Trinity Grammar School

Mathematics Department

2014

HALF-YEARLY EXAMINATION

PRELIMINARY ASSESSMENT TASK 3

Year 11

Mathematics Extension 1

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using **black** or **blue** pen
- Only approved calculators for this course are allowed in this task.

- Show all necessary working
- Write your **Name** and your **Class teacher** on the question paper and on any answer sheets or writing booklets used to write your responses to the questions submitted.
- If you do not attempt a question you must submit an answer sheet or writing booklet for that question clearly indicating **N/A** and your Name.

- **Preliminary Assessment Weighting:** 30%

(Year 12 only)

Class Teacher:

……

Name:
(Year 11 only)

……

Do NOT write solutions on this question paper. Any working on this question paper will NOT be marked.

Date of examination:

Wednesday, 7 May 2014

Total marks – 70

Section I

10 marks

- Attempt all Questions
- Allow about **20** minutes for this section

Section II

60 marks

- Attempt all Questions
- Allow about **1** hours **40** minutes for this section

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Section I 10 marks

- Attempt Questions 1 – 10.
- Allow about 20 minutes for this section.
- Shade the correct response on the multiple-choice answer sheet for Questions 1 – 10.
- Each question is worth 1 mark.

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1 What is $\frac{1+\sqrt{3}}{5-2\sqrt{3}}$ as a fraction with a rational denominator?

(A) $\frac{-5-\sqrt{3}}{7}$

(B) $\frac{-5+\sqrt{3}}{13}$

(C) $\frac{11-7\sqrt{3}}{7}$

(D) $\frac{11+7\sqrt{3}}{13}$

2 Simplify $\frac{x^3-1}{x^2-1}\times\frac{x^2-4x-5}{4x^2+4x+4}$

(A) $\frac{(x-5)}{4}$

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

(C) $\frac{(x+1)}{4}$

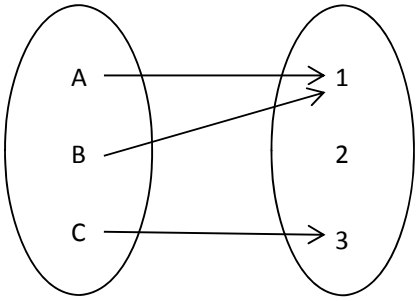
(D) $\frac{(x^2+x+1)}{4}$

3 What is the solution to the equation $81^{x+1}=\sqrt{3^x}$?

(A) $x=1\frac{1}{7}$ (B) $x=-1\frac{1}{7}$ (A) $x=\frac{1}{4}$ (A) $x=-\frac{1}{4}$

4 Consider the relations below.

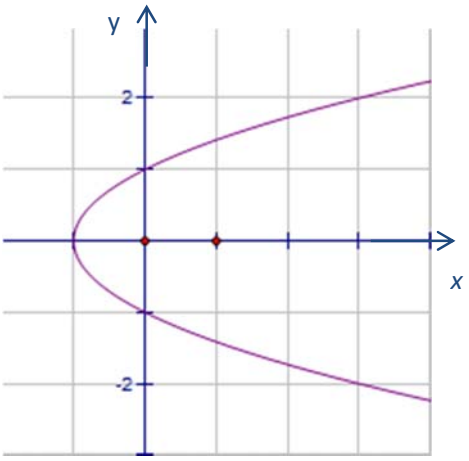
(i) Mapping:



(ii) Table:

Name	Ed	Carol	Peter	Don	Ed
Eye colour	Brown	Green	Blue	Brown	Grey

(iii) Graph:



Which of the following statements is true?

(A) Only relation (i) is a function
(B) Relation (i) and (iii) are functions
(C) All three relations above are functions
(D) None of the relations above are functions.

5 How many solutions are there to the equation $\sin\theta = \frac{1}{2}$ in the domain $0^0 \le \theta \le 720^0$?

(A) 1 solution
(B) 2 solutions
(C) 4 solutions
(D) 8 solutions

6 What is the value of ab if the lines $ax + 2y = 6$ and $4y = bx - 9$ are perpendicular?

(A) $-\frac{1}{2}$ (B) $\frac{1}{4}$
(C) -8 (D) 8

7 What is the solution to the inequality $\frac{3}{x-2} \le 4$?

(A) $x < -2$ and $x \ge -\frac{11}{4}$
(B) $x > -2$ and $x \le -\frac{11}{4}$
(C) $x < 2$ and $x \ge \frac{11}{4}$
(D) $x > 2$ and $x \le \frac{11}{4}$

8 What is the acute angle between the lines $\sqrt{3}x - y = 1$ and $y = 0$?

(A) 15^0
(B) 30^0
(C) 45^0
(D) 60^0

9 What are the coordinates of the point that divides the interval joining the points $A(7,1)$ and $B(0,-6)$ **internally** in the ratio 4:3?

(A) $(3,-3)$

(B) $(3,-2)$

(C) $(4,-2)$

(D) $(4,-3)$

10 Point A is due south of a hill and the angle of elevation from A to the top of the hill is 35º. Another point B is on a bearing of 200º from the hill and the angle of elevation from B to the top of the hill is 46º. The distance AB is 220 m.

If the point O is at the base of the hill, and the hill has a height h metres, which of the following are the correct expressions for OA and OB?

(A) $OA = \dfrac{\tan 35^\circ}{h}$ and $OB = \dfrac{\tan 46^\circ}{h}$

(B) $OA = \dfrac{h}{\tan 35^\circ}$ and $OB = \dfrac{h}{\tan 46^\circ}$

(C) $OA = h\tan 35^\circ$ and $OB = h\tan 46^\circ$

(D) $OA = 220\tan 35^\circ$ and $OB = 220\tan 46^\circ$

End of Section I

Section II commences on the next page

Section II 60 marks

- Attempt **Questions 11 – 14**
- Allow about 1 hour and 40 minutes for this section
- Answer each question in a SEPARATE writing booklet or answer sheet. Extra writing booklets are available.
- In Questions 11 – 14, your responses should include all relevant mathematical reasoning and/or calculations.

Question 11 (15 marks) Use a SEPARATE writing booklet **Marks**

(a) Write $(1+\sqrt{5})^3$ in the form $a+b\sqrt{5}$, where a and b are integers. **2**

(b) Factorise $\frac{25}{x^2}-\frac{a^2}{b^2}$. **2**

(c) Solve $3(x-1)=\frac{4}{x+1}-5$. **2**

(d) Increase the product of $(8x-5)$ and $(2x-7)$ by $(4x-1)$. **2**

(e) Simplify $\frac{4m^{-2}n}{(nm^2)^2}\times\frac{mn^{-1}}{(2mn)^3}$. **2**

(f) Simplify $\frac{5}{x^2-4}-\frac{3}{x-2}-\frac{2}{x+2}$. **2**

(g) Solve the simultaneous equations: **3**

$$a+b+c=0$$
$$a-b+c=-4$$
$$2a-3b-c=-1$$

Question 12 (15 marks) Use a SEPARATE writing booklet **Marks**

(a) If $f(x) = x^4 - 2x^2 - x$, ***show*** whether the function is odd, even or neither. **2**

(b) Consider the piecemeal function $f(x) = \begin{cases} x+1, & if\ x < 0 \\ 1-x^2, & if\ 0 \le x \le 1 \\ \sqrt{x-1}, & if\ x \ge 1 \end{cases}$. **3**

Find: (i) $f(-1)$

(ii) $f(2)$

(iii) Sketch $y = f(x)$ for $-1 \le x \le 2$.

(c) State the domain **and** range of the function $y = \sqrt{4+x^2}$. **2**

(d) Find the equation of the line passing through the point (-1,2) and perpendicular to the line $x - 2y + 2 = 0$. **3**

(e) Graph the region bounded by the inequations $x + y \le 0$ and $y \ge 2^x$. **2**

(f) Show that the line $3x - 4y + 12 = 0$ does **not** touch or cut the circle $x^2 + y^2 = 1$. **3**

Question 13 (15 marks) Use a SEPARATE writing booklet **Marks**

(a) Simplify $\dfrac{\cos\theta}{1+\cos\theta}+\dfrac{\sin^2\theta}{(1+\cos\theta)^2}$ as far as possible. **2**

(b) Find the **exact** value of $\sec(-60^0)\sin(120^0)\cos(240^0)$. **2**

(c) Solve $2\cos\theta+\sqrt{3}=0$ for $0^0\le\theta\le360^0$. **2**

(d) Prove $\cot\theta+\tan\theta=\operatorname{cosec}\theta\sec\theta$. **2**

(e) Find the area of a triangle with sides of 6 cm, 7 cm and 8 cm correct to one decimal place. **3**

(f) A ship leaves port *A* and sails 50 nautical miles due east to a port *B*.

It then proceeds a distance of 20 nautical miles at a bearing of 160^0 T to a port *C*.

(i) Find the distance of *C* from *A* to the nearest nautical mile. **2**

(ii) Find the bearing of *C* from *A* to the nearest degree. **2**

Question 14 (15 marks) Use a SEPARATE writing booklet **Marks**

(a) (i) Sketch the graph of $y = |2x-1|$. **1**

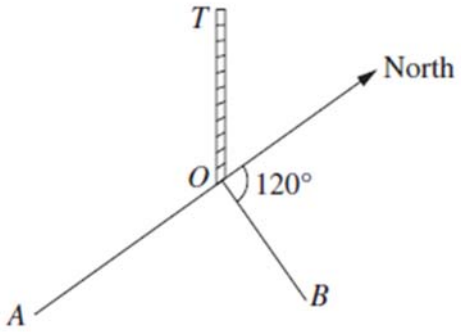
(ii) Hence, or otherwise, solve $|2x-1| \le |x-3|$. **3**

(b) The acute angle between the lines $y = 3x+5$ and $y = mx+4$ is 45^0. **2**
Find the **two** possible values of m.

(c) Make x the subject of the formula $\frac{m}{n} = \frac{x-x_1}{x_2-x}$. **3**

(d) Let *A* be the point (3,-1) and *B* be the point (9,2). Find the coordinates of the point *P* **2**
which divides the interval *AB* **externally** in the ratio 5:2.

(e) From a point *A* due south of a tower, the angle of elevation of the top of the tower *T*, is 23^0.
From another point *B*, on a bearing of 120^0 from the tower, the angle of elevation of *T* is 32^0.
The distance *AB* is 200 metres.



(i) Copy or trace the diagram, adding the given information to your diagram. **1**

(ii) Show that the height (*h*) of the tower is given by **3**

$$h = \sqrt{\frac{40\,000}{\cot^2 23^0 + \cot^2 32^0 - \cot 23^0 \cot 32^0}}.$$

End of Section II
End of Examination

Trinity Grammar School
Mathematics Department
2014
Year 11 Mathematics Extension 1
HALF-YEARLY EXAMINATION

Preliminary Assessment Task 3
Section I
Multiple Choice Answer Sheet

NSW Board of Studies Student Number
(Year 12 only)

Name: SOLUTIONS
(Year 11 only)

Class Teacher: KESBY

- Write your answers for **Section I** on this answer sheet.
- ***Shade completely only ONE answer for each question.***
- To change an answer, erase your previous mark completely and then record your new answer.

1	A	B	C	●
2	●	B	C	D
3	A	●	C	D
4	●	B	C	D
5	A	B	●	D
6	A	B	C	●
7	A	B	●	D
8	A	B	C	●
9	●	B	C	D
10	A	●	C	D

Q1. (D)

$$\frac{1+\sqrt{3}}{5-2\sqrt{3}} = \frac{(1+\sqrt{3})}{5-2\sqrt{3}} \times \frac{(5+2\sqrt{3})}{5+2\sqrt{3}}$$

$$= \frac{5 + 2\sqrt{3} + 5\sqrt{3} + 2\times 3}{25 - 12}$$

$$= \frac{11 + 7\sqrt{3}}{13}.$$

$(2\sqrt{3})^2 = 4\times 3 = 12$

Q2. (A)

$$\frac{x^3-1}{x^2-1} \times \frac{x^2-4x-5}{4x^2+4x+4} = \frac{(x-1)(x^2+x+1)}{(x-1)(x+1)} \times \frac{(x-5)(x+1)}{4(x^2+x+1)}$$

$$= \frac{x-5}{4}.$$

Q3. (B)

$$(81)^{x+1} = \sqrt{3^x}$$

$$(3^4)^{x+1} = (3^x)^{\frac{1}{2}}$$

$$3^{4x+4} = 3^{\frac{x}{2}}$$

$$4x+4 = \frac{x}{2}$$

$$8x+8 = x$$

$$7x+8 = 0$$

$$7x = -8$$

$$x = -\frac{8}{7}.$$

$$x = -1\frac{1}{7}.$$

Q4. (A)

(i) Function ✓

(ii) Not a function ✗ * (Ed, Brown) & (Ed, Grey)

(iii) Not a function ✗ * Does not satisfy the vertical line test.

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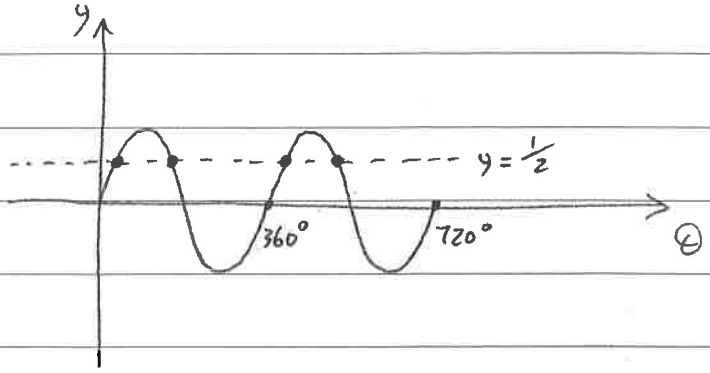
Q5. Consider $y = \sin\theta$

(c) 4 solutions



Q6. (D)

$ax + 2y = 6$

$2y = -ax + 6$

$y = \frac{-a}{2}x + 3$

$m_1 = \frac{-a}{2}$.

$4y = bx - 9$

$y = \frac{b}{4}x - \frac{9}{4}$

$m_2 = \frac{b}{4}$.

For perpendicular lines $m_1 \times m_2 = -1$

$-\frac{a}{2} \times \frac{b}{4} = -1$

$-\frac{ab}{8} = -1$

$\frac{ab}{8} = 1$

$ab = 8$.

Q7. (C)

$(x-2)^2 \times \frac{3}{(x-2)} \leq 4(x-2)^2 \quad (x \neq 2)$

$3(x-2) \leq 4(x-2)^2$

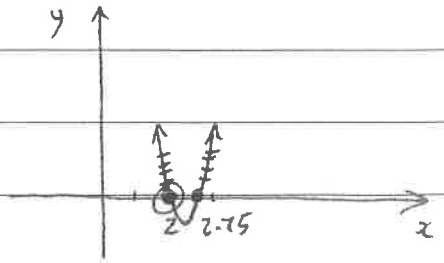
$0 \leq 4(x-2)^2 - 3(x-2)$

$4(x-2)^2 - 3(x-2) \geqslant 0$

$(x-2)(4(x-2)-3) \geqslant 0$

$(x-2)(4x-11) \geqslant 0$

Solution is $x < 2$ and $x \geqslant \frac{11}{4}$.



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Q8. (D)

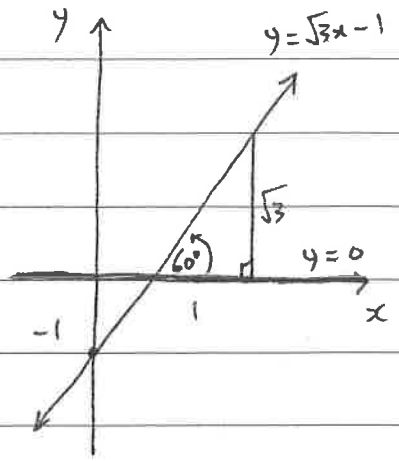
$\sqrt{3}x - y = 1$

$\sqrt{3}x = y + 1$

$\sqrt{3}x - 1 = y$

$y = \sqrt{3}x - 1$

$m_1 = \sqrt{3}.$



$m_1 = \tan\theta$

$\sqrt{3} = \tan\theta$

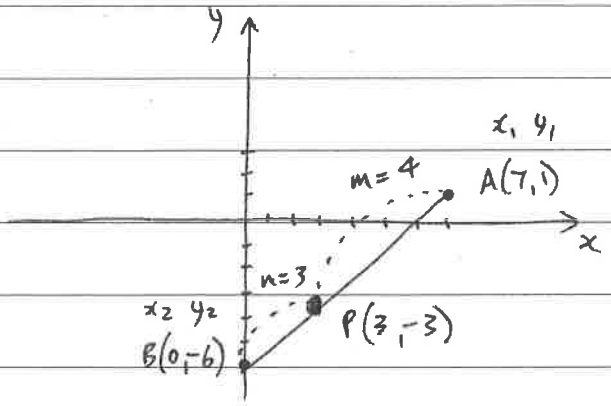
$\tan\theta = \sqrt{3}$

$\theta = \tan^{-1}(\sqrt{3})$

$\theta = 60°$

E* Q9. (A)

$m:n = 4:3$



$$x = \frac{mx_2 + nx_1}{m+n}$$

$$x = \frac{4(0) + 3(7)}{4+3}$$

$$x = \frac{0 + 21}{7}$$

$$x = 3.$$

$$y = \frac{my_2 + ny_1}{m+n}$$

$$y = \frac{4(-6) + 3(1)}{4+3}$$

$$y = \frac{-24 + 3}{7}$$

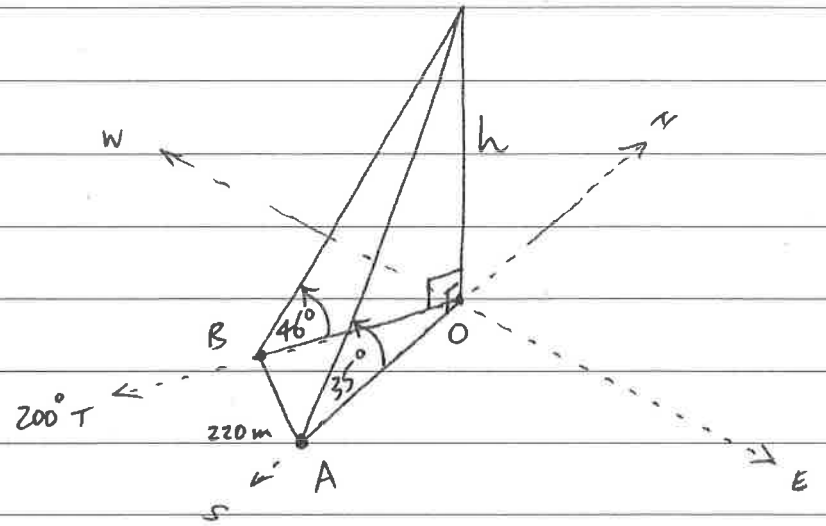
$$y = -3$$

$\therefore P(3, -3)$

Tick this box if you have continued this answer in another booklet.

Do NOT write anything, or make any marks below this line or outside borders

E* Q10. (B)



$\tan 35° = \frac{h}{OA}$ $\tan 46° = \frac{h}{OB}$

$OA \times \tan 35° = h$ $OB \times \tan 46° = h$

$OA = \frac{h}{\tan 35°}$ $OB = \frac{h}{\tan 46°}$

Do NOT write anything, or make any marks below this line or outside borders

(11) (a) $(1+\sqrt{5})^3 = (1+\sqrt{5})^2 \times (1+\sqrt{5})$

$= (1 + 2\sqrt{5} + 5)(1 + \sqrt{5})$

$= (2\sqrt{5} + 6)(1 + \sqrt{5})$ (1)

$= 2\sqrt{5} + 2\sqrt{5}\times\sqrt{5} + 6 + 6\sqrt{5}$

$= 2\sqrt{5} + 10 + 6 + 6\sqrt{5}$

$= 16 + 8\sqrt{5}$. (1)

(b) $\frac{25}{x^2} - \frac{a^2}{b^2} = \left(\frac{5}{x}\right)^2 - \left(\frac{a}{b}\right)^2$ (1)

$= \left(\frac{5}{x} + \frac{a}{b}\right)\left(\frac{5}{x} - \frac{a}{b}\right)$. (1)

(c) $3(x-1) = \frac{4}{(x+1)} - 5$

$3(x-1)(x+1) = 4 - 5(x+1)$

$3(x^2-1) = 4 - 5x - 5$

$3x^2 - 3 = -5x - 1$

$3x^2 + 5x - 2 = 0$ (1)

$(3x - 1)(x + 2) = 0$

$\therefore x = \frac{1}{3}, -2$. (1)

(d) $(8x-5)(2x-7) + (4x-1) = 16x^2 - 56x - 10x + 35 + 4x - 1$ (1)

$= 16x^2 - 62x + 34$. (1)

(e) $\frac{4m^{-2}n}{(nm^2)^2} \times \frac{mn^{-1}}{(2mn)^3} = \frac{4 \times m^{-2} \times m^1 \times n^1 \times n^{-1}}{n^2 \times m^4 \times 8 \times m^3 \times n^3}$

$= \frac{4 \times m^{-1}}{8 \times m^7 \times n^5}$ (1)

$= \frac{1}{2} \times \frac{1}{m^8} \times \frac{1}{n^5} = \frac{1}{2m^8n^5}$. (1)

Do NOT write anything, or make any marks below this line or outside borders

(11) (f) $\dfrac{5}{x^2-4} - \dfrac{3}{x-2} - \dfrac{2}{x+2} = \dfrac{5-3(x+2)-2(x-2)}{(x+2)(x-2)}$ (1)

$= \dfrac{5-3x-6-2x+4}{(x+2)(x-2)}$

$= \dfrac{-5x+3}{(x+2)(x-2)}$. (1)

(11) (g) $a+b+c=0$ — (1)

$a-b+c=-4$ — (2)

$2a-3b-c=-1$ — (3)

(1) − (2): $b-(-b) = 0-(-4)$

$2b = 4$

$b = 2$ (1)

(2) + (3) $3a-4b = -5$

Subst. $b=2$ $3a-4(2) = -5$

$3a-8 = -5$

$3a = 3$

$a = 1$ (1)

Subst. $a=1$ & $b=2$ into (1): $1+2+c=0$

$3+c=0$

$c=-3$ (1)

$\therefore$ $a=1$, $b=2$ & $c=-3$.

Do NOT write anything, or make any marks below this line or outside borders

(12) (a) $f(-x) = (-x)^4 - 2(-x)^2 - (-x)$

$= x^4 - 2x^2 + x$

$\neq x^4 - 2x^2 - x$ (1)

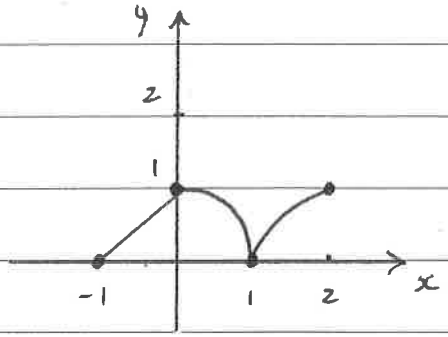
$\neq -(x^4 - 2x^2 - x)$

ie. $f(-x) \neq f(x)$ and $f(-x) \neq -f(x)$

$\therefore$ function is <u>neither</u> even nor odd. (1)

(b) $f(-1) = -1 + 1 = 0$.

$f(2) = \sqrt{2-1} = \sqrt{1} = 1$. } (1)

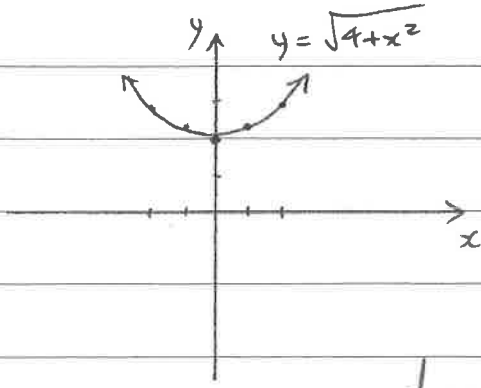


(2)

(c) <u>y-intercept</u> : $x = 0$, $y = \sqrt{4+(0)^2}$

$y = \sqrt{4}$

$y = 2$ $(0, 2)$



x	0	1	2
y	2	$\sqrt{5}$	$\sqrt{8}$

<u>domain</u> : all real x (1)

<u>range</u> : $y \geq 2$ (1)

(d) $x - 2y + 2 = 0$

$x + 2 = 2y$

$2y = x + 2$

$y = \frac{1}{2}x + 1$

$m_1 = \frac{1}{2}$

$m_2 = -2$ ①

x_1, y_1

$(-1, 2)$ $m_2 = -2$

$y - y_1 = m_2(x - x_1)$

$y - 2 = -2(x - (-1))$ ①

$y - 2 = -2(x + 1)$

$y - 2 = -2x - 2$

$\boxed{y = -2x}$ ①

(e) Consider $x + y = 0$

$y = -x$

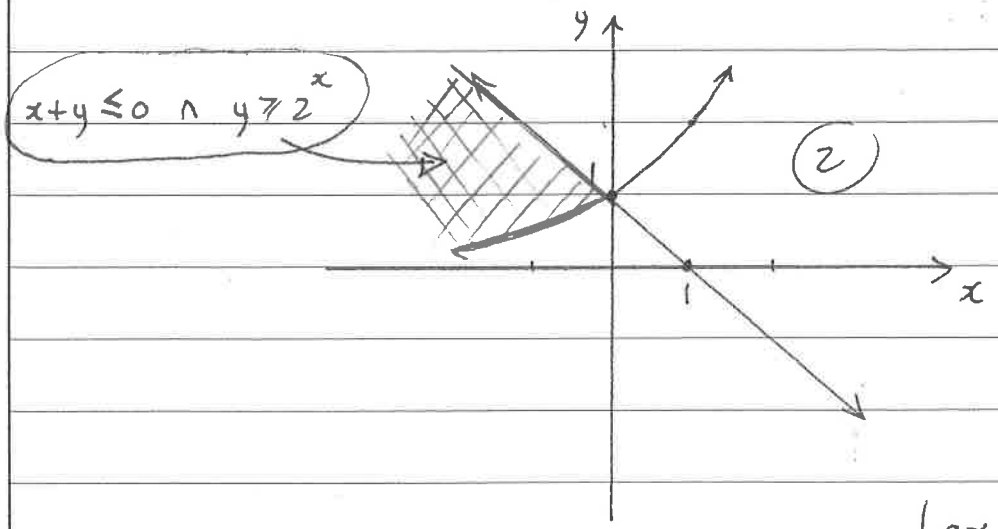
$y = 2^x$

Test $(0,0)$: $y \geq 2^x$

$0 \geq 2^0$

$0 \geq 1$

False.



$x + y \leq 0 \wedge y \geq 2^x$ ②

Test $(0,0)$: $x + y \leq 0$

$0 + 0 \leq 0$

True.

(f) $3x - 4y + 12 = 0$

$a = 3$

$b = -4$

$c = 12$

x_1, y_1

$(0, 0)$

$x^2 + y^2 = 1$

Circle, centre $(0,0)$

radius = 1 unit

$d = \dfrac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$

$d = \dfrac{|3(0) + (-4)(0) + 12|}{\sqrt{(3)^2 + (-4)^2}}$ ①

$d = \dfrac{12}{\sqrt{25}}$

$d = \frac{12}{5} = 2.4$ ①

Now, $d >$ radius $\therefore$ line does not touch or cut circle. ①

Do NOT write anything, or make any marks below this line or outside borders

(13) (a) $\dfrac{\cos\theta}{1+\cos\theta} + \dfrac{\sin^2\theta}{(1+\cos\theta)^2} = \dfrac{\cos\theta(1+\cos\theta)+\sin^2\theta}{(1+\cos\theta)^2}$ (1)

$= \dfrac{\cos\theta + \cos^2\theta + \sin^2\theta}{(1+\cos\theta)^2}$

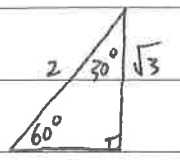
$= \dfrac{\cos\theta + 1}{(\cos\theta+1)^2}$

$= \dfrac{1}{\cos\theta + 1}$. (1)

(b) $\sec(-60^\circ) = \dfrac{1}{\cos(-60^\circ)} = \dfrac{1}{\cos 300^\circ} = \dfrac{1}{\cos 60^\circ} = \dfrac{1}{(\frac{1}{2})} = 2.$

$\sin(120^\circ) = \sin 60^\circ = \dfrac{\sqrt{3}}{2}.$

$\cos(240^\circ) = -\cos 60^\circ = -\dfrac{1}{2}.$ (1)



$\therefore \sec(-60^\circ) \times \sin(120^\circ) \times \cos(240^\circ) = 2 \times \dfrac{\sqrt{3}}{2} \times -\dfrac{1}{2}$

$= -\dfrac{\sqrt{3}}{2}.$ (1)

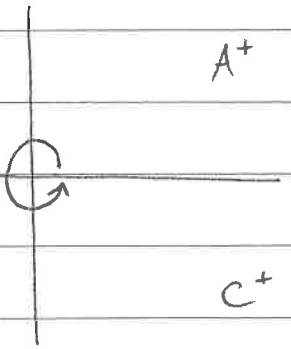
$\cos 60^\circ = \dfrac{1}{2}$

(c) $2\cos\theta = -\sqrt{3}$

$\cos\theta = \dfrac{-\sqrt{3}}{2}$

$\theta = 180^\circ - 30^\circ, 180^\circ + 30^\circ$

$\theta = 150^\circ, 210^\circ$ (1) (1)



(base angle = 30°)

(d) L.H.S. $= \cot\theta + \tan\theta$

$= \dfrac{\cos\theta}{\sin\theta} + \dfrac{\sin\theta}{\cos\theta}$

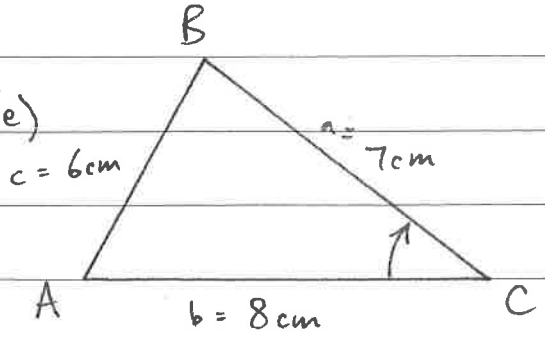
$= \dfrac{\cos^2\theta + \sin^2\theta}{\sin\theta.\cos\theta}$

$= \dfrac{1}{\sin\theta\cos\theta}$ (2)

$= \dfrac{1}{\sin\theta} \times \dfrac{1}{\cos\theta} = \operatorname{cosec}\theta.\sec\theta =$ R.H.S.

Do NOT write anything, or make any marks below this line or outside borders

(13) (e)



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

$A = \frac{1}{2} \times 7 \times 8 \times \sin(46.56746344...)$ (1)

$A = 20.33316257...$

Area = $20.3\ cm^2$ (1d.p.) (1)

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

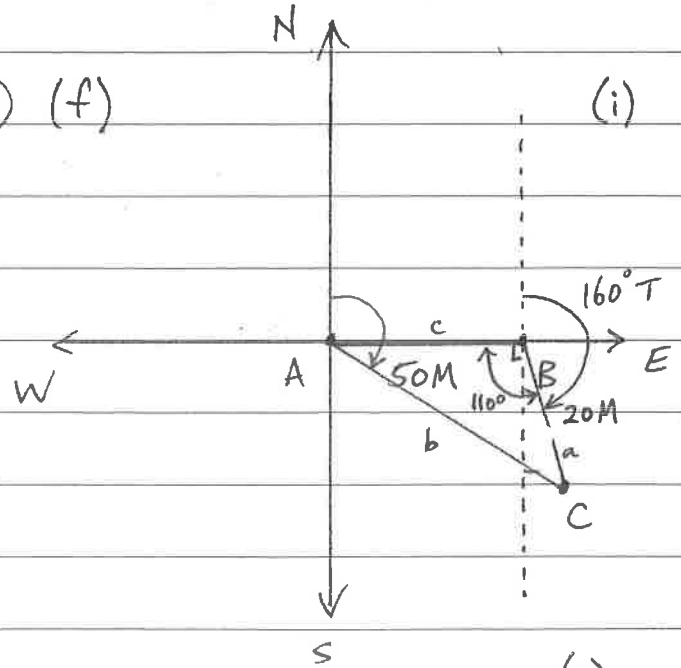
$$\cos C = \frac{7^2 + 8^2 - 6^2}{2(7)(8)}$$

$\cos C = 0.6875$

$\angle C = \cos^{-1}(0.6875)$

$\angle C = 46.56746344...$ (1)

(13) (f)



(i) $b^2 = a^2 + c^2 - 2ac\cos B$

$b^2 = 20^2 + 50^2 - 2(20)(50).\cos 110^\circ$ (1)

$b^2 = 3584.040287...$

$b = 59.86685466...$

AC = 60 nautical miles (1)

(ii) $\frac{\sin A}{20} = \frac{\sin 110^\circ}{60}$

$\sin A = \frac{20\sin 110^\circ}{60}$ (1)

$\sin A = 0.3132...$

$\angle A = 18^\circ$ (nearest degree)

$\therefore$ bearing of C from A is 108° T. (1)

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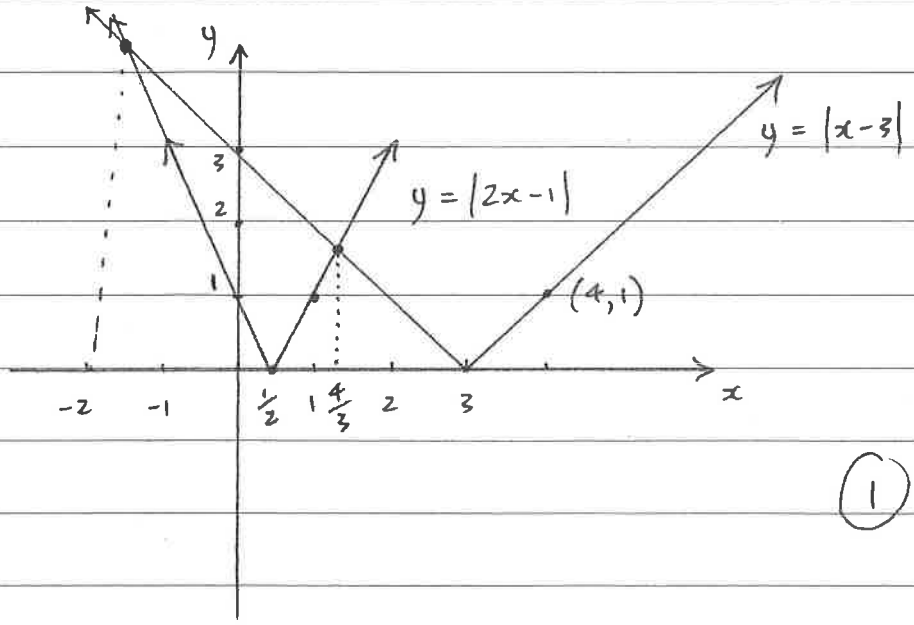
(14) (a) (i)



(1)

(a) (ii) Consider $|2x-1| = |x-3|$

$2x-1 = x-3$ OR $2x-1 = -(x-3)$

$\underline{x = -2}$ (1) $2x-1 = -x+3$

$3x = 4$

$\underline{x = \frac{4}{3}}$ (1)

$\therefore$ from the graph,

$|2x-1| \leq |x-3|$ for $\boxed{-2 \leq x \leq \frac{4}{3}}$ (1)

(14) (b) $y = 3x+5$ $y = mx+4$ $\theta = 45°$

$m_1 = 3$ $m_2 = m$

$$\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 . m_2}\right|$$

$$\tan 45° = \left|\frac{3 - m}{1 + 3m}\right|$$

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Now, $\frac{3-m}{1+3m} = 1$ or $\frac{3-m}{1+3m} = -1$

$1+3m = 3-m$ $\quad -(1+3m) = 3-m$

$4m = 2$ $\quad -1-3m = 3-m$

$m = \frac{1}{2}$ (1) $\quad -2m = 4$

$m = -2$ (1)

(14) (c) $\frac{m}{n} = \frac{x-x_1}{x_2-x}$

$m(x_2-x) = n(x-x_1)$ (1)

$mx_2 - mx = nx - nx_1$

$mx_2 + nx_1 = mx + nx$ (1)

$mx_2 + nx_1 = x(m+n)$

$\frac{mx_2+nx_1}{m+n} = x$

$\therefore x = \frac{mx_2+nx_1}{m+n}$ (1)

(14) (d) $A(3,-1)$ $B(9,2)$ $m:n = 5:-2$

$x_1\ y_1$ $\quad x_2\ y_2$

$x = \frac{mx_2+nx_1}{m+n}$ $\quad y = \frac{my_2+ny_1}{m+n}$

$x = \frac{5(9)+(-2)(3)}{5+(-2)}$ $\quad y = \frac{5(2)+(-2)(-1)}{5+(-2)}$

$x = \frac{45-6}{3}$ $\quad y = \frac{10+2}{3}$

$x = 13$ $\quad y = 4$

(1) (1)

$\therefore P(13,4)$

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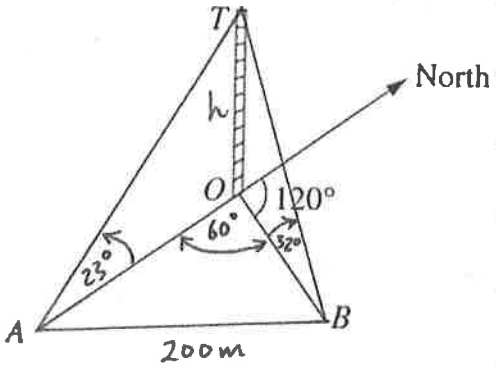
14 (e) (i)



(1)

(e) (ii) Let TO = h metres

In ΔAOT, $\tan 23^\circ = \frac{h}{AO}$

$\therefore AO = \frac{h}{\tan 23^\circ}$.

In ΔBOT, $\tan 32^\circ = \frac{h}{BO}$

$\therefore BO = \frac{h}{\tan 32^\circ}$ (1)

Note that $\angle AOB = 60^\circ$.

Using the cosine rule,

$AB^2 = AO^2 + BO^2 - 2(AO)(BO)\cos 60^\circ$ ½

$200^2 = \left(\frac{h}{\tan 23^\circ}\right)^2 + \left(\frac{h}{\tan 32^\circ}\right)^2 - 2\left(\frac{h}{\tan 23^\circ}\right)\left(\frac{h}{\tan 32^\circ}\right)\cos 60^\circ$ ½ (1)

$\therefore 40\,000 = \frac{h^2}{\tan^2 23^\circ} + \frac{h^2}{\tan^2 32^\circ} - \frac{h}{\tan 23^\circ} \times \frac{h}{\tan 32^\circ}$

$\therefore 40\,000 = h^2\left[\frac{1}{\tan^2 23^\circ} + \frac{1}{\tan^2 32^\circ} - \frac{1}{\tan 23^\circ \times \tan 32^\circ}\right]$

so, $h^2 = \frac{40\,000}{\left[\frac{1}{\tan^2 23^\circ} + \frac{1}{\tan^2 32^\circ} - \frac{1}{\tan 23^\circ} \times \frac{1}{\tan 32^\circ}\right]}$ (1)

$\therefore h = \sqrt{\frac{40\,000}{\cot^2 23^\circ + \cot^2 32^\circ - \cot 23^\circ \cot 32^\circ}}$.

☐ ← Tick this box if you have continued this answer in another booklet.