EPPING BOYS' HIGH SCHOOL

YEAR 11 YEARLY EXAM 2009

GENERAL MATHEMATICS (PRELIMINARY COURSE)

Name : _____ Monday 21st September, 2009

Class : _____

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Approved calculators may be used
- A separated Formula Sheet is provided

SECTION 1 (25 marks)

- Attempt Questions 1 – 25
- Allow about 35 minutes for this section
- Place a cross for your answer on the Answer Sheet provided

SECTION 2 (51 marks)

- This section contains 3 questions of equal value.
- Writing booklets will be provided.
- Start each new question in a new booklet.
- Allow about 85 minutes for this section.
- All necessary working should be shown in your booklet.

Section 1	Q. 23	Q. 24	Q. 25	Total	%
/ 25	/17	/17	/17	/76	/100

SECTION 1 – **Total marks - 25**

Attempt Questions 1 – 25

Allow about 35 minutes for this section

Use the Multiple Choice Answer Sheet provided

(1) Which one of the following is the correct simplification of $8a - 4b - 7a + 3b$?

(A) $a - b$ (B) $a + 7b$

(C) $a - 7b$ (D) $a + b$

(2) The Aswan Dam in Egypt has a volume of 43 000 megalitres of water. A megalitre is one million litres. 43 000 megalitres is equal to

(A) 4 300 000 litres (B) 43 000 000 litres

(C) 4 300 000 000 litres (D) 43 000 000 000 litres

(3) A microchip is square, with side length 0.000 0003 mm. What is its area, expressed in scientific notation?

(A) $3\times10^{-7}\ mm^2$ (B) $3\times10^{7}\ mm^2$

(C) $9\times10^{-14}\ mm^2$ (D) $9\times10^{14}\ mm^2$

(4) Christine receives a telephone bill for her mobile phone. This bill is 20% lower than her previous bill. If her previous bill was \$62.20, what is Christine's phone bill now?

(A) \$12.44 (B) \$42.20

(C) \$49.76 (D) \$ 62.00

(5) In a One Day Cricket game Brett Lee bowled a ball at a speed of 141.6 km/hr. This speed in m/s is closest to:

(A) 3.9 m/s (B) 39.3 m/s

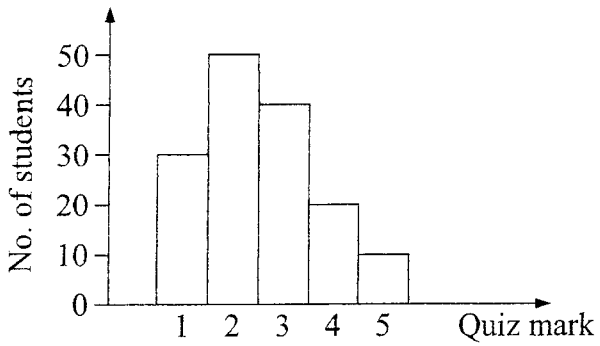
(C) 509.8 m/s (D) 2360 m/s

(6) One litre of water was used to make exactly 64 ice cubes. These ice cubes melted too quickly. It was decided to make larger ice cubes by doubling all the dimensions.

How many of these larger ice cubes can be made using one litre of water?

(A) 4 (B) 8 (C) 16 (D) 32

(7)



The graph shows the results of 150 students on a maths quiz. Which statement is correct?

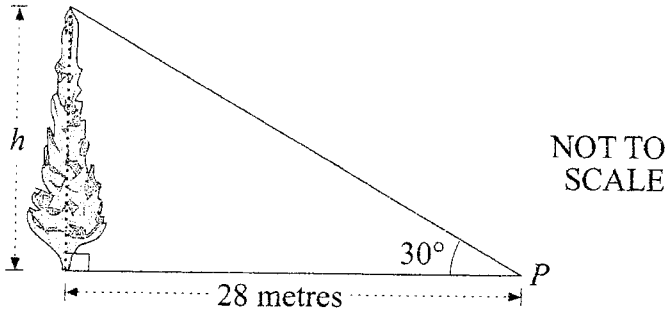
(A) The median is 3 and the mode is 2.

(B) The median is 2 and the mode is 2.

(C) The median is 2 and the mode is 3.

(D) The median is 3 and the mode is 3.

(8) The angle of elevation of the top of the tree from a point P on the ground is 30^0. The point P is 28 metres from the base of the tree.



The correct expression for h, the height of the tree, is

(A) $h = 28\tan 30^0$ (B) $h = \dfrac{28}{\tan 30^0}$

(C) $h = \dfrac{\tan 30^0}{28}$ (D) $h = 30\tan 28^0$

(9) The front wheel of Walter's bike has a circumference of 215 cm. Walter rides his bike a distance of 2.3km. Approximately how many revolutions does the front wheel make during this journey?

(A) 93 (B) 107 (C) 495 (D) 1070

(10) Solve the equation $\frac{3x-1}{2} = 7$.

(A) $x = \frac{13}{3}$ (B) $x = 5$ (C) $x = \frac{16}{3}$ (D) $x = 12$

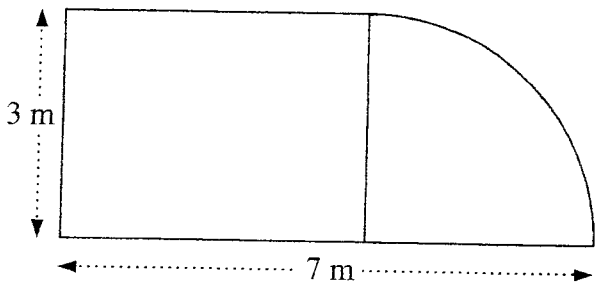
(11) The mean height of five basketball players at the start of a game is 1.88 m. During the game, a player who is 1.74 m is injured and is replaced by a player who is 1.94 m tall. What is the mean height of the 5 players now?

(A) 1. 89 m (B) 1.91 m (C) 1.92 m (D) 2.08 m

(12) Simplify $\frac{x^3}{3x^2} \div x$

(A) $\frac{1}{3}$ (B) $\frac{1}{x^2}$ (C) $\frac{x^2}{3}$ (D) 3

(13) A verandah is in the shape of a rectangle and a quarter of a circle, as shown in the diagram.



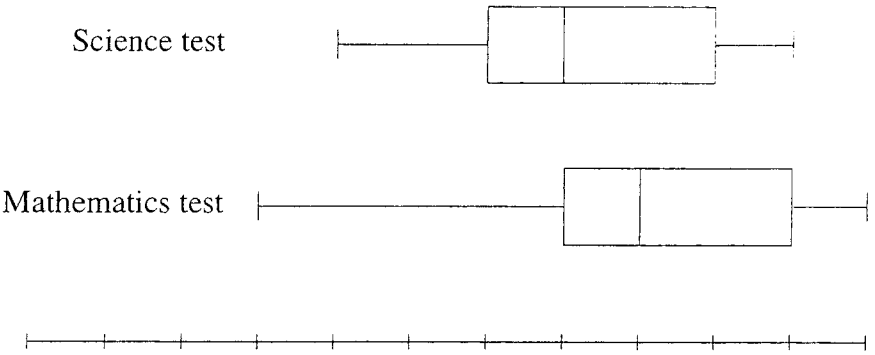
The area of the verandah is closest to

(A) 16 m² (B) 19 m² (C) 21 m² (D) 22 m²

(14) Luke's normal rate of pay is \$15 per hour. Last week he was paid for 12 hours, at time-and-a-half. How many hours would Luke need to work this week, at double time, to earn the same amount?

(A) 4 (B) 6 (C) 8 (D) 9

(15) The marks for an Science test and a Mathematics test are presented in box-and-whisker plots.



Which measure must be the same for both tests?

(A) Mean (B) Range (C) Median (D) Interquartile range

(16) As a decimal correct to 3 decimal places, the ratio $\frac{YZ}{XY}$ is:

(A) 0.510

(B) 0.891

(C) 1.963

(D) Unable to be calculated

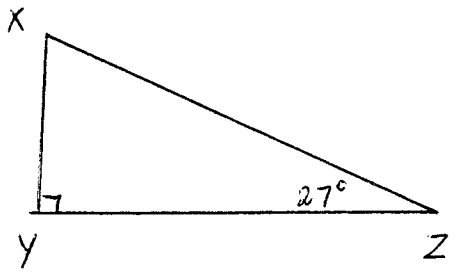


Figure Not To Scale

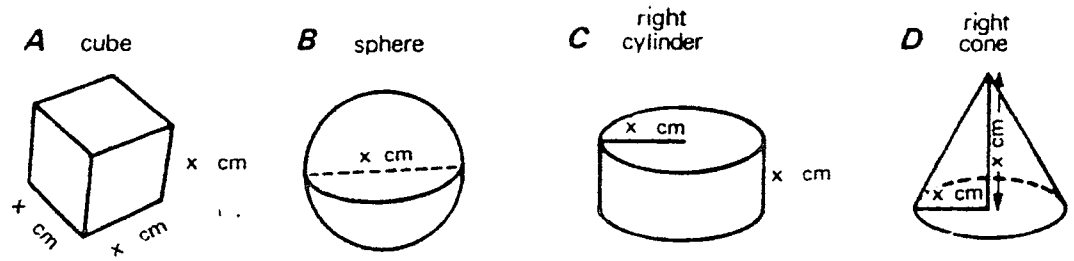
(17) Chairs are manufactured at a cost of \$30 each, and are sold to a furniture store at a profit of 20%. This store wishes to make a profit of 25% on all its sales. To do this, what price should be marked on the chairs when they are displayed for sale?

(A) \$50 (B) \$45 (C) \$42 (D) \$40

(18) Building costs are rising at 20% every 6 months. If a house costs \$ 18 000 to build now. How much will it cost to build the same type of house in 12 months time?

(A) \$18 792 (B) \$19 320 (C) \$25 200 (D) \$25 920

(19) Which one of the following has the greatest volume?



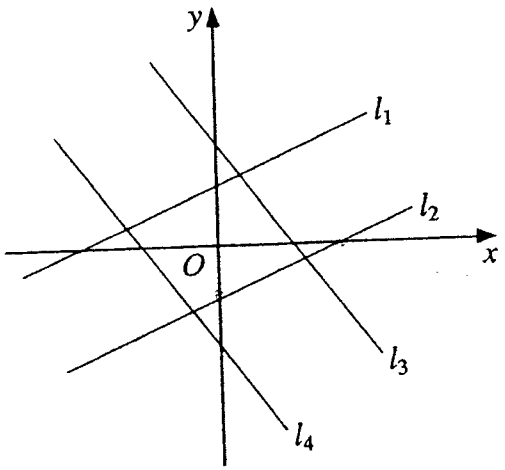
(20) The diagram shows the graphs of four lines l_1, l_2, l_3 and l_4. Which line could have equation $y = \frac{1}{2}x - 3$?

(A) l_1

(B) l_2

(C) l_3

(D) l_4



(21) A lead cube $10cm \times 10cm \times 10cm$ is melted down and made into spherical balls of diameter 0.5 cm. The greatest number of spheres that could be made would be closest to

(A) 15 (B) 150 (C) 1 500 (D) 15 000

(22) $\dfrac{112.8}{16.1\times 2.93}$ correct to 3 significant figures is

(A) 2.39 (B) 2.391 (C) 20.5 (D) 20.528

(23) Which of the following correctly expresses T as the subject of $B=2\pi\left(R+\dfrac{T}{2}\right)$?

(A) $T=\dfrac{B}{\pi}-2R$ (B) $T=\dfrac{B}{\pi}-R$

(C) $T=2R-\dfrac{B}{\pi}$ (D) $T=\dfrac{B}{4\pi}-\dfrac{R}{2}$

(24) A polar surveillance travels 62 800 km in one circular orbit of the Earth.

The radius of the Earth is about 6400 km.

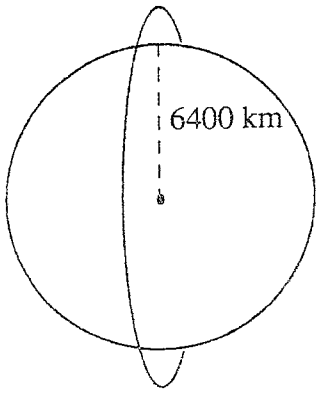
The height of the satellite above the Earth's surface is closest to

(A) 140 km

(B) 3 600 km

(C) 10 000 km

(D) 92 000 km



(25) This set of data arranged in order from smallest to largest.

5, 6, 11, x, 13, 18, 25

The range is six less than twice the value of x.

Which of the following is true?

(A) The median is 12 and the interquartile range is 7.

(B) The median is 12 and the interquartile range is 12.

(C) The median is 13 and the interquartile range is 7.

(D) The median is 13 and the interquartile range is 12.

Section 2

Attempt Questions 26 – 28

Allow about 85 minutes 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 26 (17 marks) **Marks**

(a) The formula $D = \frac{2A}{15}$ is used to calculate the dosage of Hackalot medicine to be given to a child.

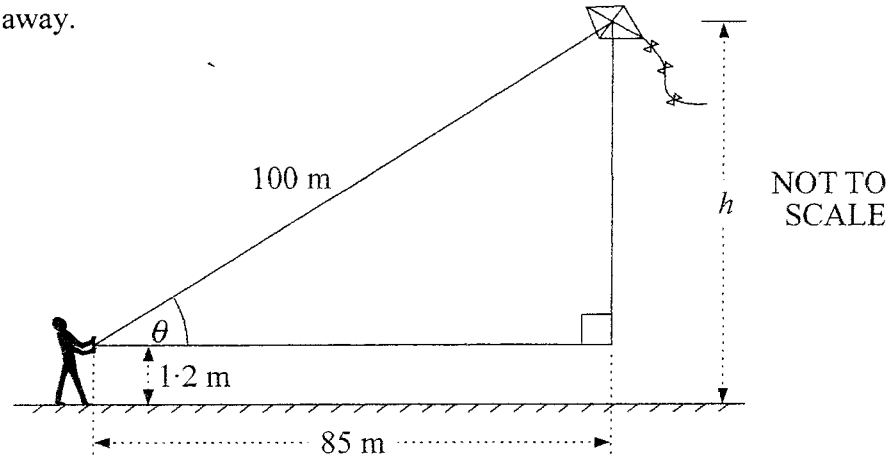
- D is the dosage of Hackalot cough medicine in milliliters (mL).
- A is the age of the child in months.

i) If George is nine months old, what dosage of Hackalot cough medicine shoule he be given? **[1 m]**

ii) The correct dosage of Hackalot cough medicine for Sam is 4 mL. What is the difference in the ages of Sam and George, in months? **[3 m]**

(b) Make L the subject of the equation $T = 2\pi L^2$. **[2 m]**

(c) Benjamin has let out 100 metres of kite string. The kite is directly above the park entrance which is 85 metres away.



i) Find θ, the angle of elevation of the kite from Benjamin's hand. **[1 m]**

ii) Find h, the height of the kite above the ground. Give tour answer correct to 1 decimal place. **[2m]**

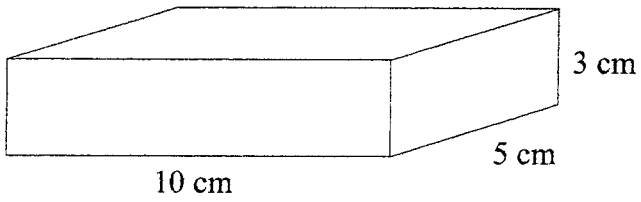
Question 26 (continued)

(d) Solve the following equations

i) $3(x - 2) = 5 - x$. **[2 m]**

ii) $\dfrac{2x + 7}{3} = -1$ **[2 m]**

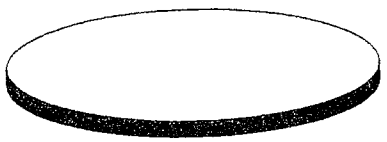
(e) A goldsmith is making gold medals. She has 15 gold ingots, each in the shape of a rectangular prism. Each ingot measures 10 cm by 5 cm by 3 cm.



i) What is the total volume of all 15 gold ingots in cubic centimetres (cm^3)? **[1 m]**

ii) After melting down the ingots, the goldsmith uses all the gold to make 200 gold medals. What is the volume of gold in each medal? **[1 m]**

iii) Each gold medal is cylindrical. If a medal is 0.4 cm thick, find the radius of the medal. **[2 m]**



$(V = \pi r^2 h)$

Question 27 (Use a *separate* writing booklet)

(a) Peter is setting up a small manufacturing business where he plans to make and sell wooden bookshelves. In order to begin the business Peter needs to purchase some equipment which costs him \$600. Each shelf he makes takes him 3 hours to build and costs \$140 in materials. He then sells his bookshelves for \$200 each.

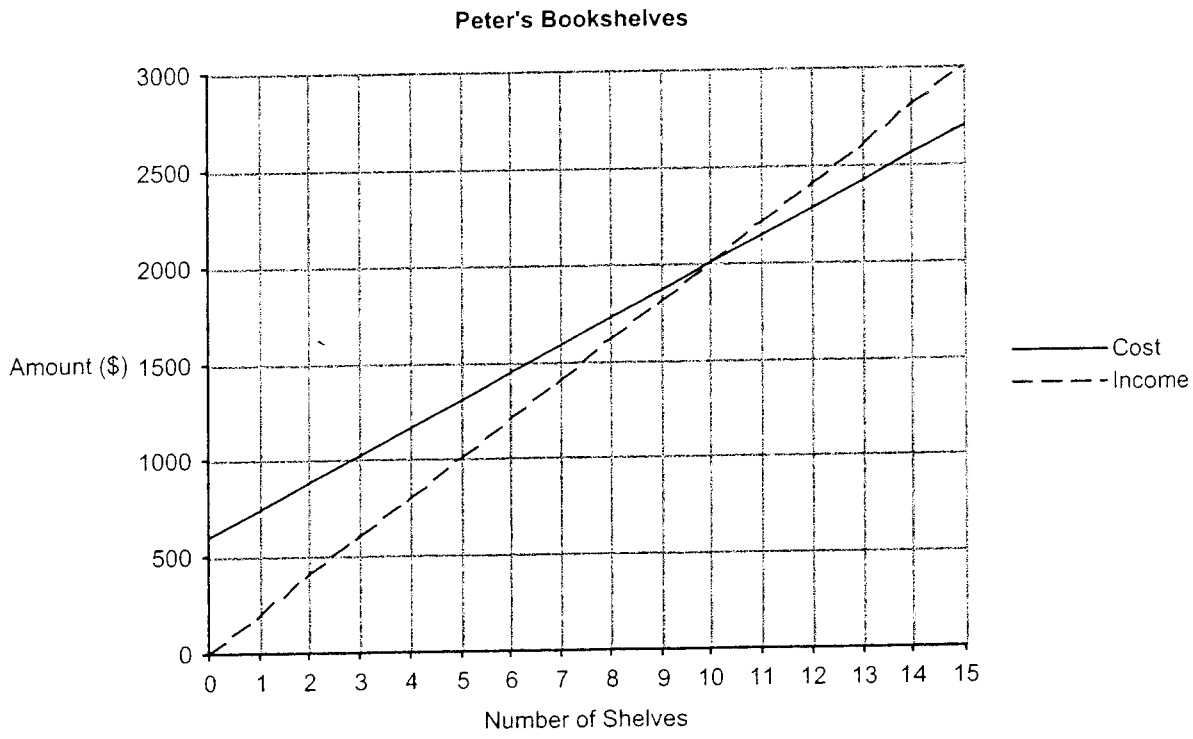
The cost (C) associated with the number of shelves (n) that Peter makes can be modelled by the equation:

$$C = 140n + 600$$

The Income (I) that Peter makes can be modelled by the equation:

$$I = 200n$$

The graphs of these equations are shown below:



(i) Explain the significance of the point where the two lines on the graph cross. [1 m]

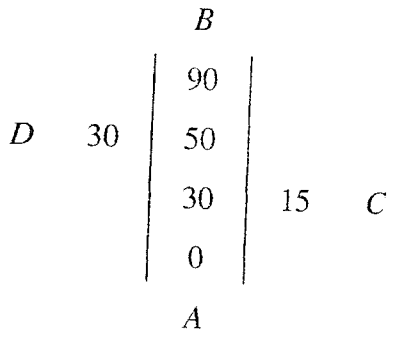
(ii) Write an expression for the profit, P, Peter makes. [2 m]

(iii) Calculate the profit he makes after completing 50 bookshelves. [1 m]

Question 27 (continued) **Marks**

(b) Simplify $\frac{ab^2}{w} \times \frac{4w}{3b}$ **[2 m]**

(c) Below is the surveyor's field diagram of a block of land.



(Measurements are in metres.)

i) Use this notebook entry to draw a neat sketch of the field. **[2 m]**

ii) Find the area of the field. **[2 m]**

(d) The Hall Family had a Garage Sale one weekend. One member of the family recorded the age and sex of the people who attended. This stem-and-leaf plot shows the results.

GARAGE SALE AGE AND GENDER SURVEY

Males							Females					
					2	0	4	5	5			
			8	6	4	1	2	5	5	7		
8	7	4	2	2	1	2	1	2	2	4	6	
			8	6	4	3	2	4				
						4	3	5	8			

(i) How many people attended? [1 m]

(ii) What was the age of the youngest person? [1 m]

(iii) What was the modal age of the group? [1 m]

(iv) Indicate which group, males or females, has the greater spread. Justify your answer with appropriate calculations and/or reasoning. [1 m]

Question 27 (continued)

(e)

Marks

Liliana wants to borrow money to buy a house. The bank sent her an email with the following table attached.

Monthly repayments

Amount borrowed	*Term of loan*				
	10 years	15 years	20 years	25 years	30 years
	120 months	180 months	240 months	300 months	360 months
$80 000	$970.62	$764.52	$669.15	$617.45	$587.01
$90 000	$1091.95	$860.09	$752.80	$694.63	$660.39
$100 000	$1213.28	$955.65	$836.44	$771.82	$733.76
$110 000	$1334.60	$1051.22	$920.08	$849.00	$807.14
$120 000	$1455.93	$1146.78	$1003.73	$926.18	$880.52
$130 000	$1577.26	$1242.35	$1087.37	$1003.36	$953.89
$140 000	$1698.59	$1337.91	$1171.02	$1080.54	$1027.27
$150 000	$1819.91	$1433.48	$1254.66	$1157.72	$1100.65
$160 000	$1941.24	$1529.04	$1338.30	$1234.91	$1174.02

(i) Liliana decides that she can afford $1000 per month on repayments. **1**

What is the maximum amount she can borrow, and how many years will she have to repay the loan?

(ii) Zali intends to borrow $160 000 over 15 years from the same bank. **2**

If she chooses to borrow $160 000 over 20 years instead, how much more interest will she pay?

Question 28 (Use a separate writing booklet) **Marks**

(a) The equation for the area of an annulus is $A = \pi(R^2 - r^2)$

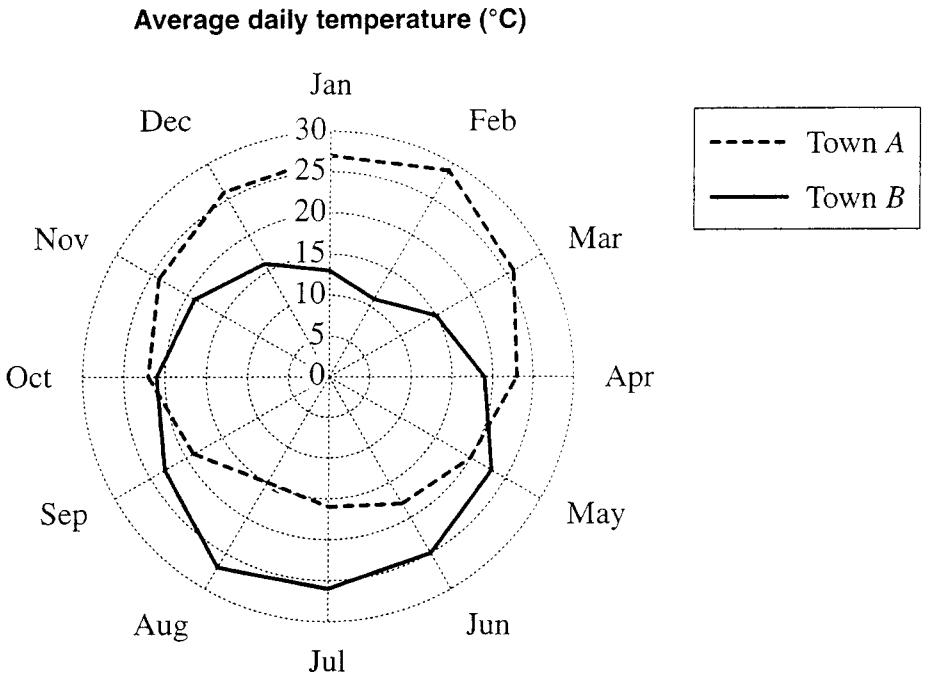
Where R is the radius of the outer circle and r the radius of the inner circle.

i) Rewrite the equation with r as the subject. **[2 m]**

ii) A concrete pipe, has an area of 216 cm² and a outer radius of 15 cm.

Calculate the inner radius of the pipe. **[2 m]**

(b) This radar chart was used to display the average daily temperatures each month for two different towns.



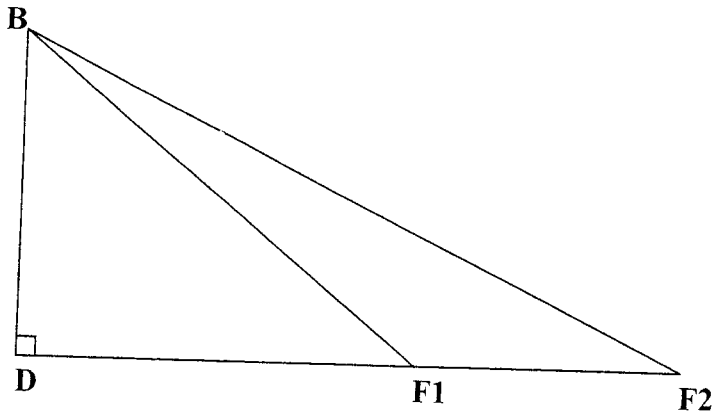
(i) What is the average daily temperature of Town B for April? [1 m]

(ii) In which month do the average daily temperatures of the two towns have the greatest difference? [1 m]

(iii) In which months is the average daily temperature in Town B higher than in Town A? [1 m]

Question 28 (continued)

(c) Bob the Builder is climbing the Sydney Harbour Bridge. When he is 72 metres above water level he notices two ferries **F1** and **F2** in line. From his position the angle of depression of **F1** is 23° while the angle of depression to **F2** is 12°.



(i) Copy the diagram into your booklet clearly showing all given information [1 m]

(ii) Find the distance between the ferries **F1** and **F2**, to the nearest metre. [2 m]

(d) Draw a box-and-whisker plot for the following set of data [2 m]

35, 35, 36, 36, 37, 38, 39, 39, 39, 40

Question 28 (continued) **Marks**

(e) Minh wants to buy a hi-fi system from Advanced Sound Systems for $5000.

(i) Minh considers buying the system on hire purchase. [3 m]

What would Minh repay monthly if he were to buy the hi-fi system on the following hire purchase terms?

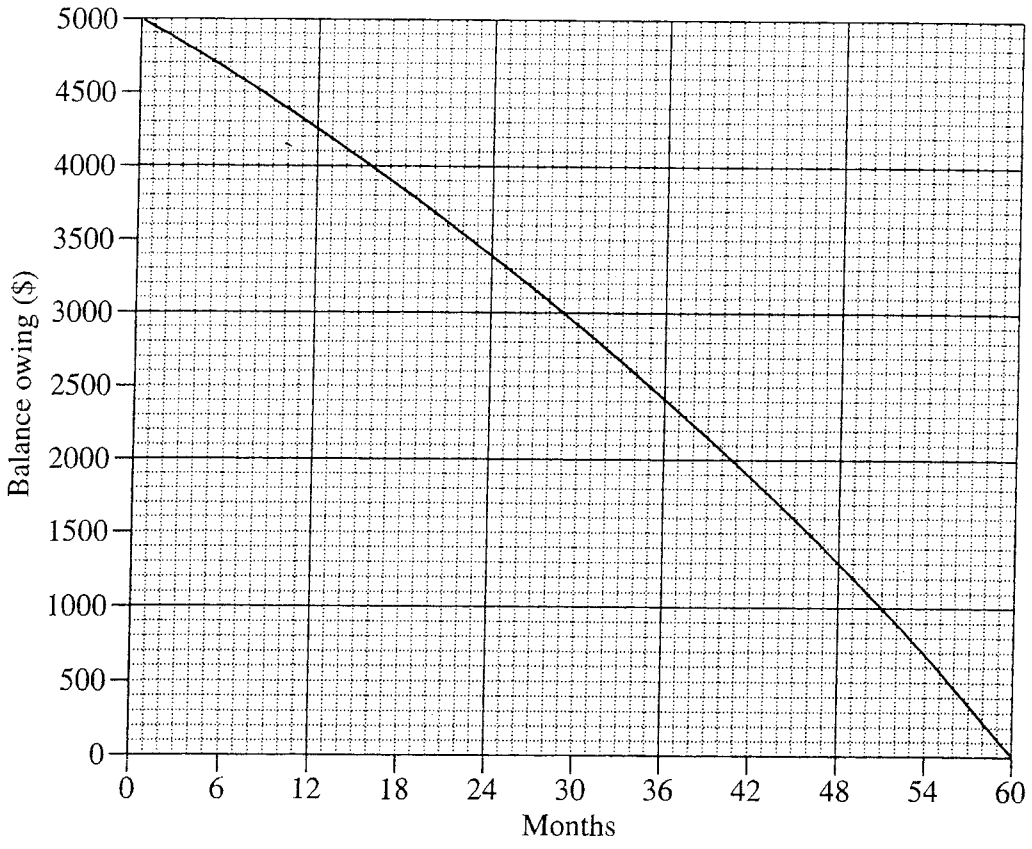
ADVANCED SOUND SYSTEMS
Hire Purchase Terms:
10% deposit
15% pa simple interest on the balance
Equal monthly repayments over 3 years

(ii) Minh decides instead to borrow the required $5000 from his local bank. The loan is a reducing balance loan over 5 years, with monthly repayments.

The graph shows the balance owing on the loan over time.

(1) Use the graph to determine the balance owing after 2 years. [1 m]

(2) Use the graph to determine when the loan is half-paid. [1 m]



END OF PAPER

General Mathematics

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

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

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:

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

Y11

Answers to 2009 General Mathematics Yearly

Section 1

(1) A (2) D

(3) C (4) C

(5) B (6) B

(7) B (8) A

(9) D (10) B

(11) C (12) A

(13) B (14) D

(15) D (16) C

(17) B (18) D

(19) C (20) B

(21) D (22) B

(23) A (24) B

(25) D

Section 2

Question 26

(a) i) $D = \frac{2A}{15}$. George is 9 months old., i.e., $A = 9$

$\Rightarrow D = \frac{2\times 9}{15} = 1.2$ mL. ✓

ii) If $D = 4$ mL, then $\frac{2A}{15} = 4$ ✓

$\Rightarrow A = 30$ (i.e., Sam is 30 months old) ✓

$\therefore$ Difference in ages is $30 - 9 = 21$ months. ✓

(b) $T = 2\pi L^2 \Rightarrow L^2 = \frac{T}{2\pi}$ ✓

$\Rightarrow L = \sqrt{\frac{T}{2\pi}}$. ✓

(c) i) $\cos\theta = \frac{85}{100} = 0.85$

$\Rightarrow \theta = 32^0$ (nearest degrees). ✓

ii) $h = 1.2 + 100\times\sin\theta$ ✓

h = 54.2 metres ✓

(d) i) $3(x - 2) = 5 - x$

$\therefore x = 11/4$ or $2\frac{3}{4}$ ✓✓

ii) $\frac{2x + 7}{3} = -1$

$2x + 7 = -3$ ✓

$\therefore x = -5$ ✓

(e) i) $V = 15\times(10\times 5\times 3) = 2,250\ \text{cm}^3$ ✓

ii) Volume of each gold medal $= \frac{2250}{200}$

$= 11.25\ \text{cm}^3$ ✓

Question 26 (continued)

iii) $\pi r^2 h = 11.25$ with $h = 0.4$ cm

$$r^2 = \frac{11.25}{0.4\pi} \Rightarrow r = \sqrt{\frac{11.25}{0.4\pi}} \checkmark$$

$$\therefore r \doteq 3cm \checkmark$$

Question 27

(a) i) At the point where two lines cross ($n = 10$), the Cost and the Income are equal, i.e., there's no gain nor loss. ✓

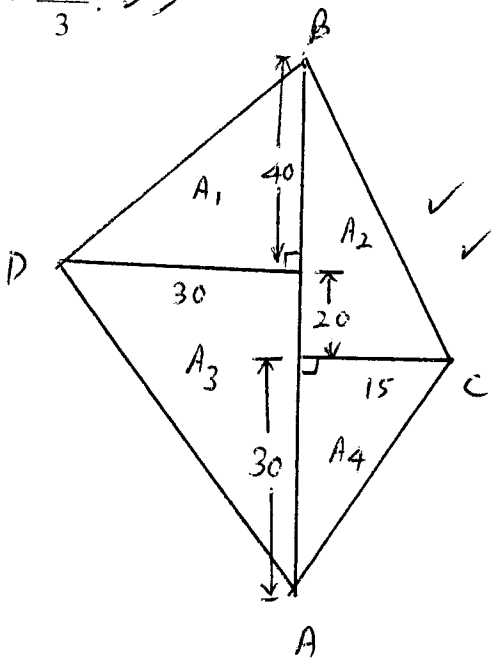
ii) $P = I - C = 200n - (140n + 600)$ ✓

$\therefore P = 60n - 600$. ✓

iii) $P = 60 \times 50 - 600 = \$\,2400$ ✓

(b) $\frac{ab^2}{w} \times \frac{4w}{3b} = \frac{4ab}{3}$. ✓✓

(c) i)



✓ ✓

ii) Area = $A_1 + A_2 + A_3 + A_4$

$= \frac{1}{2} \times (30 \times 40 + 60 \times 15 + 30 \times 50 + 30 \times 15)$ ✓

$= 2025$ m². ✓

(d) i) 30 people attending. ✓

ii) Youngest age = 2 y.o. ✓

iii) Modal age = 22 ✓

iv) With male group, the range of ages is $38 - 2 = 36$ years.

With female group, the range of ages is $48 - 4 = 44$ years. ✓

∴ Female group has greater spread

(e) i) Maximum amount Liliana can borrow is = \$ 130 000. She will have to repay in 30 years (360 months). ✓

ii) By borrowing \$160 000 over 20 years period, the total repayment is $240 \times \$1338.30 = \$321192$. ✓

By borrowing \$160 000 over 15 years period, the total repayment is $180 \times \$1529.04 = \$275\,227.20$

∴ Extra interest paid = \$ 321 192 - \$ 275 227.20 = \$ 45 964.80 ✓

Question 28

(a) i) $A = \pi(R^2 - r^2)$

$\therefore\ R^2 - r^2 = \dfrac{A}{\pi} \Rightarrow r^2 = R^2 - \dfrac{A}{\pi}$ ✓

$\therefore\ r = \sqrt{R^2 - \dfrac{A}{\pi}}$ ✓

ii) $r = \sqrt{15^2 - \dfrac{216}{\pi}}$ ✓

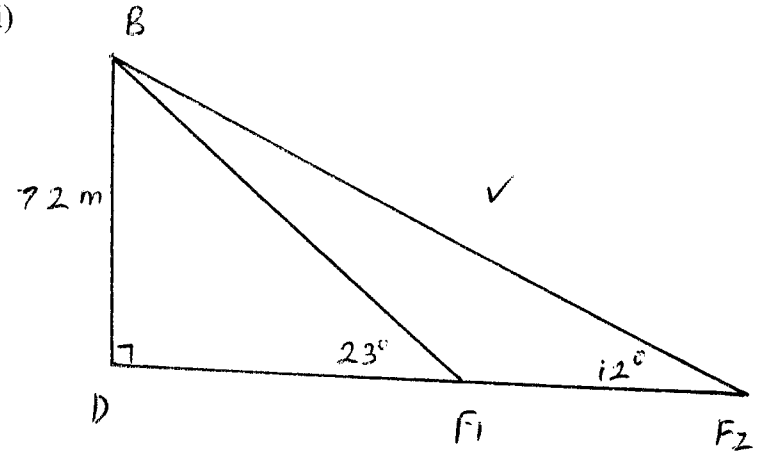
$r \doteq 12.5\ cm$ ✓

(b) i) Average temp. of Town B in April is 19°C. ✓

ii) Feb. will have the greatest difference in average temperatures. ✓

iii) Average temperatures in Town B > Average temperatures in Town A during May, June, July, August and September. ✓

(c) i)



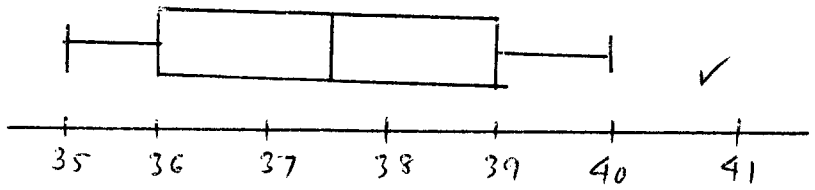
ii) $DF_2 = \dfrac{72}{\tan 12^0} \doteq 338.7m$ ✓

$DF_1 = \dfrac{72}{\tan 23^0} \doteq 169.6\,m$

$\therefore\ F_1F_2 = 338.7 - 169.6 = 169\ m$ ✓

(d) 35 35 36 36 37 38 39 39 39 40

$Q_1 = 36$ $Q_2 = 37.5$ $Q_3 = 39$ ✓



✓

(e) i) Deposit amount = \$5000 ×10% = \$ 500

$\therefore$ Balance = \$ 4 500 ✓

Balance + Interest = 4500 + 4500×15%×3 = \$ 6 525 ✓

$\therefore$ Monthly repayment = $\dfrac{\$6525}{36}$ = \$ 181.25 ✓

ii) (1) After 2 years, the balance is \$ 3 400. ✓

(2) After 35 months, the loan is half-paid. ✓