



St Stephen's School Carramar

SEMESTER 1 2007

Year 10 Mathematics Development: Section A

Name: SOLUTIONS

Teacher: S. Carjan

TIME ALLOWED FOR THIS PAPER

Reading time before commencing work: 5 minutes
Working time for paper: 75 minutes
Marks available 80 marks

MATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER

TO BE PROVIDED BY THE SUPERVISOR

Two Question Papers:	Section A – Questions 1 to 6	40 marks
	Section B – Questions 7 to 11	40 marks

TO BE PROVIDED BY THE CANDIDATE

Standard Items: pens, pencils, eraser, ruler

Special Items: Drawing instruments, templates and a maximum of 2 graphics calculators satisfying the conditions set by the Curriculum Council.
Two A4 size pages of notes.

INSTRUCTIONS TO CANDIDATES

All questions must be attempted to gain full marks.
All working should be completed with a blue pen and diagrams in pencil.
Marks are allocated for working so show ALL your working.
Enjoy, may you achieve mathematical XTC.

IMPORTANT NOTE TO CANDIDATES

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1. [6 marks]

MathXTC Insurance offers a discount of 5% on premiums for household insurance if the property owners belong to Neighbourhood Watch. A premium normally costs \$450.

- (a) How much would it cost to take out a premium if the property owner belonged to Neighbourhood Watch?

$$\begin{aligned}\text{Premium Cost} &= 0.95 \times 450 \\ &= \$427.50\end{aligned}$$

Next year MathXTC Insurance will be increasing the cost of insurance premiums by \$50.

- (b) Determine the percentage increases of insurance premiums for property owners belonging to Neighbourhood watch and for property owners who do not belong to Neighbourhood watch.

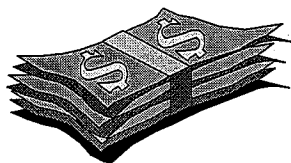
$$\% \text{ Premium Increase Not NW} = \frac{50}{450} \times \frac{100}{1} = 11.1\%$$

$$\% \text{ Premium Increase with NW} = \frac{50}{427.50} \times \frac{100}{1} \approx 11.696\%$$

2. [8 marks]

A bank offers various investment possibilities to a customer wishing to invest \$24,000 for 12 years. Calculate the final amount or balance for each of the following options:

- (a) Simple Interest at 13% p.a.
(b) Compound Interest at 12% calculated annually.
(c) Compound Interest at 10% calculated monthly
(d) Which investment would you recommend? Justify your answer.



$$\begin{aligned}\text{(a) Amount} &= 24000 + 0.13 \times 12 \times 24000 \\ &= \$61440\end{aligned}$$

$$\begin{aligned}\text{(b) Amount} &= 24000 (1.12)^{12} \\ &\approx \$93503.42\end{aligned}$$

$$\begin{aligned}\text{(c) Amount} &= 24000 \left(1 + \frac{0.1}{12}\right)^{144} \\ &\approx \$79287.58\end{aligned}$$

- (d) Recommend option (b), 12% compounded annually.
Greatest investment return.

3. [5 marks]

(a) $0.0000060876 = 6.0875 \times 10^n$, What is the value of n ? -6 ✓

(b) It is believed that the combination of the following conditions allows for total eclipses to occur :

Condition 1: The Sun's diameter is almost 400 times of the Moon,

(i) If the diameter of the Moon is 3.45×10^6 metres, what is the approximate diameter of the Sun?

$$1.38 \times 10^9 \text{ m} \quad \checkmark \checkmark$$

Condition 2: The distance from the Moon to the Earth is almost 400 times closer than the distance from the Earth to the Sun.

(ii) If the Earth is 1.946×10^{11} metres from the Sun, approximately how far is the Moon from the Earth?

$$4.865 \times 10^8 \text{ m} \quad \checkmark \checkmark$$

5

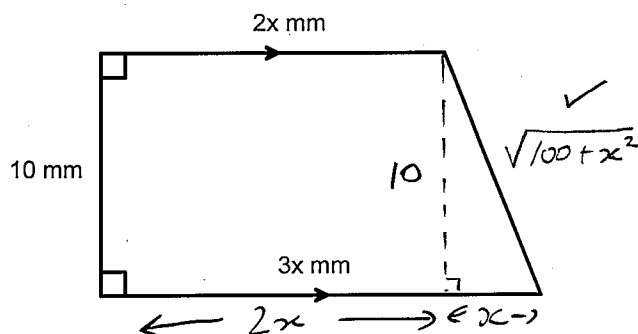
4. [5 marks]

Find the area and perimeter of the following shape expressed in terms of x mm or mm^2 .

$$\begin{aligned} \text{Area} &= \frac{10(2x+3x)}{2} \quad \checkmark \\ &= 25x \text{ mm}^2 \quad \checkmark \end{aligned}$$

$$\text{Perimeter} = 5x + 10 + \sqrt{100+x^2} \text{ mm} \quad \checkmark$$

✓ correct units.

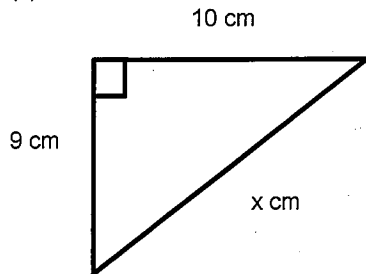


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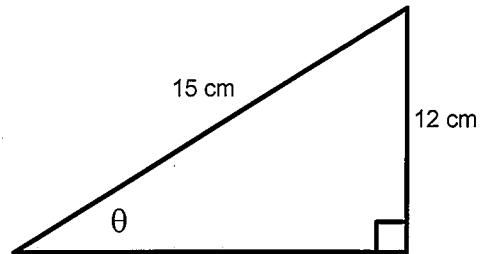
5. [8 marks]

Find the values of all the unknowns in the following triangles. (Answers accurate to 2 d.p.)
(Diagrams are not drawn to scale.)

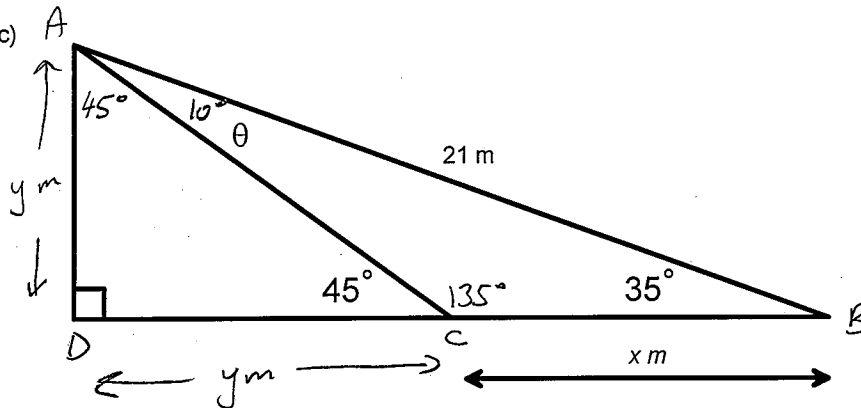
(a)



(b)



(c)



$$(a) \ x = \sqrt{100 + 81} \quad \checkmark$$

$$\approx \underline{13.45 \text{ cm}} \quad \checkmark$$

$$(b) \ \theta = \sin^{-1}\left(\frac{12}{15}\right) \quad \checkmark$$

$$\approx \underline{53.13^\circ} \quad \checkmark$$

$$(c) \ \theta = 10^\circ \quad \checkmark$$

$$\triangle ABC$$

$$\frac{x}{\sin 10^\circ} = \frac{21}{\sin 135^\circ}$$

$$\underline{x \approx 5.16 \text{ m}}$$

✓✓✓

or $\triangle ABD$

$$\sin 35^\circ = \frac{y}{21}$$

$$y \approx 12.045 \text{ m}$$

$$\cos 35^\circ = \frac{x + 12.045}{21}$$

$$x = 21 \cos 35^\circ - 12.045$$

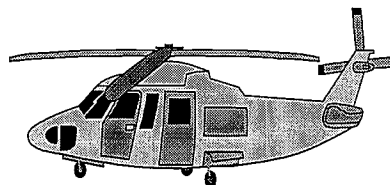
$$\approx \underline{5.16 \text{ m}}$$

8

6. [8 marks]

Two 'Sea Rescue' Radio Stations are located 120 km apart on the west coast of Australia near Exmouth. Station A is due north of Station B.

A ship sends an urgent distress message which is received by both stations.



Station A locates the ship on a bearing of 240° .

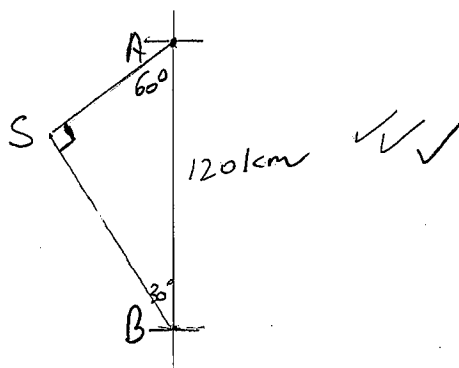
Station B locates the ship on a bearing of 330° .

~~Both~~ Both stations have a helicopter that travels at 110 km/h.

$$A = 110 \text{ km/h}$$

$$B = 200 \text{ km/h}$$

By drawing a diagram of the above situation and showing all calculations, which station should send their helicopter on the rescue mission?



$$\overline{AS} \approx 120 \sin 30^\circ \\ = 60 \text{ km} \checkmark$$

$$\overline{SB} = 120 \cos 30^\circ \\ \approx 103.92 \text{ km} \checkmark$$

$$\text{Time taken } \overline{AS} = \frac{60}{110} \approx 0.54 \text{ hours} \checkmark$$

$$\text{Time taken } \overline{SB} = \frac{103.92}{200} \approx 0.52 \text{ hours} \checkmark$$

$\therefore$ Station B should send the helicopter. $\checkmark$

30 - 40 6F
 20 - 29 5H
 15 - 19 5M
 11 - 14 5F
 5 - 10 4H
 0 - 4 4M



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Year 10 Mathematics Development: Section B

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7. [5 marks]

Transpose each of the following formulae to make x the subject:

(a) $y = \frac{w+x+z}{3}$

(b) $y = \sqrt{wxz} + 3$

$3y = w+x+z$ ✓

$\sqrt{wxz} = y-3$ ✓

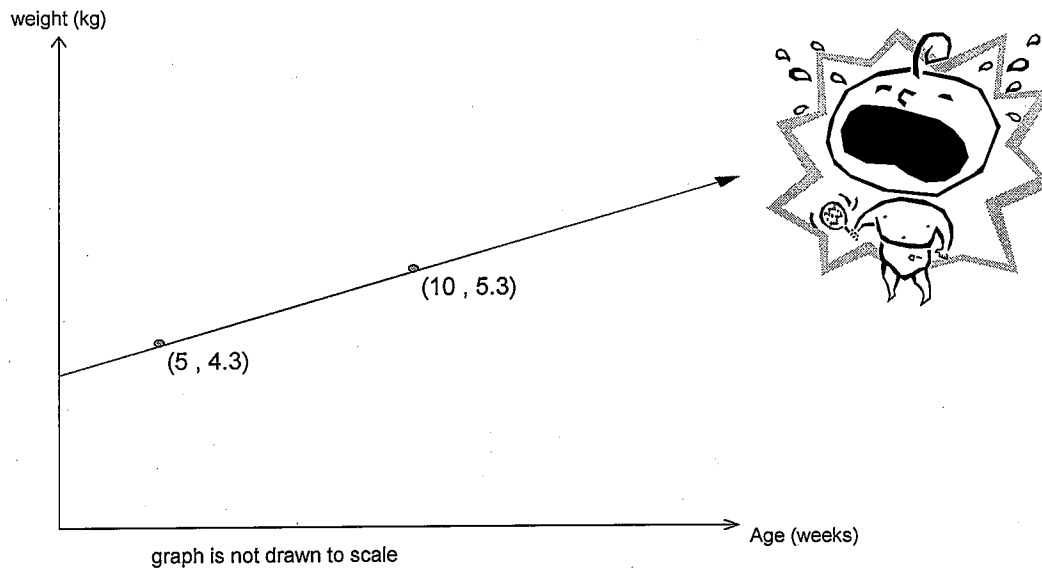
$x = 3y - w - z$ ✓

$wxz = (y-3)^2$ ✓

$x = \frac{(y-3)^2}{wz}$ ✓

8. [10 marks]

The following graph shows the increase in weight of the average Australian baby in the first few weeks of life.



(a) Find the gradient of the line.

$m = \frac{5.3-4.3}{10-5}$
 $= 0.2$ ✓

(b) Find the rule to describe the relationship of **Age (A) in weeks** and **Weight (W) in kilograms**.

$W = 0.2A + c$

$4.3 = 0.2 \times 5 + c$

$c = 3.3$

$W = 0.2A + 3.3$ ✓✓

- (c) Use your rule in (b) to find the average baby weight at birth.

$$3.3 \text{ kg} \checkmark$$

- (d) If a baby continued to grow at the same rate, what would the predicted weight at

- (i) one year

$$13.7 \text{ kg} \checkmark$$

- (ii) 10 years

$$107.3 \text{ kg} \checkmark$$

- (e) Does this make sense? What do you think is wrong?

One year yes, 10 years too big. $\checkmark$
 Growth rates must change as you get too old. $\checkmark$
 Not a linear relationship past the early years as a child. $\checkmark$

- (f) Some researchers do not agree with the above graph. Their model follows a straight line **parallel** to the above line and passes through the point (2, 4).

Find the equation of this line.

$$m = 0.2 \quad (2, 4)$$

$$(w - 4) = 0.2(A - 2)$$

$$w = 0.2A + 3.6 \quad \checkmark \checkmark$$

10

9. [5 marks]

The sum of three consecutive numbers is 2964.

- (a) Write the equation that best represents this situation.

$$n + (n+1) + (n+2) = 2964 \quad \checkmark \checkmark$$

- (b) Solve the equation to find the numbers.

$$3n = 2961 \quad \checkmark$$

$$n = 987 \quad \checkmark$$

numbers are 987, 988 and 989 $\checkmark$

15

10. [10 marks]

Simplify and express with **positive indices**:

(a) $\frac{m^0}{5^{-1}} = 5 \checkmark$

(b) $x^{\frac{1}{2}} \times x^{\frac{1}{2}} = x \checkmark$

(c) $(a^{-7} \times a^3)^{\frac{1}{2}}$
 $= (a^{-4})^{\frac{1}{2}} \checkmark$
 $= \frac{1}{a^2} \checkmark$

(d) $\frac{10p^5q^{-2} \times p^2q^3}{5p^4q^7 \times pq^{-4}}$
 $= \frac{2p^2}{q^2} \checkmark \checkmark \checkmark$

(e) $\left(\frac{5}{k}\right)^{-1} \div \left(\frac{5}{k^2}\right)^{-4}$
 $= \frac{k}{5} \div \left(\frac{5^{-4}}{k^{-8}}\right) \checkmark$
 $= \frac{k}{5} \times \frac{k^{-8}}{5^{-4}}$
 $= \frac{125}{k^7} \checkmark \checkmark$

11. [10 marks]

Two tourists, Jack and Jill, are staying at a hotel in Perth. They decided to visit Kings Park. Both set off for Kings Park a short time after breakfast was served at the hotel. Jack was the first one to leave and he decides to walk to Kings Park while Jill decides to ride a bicycle.

If t is the time in minutes after breakfast was served at the hotel, then the two tourists' distances, d , from the hotel in kilometres are given by the two equations:

$$4d = t - 30 \quad \text{and} \quad 12d = t - 10$$

$$d = \frac{1}{4}t - 7.5 \quad d = \frac{t-10}{12}$$

Plot each of these equations as graphs on your graphics calculator.

(a) Which equation belongs to Jack?

Write a brief sentence why you chose that equation.

Jack is $12d = t - 10$, smaller gradient because walking is slower than riding. ✓✓

(b) How long after breakfast was served did Jill leave the hotel?

$$4d = t - 30, \quad d = \frac{1}{4}t - 7.5$$

$$\Rightarrow (d=0) \quad 0 = \frac{1}{4}t - 7.5$$

$$\therefore t = 30 \text{ mins} \quad \checkmark$$



(c) If the hotel is 5 kilometres from Kings Park,

(i) Find out the time taken by each tourist to arrive at Kings Park

Jill (30 mins)

$$20 = t - 30$$

$$t = 50 \quad \checkmark$$

$\Rightarrow$ Jill took

20 mins ✓

Jack (10 mins)

$$60 = t - 10$$

$$= 70$$

$\Rightarrow$ Jack took 60 mins ✓

(ii) State the values of t and d that fit both equations (ie point of intersection) and explain what this tells us.

$$t = 40, \quad d = 2.5 \quad \checkmark$$

At 40 mins after breakfast was served they were both half way towards reaching Kings Park. ✓