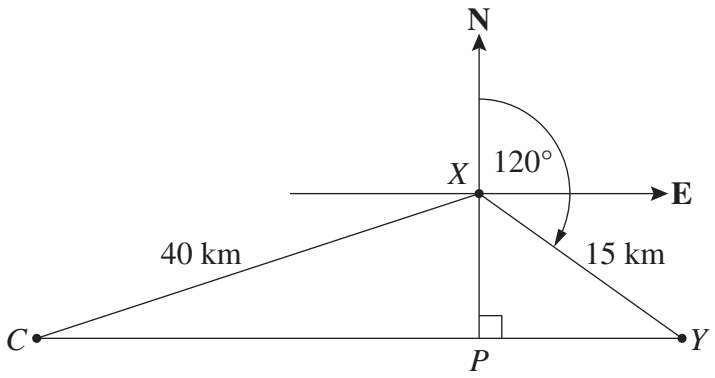
Question 29 (4 marks)

The diagram shows the location of three places X, Y and C.

Y is on a bearing of 120° and 15 km from X.

C is 40 km from X and lies due west of Y.

P lies on the line joining C and Y and is due south of X.



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(a) Find the distance from X to P. **2**

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(b) What is the bearing of C from X, to the nearest degree? **2**

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Question 30 (3 marks)

A plumber leases equipment which is valued at $60 000. **3**

The salvage value of the equipment at any time can be calculated using either of the two methods of depreciation shown in the table.

Method of depreciation	*Rate of depreciation*
Straight-line method	$3500 per annum
Declining-balance method	12% per annum

Under which method of depreciation would the salvage value of the equipment be lower at the end of 3 years? Justify your answer with appropriate mathematical calculations.

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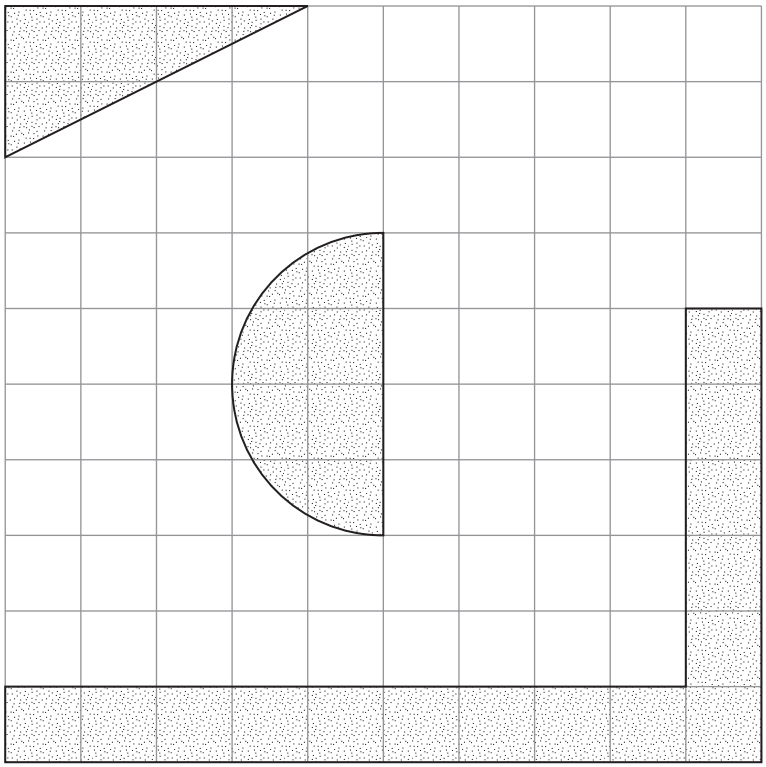
Question 31 (5 marks)

A scale drawing of a garden plan, where 1 cm represents 2 m, is shown. **5**

The shaded areas in the diagram represent the garden beds.



Woodchips will be laid as a mulch on the garden beds to a depth of 10 cm.

What is the volume of woodchips required?

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NSW Education Standards Authority

2023 **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

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

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

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

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

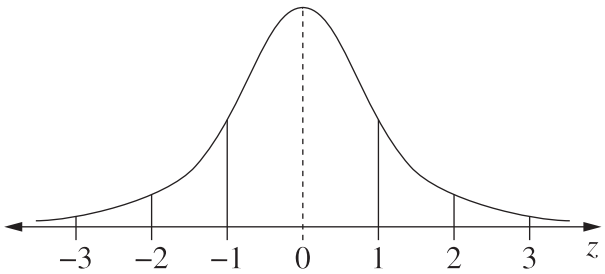
less than $Q_1 - 1.5 \times IQR$

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

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