NAME MASTER

SYDNEY GRAMMAR SCHOOL

2017 Half-Yearly Examination

FORM V

MATHEMATICS 2 UNIT

Tuesday 16th May 2017

General Instructions

- Writing time — 1 hour 30 minutes
- Write using black pen.
- Board-approved calculators and templates may be used.

Total — 80 Marks

- All questions may be attempted.

Section I – 8 Marks

- Questions 1–8 are of equal value.
- Record your answers to the multiple choice on the sheet provided.

Section II – 72 Marks

- Questions 9–14 are of equal value.
- All necessary working should be shown.
- Start each question in a new booklet.

Collection

- Write your name, class and Master on each answer booklet and on your multiple choice answer sheet.
- Hand in the booklets in a single well-ordered pile.
- Hand in a booklet for each question in Section II, even if it has not been attempted.
- If you use a second booklet for a question, place it inside the first.
- Write your name, class and Master on this question paper and hand it in with your answers.
- Place everything inside the answer booklet for Question Nine.

5A: RCF	5B: SO	5C: BR	5D: REJ
5E: LYL	5F: LJF	5G: SDP	5H: CMDB
5P: BDD	5Q: LL	5R: TCW	

Checklist

- SGS booklets — 6 per boy
- Multiple choice answer sheet
- Candidature — 190 boys

Examiner

SDP

SECTION I - Multiple Choice

Answers for this section should be recorded on the separate answer sheet handed out with this examination paper.

QUESTION ONE

The expression $\frac{x}{2} + \frac{x}{3}$ simplifies to which of the following?

(A) $\frac{2x}{5}$

(B) $\frac{x^2}{6}$

(C) $\frac{5x}{6}$

(D) $\frac{2x}{6}$

QUESTION TWO

Which of the following is NOT equal to $\sqrt{24}$?

(A) $2\sqrt{6}$

(B) $\sqrt{12} \times \sqrt{2}$

(C) $\frac{1}{2}\sqrt{48}$

(D) $2\sqrt{3} \times \sqrt{2}$

QUESTION THREE

What is the natural domain of the function $f(x) = \frac{1}{x+5}$?

(A) all real values of x, where $x \neq 5$

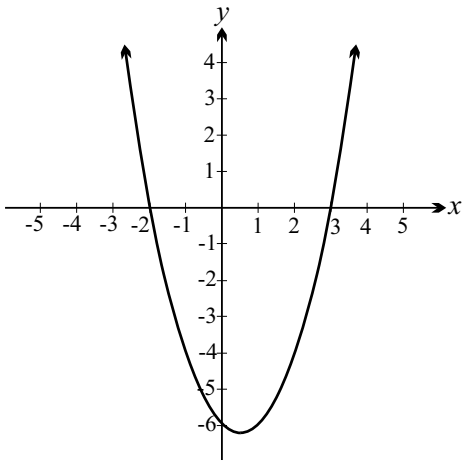
(B) all real values of x, where $x \neq -5$

(C) all real values of x, where $x < 5$

(D) all real values of x, where $x > 5$

Examination continues next page ...

QUESTION FOUR



The above diagram shows the graph of $y = (x-3)(x+2)$.

Which of the following is the correct solution to the inequation $(x-3)(x+2) < 0$?

(A) $x > 3$ or $x < -2$

(B) $x > 2$ or $x < -3$

(C) $-2 < x < 3$

(D) $-3 < x < 2$

QUESTION FIVE

Which of the following is the exact value of $\text{cosec}(-60^\circ)$?

(A) $-\dfrac{2\sqrt{3}}{3}$

(B) $\dfrac{2\sqrt{3}}{3}$

(C) 2

(D) -2

Examination continues overleaf ...

QUESTION SIX

What is the perpendicular distance between the point $(3, 5)$ and the line $3x - y + 2 = 0$?

(A) $\dfrac{8\sqrt{34}}{17}$

(B) $\dfrac{3\sqrt{34}}{17}$

(C) $\dfrac{8\sqrt{10}}{5}$

(D) $\dfrac{3\sqrt{10}}{5}$

QUESTION SEVEN

Which of the following is the correct factorisation of $54x^3 + 2y^3$?

(A) $2(3x - y)(9x^2 + 3xy + y^2)$

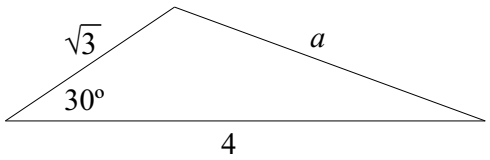
(B) $2(3x + y)(9x^2 - 3xy + y^2)$

(C) $2(3x - y)(3x + 3xy + y)$

(D) $2(3x + y)(3x - 3xy + y)$

QUESTION EIGHT

Which of the following is the correct value of a?



(A) $\sqrt{31}$

(B) $\sqrt{13}$

(C) $\sqrt{7}$

(D) 1

End of Section I

Examination continues next page ...

SECTION II - Written Response

Answers for this section should be recorded in the booklets provided.

Show all necessary working.

Start a new booklet for each question.

QUESTION NINE (12 marks) Use a separate writing booklet. **Marks**

(a) Evaluate $\left|2\right| - \left|-3 \times 4\right|$. **1**

(b) Factorise fully:

(i) $x^2 + 3x - 10$ **1**

(ii) $9x^2 - 16$ **1**

(c) Express $\dfrac{12}{3 - \sqrt{6}}$ as a fraction with a rational denominator. **2**

(d) Find the x-intercept of the line $y = 3x - 6$. **1**

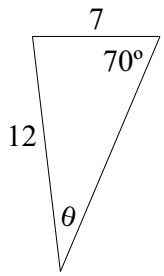
(e) Find the acute angle θ, given that $\cos\theta = \dfrac{\sqrt{3}}{2}$. **1**

(f) Expand and simplify $(x - 3)(x^2 + 3x + 9)$. **1**

(g) (i) Find the midpoint M of the interval joining the point $(4, 2)$ and the origin. **1**

(ii) Hence find the equation of the line through the point M with gradient 3. **1**

(h)



Find the value of θ in the diagram above, correct to the nearest degree. **2**

Examination continues overleaf ...

QUESTION TEN (12 marks) Use a separate writing booklet. **Marks**

(a) Find $f(2)$ when $f(x) = \dfrac{2}{\sqrt{x^2+12}}$. **1**

(b) (i) Write down the domain of $y = \log_2 x$. **1**

(ii) Write down the range of $y = \log_2 x$. **1**

(c) Solve the following:

(i) $3 \leq 2x + 1 \leq 7$ **1**

(ii) $|x - 2| = 10$ **2**

(d) Find the equation of the line which is parallel to $y = 2x - 5$ and passes through the point $(1, 5)$. Give your answer in general form. **2**

(e) (i) Complete the square for $f(x) = x^2 + 10x + 17$. **1**

(ii) Hence solve $f(x) = 0$. Leave your answers in exact form. **1**

(f) Solve $\cos x = \dfrac{1}{2}$ for $0^\circ \leq x \leq 360^\circ$. **2**

QUESTION ELEVEN (12 marks) Use a separate writing booklet. **Marks**

(a) Describe the transformation of the circle $x^2 + y^2 = 16$ to the circle $(x+3)^2 + (y-2)^2 = 16$. **1**

(b) Simplify $\sqrt{8} + \sqrt{25} + \sqrt{50}$. **1**

(c) Simplify $\dfrac{x^2 + 5x + 6}{2x + 4}$. **2**

(d) Find the coordinates of the vertex of $y = x^2 - 4x - 32$. **2**

(e) Solve $-x^2 - 2x + 15 \geq 0$. **2**

(f) Prove $\dfrac{\sin x}{\cos x} + \dfrac{\cos x}{\sin x} = \operatorname{cosec} x \sec x$. **2**

(g) Determine whether or not the following lines are concurrent: **2**

$$l_1 : y = 2x + 4 \qquad l_2 : y = x + 14 \qquad l_3 : y = 3x - 6$$

Clearly show your working.

Examination continues next page ...

QUESTION TWELVE (12 marks) Use a separate writing booklet. **Marks**

(a) Solve $x = \dfrac{1+4x}{x}$. Leave your answer in exact form. **2**

(b) Find the value of m such that $\dfrac{2}{\sqrt{3}-\sqrt{2}} = m(\sqrt{2}+\sqrt{3})$. **2**

(c) (i) Solve $|x-2| < 22$. **2**

(ii) Show your solution on a number line. **1**

(d) (i) Fully factorise $x^3 - 7x^2 + 10x$. **2**

(ii) Hence solve $x^3 - 7x^2 + 10x = 0$. **1**

(iii) Sketch the curve $y = x^3 - 7x^2 + 10x$, showing any intercepts with the axes. **2**

QUESTION THIRTEEN (12 marks) Use a separate writing booklet. **Marks**

(a) Simplify $\dfrac{6x-30}{3x^2-75} \div \dfrac{1}{4x+20}$. **2**

(b) (i) Sketch $y = \sqrt{9-x^2}$, showing any intercepts with the axes. **2**

(ii) Write down the domain of this function. **1**

(iii) Write down the range of this function. **1**

(c) In $\triangle ABC$, $\angle BAC = 30°$, $\angle BCA = \theta$, length $AB = 4\sqrt{2}\,\text{cm}$ and length $BC = 4\,\text{cm}$. Find the two possible values of θ. **3**

(d) Find the equation of the perpendicular bisector of the line joining the points $(2, 10)$ and $(8, 0)$. Give your answer in gradient–intercept form. **3**

Examination continues overleaf ...

QUESTION FOURTEEN (12 marks) Use a separate writing booklet. **Marks**

(a) Determine whether $f(x) = x(x^2 - 4)$ is odd, even or neither. **1**

(b) (i) Sketch $y = 2^x$, showing any intercepts with the axes and any asymptotes. **1**

(ii) Hence sketch $y = -2^x + 2$ and find the x-intercept. **2**

(c) (i) Accurately sketch $y = 2|x + 2|$ and $y = x + 5$ on the same set of axes. **1**

(ii) Write down the coordinates of any points of intersection. **1**

(iii) Hence or otherwise, solve $2|x + 2| < x + 5$. **1**

(d) Prove $\operatorname{cosec} x - \sin x = \cot x \cos x$. **2**

(e) If $\sqrt{15} = ap^2 + b$ and $p = \dfrac{1}{\sqrt{3}} + \dfrac{1}{\sqrt{5}}$, find the values of a and b, where a and b are rational numbers. **3**

End of Section II

END OF EXAMINATION

NAME: .....

CLASS: .....MASTER: .....

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- Record your multiple choice answers by filling in the circle corresponding to your choice for each question.
- Fill in the circle completely.
- Each question has only one correct answer.

Question One

A ○ B ○ C ○ D ○

Question Two

A ○ B ○ C ○ D ○

Question Three

A ○ B ○ C ○ D ○

Question Four

A ○ B ○ C ○ D ○

Question Five

A ○ B ○ C ○ D ○

Question Six

A ○ B ○ C ○ D ○

Question Seven

A ○ B ○ C ○ D ○

Question Eight

A ○ B ○ C ○ D ○

Solutions Form V 2 Unit Half-Yearly 2017

Multiple Choice

1) $\frac{x}{2} + \frac{x}{3} = \frac{3x}{6} + \frac{2x}{6}$

$= \frac{5x}{6}$ (C) ✓

2) A → $2\sqrt{6} = \sqrt{4} \times \sqrt{6}$

$= \sqrt{24}$ ✓

B → $\sqrt{12} \times \sqrt{2} = \sqrt{24}$ ✓

C → $\frac{1}{2}\sqrt{48} = \sqrt{\frac{1}{4}} \times \sqrt{48}$

$= \sqrt{12}$ ✗

(C) ✓

D → $2\sqrt{3} \times \sqrt{2} = \sqrt{4} \times \sqrt{3} \times \sqrt{2}$

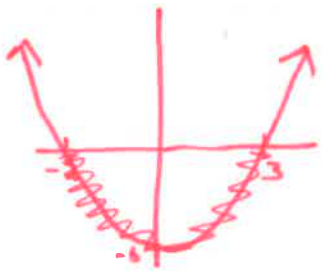
$= \sqrt{24}$ ✓

3) Denominator cannot equal 0. So $x+5 \neq 0$

$x \neq -5$ (B) ✓

4) $(x-3)(x+2) < 0$

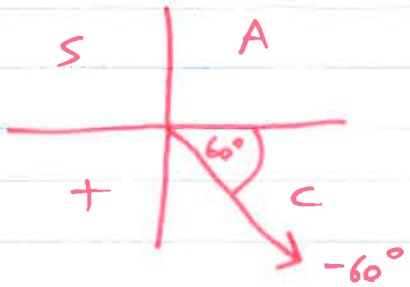
as less than zero, solutions lie under x-axis



← WANT

so $-2 < x < 3$ (C) ✓

5) $\operatorname{cosec}(-60) = \frac{1}{\sin(-60)}$



related angle $= 60°$

negative sin quadrant

so $\sin(-60) = -\sin(60)$

$= -\frac{\sqrt{3}}{2}$

so $\operatorname{cosec}(-60) = \frac{1}{-\frac{\sqrt{3}}{2}}$

$= -\frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= -\frac{2\sqrt{3}}{3}$

(A) ✓

6) perp. distance $= \frac{|ax_1 + by_1 + c|}{\sqrt{a^2+b^2}}$

$x_1 = 3$ $\quad a = 3$

$y_1 = 5$ $\quad b = -1$

$c = 2$

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

$= \frac{|9 - 5 + 2|}{\sqrt{9+1}}$

$= \frac{|6|}{\sqrt{10}}$

$= \frac{6}{\sqrt{10}} \times \frac{\sqrt{10}}{\sqrt{10}}$

$= \frac{6\sqrt{10}}{10} = \frac{3\sqrt{10}}{5}$

(D) ✓

7) $54x^3 + 2y^3 = 2(27x^3 + y^3)$

$= 2((3x)^3 + y^3)$

$= 2(3x + y)((3x)^2 - (3x)(y) + y^2)$

$= 2(3x + y)(9x^2 - 3xy + y^2)$ (B) ✓

8) cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

$a^2 = (\sqrt{3})^2 + 4^2 - 2 \times \sqrt{3} \times 4 \times \cos 30$

$= 19 - 8\sqrt{3} \times \frac{\sqrt{3}}{2}$

$= 19 - 12$

$a^2 = 7$

so $a = \sqrt{7}$ (C) ✓

Question 9

a) $|21 - 1 - 3 \times 4| = |21 - 1 - 12|$

$= 2 - 12$

$= -10$ ✓

bi) $x^2 + 3x - 10 = (x + 5)(x - 2)$ ✓

ii) $9x^2 - 16 = (3x + 4)(3x - 4)$ ✓

c) $\frac{12}{3 - \sqrt{6}} \times \frac{3 + \sqrt{6}}{3 + \sqrt{6}}$ ✓ $= \frac{36 + 12\sqrt{6}}{9 - 6}$

$= \frac{36 + 12\sqrt{6}}{3}$

$= 12 + 4\sqrt{6}$ ✓

8d) x-intercept when $y = 0$

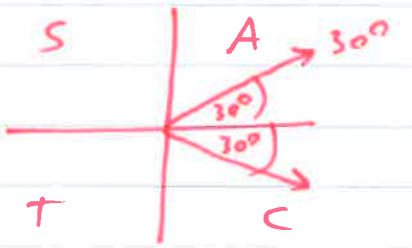
so $0 = 3x - 6$

$3x = 6$

$x = 2$ ✓ allow (2, 0)

e) $\cos\theta = \frac{\sqrt{3}}{2}$

related angle $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right) = 30°$



positive and acute angle so $\theta = 30°$ ✓

f) $(x-3)(x^2+3x+9) = x^3 - 27$ ✓

g i) (4, 2) and (0, 0) $M = \left(\frac{4+0}{2}, \frac{2+0}{2}\right)$

$M = (2, 1)$ ✓

ii) $y - y_1 = m(x - x_1)$

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

$y - 1 = 3x - 6$

$y = 3x - 5$ ✓ allow $3x - y - 5 = 0$

h) use sin rule $\frac{\sin\theta}{7} = \frac{\sin 70}{12}$ ✓ or similar

$\sin\theta = \frac{7\sin 70}{12}$

$\theta = \sin^{-1}\left(\frac{7\sin 70}{12}\right)$

$\theta = 33°$ (nearest degree) ✓

Question 10

a) $f(2) = \frac{2}{\sqrt{2^2+12}}$

$= \frac{2}{\sqrt{4+12}}$

$= \frac{2}{\sqrt{16}}$

$= \frac{2}{4}$

$= \frac{1}{2}$ ✓

bi) cannot put negatives into a log

so all real values of x, where $x > 0$ ✓

ii) can get any value out of logs

so all real values of y ✓

ci) $3 \leq 2x + 1 \leq 7$

$2 \leq 2x \leq 6$

$1 \leq x \leq 3$ ✓

ii) $|x-2| = 10$

$x - 2 = 10$ or $-(x-2) = 10$

$x = 12$ $x - 2 = -10$

$x = -8$

$x = 12$ ✓ or $x = -8$ ✓

10d) parallel so gradient = 2 ✓

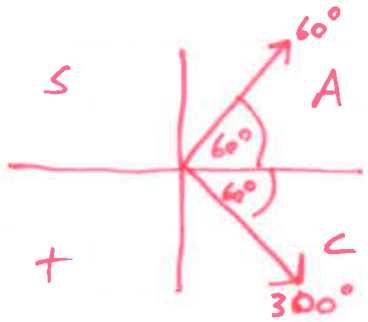
$$y - 5 = 2(x - 1)$$
$$y - 5 = 2x - 2$$
$$y = 2x + 3$$
$$2x - y + 3 = 0$$ ✓

e i) $g(x) = x^2 + 10x + 17$
$= (x + 5)^2 - 25 + 17$
$= (x + 5)^2 - 8$ ✓

ii) $0 = (x + 5)^2 - 8$
$8 = (x + 5)^2$
$x + 5 = \sqrt{8}$ or $x + 5 = -\sqrt{8}$
$x + 5 = 2\sqrt{2}$ $x + 5 = -2\sqrt{2}$
$x = -5 + 2\sqrt{2}$ $x = -5 - 2\sqrt{2}$ ✓ both

allow $x = -5 \pm \sqrt{8}$

f) $\cos x = \frac{1}{2}$
related angle $x = \cos^{-1}(\frac{1}{2})$
$= 60°$ ✓



so $x = 60°$ or $300°$ ✓

Question 11

a) Shift left 3
Shift up 2 ✓ both

b) $\sqrt{8} + \sqrt{25} + \sqrt{50} = 2\sqrt{2} + 5 + 5\sqrt{2}$
$= 5 + 7\sqrt{2}$ ✓

c) $\frac{x^2 + 5x + 6}{2x + 4} = \frac{(x+2)(x+3)}{2(x+2)}$ ✓ factorise top

$= \frac{x+3}{2}$ ✓

d) $y = x^2 - 4x - 32$

vertex $x = -\frac{b}{2a}$

$x = -\frac{(-4)}{2\times 1}$

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

$x = 2$ ✓

when $x = 2$, $y = 2^2 - 4\times 2 - 32$

$y = 4 - 8 - 32$

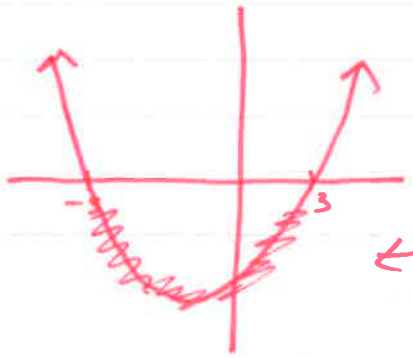
$y = -36$ ✓

vertex $(2, -36)$

11e) $-x^2 - 2x + 15 \geq 0$

$x^2 + 2x - 15 \leq 0$

$(x+5)(x-3) \leq 0$



← WANT

$-5 \leq x \leq 3$ ✓ ✓

f) $\frac{\sin x}{\cos x} + \frac{\cos x}{\sin x} = \text{cosec } x \sec x$

$LHS = \frac{\sin x}{\cos x} + \frac{\cos x}{\sin x}$

$= \frac{\sin x \times \sin x}{\sin x \cos x} + \frac{\cos x \times \cos x}{\sin x \cos x}$

$= \frac{\sin^2 x + \cos^2 x}{\sin x \cos x}$ ✓

$= \frac{1}{\sin x \cos x}$

$= \frac{1}{\sin x} \times \frac{1}{\cos x}$

$= \text{cosec } x \sec x$

$= RHS$ ✓

11g) l_1 : $y = 2x + 4$

l_2 : $-(y = x + 14)$

concurrent → all intersect at same point ✱

$0 = x - 10$

$x = 10$

when $x = 10$, l_1 : $y = 2 \times 10 + 4$

$y = 24$ ✓ both x and y

$x = 10$, $y = 24$ in l_3 : $y = 3x - 6$

LHS $= 3x - 6$ RHS $= y$

$= 3 \times 10 - 6$ $= 24$

$= 30 - 6$

$= 24$

LHS = RHS ✓ so l_1, l_2, l_3 concurrent

Question 12

a) $x = \frac{1 + 4x}{x}$

$x^2 = 1 + 4x$

$x^2 - 4x - 1 = 0$ ✓

$(x-2)^2 - 4 - 1 = 0$

$(x-2)^2 - 5 = 0$

$x - 2 = \sqrt{5}$ or $x - 2 = -\sqrt{5}$

$x = 2 + \sqrt{5}$ $x = 2 - \sqrt{5}$ ✓ both

12b) $\frac{2}{\sqrt{3}-\sqrt{2}} = m(\sqrt{2}+\sqrt{3})$

$\frac{2}{(\sqrt{3}-\sqrt{2})(\sqrt{2}+\sqrt{3})} = m$ ✓

$m = \frac{2}{3-2}$

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

$m = 2$ ✓

OR

$\frac{2}{\sqrt{3}-\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ ✓

$= \frac{2\sqrt{3}+\sqrt{2}}{3-2}$

$= 2(\sqrt{2}+\sqrt{3})$

so $m = 2$ by inspection ✓

ci) $|x-2| < 22$

$x - 2 < 22$

$x < 24$ ✓

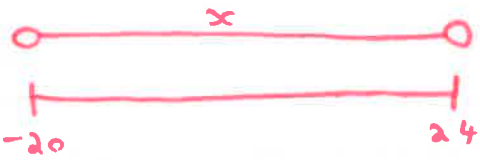
$-(x-2) < 22$

$x - 2 > -22$

$x > -20$ ✓

so $-20 < x < 24$

ii)



✓

di) $x^3 - 7x^2 + 10x = x(x^2 - 7x + 10)$ ✓

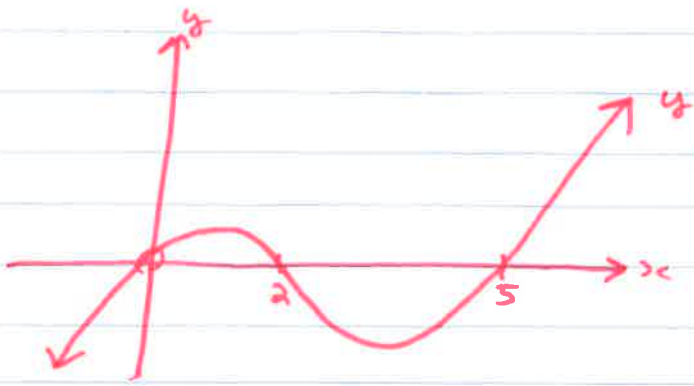
$= x(x-2)(x-5)$ ✓

ii) $0 = x(x-2)(x-5)$

$x = 0$ or $x - 2 = 0$ or $x - 5 = 0$

$x = 0$ or $x = 2$ or $x = 5$ ✓ all 3

12 diii) when $x = 10$, $y = 400$ so ~ (not ∽)



✓ shape
✓ intercepts

Question 13

a) $$\frac{6x-30}{3x^2-75} \div \frac{1}{4x+20} = \frac{6(x-5)}{3(x^2-25)} \times \frac{4x+20}{1}$$

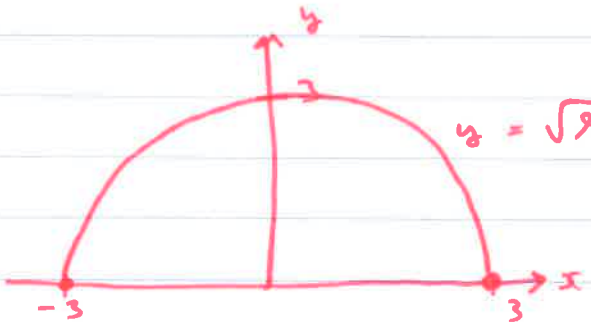
$$= \frac{6(x-5)}{3(x+5)(x-5)} \times \frac{4(x+5)}{1}$$ ✓

$$= \frac{6 \times 4}{3 \times 1}$$

$$= \frac{24}{3}$$

$$= 8$$ ✓

bi)

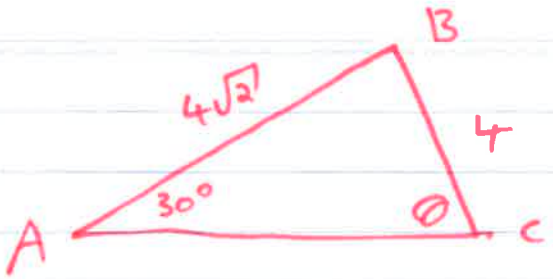


✓ shape
✓ intercepts

ii) values on x-axis, so
Domain: all real values of x, where $-3 \leq x \leq 3$ ✓

iii) values on y-axis, so
Range: all real values of y, where $0 \leq y \leq 3$ ✓

13c)



use sine rule $\frac{\sin\theta}{4\sqrt{2}} = \frac{\sin 30}{4}$ ✓

$\sin\theta = \frac{4\sqrt{2}\sin 30}{4}$

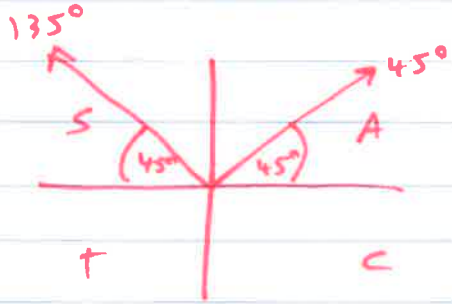
$\sin\theta = \frac{4\sqrt{2} \times \frac{1}{2}}{4}$

$= \frac{2\sqrt{2}}{4}$

$\sin\theta = \frac{\sqrt{2}}{2}$

related $\angle\ \theta = \sin^{-1}\left(\frac{\sqrt{2}}{2}\right)$

$= 45°$



so $\theta = 45°$ ✓ or $135°$ ✓

d) $M = \left(\frac{2+8}{2}, \frac{10+0}{2}\right)$

$= (5, 5)$ ✓

gradient $m = \frac{10-0}{2-8}$

$= -\frac{10}{6}$

$= -\frac{5}{3}$

perpendicular gradient $= \frac{3}{5}$ ✓

$y - 5 = \frac{3}{5}(x - 5)$

$y - 5 = \frac{3}{5}x - 3$

$y = \frac{3}{5}x + 2$ ✓

Question 14

a) $g(x) = x(x^2 - 4)$

$g(-x) = -x((-x)^2 - 4)$

$= -x(x^2 - 4)$

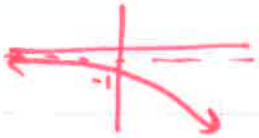
$= -g(x)$ so ODD ✓

b i)

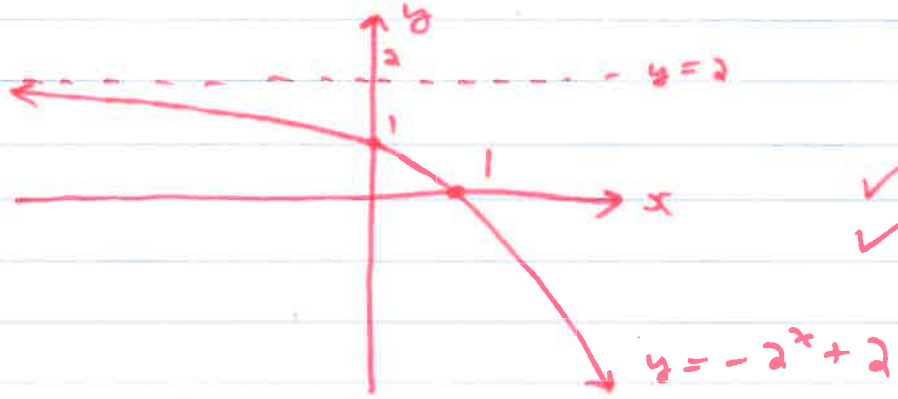
✓ shape and ✓ intercept

ii) $y = -2^x + 2$

first reflect in x-axis's

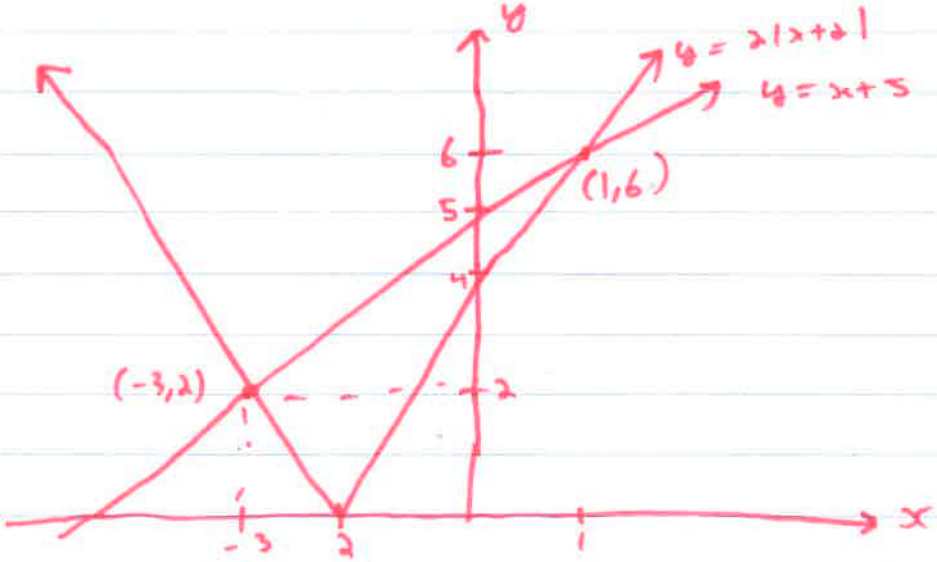


then shift up by 2:



✓ shape
✓ x-intercept

ci)



✓ both shape

14cii) $2|x+2| = x+5$

$2(x+2) = x+5$

$2x+4 = x+5$

$x = 1$

$y = 6$

$-2(x+2) = x+5$

$-2x-4 = x+5$

$-9 = 3x$

$x = -3$

$y = 2$

$(1, 6)$ and $(-3, 2)$ ✓

iii) where $y = 2|x+2|$ is below $y = x+5$

$-3 < x < 1$ ✓

d) $\text{cosec}\, x - \sin x = \cot x \cos x$

$LHS = \text{cosec}\, x - \sin x$

$= \frac{1}{\sin x} - \frac{\sin x}{1}$

$= \frac{1}{\sin x} - \frac{\sin^2 x}{\sin x}$

$= \frac{1-\sin^2 x}{\sin x}$ ✓

$= \frac{\cos^2 x}{\sin x}$

$= \frac{\cos x}{\sin x} \times \cos x$

$= \cot x \cos x$ ✓

e) $p^2 = \left(\frac{1}{\sqrt{3}} + \frac{1}{\sqrt{5}}\right)^2$

$= \frac{1}{3} + \frac{1}{5} + \frac{2}{\sqrt{15}}$ ✓

$= \frac{8}{15} + \frac{2}{\sqrt{15}}$

$= \frac{8}{15} + \frac{2\sqrt{15}}{15}$

$= \frac{8+2\sqrt{15}}{15}$

$\sqrt{15} = ap^2 + b$

PTO →

14 e continued...)

$$\text{so } \sqrt{15} = ap^2 + b = \frac{8a}{15} + \frac{2\sqrt{15}\,a}{15} + b$$

compare irrational numbers: $\sqrt{15} = \frac{2\sqrt{15}}{15} \times a$

$$a = \frac{15}{2} \quad \checkmark$$

compare rational numbers: $b + \frac{8a}{15} = 0$

$$b + 4 = 0$$

$$b = -4 \quad \checkmark$$

so $a = \frac{15}{2}$ and $b = -4$.