BOARD OF STUDIES
NEW SOUTH WALES

2004

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

Total marks – 100

Section I Pages 2–11

22 marks

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

Section II Pages 12–23

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.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

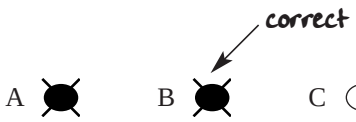
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



A ⊗ B ⊗ C ○ D ○

1 Which fraction is equal to a probability of 25%?

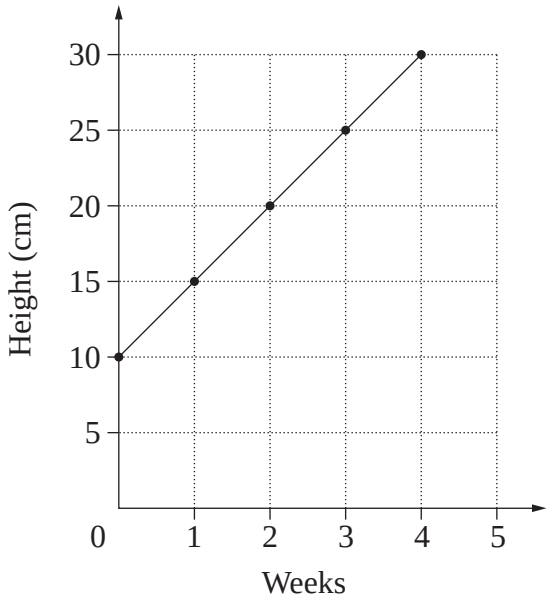
(A) $\frac{1}{25}$

(B) $\frac{1}{4}$

(C) $\frac{1}{3}$

(D) $\frac{1}{2}$

2 Susan drew a graph of the height of a plant.



What is the gradient of the line?

(A) 1

(B) 5

(C) 7.5

(D) 10

3 If $K = Ft^3$, $F = 5$ and $t = 0.715$, what is the value of K correct to three significant figures?

(A) 1.82

(B) 1.827

(C) 1.828

(D) 1.83

4 A real estate agent sells a house for \$400 000. From the selling price he earns \$10 000 for his services.

Which term is used to describe the money he earns?

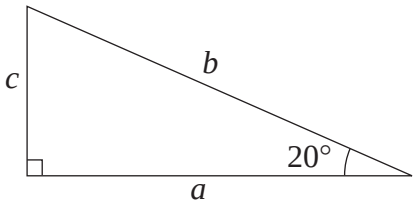
(A) Commission

(B) Income tax

(C) Royalty

(D) Superannuation

5 What is the correct expression for $\tan 20°$ in this triangle?



NOT TO SCALE

(A) $\frac{a}{b}$

(B) $\frac{a}{c}$

(C) $\frac{c}{b}$

(D) $\frac{c}{a}$

Use the set of scores 1, 3, 3, 3, 4, 5, 7, 7, 12 to answer Questions 6 and 7.

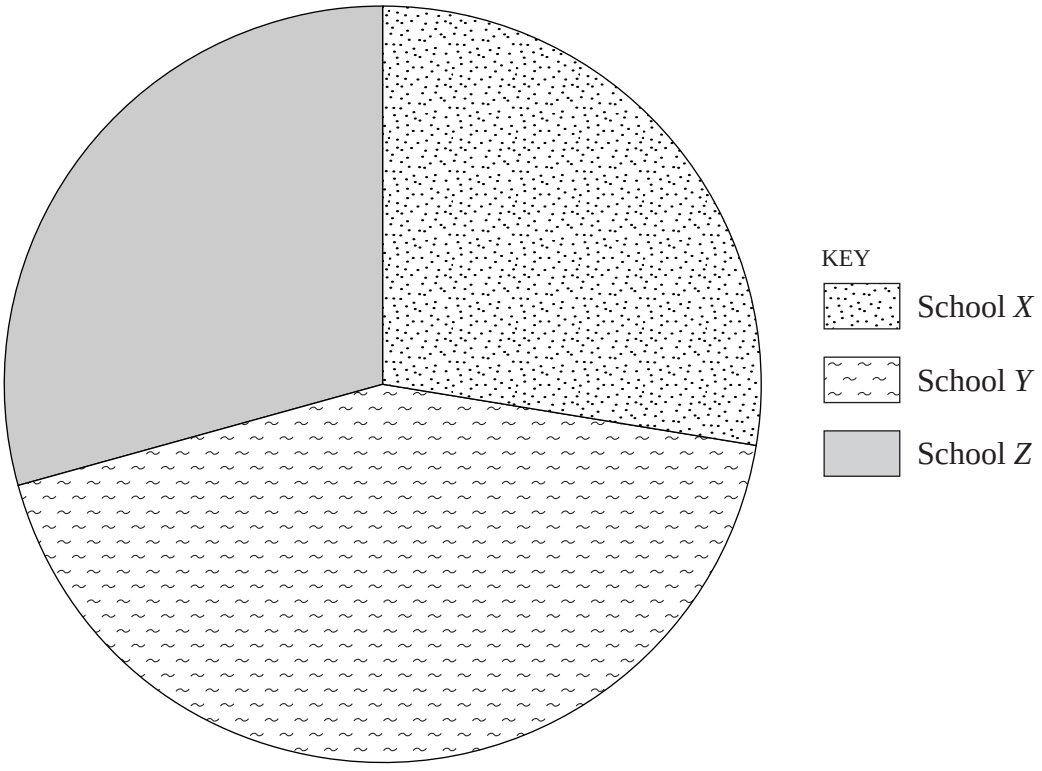
6 What is the range of the set of scores?

(A) 6
(B) 9
(C) 11
(D) 12

7 What are the median and the mode of the set of scores?

(A) Median 3, mode 5
(B) Median 3, mode 3
(C) Median 4, mode 5
(D) Median 4, mode 3

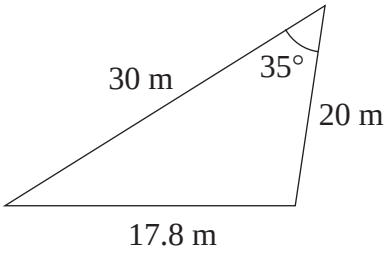
8 This sector graph shows the distribution of 116 prizes won by three schools: *X*, *Y* and *Z*.



How many prizes were won by School *X*?

(A) 26
(B) 32
(C) 81
(D) 99

9 What is the area of the triangle to the nearest square metre?



NOT TO SCALE

(A) 102 m^2

(B) 153 m^2

(C) 172 m^2

(D) 178 m^2

10 Using the tax table, determine the tax payable on a taxable income of $47 000.

Taxable income	*Tax on this income*
$0 – $6 000	NIL
$6 001 – $22 000	16 cents for each $1 over $6 000
$22 001 – $45 000	$2 560 plus 25 cents for each $1 over $22 000
$45 001 – $60 000	$8 310 plus 40 cents for each $1 over $45 000
$60 001 and over	$14 310 plus 48 cents for each $1 over $60 000

(A) $8 310.40

(B) $9 109.60

(C) $9 110.00

(D) $10 310.40

11 If $d = 6t^2$, what is a possible value of t when $d = 2400$?

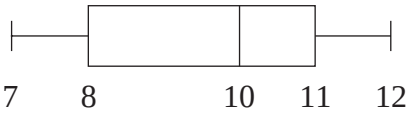
(A) 0.05

(B) 20

(C) 120

(D) 400

12 This box-and-whisker plot represents a set of scores.



What is the interquartile range of this set of scores?

(A) 1

(B) 2

(C) 3

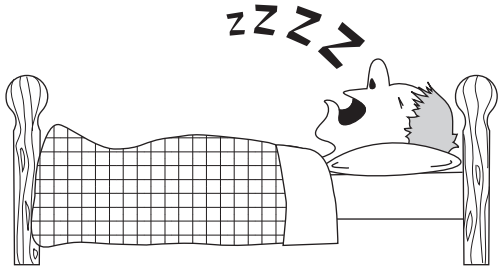
(D) 5

13

How much air do you breathe?



100 litres per minute while exercising



6 litres per minute while resting

During a ten-minute period, Kath is exercising and Jim is resting.

How much more air would Kath breathe than Jim during this time?

(A) 40 litres

(B) 94 litres

(C) 940 litres

(D) 1060 litres

14 Mike plays a game in which he has:

- $\frac{1}{10}$ chance of winning \$20
- $\frac{1}{2}$ chance of winning \$1
- $\frac{2}{5}$ chance of losing \$2.

What is Mike's financial expectation when playing this game?

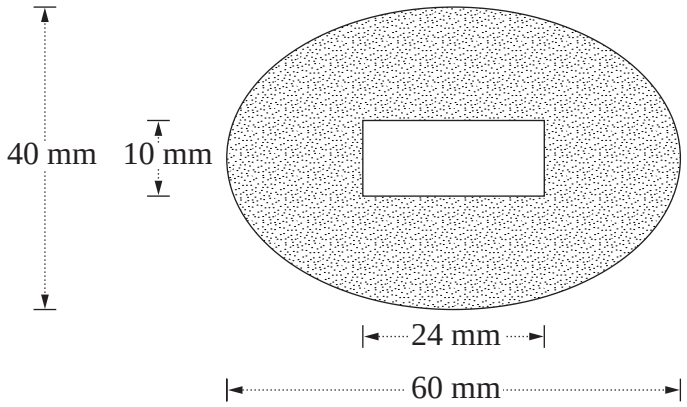
(A) \$1.70

(B) \$3.30

(C) \$17.00

(D) \$19.00

15 The figure shows an ellipse and a rectangle.



NOT TO SCALE

What is the area of the shaded part of the figure to the nearest square millimetre?

(A) 1645 mm^2

(B) 2160 mm^2

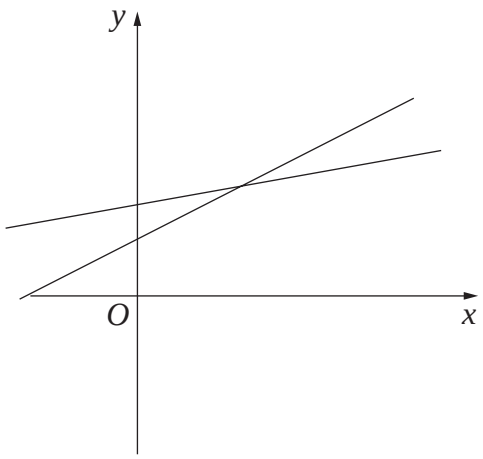
(C) 3530 mm^2

(D) 7300 mm^2

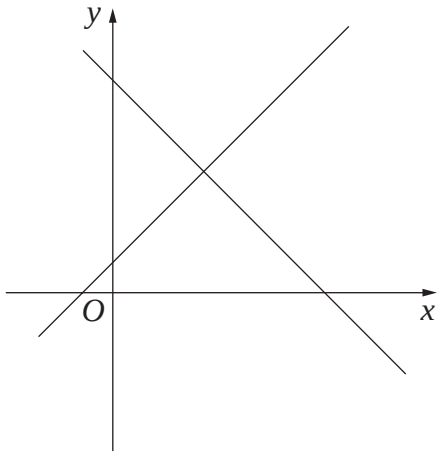
16 George drew a correct diagram that gave the solution to the simultaneous equations $y = 2x - 5$ and $y = x + 6$.

Which diagram did he draw?

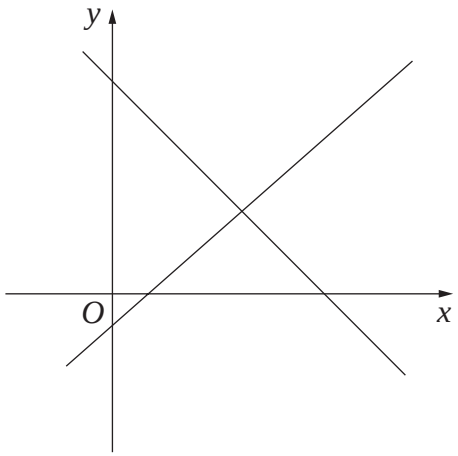
(A)



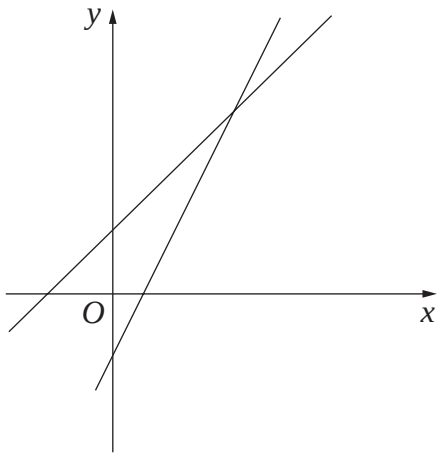
(B)



(C)



(D)



17 Rita purchased a camera for $880 while on holidays in Australia. This price included 10% GST. When she left Australia she received a refund of the GST.

What was Rita's refund?

(A) $80

(B) $88

(C) $792

(D) $800

18 Two dice are rolled. What is the probability that only one of the dice shows a six?

(A) $\frac{5}{36}$

(B) $\frac{1}{6}$

(C) $\frac{5}{18}$

(D) $\frac{11}{36}$

19 Kerry has a credit card. She is charged 0.05% compound interest per day on outstanding balances.

How much interest is Kerry charged on an amount of $250, which is outstanding on her credit card for 30 days?

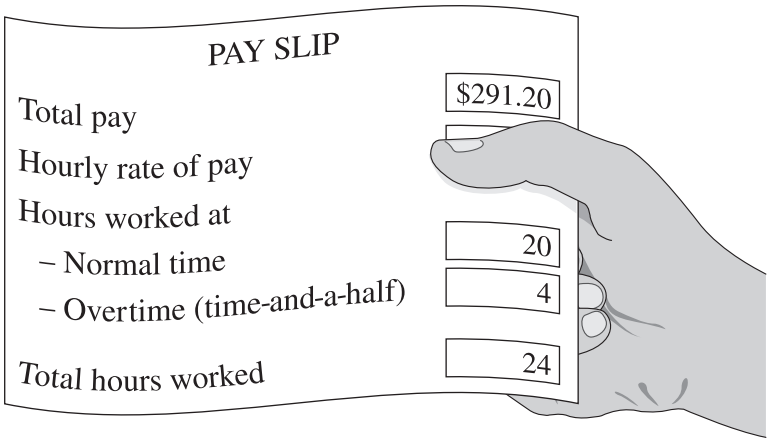
(A) $3.75

(B) $3.78

(C) $253.75

(D) $253.78

20 Stan worked for 24 hours as shown on his pay slip.



What was his hourly rate of pay?

(A) $11.20

(B) $12.13

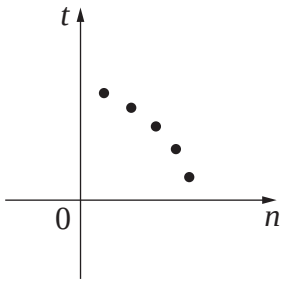
(C) $14.56

(D) $18.20

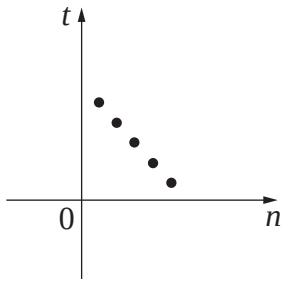
21 The time (t) taken to clean a house varies inversely with the number (n) of people cleaning the house.

Which graph represents this relationship?

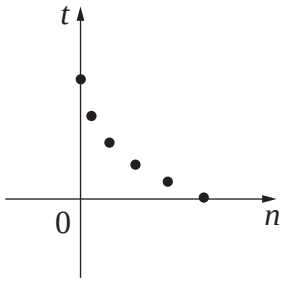
(A)



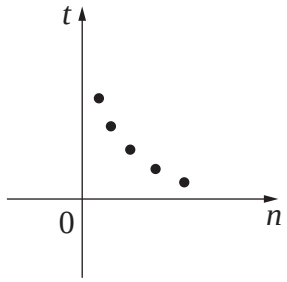
(B)



(C)



(D)



22 John knows that

- one Australian dollar is worth 0.62 euros
- one Vistabella dollar ($V) is worth 1.44 euros.

John changes 25 Australian dollars to Vistabella dollars.

How many Vistabella dollars will he get?

(A) $V 10.76

(B) $V 22.32

(C) $V 28.00

(D) $V 58.06

Section II

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

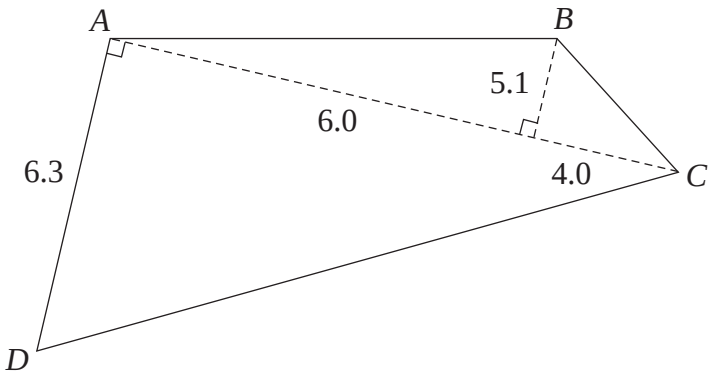
Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

All necessary working should be shown in every question.

Marks

Question 23 (13 marks) Use a SEPARATE writing booklet.

(a) The diagram shows the shape of Carmel's garden bed. All measurements are in metres.



NOT TO SCALE

(i) Show that the area of the garden bed is 57 square metres. **2**

(ii) Carmel decides to add a 5 cm layer of straw to the garden bed. Calculate the volume of straw required. Give your answer in cubic metres. **2**

(iii) Each bag holds 0.25 cubic metres of straw. How many bags does she need to buy? **2**

(iv) A straight fence is to be constructed joining point *A* to point *B*. Find the length of this fence to the nearest metre. **2**

Question 23 continues on page 13

Marks

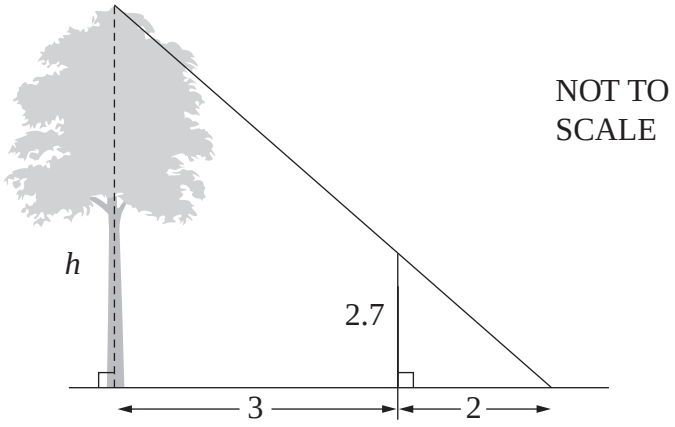
Question 23 (continued)

(b) Kirbee is shopping for computer software. *Novirus* costs \$115 more than *Funmaths*. Let x dollars be the cost of *Funmaths*.

(i) Write an expression involving x for the cost of *Novirus*. **1**

(ii) *Novirus* and *Funmaths* together cost \$415. Write an equation involving x and solve it to find the cost of *Funmaths*. **2**

(c) Calculate the height (h metres) of the tree in the diagram. All measurements are in metres. **2**



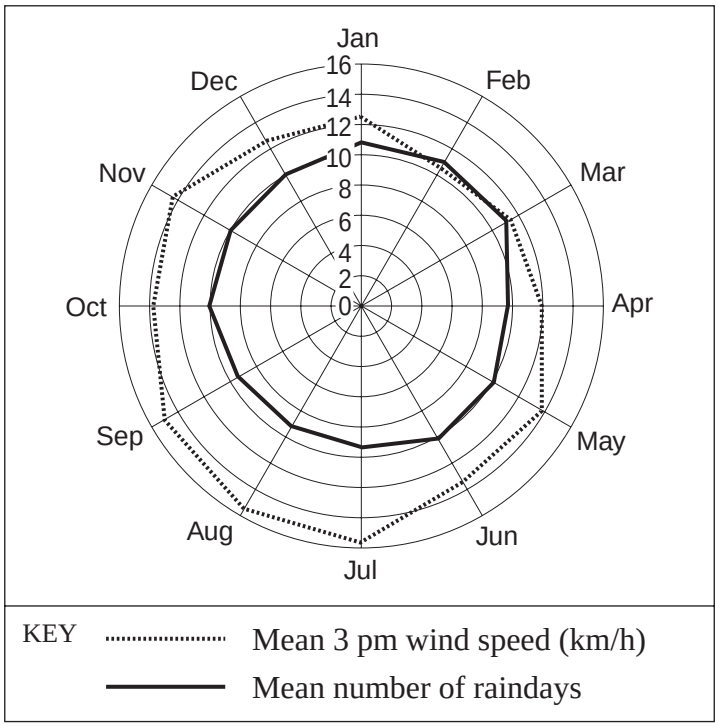
End of Question 23

Marks

Question 24 (13 marks) Use a SEPARATE writing booklet.

(a) The following graphs have been constructed from data taken from the Bureau of Meteorology website. The information relates to a town in New South Wales.

The graphs show the mean 3 pm wind speed (in kilometres per hour) for each month of the year and the mean number of days of rain for each month (raindays).



(i) What is the mean 3 pm wind speed for September? **1**

(ii) Which month has the lowest mean 3 pm wind speed? **1**

(iii) In which three-month period does the town have the highest number of raindays? **1**

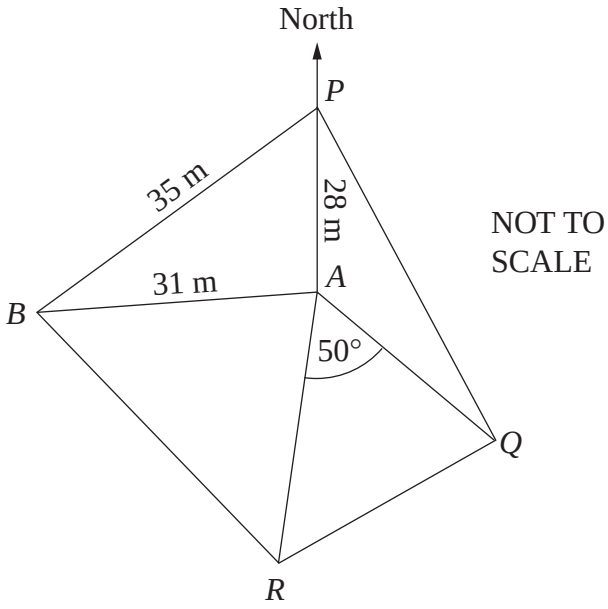
(iv) Briefly describe the pattern relating wind speed with the number of raindays for this town. Refer to specific months. **2**

Question 24 continues on page 15

Marks

Question 24 (continued)

(b) The diagram shows a radial survey of a piece of land.

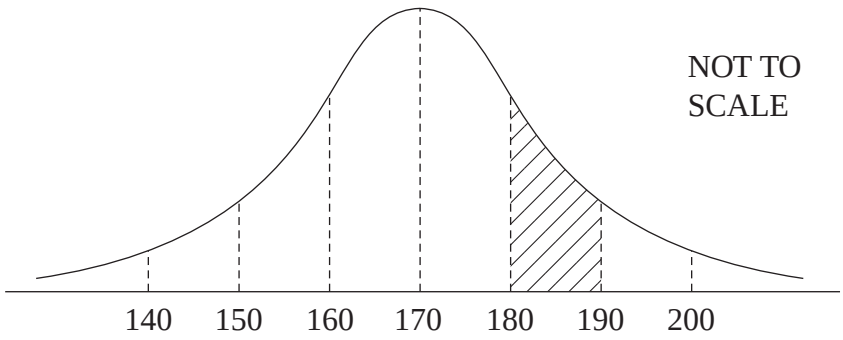


(i) Q is south-east of A. What is the size of angle PAQ? **1**

(ii) What is the bearing of R from A? **1**

(iii) Find the size of angle PAB to the nearest degree. **3**

(c) The normal distribution shown has a mean of 170 and a standard deviation of 10.



(i) Roberto has a raw score in the shaded region. What could his z-score be? **1**

(ii) What percentage of the data lies in the shaded region? **2**

End of Question 24

Marks

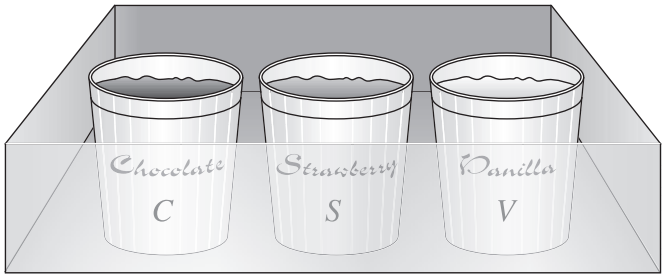
Question 25 (13 marks) Use a SEPARATE writing booklet.

(a) Tai uses the declining balance method of depreciation to calculate tax deductions for her business. Tai's computer is valued at $6500 at the start of the 2003 financial year. The rate of depreciation is 40% per annum.

(i) Calculate the value of her tax deduction for the 2003 financial year. **1**

(ii) What is the value of her computer at the start of the 2006 financial year? **2**

(b) Joe sells three different flavours of ice-cream from three different tubs in a cabinet. The flavours are chocolate, strawberry and vanilla.



(i) In how many different ways can he arrange the tubs in a row? Show working to justify your answer. **2**

(ii) Paul buys an ice-cream from Joe on two different days. He chooses the flavour at random. What is the probability that he chooses chocolate on both days? **1**

(iii) Mei-Ling buys an ice-cream from Joe and chooses any two different flavours at random. What is the probability that she chooses chocolate first and then strawberry? **2**

Question 25 continues on page 17

Question 25 (continued)

(c) Lie detector tests are not always accurate. A lie detector test was administered to 200 people.

The results were:

- 50 people lied. Of these, the test indicated that 40 had lied;
- 150 people did NOT lie. Of these, the test indicated that 20 had lied.

(i) Copy the table into your writing booklet and complete it using the information above. **2**

	Test indicated a lie	*Test did not indicate a lie*	*Total*
People who lied			50
People who did NOT lie			150

(ii) For how many of the people tested was the lie detector test accurate? **1**

(iii) For what percentage of the people tested was the test accurate? **1**

(iv) What is the probability that the test indicated a lie for a person who did NOT lie? **1**

End of Question 25

Marks

Question 26 (13 marks) Use a SEPARATE writing booklet.

(a) (i) The number of bacteria in a culture grows from 100 to 114 in one hour. What is the percentage increase in the number of bacteria? **1**

(ii) The bacteria continue to grow according to the formula $n = 100(1.14)^t$, where n is the number of bacteria after t hours. What is the number of bacteria after 15 hours? **1**

Time in hours (t)	0	5	10	15
Number of bacteria (n)	100	193	371	?

(iii) Use the values of n from $t = 0$ to $t = 15$ to draw a graph of $n = 100(1.14)^t$. Use about half a page for your graph and mark a scale on each axis. **4**

(iv) Using your graph or otherwise, estimate the time in hours for the number of bacteria to reach 300. **1**

(b) The location of Sorong is 1°S 131°E and the location of Darwin is 12°S 131°E.

(i) What is the difference in the latitudes of Sorong and Darwin? **1**

(ii) The radius of Earth is approximately 6400 km. One nautical mile is approximately 1.852 km.

(1) Show that the great circle distance between Sorong and Darwin is approximately 1200 km. **2**

(2) A group of tourists can travel on a yacht at an average speed of 15 knots, from Darwin to Sorong. They need to complete this trip in 48 hours or less. **3**

Will this be possible? Use suitable calculations, with appropriate units, to justify your answer.

Marks

Question 27 (13 marks) Use a SEPARATE writing booklet.

(a) Aaron decides to borrow $150 000 over a period of 20 years at a rate of 7.0% per annum.

MONTHLY REPAYMENT TABLE

Principal and interest per $1000 borrowed

Interest rate (pa)	Term of loan – years					
	5	**10**	**15**	**20**	**25**	**30**
6.5%	19.57	11.35	8.71	7.46	6.75	6.32
7.0%	19.80	11.61	8.99	7.75	7.07	6.65
7.5%	20.04	11.87	9.27	8.06	7.39	6.99
8.0%	20.28	12.13	9.56	8.36	7.72	7.34

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(i) Using the Monthly Repayment Table, calculate Aaron's monthly repayment. **2**

(ii) How much interest does he pay over the 20 years? **2**

(iii) Aaron calculates that if he repays the loan over 15 years, his total repayments would be $242 730. **2**

How much interest would he save by repaying the loan over 15 years instead of 20 years?

Question 27 continues on page 20

Marks

Question 27 (continued)

(b) David is paid at these rates:

Weekday rate	\$18.00 per hour
Saturday rate	Time-and-a-half
Sunday rate	Double time

His time sheet for last week is:

	Start	*Finish*	*Unpaid break*
Friday	9.00 am	1.30 pm	30 minutes
Saturday	9.00 am	4.00 pm	1 hour
Sunday	8.00 am	2.00 pm	1 hour

(i) Calculate David's gross pay for last week. **3**

(ii) David decides not to work on Saturdays. He wants to keep his weekly gross pay the same. How many extra hours at the weekday rate must he work? **1**

(c) Sanjeev starts saving for a holiday that he wants to take when he finishes his TAFE course. He decides to invest \$200 per month, at the end of each month, by placing it into an account earning 6% per annum compounded monthly. He will do this for four years. **3**

Will Sanjeev reach his goal of \$10 500? By how much will he fall short of or exceed his goal?

End of Question 27

Marks

Question 28 (13 marks) Use a SEPARATE writing booklet.

(a) A health rating, R, is calculated by dividing a person's weight, w, in kilograms by the square of the person's height, h, in metres.

(i) Fred is 150 cm and weighs 72 kg. Calculate Fred's health rating. **1**

(ii) Over several years, Fred expects to grow 10 cm taller. By this time he wants his health rating to be 25. How much weight should he gain or lose to achieve his aim? Justify your answer with mathematical calculations. **2**

(b)



A set of garden gnomes is made so that the cost ($\$C$) varies directly with the cube of the base length (b centimetres). A gnome with a base length of 10 cm has a cost of \$50.

(i) Write an equation relating the variables C and b, and a constant k. **1**

(ii) Find the value of k. **1**

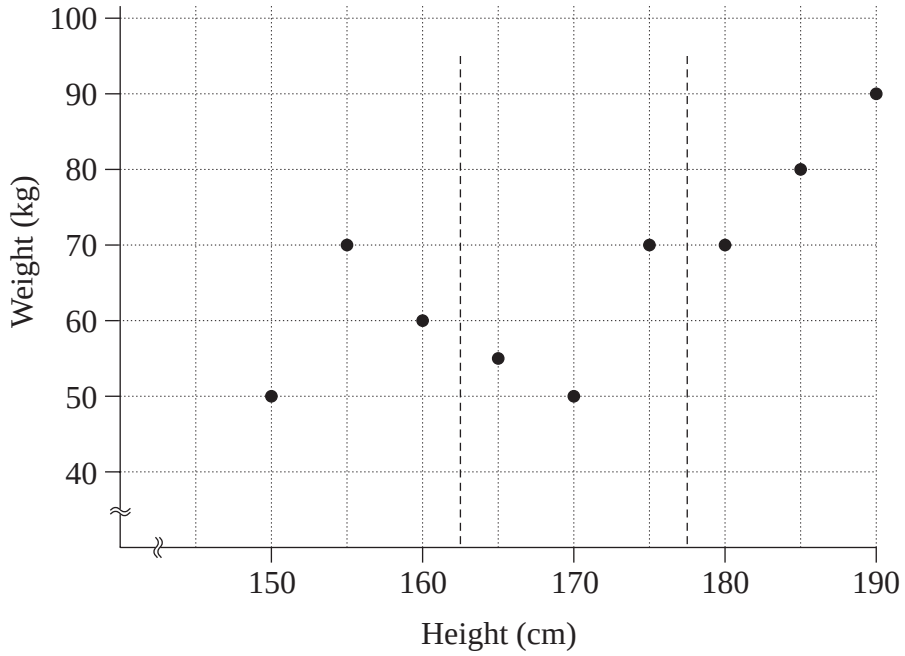
(iii) Felicity says, 'If you double the base length, you double the cost.' **2**

Is she correct? Justify your answer with mathematical calculations.

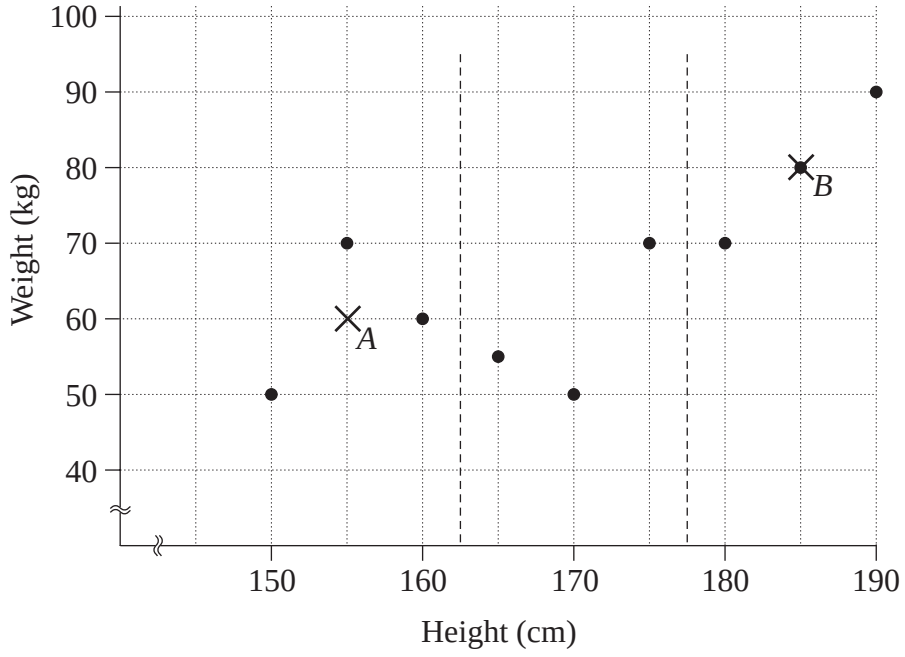
Question 28 continues on page 22

Question 28 (continued)

(c) Jill has collected data about the height and weight of nine adults. This is shown in the scatterplot below. Using a ruler and pencil, Jill is preparing to fit a median regression line to the data. As a first step she divides the data into three sections as shown.



(i) In the second step, Jill calculates the points A and B as shown in the diagram below. What are the coordinates of the corresponding point C in the middle section? **2**



Question 28 continues on page 23

Marks

Question 28 (continued)

(ii) In the third step, Jill draws a line through A and B. What is the fourth and final step needed to complete her construction of the median regression line? **2**

(iii) The equation of the median regression line for the data may be approximated by

$$\text{weight in kg} = \frac{2}{3}\,(\text{height in cm}) - 50.$$

(1) Use this model to predict the height of a person who weighs 75 kg. **1**

(2) Give ONE limitation of this model for predicting weights from heights. **1**

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:

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