NSW Education Standards Authority

2019 **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 2–7)

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

Section II – 70 marks (pages 9–32)

- Attempt Questions 11–36
- 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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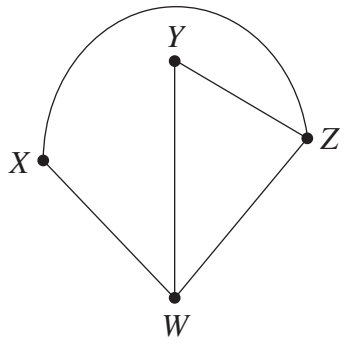
1 A network diagram is given.



What is the degree of vertex W?

A. 1

B. 2

C. 3

D. 4

2 What is the time difference between 8:35 am and 2:10 pm?

A. 5 hours and 25 minutes

B. 5 hours and 35 minutes

C. 6 hours and 25 minutes

D. 6 hours and 35 minutes

3 Sugar is sold in four different sized packets.

Which is the best buy?

A. 100 g for $0.40

B. 500 g for $1.65

C. 1 kg for $3.50

D. 2 kg for $6.90

4 Which compass bearing is the same as a true bearing of 110°?

A. S20°E

B. S20°W

C. S70°E

D. S70°W

5 Which expression can be used to convert a speed of 3 metres per minute to a speed in centimetres per second?

A. $3 \times 100 \div 60$

B. $3 \times 100 \times 60$

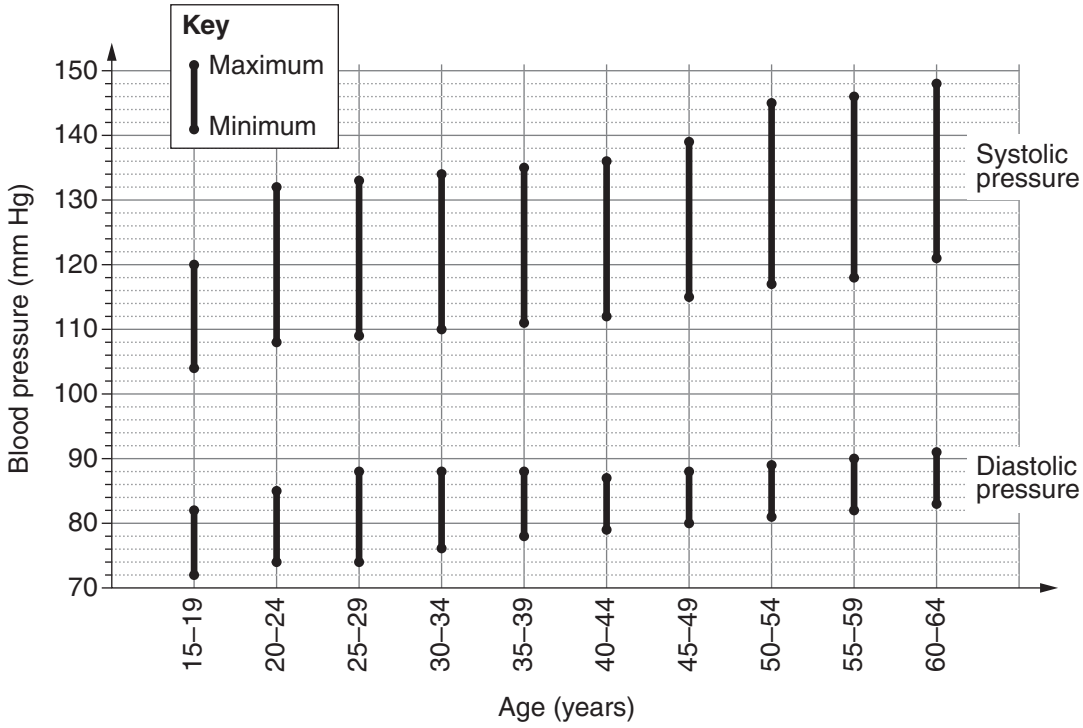
C. $3 \div 100 \div 60$

D. $3 \div 100 \times 60$

Please turn over

6 When blood pressure is measured, two numbers are recorded: systolic pressure and diastolic pressure. If the measurements recorded are 130 systolic and 85 diastolic, then the blood pressure is written as '130 over 85'.

The bars on the graph indicate the healthy ranges of blood pressure for people of various ages.



Which person has both blood pressure measurements in the healthy range for their age?

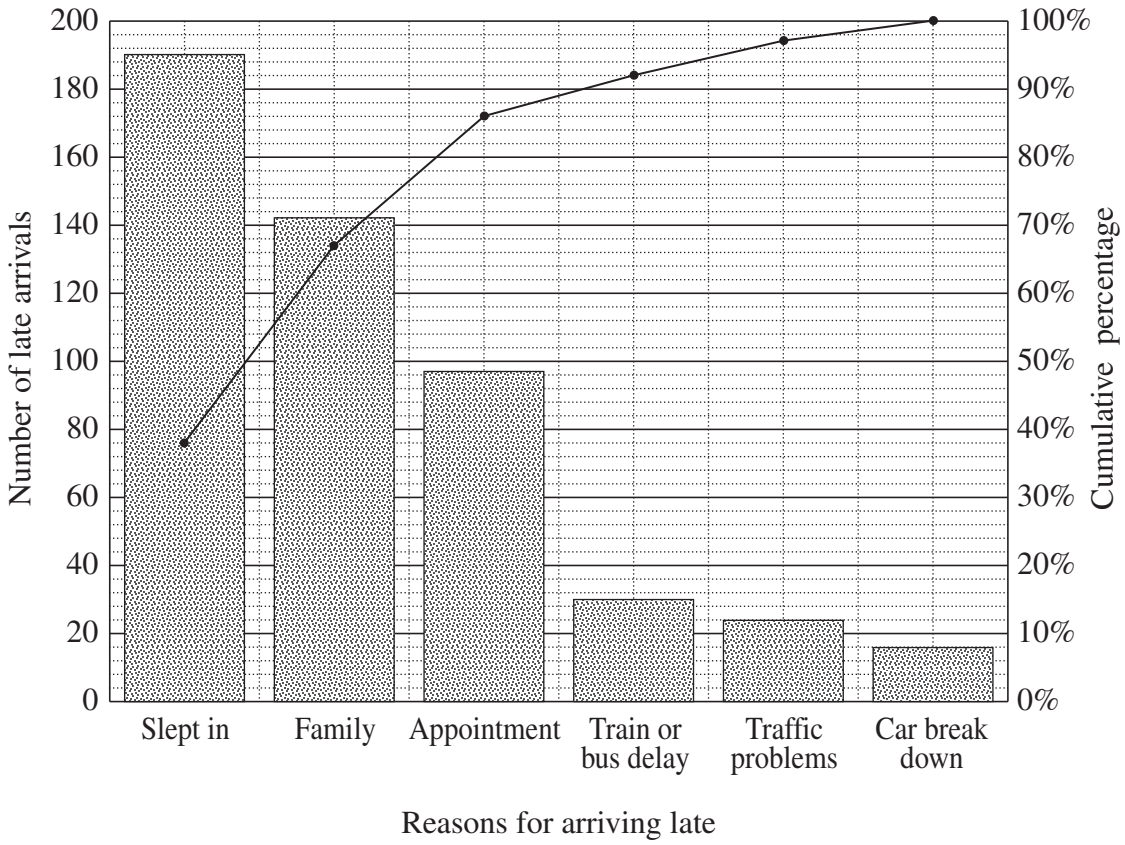
A. Stella aged 23 with blood pressure 120 over 72

B. Shane aged 35 with blood pressure 124 over 90

C. Jon aged 54 with blood pressure 137 over 94

D. Annie aged 61 with blood pressure 142 over 88

7 A school collected data related to the reasons given by students for arriving late. The Pareto chart shows the data collected.



What percentage of students gave the reason 'Train or bus delay'?

A. 6%

B. 15%

C. 30%

D. 92%

8 Heart rate is measured in beats per minute. Maximum heart rate (MHR) is calculated using the following formula.

$$\text{MHR} = 220 - \text{age}$$

Target heart rates are calculated as a percentage of MHR.

Felicity's age is 28. Her trainer calculates that her target heart rate range is 60% to 80% of her MHR.

Which of the following lies within this target heart rate range?

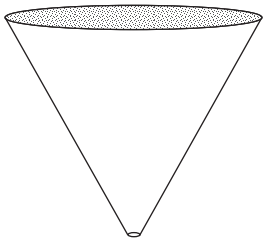
A. 100 beats per minute

B. 140 beats per minute

C. 180 beats per minute

D. 220 beats per minute

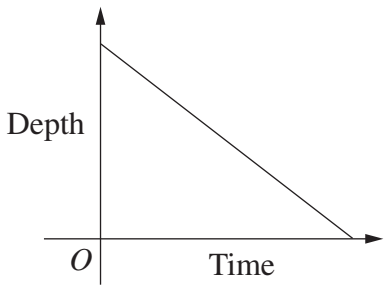
9 The container shown is initially full of water.



Water leaks out of the bottom of the container at a constant rate.

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

A.



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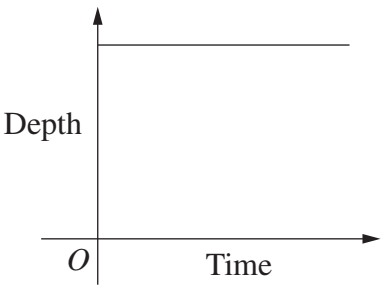
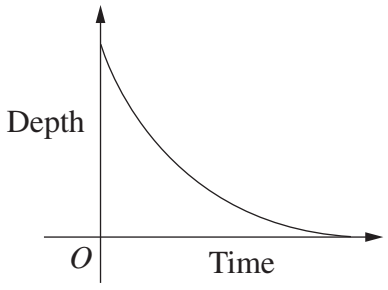
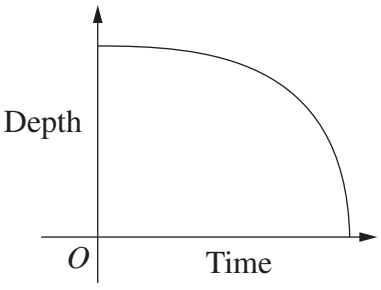


C.

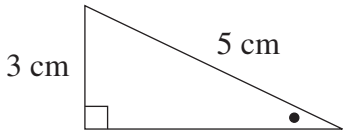


D.

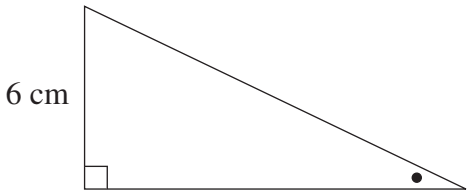


10 Triangle I and Triangle II are similar. Pairs of equal angles are shown.

Triangle I



Triangle II



NOT TO SCALE

What is the area of Triangle II?

A. 18 cm^2

B. 24 cm^2

C. 30 cm^2

D. 48 cm^2

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2019 HIGHER SCHOOL CERTIFICATE EXAMINATION

Centre Number

Student Number

Mathematics Standard 1

Section II Answer Booklet

70 marks
Attempt Questions 11–36
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 (2 marks)

Julie earns $28 per hour. She is also paid an $8 travel allowance per shift. **2**

How much will she earn for a 4-hour shift?

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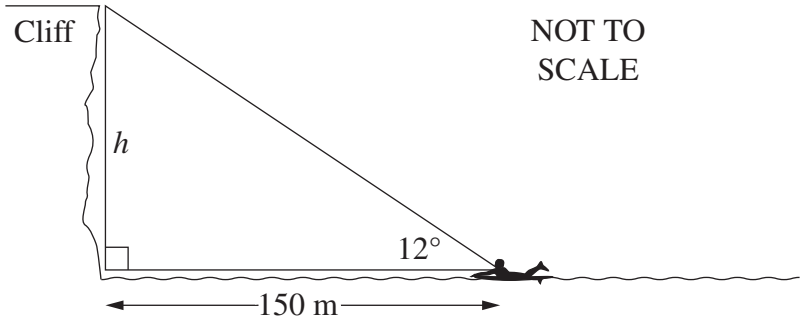
Question 12 (2 marks)

A surfer is 150 metres out to sea. From that point, the angle of elevation to the top of a cliff is 12°. **2**



How high is the cliff, to the nearest metre?

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Question 13 (2 marks)

Elyse borrowed $6000 from a bank. She repaid the loan in full with payments of $200 every month for 3 years. **2**

How much interest did Elyse pay to the bank?

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Question 14 (2 marks)

Part of a supermarket receipt is shown. **2**

SUPERMARKET

RECEIPT

Date: 22/09/2019

Description	$
*Chocolates 300 g	*A*
Tomatoes 1 kg	5.00
Natural almonds 400 g	9.00
Cheese slices 500 g	8.50
Milk 2 L	3.20
Bananas 570 g	2.85
Total for 6 items	*B*
GST included in total	0.70

*GST of 10% is included in the price of item.

The chocolates cost $7.00 before the GST was added.

Determine the missing values, *A* and *B*, to complete the receipt.

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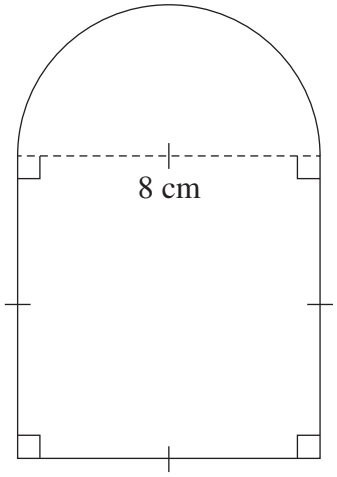
Question 15 (3 marks)

The diagram shows a shape made up of a square of side length 8 cm and a semicircle. **3**



NOT TO SCALE

Find the area of the shape to the nearest square centimetre.

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Question 16 (2 marks)

What is the interest earned when $800 is invested for 7 months at a simple interest rate of 3% per annum? **2**

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Question 17 (2 marks)

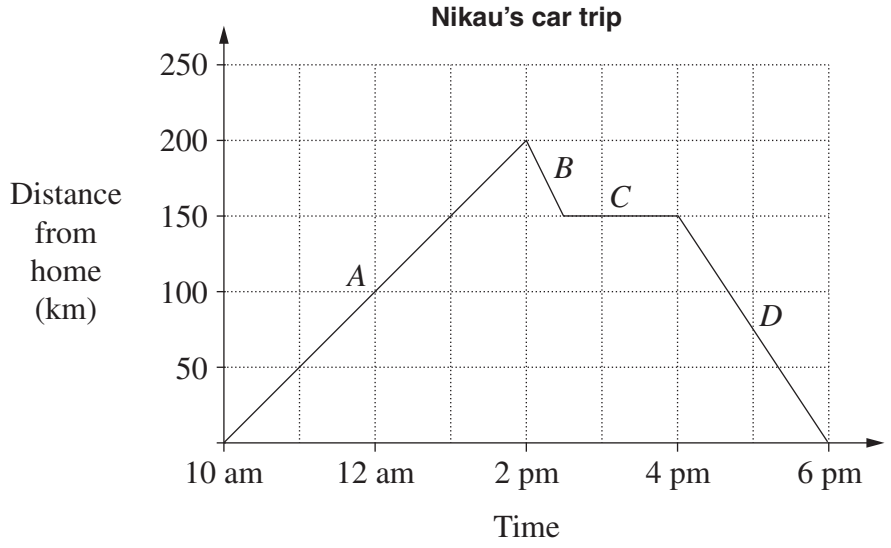
A regional airline operates flights in Queensland. Flight times between connected towns are shown in the table. **2**

	Cairns	*Kowanyama*	*Mt Isa*	*Pormpuraaw*	*Townsville*
Cairns	–	1 h 50 min	2 h 5 min	–	55 min
Kowanyama	1 h 50 min	–	–	20 min	–
Mt Isa	2 h 5 min	–	–	–	1 h 40 min
Pormpuraaw	–	20 min	–	–	–
Townsville	55 min	–	1 h 40 min	–	–

Draw a network diagram to show how the towns are connected, with weights on the edges showing the flight times.

Question 18 (2 marks)

The travel graph displays Nikau's car trip along a straight road from home and back again. The trip has been broken into four separate sections: *A*, *B*, *C* and *D*.



(a) How far did Nikau travel in total? **1**

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(b) In which section of the trip, *A*, *B*, *C* or *D*, did Nikau travel the fastest? **1**

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Question 19 (3 marks)

The heights, in centimetres, of 10 players on a basketball team are shown. **3**

170, 180, 185, 188, 192, 193, 193, 194, 196, 202

Is the height of the shortest player on the team considered an outlier? Justify your answer with calculations.

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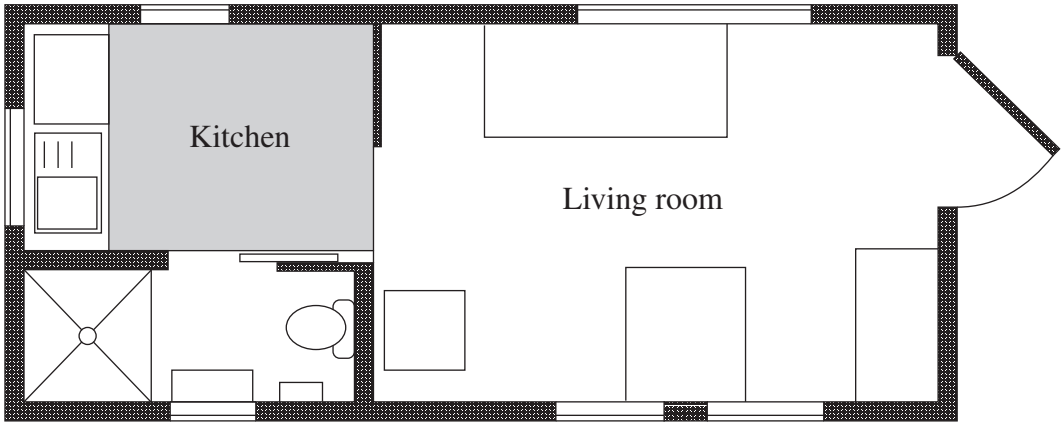
Question 20 (3 marks)

The plan of the lower level of a small house is shown.

Scale 1 cm = 0.5 m



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

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(b) What is the actual perimeter, in metres, of the shaded part of the kitchen floor? **2**

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Question 21 (2 marks)

A new car is bought for $24 950. Each year the value of the car depreciates by 14%. **2**

Using the declining-balance method, calculate the salvage value of the car at the end of 10 years.

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Question 22 (1 mark)

A survey question is shown. **1**

What is your favourite colour?

Tick the box beside your favourite colour.

Blue ☐

Yellow ☐

Orange ☐

Give ONE reason why this survey question may be considered to be poorly designed.

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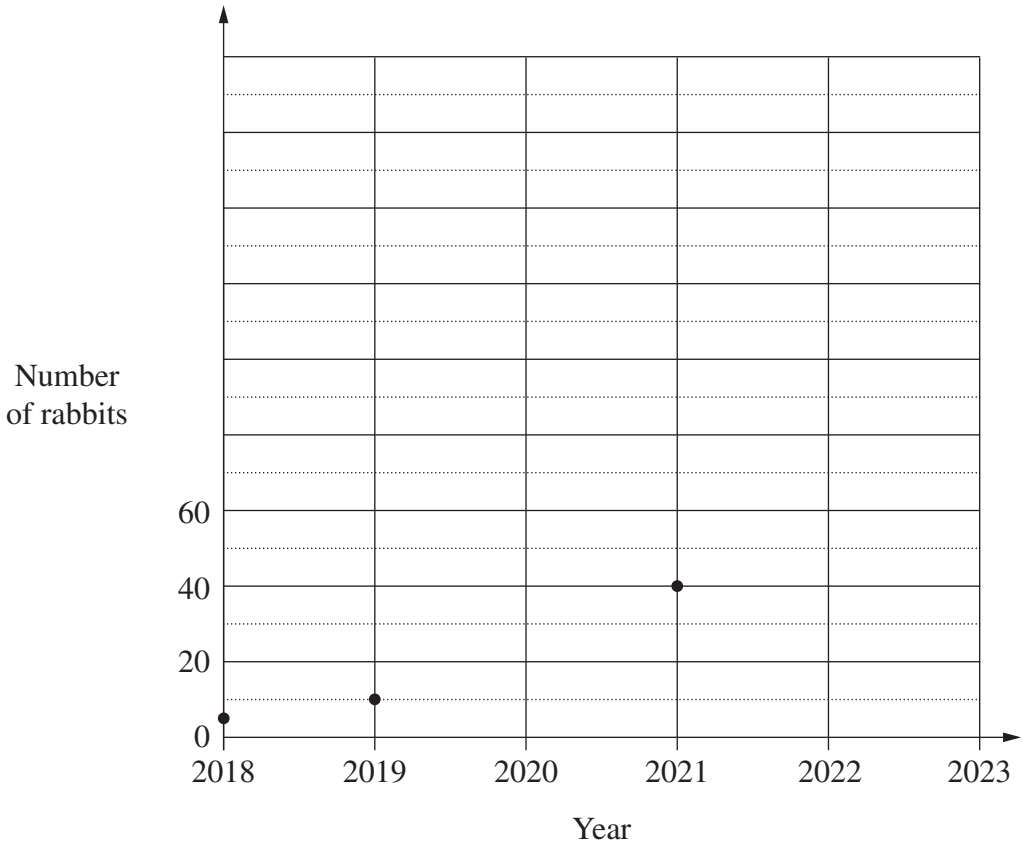
Question 23 (4 marks)

Five rabbits were introduced onto a farm at the start of 2018. At the start of 2019 there were 10 rabbits on the farm. It is predicted that the number of rabbits on the farm will continue to double each year.

(a) Complete the following table. **1**

Start of year	2018	2019	2020	2021	2022	2023
Number of rabbits	5	10		40		

(b) Complete the scale on the vertical axis and then plot the data from part (a) on the grid. **2**



(c) Would a linear model or an exponential model better fit this graph? Explain briefly the reason for your answer. **1**

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Question 24 (3 marks)

The faces on a biased six-sided die are labelled 1, 2, 3, 4, 5 and 6. The die was rolled twenty times. The relative frequency of rolling a 6 was 30% and the relative frequency of rolling a 2 was 15%. The number 3 was the only other number rolled in the twenty rolls. **3**

How many times was the number 3 rolled in the twenty rolls of the die?

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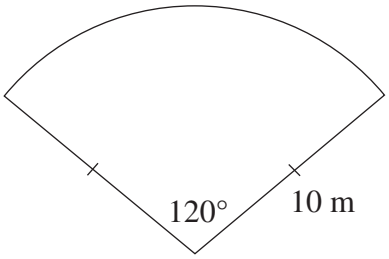
Question 25 (3 marks)

The diagram shows a sector with an angle of 120° cut from a circle with radius 10 m. **3**



NOT TO SCALE

What is the perimeter of the sector? Write your answer correct to 1 decimal place.

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Questions 11–25 are worth 36 marks in total

Question 26 (4 marks)

Scott decided to have a shed built at his home. He agreed to the following costs: **4**

- Materials
  - Timber $5400
  - Roof $1800
  - Nails $160
  - Paint $375
- $70 per hour for the builder when working Monday to Friday
- $30 per hour for the labourer when working Monday to Friday
- Builder and labourer paid time-and-a-half when working on Saturday.

It took six days to build the shed. The builder and labourer both worked from 8 am until 4 pm each day from Monday to Friday. On each of these days, they both took a 1 hour unpaid lunch break at 12 noon.

The builder and labourer also both worked 4 hours on Saturday, without a break, to finish the job.

What was the total cost to build the shed?

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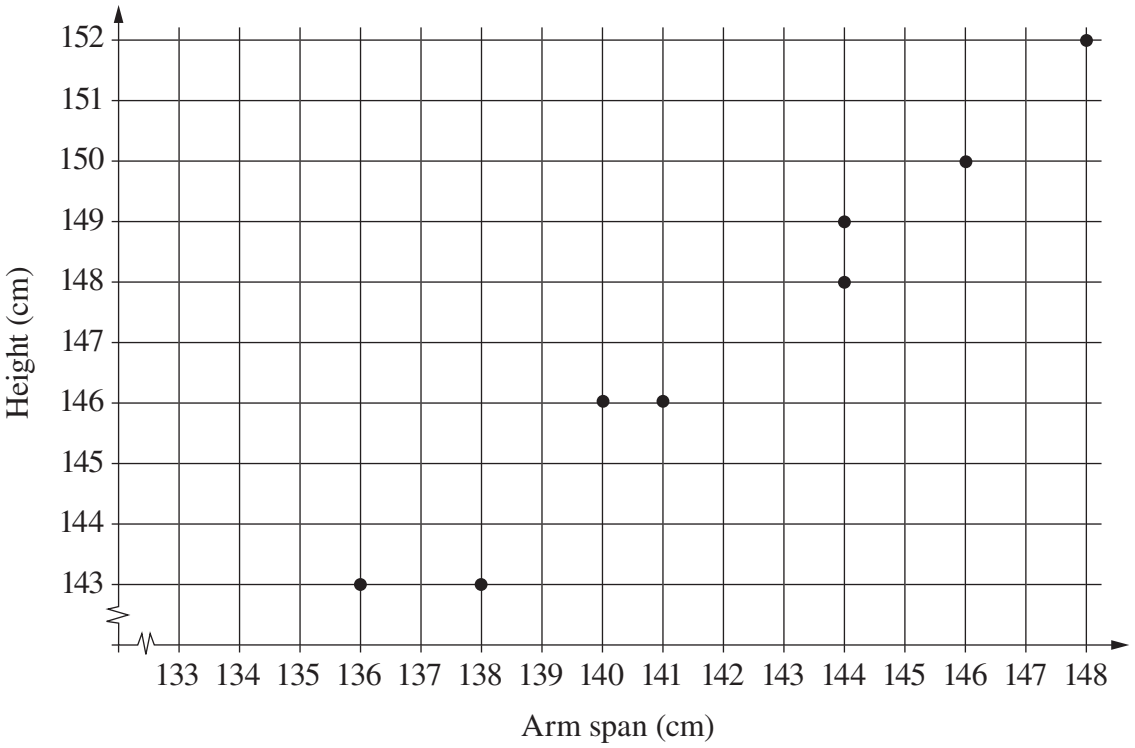
Question 27 (2 marks)

A set of bivariate data is collected by measuring the height and arm span of eight children. The graph shows a scatterplot of these measurements.



(a) On the graph, draw a line of best fit by eye. **1**

(b) Robert is a child from the class who was absent when the measurements were taken. He has an arm span of 147 cm. Using your line of best fit from part (a), estimate Robert's height. **1**

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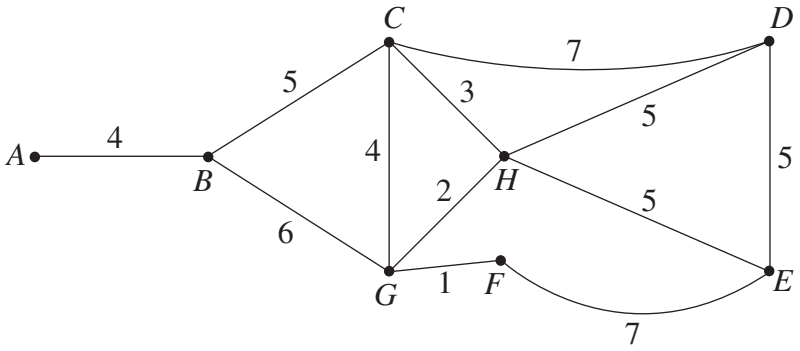
Question 28 (3 marks)

The network diagram shows the tracks connecting 8 picnic sites in a nature park. The vertices A to H represent the picnic sites. The weights on the edges represent the distances along the tracks between the picnic sites, in kilometres.



(a) Each picnic site needs to provide drinking water. The main water source is at site A. **2**

By drawing a minimum spanning tree in the space below, calculate the minimum length of water pipes required to supply water to all the sites if the water pipes can only be laid along the tracks.

Minimum length = ...

(b) One day, the track between C and H is closed. State the vertices that identify the shortest path from C to E that avoids the closed track. **1**

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Question 29 (2 marks)

Concrete is made by mixing cement, sand and aggregate. Different types of concrete are produced by changing the ratio of the mix of these materials. **2**

The table shows the ratio of the materials for different types of concrete and examples of their common use.

Ratio of cement : sand : aggregate	*Common use*
1 : 2 : 2	Foundation for fence posts
1 : 3 : 6	Footpath, patio slab
1 : 1 : 2	House slab

The amount of concrete required for a patio slab is 3.5 cubic metres.

How many cubic metres of sand will be needed?

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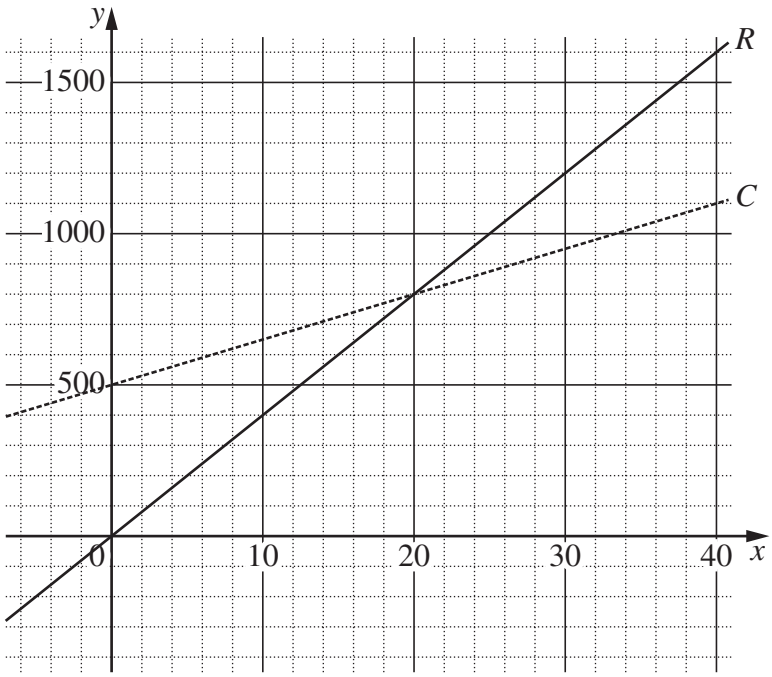
Question 30 (3 marks)

A small business makes and sells bird houses.

Technology was used to draw straight-line graphs to represent cost (C) and revenue (R). The x-axis displays the number of bird houses and the y-axis displays the cost/revenue in dollars.



(a) How many bird houses need to be sold to break even? **1**

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(b) What profit will the business make if it sells 40 bird houses? **2**

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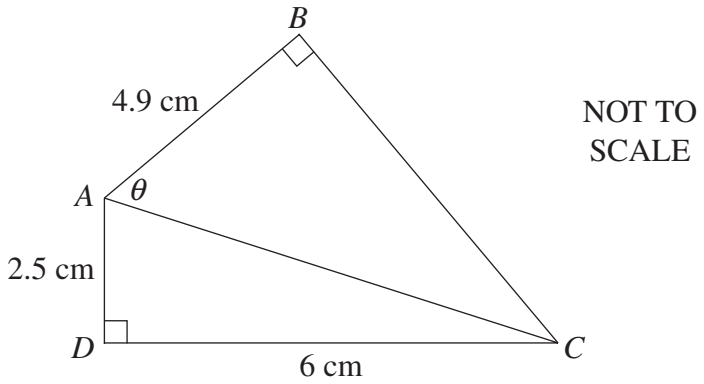
Question 31 (3 marks)

Two right-angled triangles, *ABC* and *ADC*, are shown. **3**



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

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Question 32 (3 marks)

Ashley has a credit card with the following conditions: **3**

- There is no interest-free period.
- Interest is charged at the end of each month at 18.25% per annum, compounding daily, from the purchase date (included) to the last day of the month (included).

Ashley's credit card statement for April is shown, with some figures missing.

Statement period: 1 April to 30 April

Date	**Details**	**Amount ($)**
1 April	Opening balance	0
20 April	Furniture	3700
30 April	Interest charged	***
30 April	Closing balance	***

Minimum payment: ☐

The minimum payment is calculated as 2% of the closing balance on 30 April.

Calculate the minimum payment.

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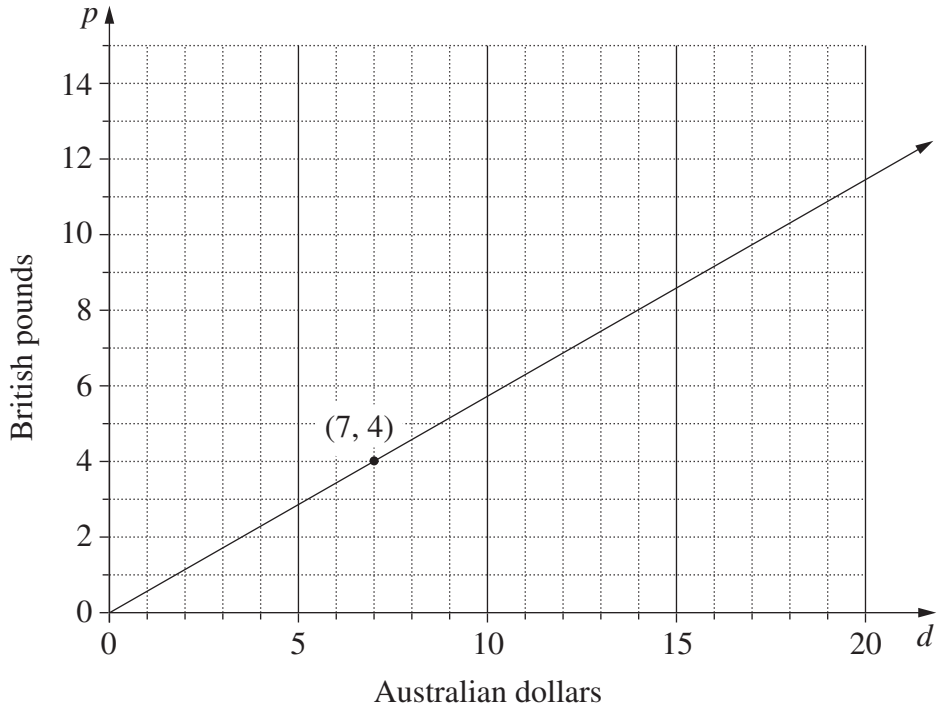
Question 33 (3 marks)

The relationship between British pounds (p) and Australian dollars (d) on a particular day is shown in the graph.



(a) Write the direct variation equation relating British pounds to Australian dollars in the form $p = md$. Leave m as a fraction. **1**

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(b) The relationship between Japanese yen (y) and Australian dollars (d) on the same day is given by the equation $y = 76d$. **2**

Convert 93 100 Japanese yen to British pounds.

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Question 34 (3 marks)

Given the formula $C = \frac{A(y+1)}{24}$, calculate the value of y when $C = 120$ and $A = 500$. **3**

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Question 35 (4 marks)

A bank offers two different savings accounts.

Account *X* offers simple interest of 7% per annum.
Account *Y* offers compound interest of 6% per annum compounded yearly.

The table displays the future values of $20 000 invested in each account for the first 2 years.

Future value		
End of year	*Account X*	*Account Y*
1	$21 400	$21 200
2	$22 800	$22 472

(a) How much more money is there in Account *X* than in Account *Y* at the end of 2 years? **1**

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(b) Show that there would be more money in Account *Y* than in Account *X* at the end of 8 years. **3**

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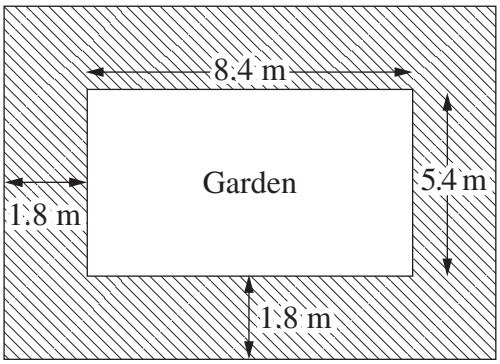
Please turn over

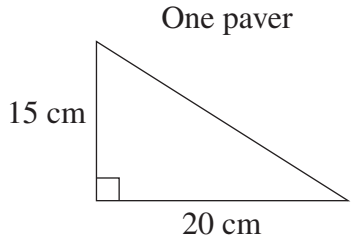
Question 36 (4 marks)

A path 1.8 m wide is being built around a rectangular garden. The garden is 8.4 m long and 5.4 m wide. The path is shaded in the diagram. **4**



NOT TO SCALE

The path is to be covered with triangular pavers with side lengths of 15 cm and 20 cm as shown.



NOT TO SCALE

The pavers are to be laid to cover the path with no gaps or overlaps.

How many pavers are needed?

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Section II extra writing space

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NSW Education Standards Authority

2019 **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

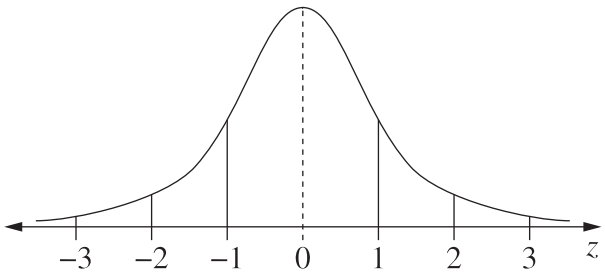
less than $Q_1 - 1.5 \times IQR$

or

more than $Q_3 + 1.5 \times IQR$

$$z = \frac{x - \overline{x}}{s}$$

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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