BOARD OF STUDIES
NEW SOUTH WALES

2010

HIGHER SCHOOL CERTIFICATE EXAMINATION

General Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – $2\frac{1}{2}$ hours
- Write using black or blue pen
- Calculators may be used
- A formulae sheet is provided at the back of this paper
- Write your Centre Number and Student Number on the Question 25 Writing Booklet

Total marks – 100

Section I Pages 2–12

22 marks

- Attempt Questions 1–22
- Allow about 30 minutes for this section

Section II Pages 13–27

78 marks

- Attempt Questions 23–28
- Allow about 2 hours for this section

Section I

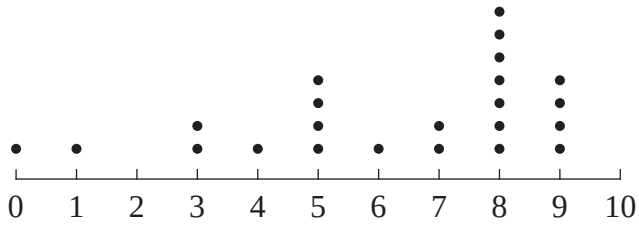
22 marks
Attempt Questions 1–22
Allow about 30 minutes for this section

Use the multiple-choice answer sheet for Questions 1–22.

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1 The results of a survey are displayed in the dot plot.

What is the range of this data?



(A) 7

(B) 8

(C) 9

(D) 10

2 A new phone was purchased for $725 which included 10% GST.

What was the price of the phone without GST, correct to the nearest cent?

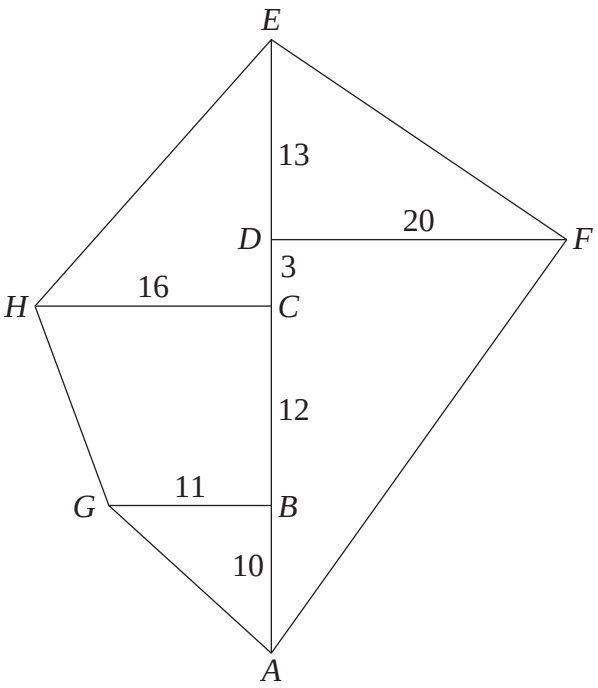
(A) $65.91

(B) $72.50

(C) $652.50

(D) $659.09

3 A field diagram has been drawn from an offset survey.



NOT TO SCALE

All measurements are in metres.

AB = 10 m
BC = 12 m
CD = 3 m
DE = 13 m

What is the distance from G to H, correct to the nearest metre?

(A) 11

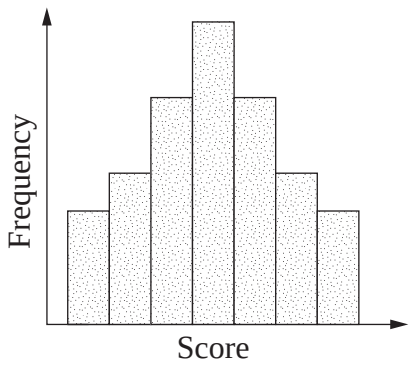
(B) 13

(C) 16

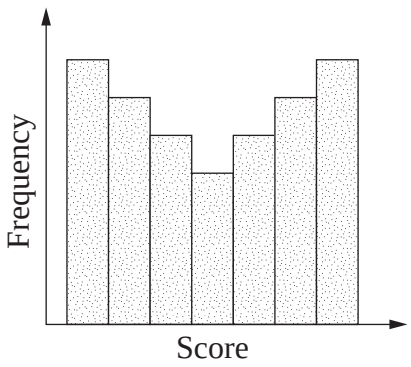
(D) 20

4 Which of the following frequency histograms shows data that could be normally distributed?

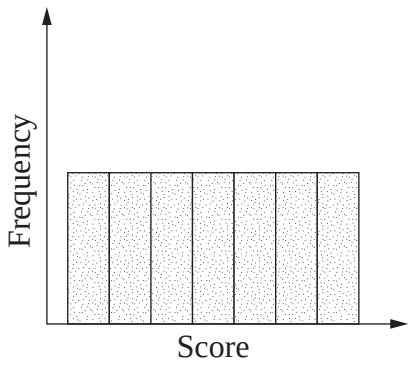
(A)



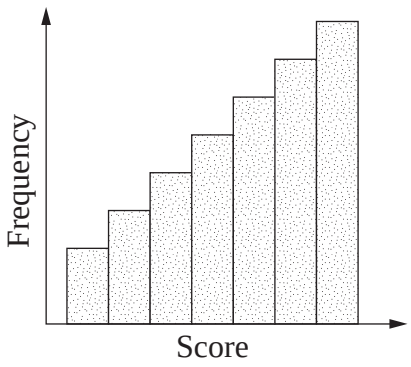
(B)



(C)



(D)



5 Minjy invests $2000 for 1 year and 5 months. The simple interest is calculated at a rate of 6% per annum.

What is the total value of the investment at the end of this period?

(A) $2170

(B) $2180

(C) $3003

(D) $3700

6 A survey of Year 7 students found a number of relationships with a high degree of correlation.

Which of the following relationships also demonstrates causality?

(A) Students' height and the length of their arm span

(B) The size of students' left feet and the size of their right feet

(C) Students' test scores in Mathematics and their test scores in Music

(D) The number of hours students spent studying for a test and their results in that test

7 If $M = -9$, what is the value of $\dfrac{3M^2 + 5M}{6}$?

(A) -250.5

(B) -48

(C) 33

(D) 235.5

8 A bag contains red, green, yellow and blue balls.

Colour	*Probability*
Red	$\frac{1}{3}$
Green	$\frac{1}{4}$
Yellow	?
Blue	$\frac{1}{6}$

The table shows the probability of choosing a red, green or blue ball from the bag.

If there are 12 yellow balls in the bag, how many balls are in the bag altogether?

(A) 16

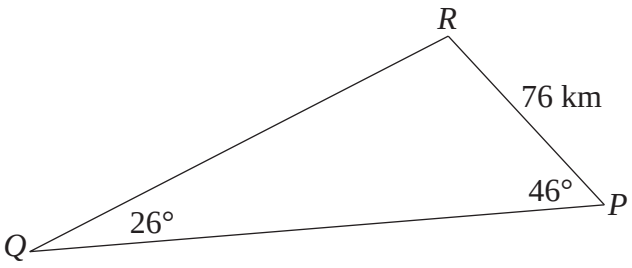
(B) 36

(C) 48

(D) 60

9 Three towns *P*, *Q* and *R* are marked on the diagram.

The distance from *R* to *P* is 76 km. $\angle RQP = 26°$ and $\angle RPQ = 46°$.



NOT TO SCALE

What is the distance from *P* to *Q* to the nearest kilometre?

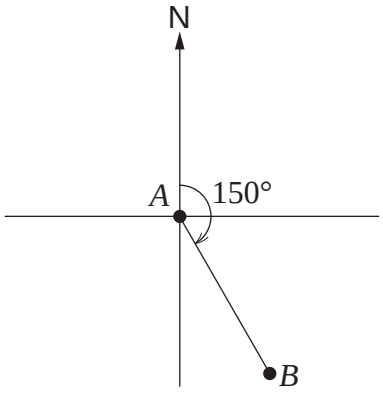
(A) 100 km

(B) 125 km

(C) 165 km

(D) 182 km

10 A plane flies on a bearing of 150° from *A* to *B*.



NOT TO SCALE

What is the bearing of *A* from *B*?

(A) 30°

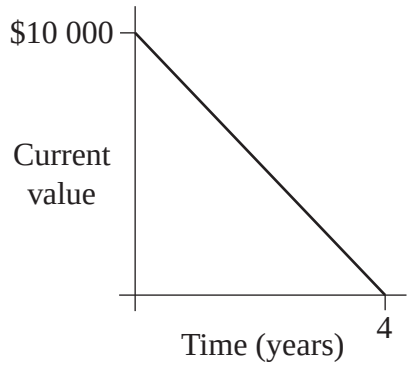
(B) 150°

(C) 210°

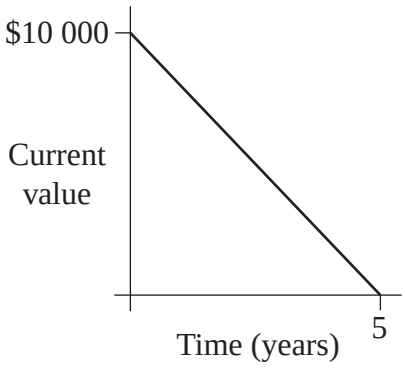
(D) 330°

11 Which of the following graphs shows the lowest rate of depreciation over the given time period?

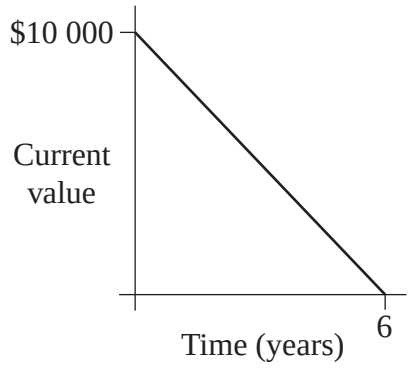
(A)



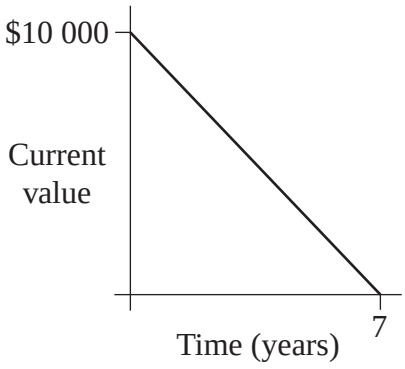
(B)



(C)



(D)



12 A group of 347 people was tested for flu and the results were recorded. The flu test results are not always accurate.

		Test results	
	Test indicated flu	*Test did not indicate flu*	*Total*
People with flu	72	3	75
People without flu	16	256	272
	88	259	347

A person is selected at random from the tested group.

What is the probability that their test result is accurate, to the nearest per cent?

(A) 21%

(B) 22%

(C) 95%

(D) 96%

13 The number of hours that it takes for a block of ice to melt varies inversely with the temperature. At 30°C it takes 8 hours for a block of ice to melt.

How long will it take the same size block of ice to melt at 12°C?

(A) 3.2 hours

(B) 20 hours

(C) 26 hours

(D) 45 hours

14 A restaurant serves three scoops of different flavoured ice-cream in a bowl. There are five flavours to choose from.

How many different combinations of ice-cream could be chosen?

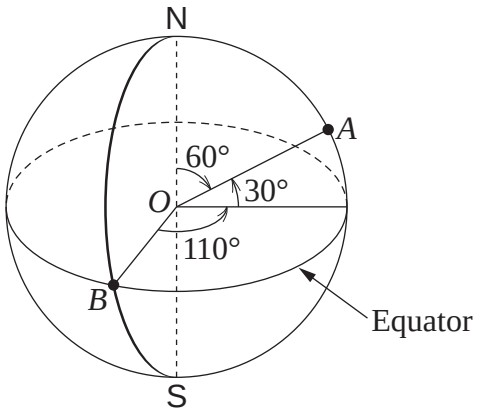
(A) 10

(B) 15

(C) 30

(D) 60

15 In this diagram of the Earth, *O* represents the centre and *B* lies on both the Equator and the Greenwich Meridian.



NOT TO SCALE

What is the latitude and longitude of point *A*?

(A) 30°N 110°E

(B) 30°N 110°W

(C) 60°N 110°E

(D) 60°N 110°W

16 This back-to-back stem-and-leaf plot displays the test results for a class of 26 students.

Boys					Girls				
			1	2	1	2	4		
			3	3	0	2	3	5	
	9	7	4	4	4	4	5	9	9
6	4	2	2	5	3				
		3	0	6	1	9			

What is the median test result for the class?

(A) 44

(B) 46

(C) 48

(D) 49

17 During a flood 1.5 hectares of land was covered by water to a depth of 17 cm.

How many kilolitres of water covered the land? (1 hectare = 10 000 m^2)

(A) 2.55 kL

(B) 2 550 kL

(C) 255 000 kL

(D) 2 550 000 kL

18 Which of the following correctly expresses x as the subject of $a = \frac{nx}{5}$?

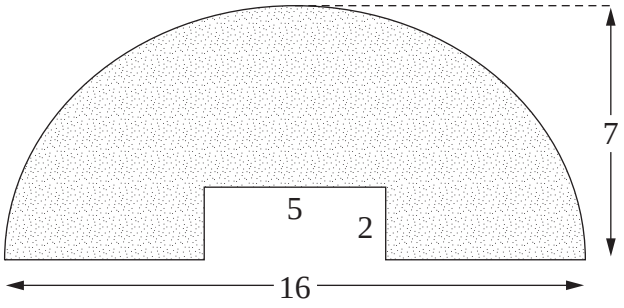
(A) $x = \frac{an}{5}$

(B) $x = \frac{5a}{n}$

(C) $x = \frac{a-5}{n}$

(D) $x = 5a - n$

19 The diagram shows half an ellipse with a rectangle cut out.



NOT TO SCALE

All measurements are in centimetres.

What is the area of the shape to the nearest square centimetre?

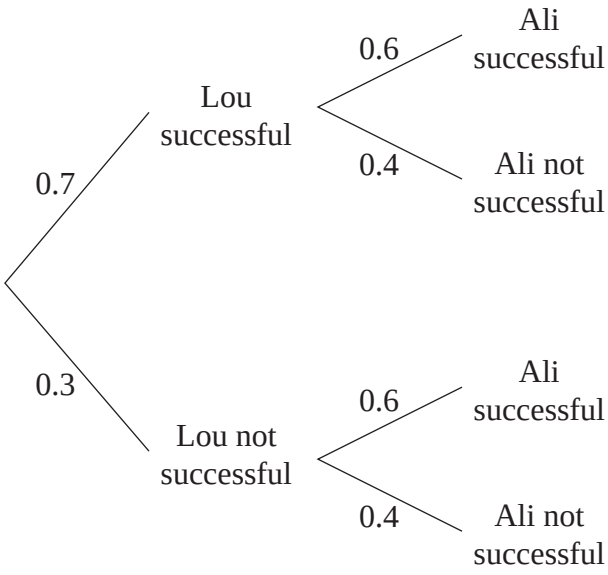
(A) 78 cm^2

(B) 83 cm^2

(C) 166 cm^2

(D) 171 cm^2

20 Lou and Ali are on a fitness program for one month. The probability that Lou will finish the program successfully is 0.7 while the probability that Ali will finish successfully is 0.6. The probability tree shows this information.



What is the probability that only one of them will be successful?

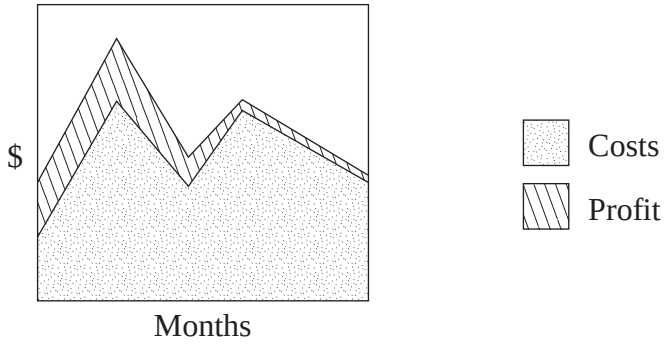
(A) 0.18

(B) 0.28

(C) 0.42

(D) 0.46

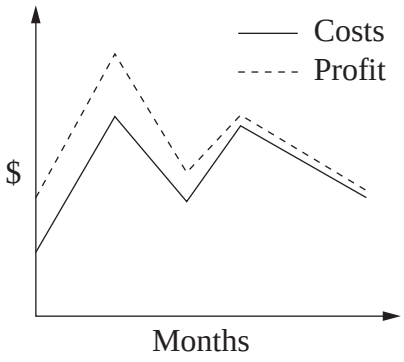
21 The area graph shows the costs and profits for a business over a period of time.



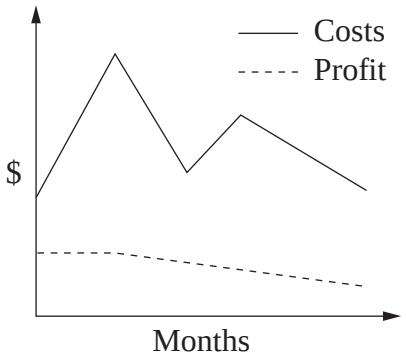
The information in the area graph is then displayed as a line graph.

Which of the following line graphs best displays the data from the area graph?

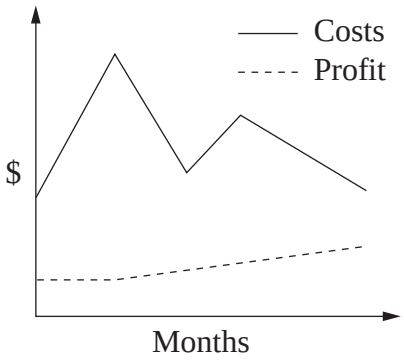
(A)



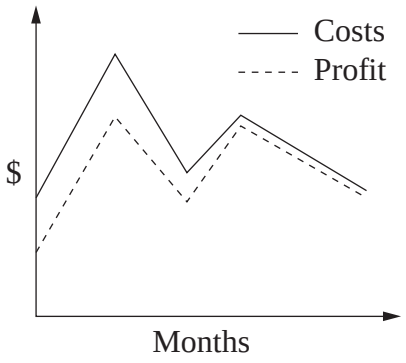
(B)



(C)



(D)



22 In July, Ms Alott received a statement for her credit card account. The account has no interest free period. Simple interest is calculated and charged to her account on the statement date.

Ms I O Alott

Dollar Bank



Credit limit: $5000

Credit card statement

Statement date: 23 July 2010

Previous Balance	Payments	Purchases	Interest charged
$529.46	$529.46	$1721.50	?

Date	Purchases	Amount	Closing Balance
29 June	Hi-Fi	$1721.50	?

Annual percentage rate: 19%

Daily percentage rate: 0.0521%

Note: Interest is charged on amounts from (and including) the date of purchase up to (and including) the statement date.

Minimum payment due: $25 or 5% of closing balance whichever is the larger.

What is the minimum payment due on this account?

(A) $22.42

(B) $25.00

(C) $86.08

(D) $87.20

Section II

78 marks
Attempt Questions 23–28
Allow about 2 hours for this section

Answer each question in the appropriate writing booklet. Extra writing booklets are available.

All necessary working should be shown in every question.

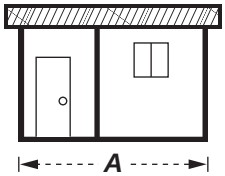
Question 23 (13 marks) Use the Question 23 Writing Booklet.

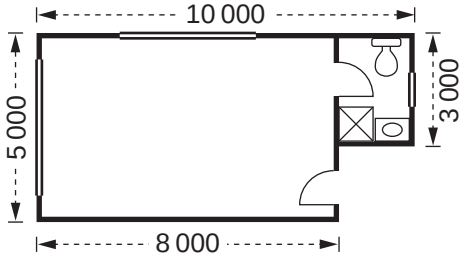
(a) This advertisement appeared in a newspaper. **2**

> **Civil Engineer**
>
> Base rate of pay: $1586.70 per week.
>
> Depending upon qualifications and experience, up to an additional 3.5% may be added to the weekly base rate of pay.

What is the maximum possible salary per annum for this civil engineer, correct to the nearest dollar?

(b) The elevation and floor plan of a building are shown.





All measurements are in millimetres.

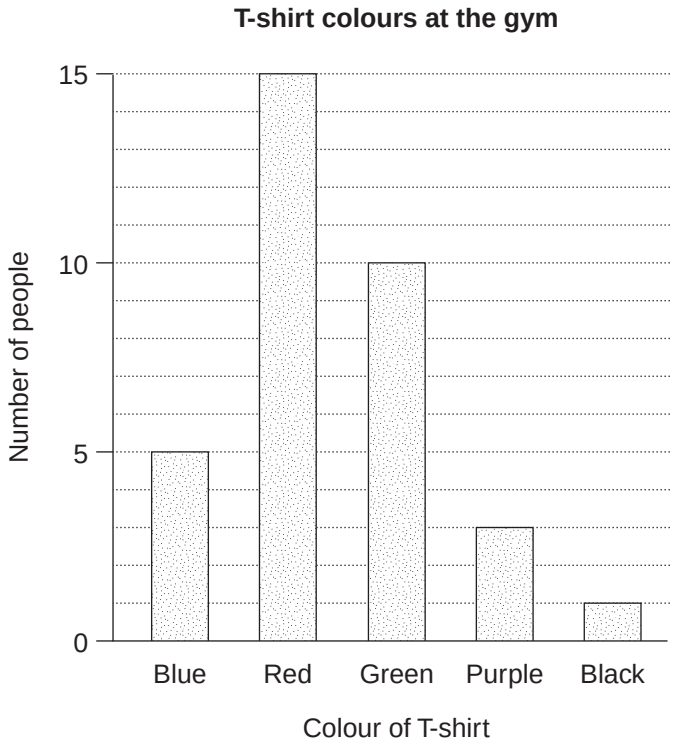
(i) What does this symbol ⊠ represent on the plan? **1**

(ii) What is the value of A on the elevation? **1**

(iii) Calculate the area of the floor of this building in square metres. **2**

Question 23 continues on page 14

(c) On Saturday, Jonty recorded the colour of T-shirts worn by the people at his gym. The results are shown in the graph.

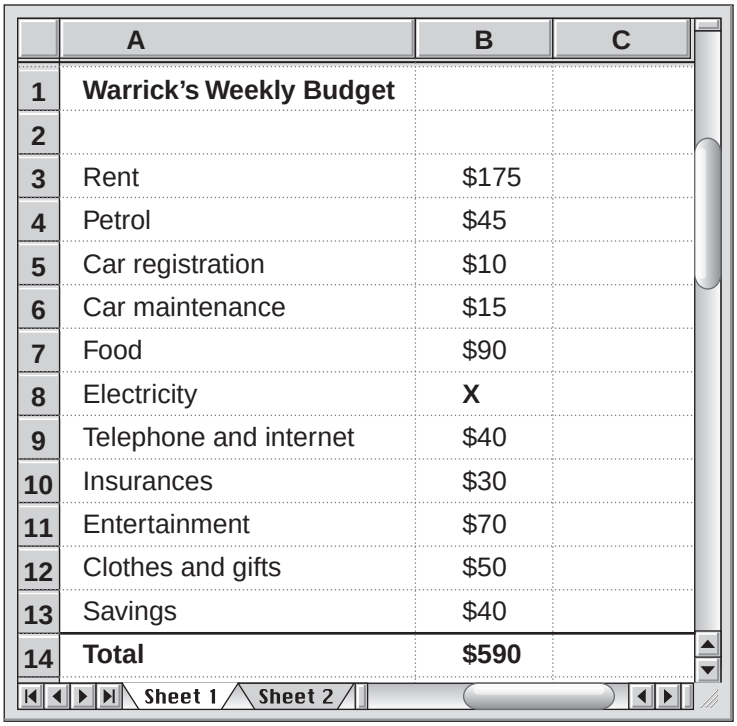


(i) How many people were at the gym on Saturday? (Assume everyone was wearing a T-shirt.) **1**

(ii) What is the probability that a person selected at random at the gym on Saturday, would be wearing either a blue or green T-shirt? **1**

Question 23 continues on page 15

(d) Warrick has a net income of $590 per week. He has created a budget to help manage his money.



	A	B	C
1	**Warrick's Weekly Budget**		
2			
3	Rent	$175	
4	Petrol	$45	
5	Car registration	$10	
6	Car maintenance	$15	
7	Food	$90	
8	Electricity	**X**	
9	Telephone and internet	$40	
10	Insurances	$30	
11	Entertainment	$70	
12	Clothes and gifts	$50	
13	Savings	$40	
14	**Total**	**$590**	

Sheet 1 Sheet 2

(i) Find the value of **X**, the amount that Warrick allocates towards electricity each week. **1**

(ii) Warrick has an unexpectedly high telephone and internet bill. For the last three weeks, he has put aside his savings as well as his telephone and internet money to pay the bill. **1**

How much money has he put aside altogether to pay the bill?

(iii) The bill for the telephone and internet is $620. It is due in two weeks time. Warrick realises he has not put aside enough money to pay the bill. **3**

How could Warrick reallocate non-essential funds in his budget so he has enough money to pay the bill? Justify your answer with suitable reasons and calculations.

End of Question 23

Question 24 (13 marks) Use the Question 24 Writing Booklet.

(a) Fred tried to solve this equation and made a mistake in Line 2.

$$\begin{aligned} 4(y+2)-3(y+1) &= -3 && \text{Line 1} \\ 4y+8-3y+3 &= -3 && \text{Line 2} \\ y+11 &= -3 && \text{Line 3} \\ y &= -14 && \text{Line 4} \end{aligned}$$

Copy the equation in Line 1 into your writing booklet.

(i) Rewrite Line 2 correcting his mistake. **1**

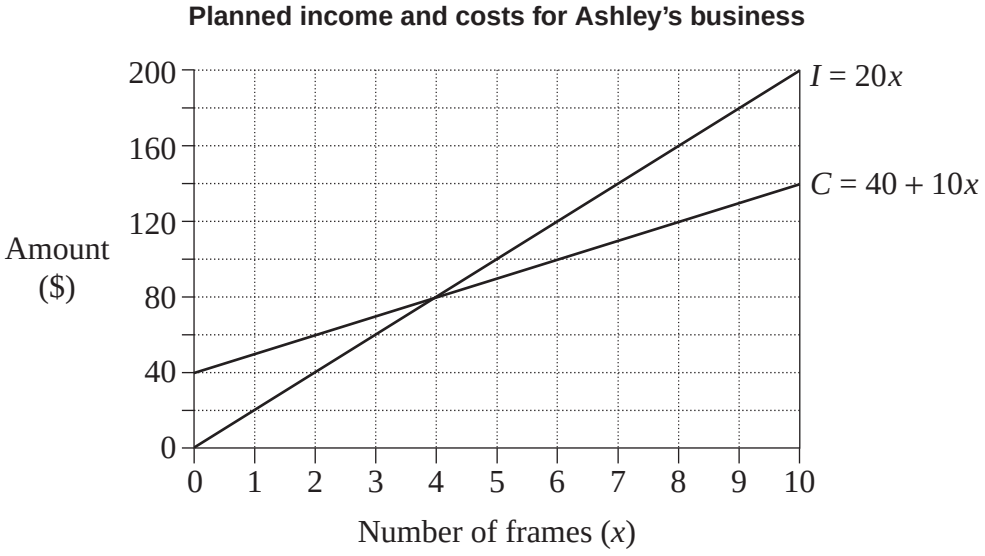
(ii) Continue your solution showing the correct working for Lines 3 and 4 to solve this equation for y. **1**

(b) Ashley makes picture frames as part of her business. To calculate the cost, C, in dollars, of making x frames, she uses the equation **2**

$$C = 40 + 10x.$$

She sells the frames for \$20 each and determines her income, I, in dollars, using the equation

$$I = 20x.$$



Use the graph to solve the two equations simultaneously for x and explain the significance of this solution for Ashley's business.

Question 24 continues on page 17

(c) The marks in a class test are normally distributed. The mean is 100 and the standard deviation is 10.

(i) Jason's mark is 115. What is his z-score? **1**

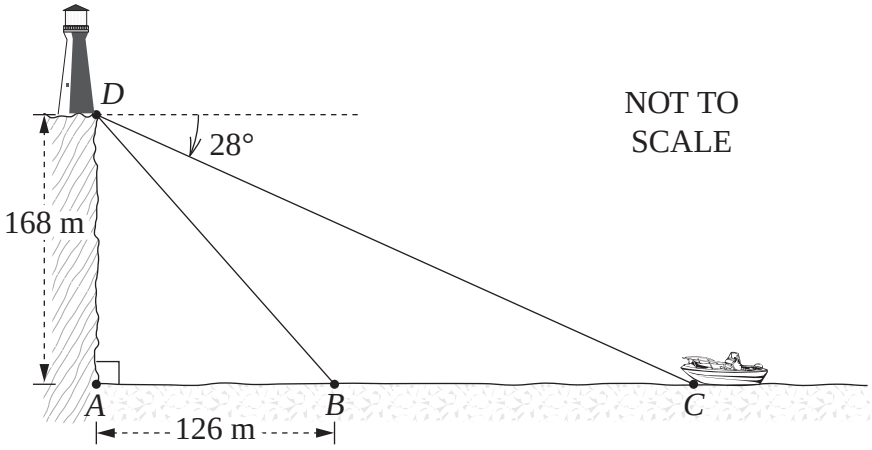
(ii) Mary has a z-score of 0. What mark did she achieve in the test? **1**

(iii) What percentage of marks lie between 80 and 110? **2**

You may assume the following:

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

(d) The base of a lighthouse, D, is at the top of a cliff 168 metres above sea level. The angle of depression from D to a boat at C is 28°. The boat heads towards the base of the cliff, A, and stops at B. The distance AB is 126 metres.



(i) What is the angle of depression from D to B, correct to the nearest minute? **3**

(ii) How far did the boat travel from C to B, correct to the nearest metre? **2**

End of Question 24

Question 25 (13 marks) Use the Question 25 Writing Booklet.

(a) Rainfall data has been collected at nine locations across NSW. This data is displayed in the scatterplot on page 1 of the Question 25 Writing Booklet.

(i) On the scatterplot circle the median points and hence construct a median regression line. **2**

(ii) Use this model to predict the average annual rainfall in a location that has 120 days on which rain falls. **1**

(b) William wants to buy a car. He takes out a loan for $28 000 at 7% per annum interest for four years. **2**

Monthly repayments for loans at different interest rates are shown in the spreadsheet.

	A	B	C	D	E
1		**Monthly repayments**			
2		**Term of loan (in months)**		48	
3					
4	**Amount**	**Interest rate p.a.**			
5	**borrowed**	6%	7%	8%	9%
6	$27 000	$634.10	$646.55	$659.15	$671.90
7	$27 500	$645.84	$658.52	$671.36	$684.34
8	$28 000	$657.58	$670.49	$683.56	$696.78
9	$28 500	$669.32	$682.47	$695.77	$709.22
10	$29 000	$681.07	$694.44	$707.97	$721.67
11	$29 500	$692.81	$706.41	$720.18	$734.11
12	$30 000	$704.55	$718.39	$732.39	$746.55

Sheet 1 Sheet 2

How much interest does William pay over the term of this loan?

Question 25 continues on page 19

(c) Lee is going on a cruise ship holiday.

(i) The ship leaves Port Ary (15°S, 167°E) and sails north to Nauru (1°S, 167°E) at an average speed of 15 knots. **2**

How long does the journey take? (You may assume that 1° on a great circle equals 60 nautical miles.)

(ii) Lee wants to call home to Sydney (34°S, 151°E) from Papeete, Tahiti (17°S, 149°W) when it is 7 pm on Friday in Sydney. **2**

Give the time and day in Papeete when she should make the call. (Ignore time zones.)

(d) Mark needs $8000 to go on a holiday in three years time. He has a 'Holiday Savings Account' with a balance of $600. **4**

He arranges to deposit $150 into this account at the end of each month for the next three years.

He earns 6% per annum interest on the money in his account, compounded monthly.

Will Mark have enough money for his trip at the end of three years? Justify your answer with suitable calculations.

End of Question 25

Question 26 (13 marks) Use the Question 26 Writing Booklet.

(a) A design of numberplates has a two-digit number, two letters and then another two-digit number, for example `22 AC 14` or `76 BB 08`.

(i) How many different numberplates are possible using this design? **1**

(ii) Jo's birthday is 30 December 1992, so she would like a numberplate with either `30 JO 12` or `19 JO 92`. **2**

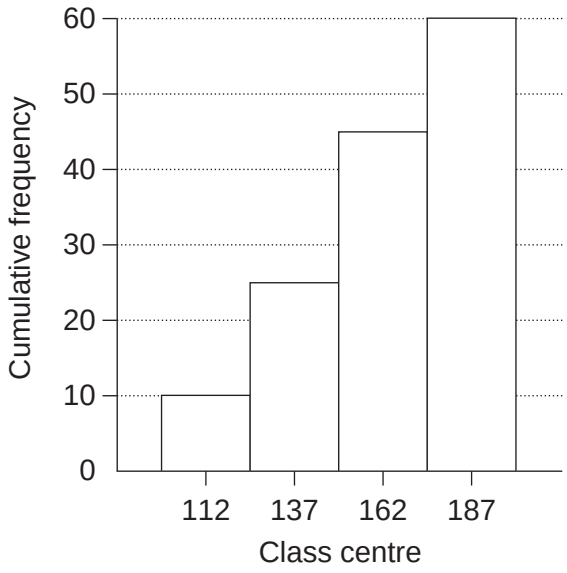
Jo can order a numberplate with '`JO`' in the middle but will have to have randomly selected numbers on either side.

What is the probability that Jo is issued with one of the numberplates she would like?

(b) A new shopping centre has opened near a primary school. A survey is conducted to determine the number of motor vehicles that pass the school each afternoon between 2.30 pm and 4.00 pm.

The results for 60 days have been recorded in the table and are displayed in the cumulative frequency histogram.

Score	*Class centre*	*Frequency*	*Cumulative frequency*
100–124	112	10	10
125–149	137	×	25
150–174	162	20	45
175–199	187	15	60



Question 26 continues on page 21

(i) Find the value of $\times$ in the table. **1**

(ii) Carefully copy the cumulative frequency histogram into your writing booklet. **1**

On the cumulative frequency histogram you have copied draw a cumulative frequency polygon (ogive) for this data.

(iii) Use your graph to determine the median. Show, by drawing lines on your graph, how you arrived at your answer. **1**

(iv) Prior to the opening of the new shopping centre, the median number of motor vehicles passing the school between 2.30 pm and 4.00 pm was 57 vehicles per day. **2**

What problem could arise from the change in the median number of motor vehicles passing the school before and after the opening of the new shopping centre?

Briefly recommend a solution to this problem.

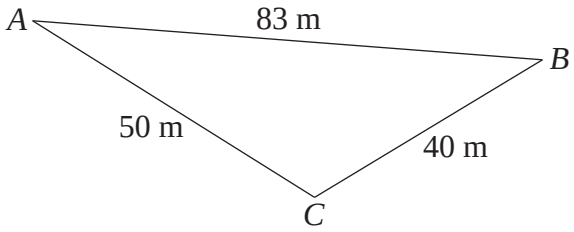
(c) Tai plays a game of chance with the following outcomes. **2**

- $\frac{1}{5}$ chance of winning \$10
- $\frac{1}{2}$ chance of winning \$3
- $\frac{3}{10}$ chance of losing \$8

The game has a \$2 entry fee.

What is his financial expectation from this game?

(d) **3**



NOT TO SCALE

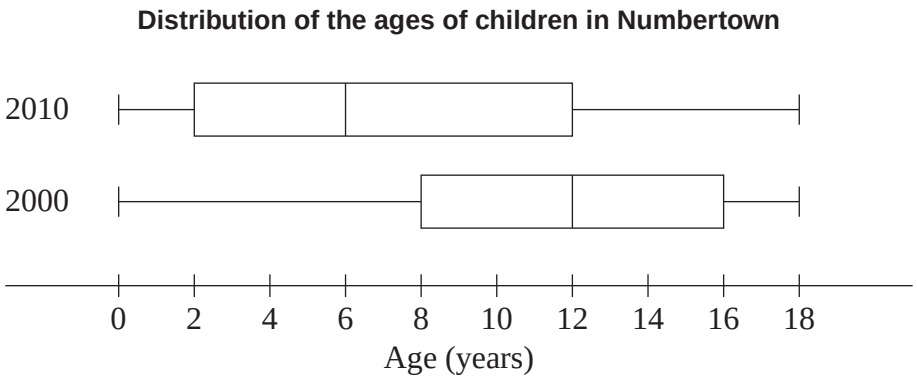
Find the area of triangle *ABC*, correct to the nearest square metre.

End of Question 26

Question 27 (13 marks) Use the Question 27 Writing Booklet.

(a) Fully simplify $\frac{4x^2}{3y} \div \frac{xy}{5}$. **3**

(b) The graphs show the distribution of the ages of children in Numbertown in 2000 and 2010.



(i) In 2000 there were 1750 children aged 0–18 years. **1**

How many children were aged 12–18 years in 2000?

(ii) The number of children aged 12–18 years is the same in both 2000 and 2010. **1**

How many children aged 0–18 years are there in 2010?

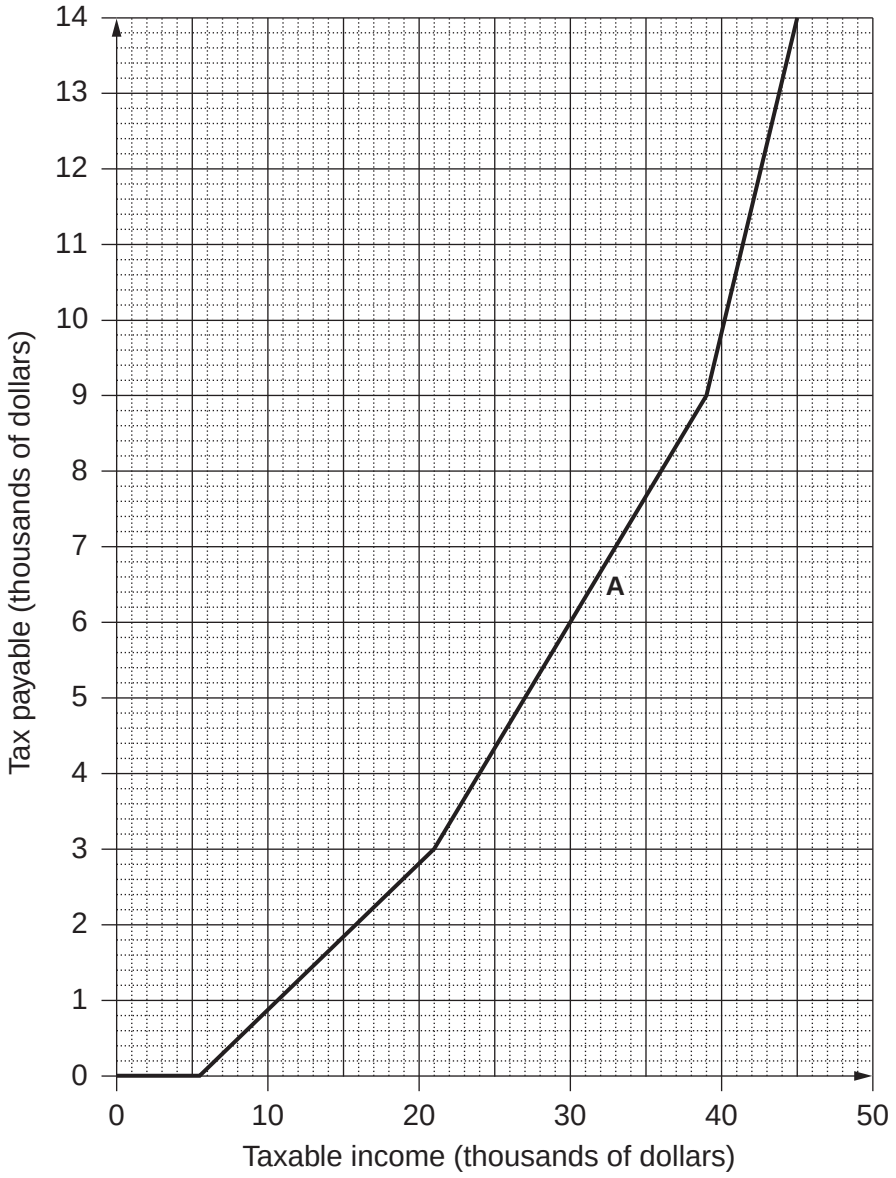
(iii) Identify TWO changes in the distribution of ages between 2000 and 2010. In your answer, refer to measures of location or spread or the shape of the distributions. **2**

(iv) What would be ONE possible implication for government planning, as a consequence of this change in the distribution of ages? **1**

Question 27 continues on page 23

Question 27 (continued)

(c) The graph shows tax payable against taxable income, in thousands of dollars.



(i) Use the graph to find the tax payable on a taxable income of \$21 000. **1**

(ii) Use suitable points from the graph to show that the gradient of the section of the graph marked **A** is $\frac{1}{3}$. **1**

(iii) How much of each dollar earned between \$21 000 and \$39 000 is payable in tax? **1**

(iv) Write an equation that could be used to calculate the tax payable, T, in terms of the taxable income, I, for taxable incomes between \$21 000 and \$39 000. **2**

End of Question 27

Question 28 (13 marks) Use the Question 28 Writing Booklet.

(a) The table shows monthly home loan repayments with interest rate changes from February to October 2009.

Monthly home loan repayments

	A	B	C	D	E
1					
2	*Dates*	Feb 2009	Apr 2009	Jun 2009	Oct 2009
3	*Increase/Decrease*	*–1.0%*	*–0.1%*	*0.05%*	*0.25%*
4	***Rate***	***5.85%***	***5.75%***	***5.80%***	***6.05%***
5	$1 000	$6.35	$6.29	$6.32	$6.47
6	$50 000	$318	$315	$316	$324
7	$100 000	$635	$629	$632	$647
8	$150 000	$953	$944	$948	$971
9	$200 000	$1 270	$1 258	$1 264	$1 295
10	$250 000	$1 588	$1 573	$1 580	$1 618
11	$300 000	$1 905	$1 887	$1 896	$1 942
12	$350 000	$2 223	$2 202	$2 212	$2 266
13	$400 000	$2 541	$2 516	$2 529	$2 589
14					

Sheet 1 Sheet 2

(i) What is the change in monthly repayments on a $250 000 loan from February 2009 to April 2009? **1**

(ii) Xiang wants to borrow $307 000 to buy a house. **3**

Xiang's bank approves loans for customers if their loan repayments are no more than 30% of their monthly gross salary.

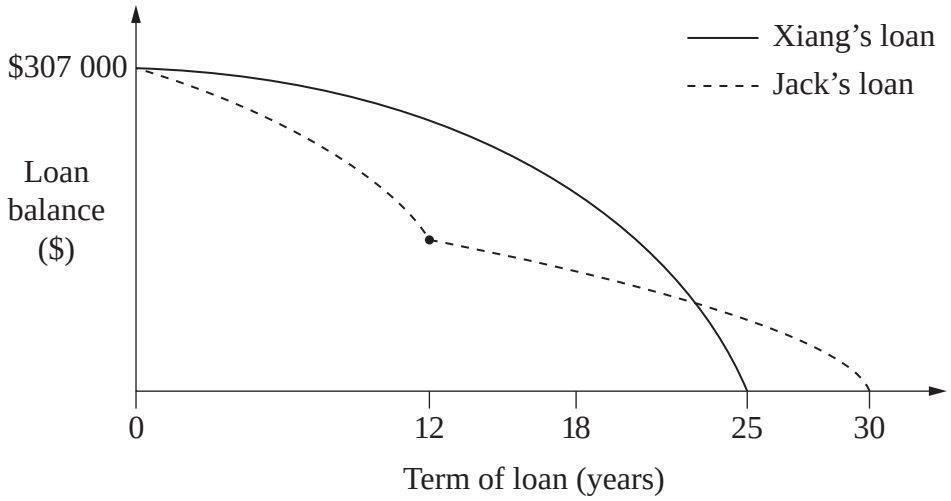
Xiang's monthly gross salary is $6 500.

If she had applied for the loan in October 2009, would her bank have approved her loan?

Justify your answer with suitable calculations.

Question 28 continues on page 25

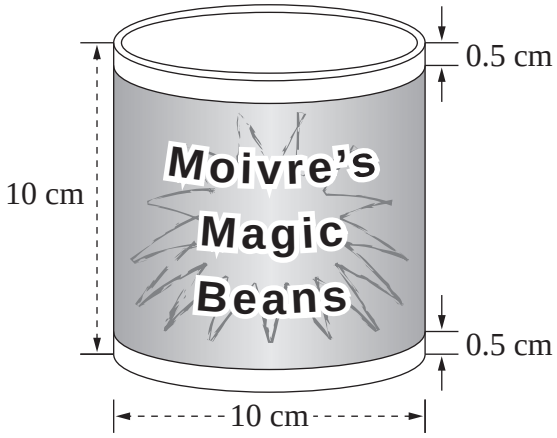
(iii) Jack took out a loan at the same time and for the same amount as Xiang. Graphs of their loan balances are shown. **2**



Identify TWO differences between the graphs and provide a possible explanation for each difference, making reference to interest rates and/or loan repayments.

Question 28 continues on page 26

(b) Moivre's manufacturing company produces cans of Magic Beans. The can has a diameter of 10 cm and a height of 10 cm.



(i) Cans are packed in boxes that are rectangular prisms with dimensions $30\text{ cm} \times 40\text{ cm} \times 60\text{ cm}$. **1**

What is the maximum number of cans that can be packed into one of these boxes?

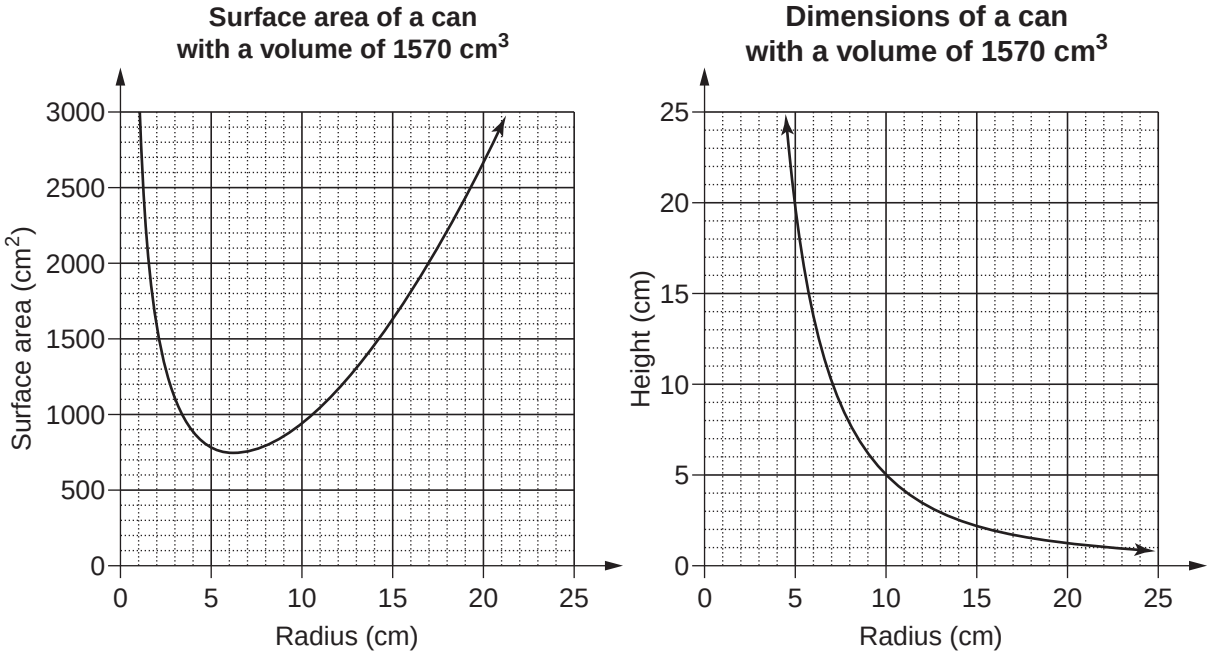
(ii) The shaded label on the can shown wraps all the way around the can with no overlap. **2**

What area of paper is needed to make the labels for all the cans in this box when the box is full?

(iii) The company is considering producing larger cans. Monica says if you double the diameter of the can this will double the volume. Is Monica correct? Justify your answer with suitable calculations. **2**

Question 28 continues on page 27

(iv) The company wants to produce a can with a volume of 1570 cm^3, using the least amount of metal. Monica is given the job of determining the dimensions of the can to be produced. She considers the following graphs. **2**



What radius and height should Monica recommend that the company use to minimise the amount of metal required to produce these cans? Justify your choice of dimensions with reference to the graphs and/or suitable calculations.

End of paper

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FORMULAE SHEET

Area of an annulus

$A = \pi\left(R^2 - r^2\right)$

R = radius of outer circle
r = radius of inner circle

Area of an ellipse

$A = \pi ab$

a = length of semi-major axis
b = length of semi-minor axis

Area of a sector

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

θ = number of degrees in central angle

Arc length of a circle

$l = \dfrac{\theta}{360}2\pi r$

θ = number of degrees in central angle

Simpson's rule for area approximation

$A \approx \dfrac{h}{3}\left(d_f + 4d_m + d_l\right)$

h = distance between successive measurements
d_f = first measurement
d_m = middle measurement
d_l = last measurement

Surface area

Sphere $A = 4\pi r^2$

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

r = radius
h = perpendicular height

Volume

Cone $V = \dfrac{1}{3}\pi r^2 h$

Cylinder $V = \pi r^2 h$

Pyramid $V = \dfrac{1}{3}Ah$

Sphere $V = \dfrac{4}{3}\pi r^3$

r = radius
h = perpendicular height
A = area of base

Sine rule

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

Area of a triangle

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

Cosine rule

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

or

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

FORMULAE SHEET

Simple interest

$$I = Prn$$

P = initial quantity
r = percentage interest rate per period, expressed as a decimal
n = number of periods

Compound interest

$$A = P(1+r)^n$$

A = final balance
P = initial quantity
n = number of compounding periods
r = percentage interest rate per compounding period, expressed as a decimal

Future value (A) of an annuity

$$A = M\left\{\frac{(1+r)^n - 1}{r}\right\}$$

M = contribution per period, paid at the end of the period

Present value (N) of an annuity

$$N = M\left\{\frac{(1+r)^n - 1}{r(1+r)^n}\right\}$$

or

$$N = \frac{A}{(1+r)^n}$$

Straight-line formula for depreciation

$$S = V_0 - Dn$$

S = salvage value of asset after n periods
V_0 = purchase price of the asset
D = amount of depreciation apportioned per period
n = number of periods

Declining balance formula for depreciation

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

S = salvage value of asset after n periods
r = percentage interest rate per period, expressed as a decimal

Mean of a sample

$$\bar{x} = \frac{\sum x}{n}$$

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$\bar{x}$ = mean
x = individual score
n = number of scores
f = frequency

Formula for a z-score

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

s = standard deviation

Gradient of a straight line

$$m = \frac{\text{vertical change in position}}{\text{horizontal change in position}}$$

Gradient–intercept form of a straight line

$$y = mx + b$$

m = gradient
b = y-intercept

Probability of an event

The probability of an event where outcomes are equally likely is given by:

$$P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$$

BOARD OF STUDIES
NEW SOUTH WALES

Centre Number

Student Number

2010

HIGHER SCHOOL CERTIFICATE EXAMINATION

General Mathematics

Writing Booklet

Question Number
25

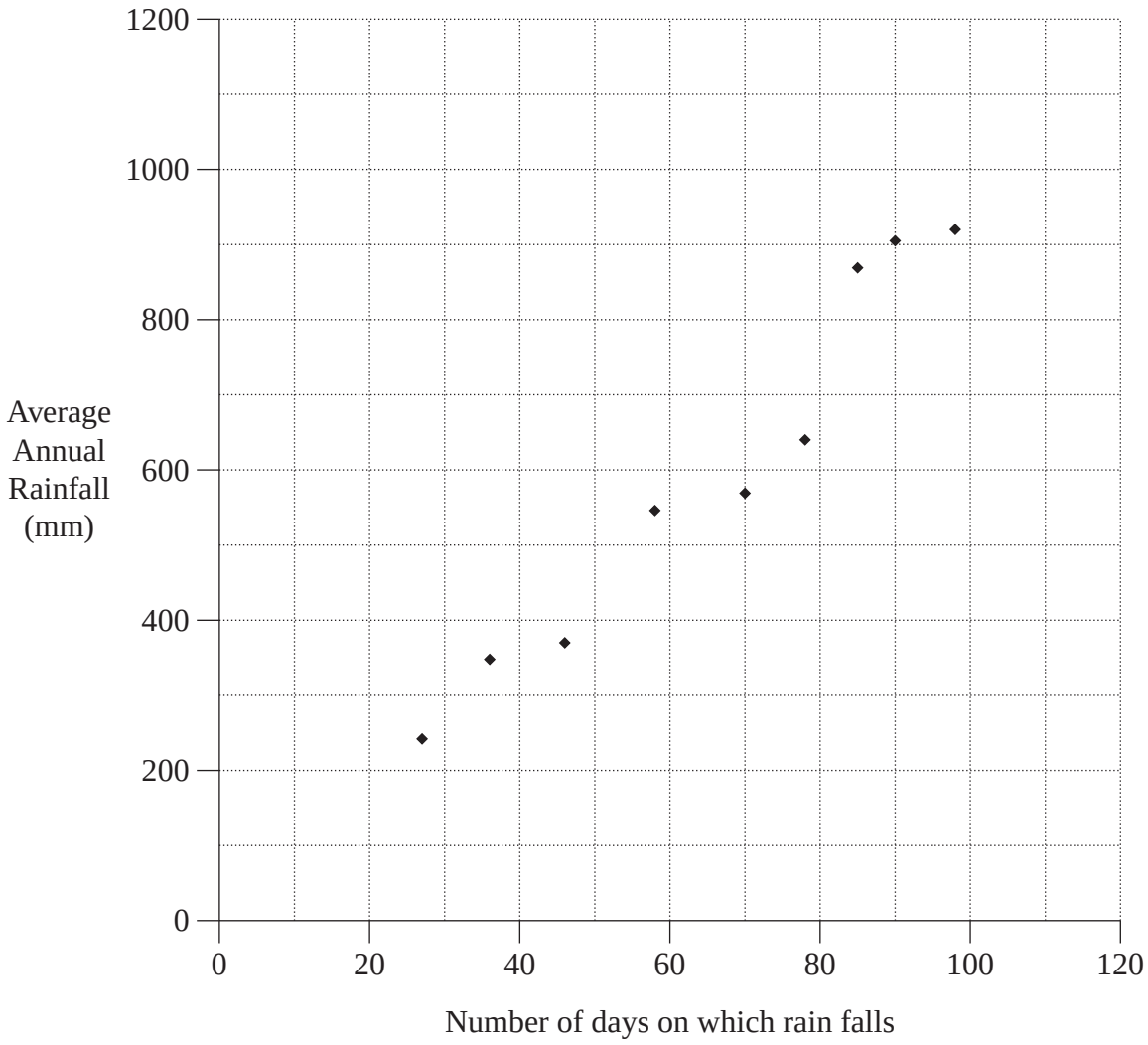
Instructions

- Use this Writing Booklet to answer Question 25.
- Write your Centre Number and Student Number at the top of this page.
- If you have not attempted the question, you must still hand in the Writing Booklet, with the words 'NOT ATTEMPTED' written clearly on the front cover.
- Write the number of each question part inside the margin at the beginning of each answer.
- Write using black or blue pen. (Black pen is recommended.)
- You may ask for an extra Writing Booklet if you need more space.
- **You may NOT take any Writing Booklets, used or unused, from the examination room.**

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

Start here.

Question 25 (a) (i)



Question 25 (a) (ii)

.....

Additional writing space on back page.

You may ask for an extra Writing Booklet if you need more space.

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