NSW Education Standards Authority

2022 **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

Total marks: 80

Section I – 10 marks (pages 2–5)

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

Section II – 70 marks (pages 9–32)

- Attempt Questions 11–32
- 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 650 000 000 expressed in standard form?

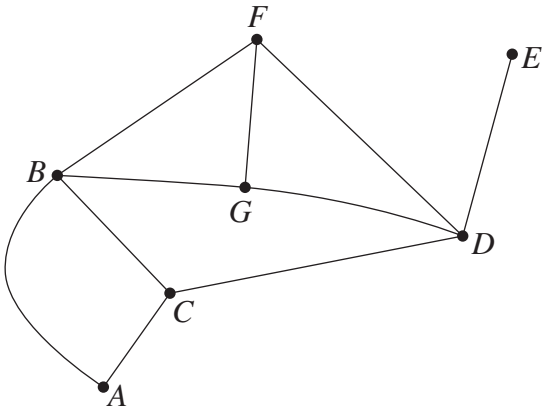
A. 6.5×10^7

B. 6.5×10^8

C. 65×10^6

D. 65×10^7

2 A network diagram is shown.



What is the number of edges in this network?

A. 6

B. 7

C. 9

D. 10

3 A jar contains 12 red, 10 black and 13 white lollies.

Alex picks out a red lolly and eats it. He then randomly picks a second lolly.

What is the probability that the second lolly is also red?

A. $\frac{11}{34}$

B. $\frac{11}{35}$

C. $\frac{12}{34}$

D. $\frac{12}{35}$

4 The area (A) of a circle is given by the formula $A = \pi r^2$, where r is the radius.

What is the value of A, correct to three significant figures, if $r = 3.55$?

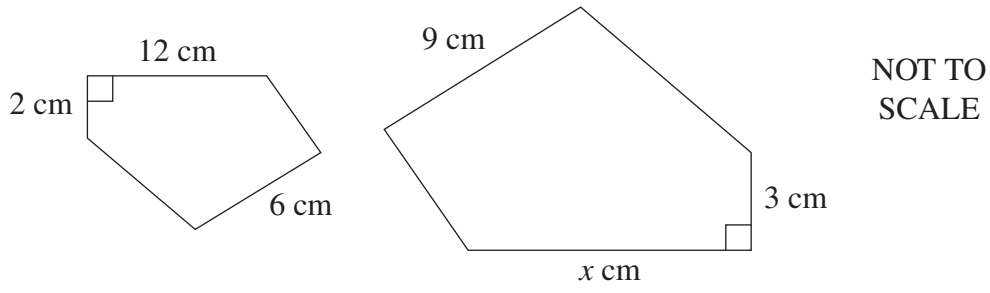
A. 39.5

B. 39.6

C. 39.591

D. 39.592

5 Two similar figures are shown.



What is the value of x?

A. 6

B. 8

C. 18

D. 27

6 A water tank holds 6000 litres when full.

The tank is full when water starts to flow out of it at a constant rate of 3 litres per minute until the tank is empty.

Which expression represents the volume (V litres) of water in the tank after t minutes?

A. $V = 6000 - 3t$

B. $V = 6000t - 3$

C. $V = 3 - 6000t$

D. $V = 3t - 6000$

7 Tian is paid $20.45 per hour, as well as a meal allowance of $16.20 per day.

What are Tian's total earnings if she works 9 hours per day for 5 days?

A. $329.85

B. $936.45

C. $1001.25

D. $1649.25

8 Which true bearing is the same as S48°W?

A. 132°

B. 222°

C. 228°

D. 312°

9 In ten years, the future value of an investment will be \$150 000. The interest rate is 4% per annum, compounded half-yearly.

Which equation will give the present value (PV) of the investment?

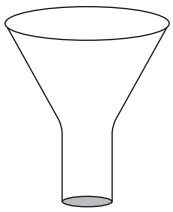
A. $PV = \dfrac{150\,000}{(1 + 0.04)^{10}}$

B. $PV = \dfrac{150\,000}{(1 + 0.04)^{20}}$

C. $PV = \dfrac{150\,000}{(1 + 0.02)^{10}}$

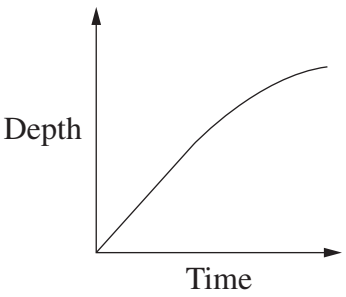
D. $PV = \dfrac{150\,000}{(1 + 0.02)^{20}}$

10 The diagram shows a container, closed at the base. It is to be filled with water at a constant rate.



Which graph best shows the depth of water in the container as time varies?

A.



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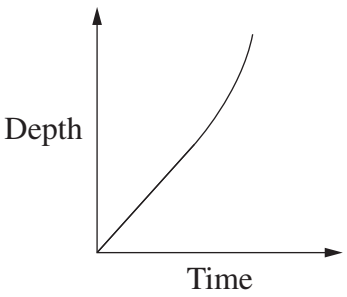
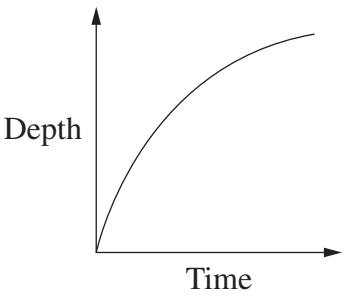
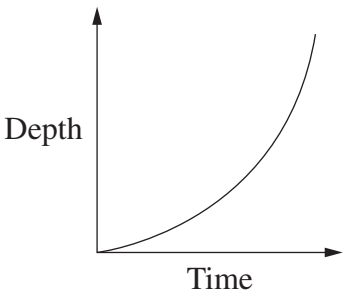


C.



D.



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2022 HIGHER SCHOOL CERTIFICATE EXAMINATION

Centre Number

Student Number

Mathematics Standard 1

Section II Answer Booklet

70 marks
Attempt Questions 11–32
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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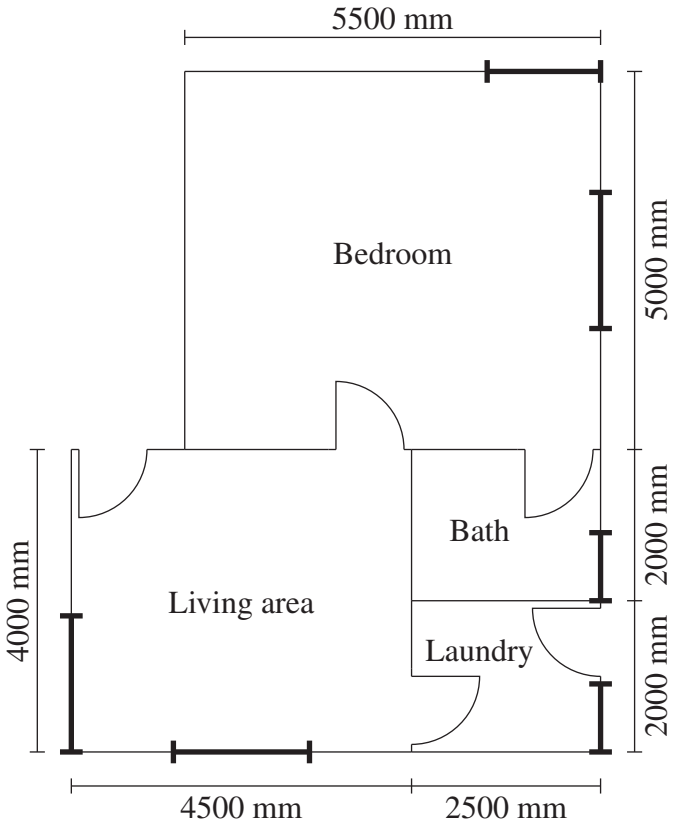
Question 11 (4 marks)

The floor plan of a home unit has been drawn to scale.



(a) How many doors are shown on the plan? **1**

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(b) Show that the scale of the plan is 1 : 100. **1**

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(c) What is the total floor area of the home unit in square metres? **2**

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Question 12 (2 marks)

The cost of hiring a campervan is $210 per day. There is also a charge of $0.35 per km travelled. **2**

A family hired a campervan for 9 days and travelled 2700 km.

How much did the family pay in total?

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Please turn over

Question 13 (4 marks)

Kim wants to investigate what students think about the food that is sold at the school's canteen. Kim decides to use a survey to interview a sample group of students to find out their opinions on a number of different issues.

(a) As part of the survey, Kim is thinking about using one of the options listed below. **2**

Option A

Do you like the food at the school canteen?

Yes / No (circle your choice)

Option B

Rate the food at the canteen by choosing a number from 1 to 10, where 1 represents you dislike the food and 10 represents you enjoy the food a lot.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐

Name ONE advantage for each option.

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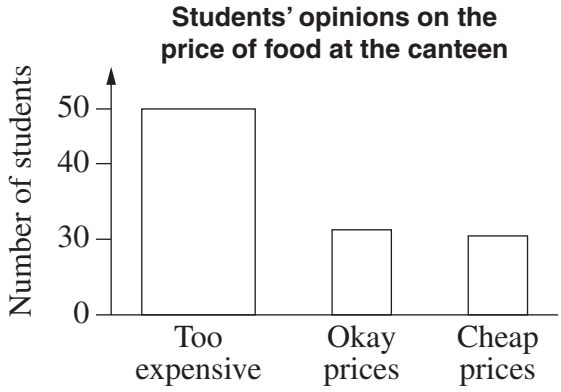
(b) After collecting data, Kim drew the following graph to summarise the opinions related to the price of the food. **2**



What TWO features of the graph make it misleading?

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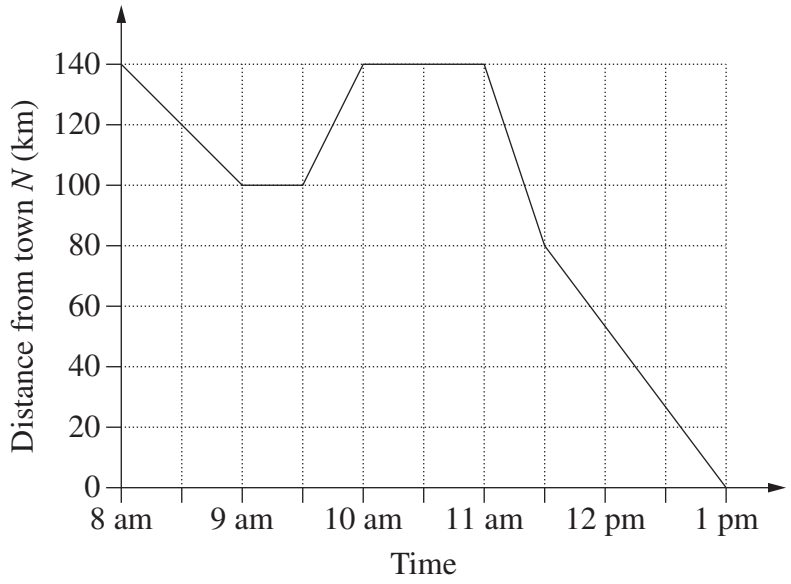
Question 14 (5 marks)

The travel graph displays Jamie's trip which began at town *M* at 8 am and finished at town *N*.



(a) How far apart are the two towns? **1**

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(b) At what time during the day did Jamie arrive back at town *M*? **1**

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(c) What was the total distance that Jamie travelled? **1**

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(d) Between which times in the day was Jamie travelling at the fastest speed? Justify your answer, without calculations. **2**

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Question 15 (3 marks)

Tom is 25 years old, and likes to keep fit by exercising.

(a) Use this formula to find his maximum heart rate (bpm). **1**

Maximum heart rate = 220 − age in years

Tom's maximum heart rate is ..... bpm.

(b) Tom will get the most benefit from this exercise if his heart rate is between 50% and 85% of his maximum heart rate. **2**

Between what two heart rates should Tom be aiming for to get the most benefit from his exercise?

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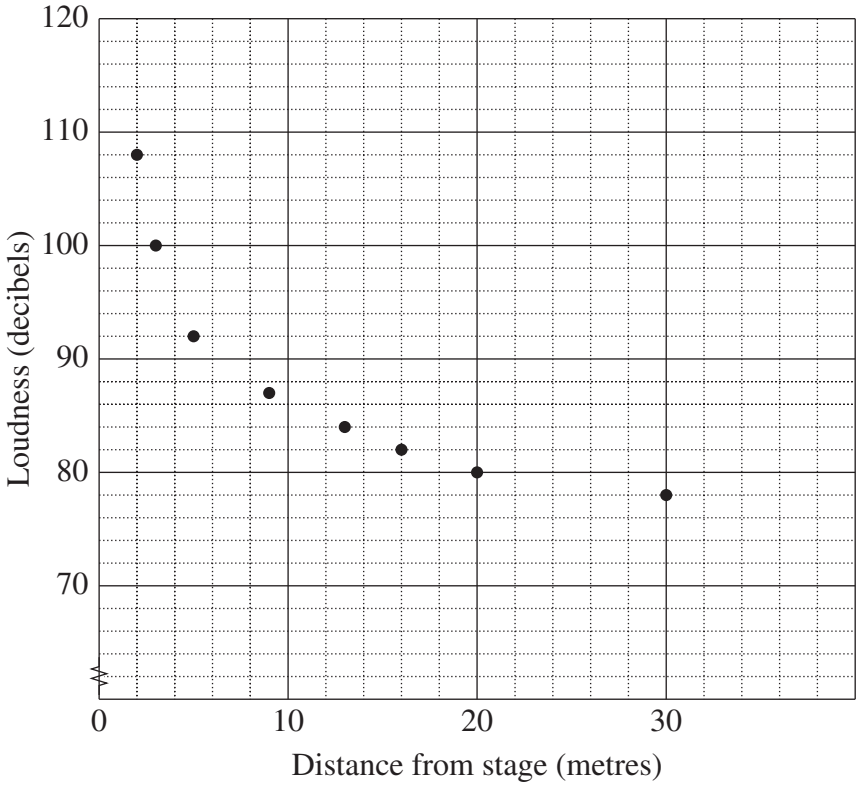
Question 16 (2 marks)

A concert organiser is interested in the relationship between the distance from the stage, in metres, and the loudness of the sound measured in decibels.

The data the concert organiser collected is shown on the graph.



(a) Is the relationship between distance and loudness linear or non-linear? **1**

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(b) Based on this dataset, at approximately what distance from the stage would the sound be at 90 decibels? **1**

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Question 17 (3 marks)

Each number from 1 to 30 is written on a separate card. The 30 cards are shuffled. A game is played where one of these cards is selected at random. Each card is equally likely to be selected.

Ezra is playing the game, and wins if the card selected shows an odd number between 20 and 30.

(a) List the numbers which would result in Ezra winning the game. **1**

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(b) What is the probability that Ezra does NOT win the game? **2**

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Question 18 (2 marks)

Singapore is 8 hours ahead of Coordinated Universal Time (UTC +8) and New York is 5 hours behind Coordinated Universal Time (UTC −5). **2**

What is the time and day in Singapore when it is 9 pm Monday in New York?

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Question 19 (2 marks)

Fried's formula is used to calculate the dosage of medication for children aged 1–2 years based on the adult dosage. The formula is **2**

$$\text{Dosage} = \frac{\text{age (in months)} \times \text{adult dosage}}{150}.$$

The adult dosage of a particular medication is 200 mg.

Betty's dosage is calculated to be 24 mg.

How old is Betty in months?

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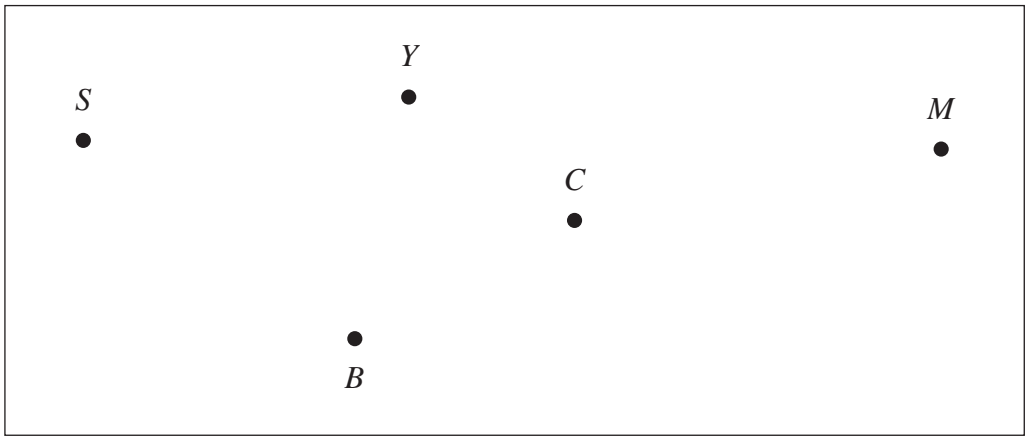
Question 20 (5 marks)

The table below shows the distances, in kilometres, between a number of towns.

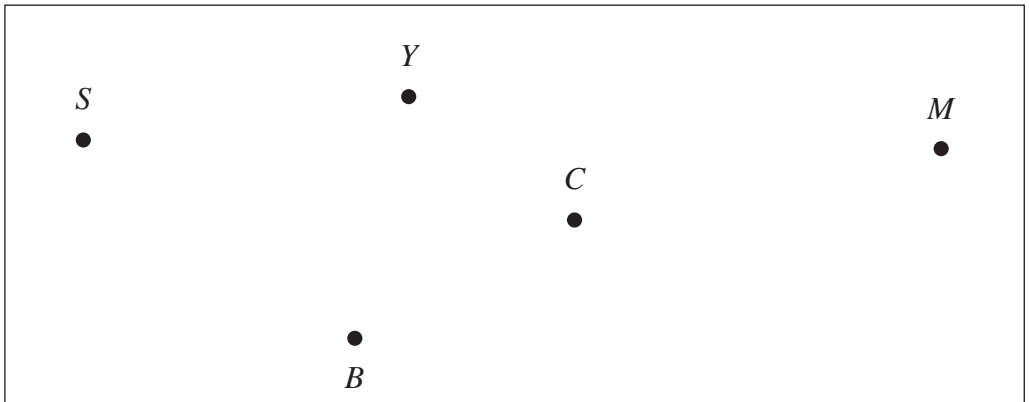
Towns	Snowtown (*S*)	Clairville (*C*)	Yuma (*Y*)	Bosten (*B*)	Morrella (*M*)
(*S*)	–	–	280	275	–
(*C*)	–	–	60	150	–
(*Y*)	280	60	–	–	530
(*B*)	275	150	–	–	790
(*M*)	–	–	530	790	–

(a) Using the vertices given, draw a weighted network diagram to represent the information shown in the table. **2**



(b) A tourist wishes to visit each town. **3**

Draw the minimum spanning tree which will allow for this AND determine its length.



Length of minimum spanning tree = ...

Question 21 (2 marks)

A real estate agent's commission for selling houses is 2% for the first $800 000 of the sale price and 1.5% for any amount over $800 000. **2**

Calculate the commission earned in selling a house for $1 500 000.

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Question 22 (2 marks)

A 2500-watt air-conditioning system is turned on for 3 hours each day. Electricity is charged at 27 cents per kWh. **2**

What is the cost of electricity for using the air-conditioning system over a seven-day period?

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Questions 11–22 are worth 36 marks in total

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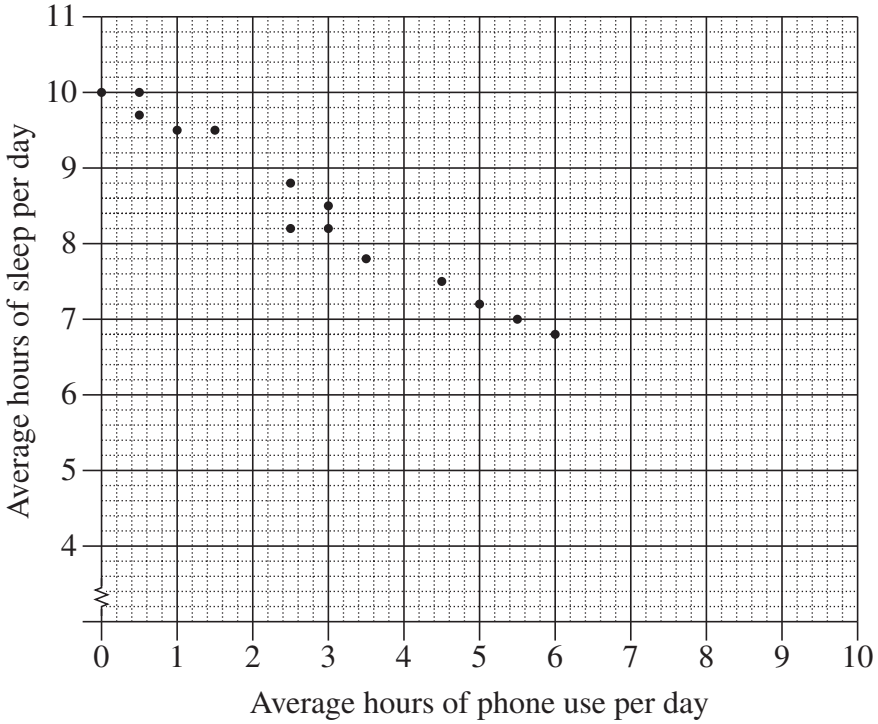
Question 23 (4 marks)

A teacher surveyed the students in her Year 8 class to investigate the relationship between the average number of hours of phone use per day and the average number of hours of sleep per day.

The results are shown on the scatterplot below.



(a) The data for two new students, Alinta and Birrani, are shown in the table below. Plot their results on the scatterplot. **2**

	Average hours of phone use per day	*Average hours of sleep per day*
Alinta	4	8
Birrani	0	10.5

(b) By first fitting the line of best fit by eye on the scatterplot, estimate the average number of hours of sleep per day for a student who uses the phone for an average of 2 hours per day. **2**

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Question 24 (4 marks)

Peta has the choice of investing $7000 in two different investment funds. **4**

Fund A: 5.2% per annum simple interest

Fund B: 5% per annum interest, compounded annually

What is the difference between the amounts of interest earned in the two investment funds over 3 years?

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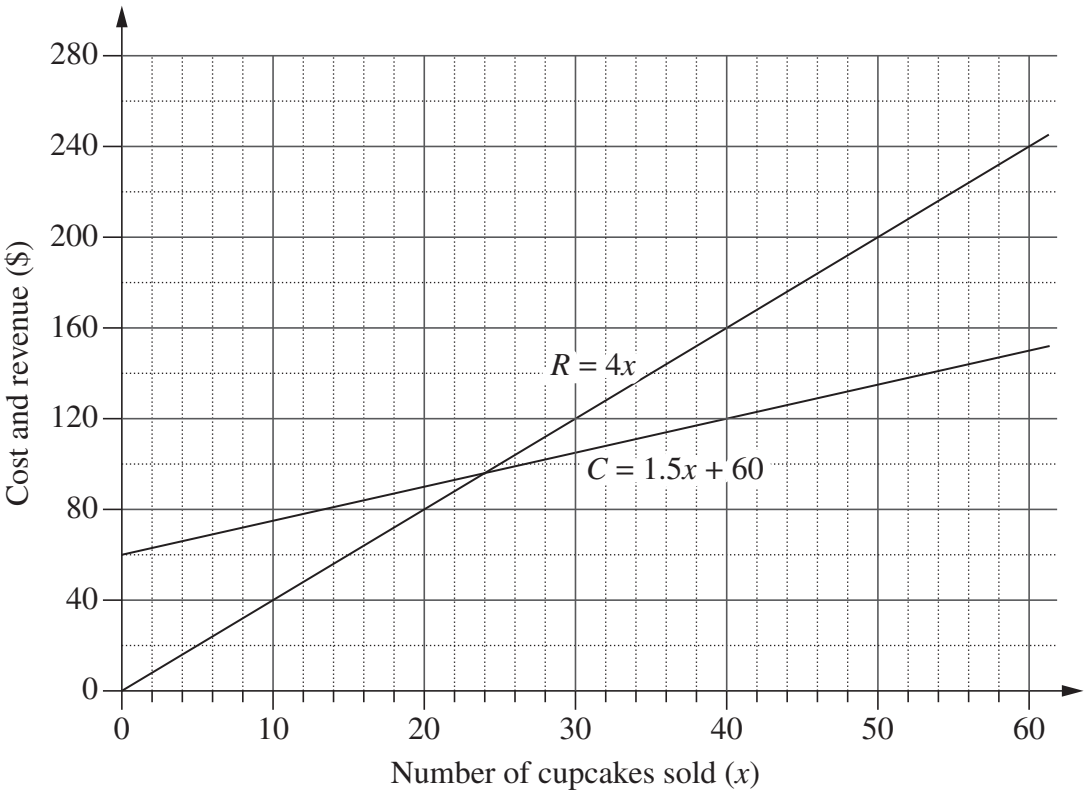
Question 25 (3 marks)

Sam is making cupcakes to sell at a market. It costs Sam \$60 to hire a stall, and each cupcake costs \$1.50 to make. Sam intends to sell each cupcake for \$4.00.

The equations representing Sam's cost (\$$C$) and revenue (\$$R$), are

$C = 1.5x + 60$ and $R = 4x$, where x is the number of cupcakes sold.

The graphs of C and R are shown below.



(a) How many cupcakes must Sam sell in order to break even? **1**

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(b) If Sam sells 60 cupcakes, what profit is made? **2**

You may assume that Profit = Revenue − Cost.

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Question 26 (3 marks)

A family uses a credit card to purchase a lounge during the month of November. **3**

The credit card has no interest-free period. Interest is charged at a rate of 21% per annum, compounded daily, from and including the date of purchase to the last day of the month.

The table shows the only purchases and payments on the credit card during the month of November.

Date	*Details*	*Amount* ($)
1 November	Opening balance	0
15 November	Lounge	7500
30 November	Interest charged	*
30 November	Payment	−2000
30 November	Closing balance	*

What is the closing balance owing on the credit card on 30 November?

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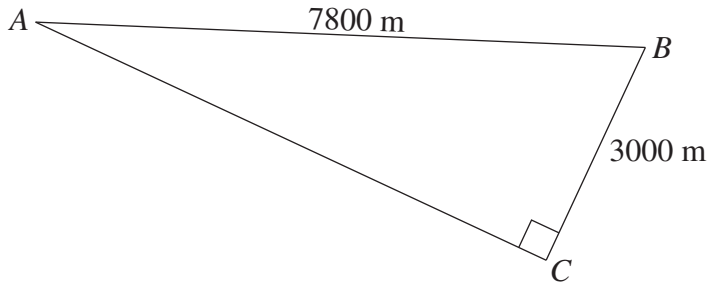
Question 27 (4 marks)

Shan is interested in buying a block of bushland. The price per hectare is $500. The land he wishes to purchase is in the shape of a right-angled triangle as shown. **4**

The length of side *AB* is 7800 metres and the length of side *BC* is 3000 metres. The right angle of the triangle is angle *ACB*.



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Note: 1 hectare = 10 000 m^2

What is the cost of the block of bushland?

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Question 28 (3 marks)

Julie has a gross annual salary of $67 000. During the year she also received an income of $780 from investments and had tax deductions totalling $1000. **3**

The table below shows the income tax rates for the 2021–2022 financial year.

Taxable income ($)	*Tax payable*
$0 – $18 200	Nil
$18 201 – $45 000	19c for each $1 over $18 200
$45 001 – $120 000	$5092 plus 32.5c for each $1 over $45 000
$120 001 – $180 000	$29 467 plus 37c for each $1 over $120 000
$180 001 and over	$51 667 plus 45c for each $1 over $180 000

Calculate the tax payable on Julie's taxable income, ignoring the Medicare levy.

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Question 29 (3 marks)

The ages of the 10 members in a tennis club are **3**

24 25 27 33 34 34 35 39 47 59.

Could the age 59 be considered an outlier? Justify your answer with calculations.

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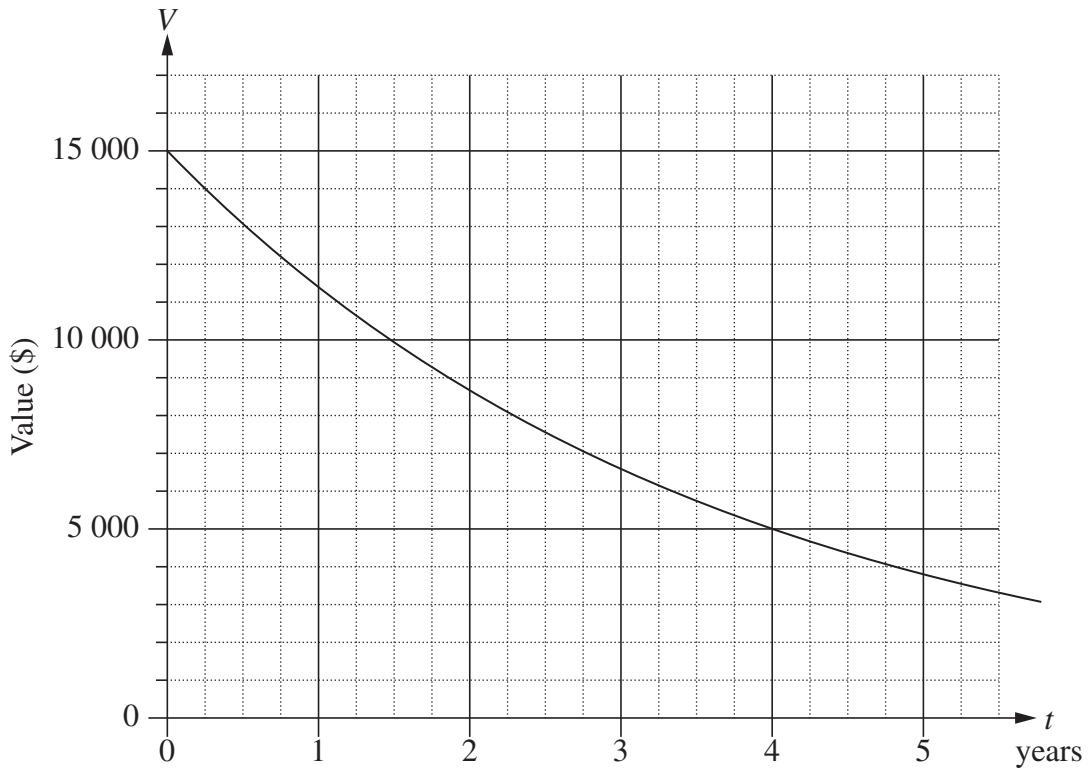
Question 30 (4 marks)

A car is purchased for \$15 000. The graph shows the value of the car, \$$V$, at time t years since it was purchased, using the declining-balance method of depreciation.



(a) When using the straight-line method of depreciation, the value of the car depreciates at a rate of \$2500 per year. **2**

By first completing the table, plot on the grid above the value of the car for the first three years based on the straight-line method of depreciation.

End of year	*Straight-line depreciated value* (\$)
0	15 000
1	
2	
3	

(b) After how many years will the value of the car using the straight-line method of depreciation be equal to its value using the declining-balance method? **2**

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Question 31 (2 marks)

A watch is currently worth $6100. It has appreciated by 5.8% per annum since purchase. **2**

What was its value 10 years ago?

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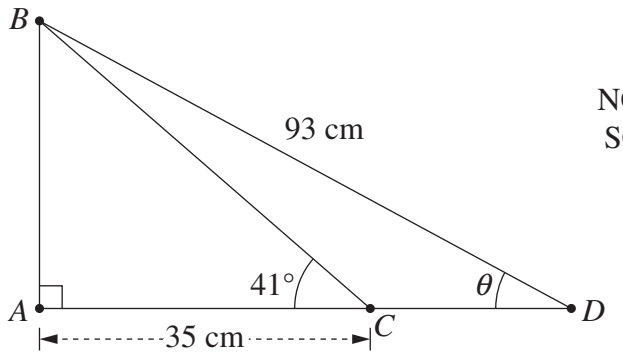
Please turn over

Question 32 (4 marks)

The diagram shows two right-angled triangles, ABC and ABD, **4**

where $AC = 35$ cm, $BD = 93$ cm, $\angle ACB = 41°$ and $\angle ADB = \theta$.



Calculate the size of angle θ, to the nearest minute.

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NSW Education Standards Authority

2022 **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

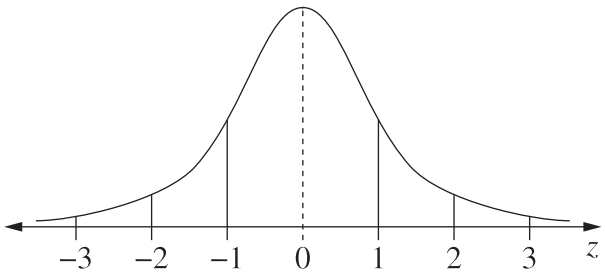
less than $Q_1 - 1.5 \times IQR$

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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