

**Question 1:** [10 marks]

(a) Simplify (i)  $2\sqrt{125} - 4\sqrt{80}$  [1]

(i)  $(3\sqrt{2} - 1)^2$  [1]

(b) Show that  $\frac{1}{3-\sqrt{2}} + \frac{1}{3+\sqrt{2}}$  is rational. [2]

(c) Factorise fully and simplify where possible (i)  $x^6 - 64$  [2]

(ii)  $\frac{2x^2 - 7x + 3}{x^2 - 9}$  [2]

(d) Find 0.027 as a simple fraction [2]

*Handwritten notes:*  
 $x^2 + 4x + 16$   
 ~~$x^2 + 4x + 16$~~

**Question 2:** [10 marks]

(a) Expand  $(2a + b)^3$   $a^3 + 3a^2b + 3ab^2 + b^3$  [2]

(b) Solve

(i)  $\frac{x+2}{3} + \frac{x}{4} = 7$  [2]

(ii)  $|2x - 3| = |3x - 7|$  [3]

(iii)  $4x^3 + 7x^2 - 2x = 0$  (hint: factorise first) [3]

**Question 3:**

**[10 marks]**

Find the values of  $x$  which satisfy the following inequalities:

(i)  $-3(x - 5) \leq 3$

[2]

(ii)  $x^2 - 7x + 12 < 0$

[2]

(iii)  $|5 + 2x| < 3x - 1$

[3]

(iv)  $\frac{3x - 2}{x + 4} < 1$

[3]

**Question 4:**

**[10 marks]**

(a) What is the domain and range of the function  $f(x) = \frac{3}{\sqrt{x-1}}$

[2]

(b) Is the function  $f(x) = \frac{x^3}{x^2 - 1}$  odd, even or neither? Support your answer.

[2]

(c) Sketch the graph of  $|x| + |y| = 1$  (hint: do it quadrant by quadrant)

[3]

(d) Solve  $\sqrt{x} + \sqrt{3x+1} = 3$

[3]

Q1

a) i) ~~25~~  $2 \times 5\sqrt{5} - 4\sqrt{16 \times 5}$

$\frac{9}{10}$

$\frac{1}{1}$

$$= 10\sqrt{5} - 16\sqrt{5}$$

$$= -6\sqrt{5} \quad \checkmark$$

ii)  $18 - 6\sqrt{2} + 1$

$\frac{1}{1}$

$$= 19 - 6\sqrt{2} \quad \checkmark$$

b)

$\frac{2}{2}$

$$\frac{3+\sqrt{2} + 3-\sqrt{2}}{9-2} = \frac{6}{7} \quad \text{--- a fraction } \therefore \text{rational}$$

c) i) let  $x^2 = a, \quad 4 = b$

$\frac{1}{2}$

$$(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$$

$$= (x^2 - 4)(x^4 + 4x^2 + 16)$$

$$= (x+2)(x-2)(x^4 + 4x^2 + 16) \quad \checkmark$$

as difference of 2 squares  $\therefore (x-2)(x+2)(x^2-2x+4)(x^2+2x+4)$

ii)  $\frac{2x^2 - 6x - x + 3}{(x+3)(x-3)} = \frac{2x(x-3) - (x-3)}{(x+3)(x-3)} = \frac{(2x-1)(x-3)}{(x+3)(x-3)}$

$\frac{2}{2}$

$$= \frac{2x-1}{x+3} \quad \checkmark \checkmark$$

d) Let  $0.0\dot{2}\dot{7} = x$

$$1000x = 27.\dot{2}\dot{7}$$

$$10x = 0.\dot{2}\dot{7}$$

$$990x = 27$$

$\frac{2}{2}$

$$x = \frac{27}{990} = \frac{3}{110} \quad \checkmark \checkmark$$

Q 2

a) ~~8a<sup>3</sup>~~  $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

(2/2)  $(2a+b)^3 = 8a^3 + 3 \times 4a^2 \times b + 3 \times 2a \times b^2 + b^3$   
 $= 8a^3 + 12a^2b + 6ab^2 + b^3$  ✓

b) i)  $\frac{x+2}{3} + \frac{x}{4} = 7$

$4(x+2) + 3x = 84$

~~~~~~~~~

$4x+8+3x=84$

$7x=76$

$x = \frac{76}{7}$  //

(10/10)

Feb

(except....)

(2/2)

ii) Either  $2x-3=3x-7$   
 $4=x$  ✓

or

$2x-3=-(3x-7)$

$2x-3=-3x+7$  ✓

$5x=10$

$x=2$

check answers!

(3/3)

iii)  $x(4x^2+7x-2)=0$

$x(4x^2+8x-x-2)=0$

$x(4x(x+2)-(x+2))=0$

$x(4x-1)(x+2)=0$  //

$x=0, \frac{1}{4} \text{ or } -2$

(3/3)

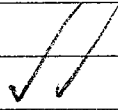
Q3

i)  $-3x + 15 \leq 3$

~~$-x + 15 \leq 1$~~

$-x + 5 \leq 1$

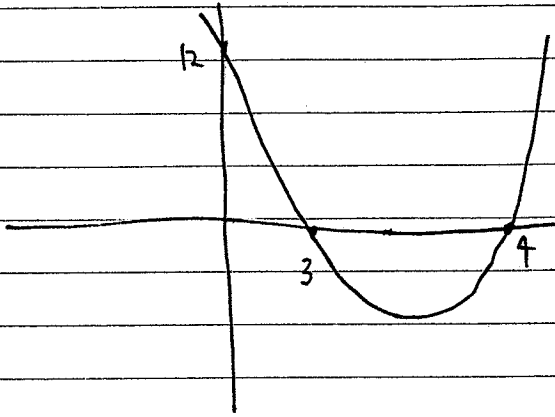
$4 \leq x$



$\frac{9}{10}$

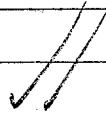
$\frac{2}{2}$

ii)  $(x-4)(x-3) < 0$



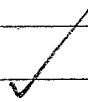
$\frac{2}{2}$

$3 < x < 4$



iii) Either  $5 + 2x < 3x - 1$

$6 < x$

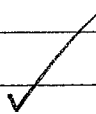


or  $-(5 + 2x) < 3x - 1$

$-5 - 2x < 3x - 1$

$-4 < 5x$

$\frac{-4}{5} < x$



check solns ✓

??

$\frac{2}{3}$

~~$5x < 2x$~~

Q3

$$\text{iv) } \frac{3x-2-(x+4)}{x+4} < 0$$

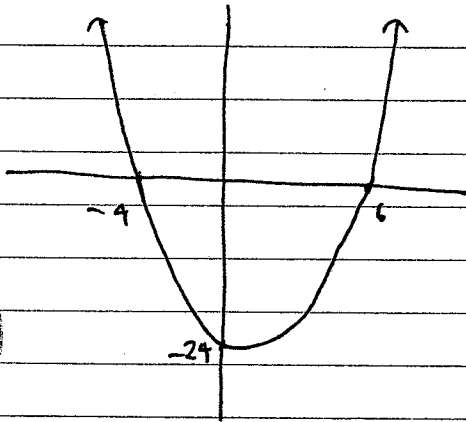
$$\frac{3x-2-x-4}{x+4} < 0$$

$$\frac{2x-6}{x+4} < 0$$

$$(2x-6)(x+4) < 0$$

$$\frac{2(x-3)(x+4)}{(x-3)}$$

CAB! oops!



3/3

$$-4 < x < 6/3$$

Q4

a) Domain:  $x-1 > 0$   
 $x > 1$  ✓

$\frac{2}{2}$   
 $\frac{2}{2}$

Range:  $f(x) \neq 0$   
 $f(x) > 0$  ✓

$\frac{10}{10}$

b) a if ~~all~~ even,  $f(x) = f(-x)$

Fab!

?  $\frac{x^3}{x^2-1} = \frac{(-x)^3}{(-x)^2-1}$

$\frac{x^3}{x^2-1} = \frac{-x^3}{x^2-1}$  ✗ False

So  $f(x)$  is not even

If odd,  $f(-x) = -f(x)$

$f(-x) = \frac{-x^3}{x^2-1}$

$-f(x) = -1 \times \frac{x^3}{x^2-1}$

$= \frac{-x^3}{x^2-1}$

you only need  
to look at

$\frac{2}{2}$   
 $\frac{2}{2}$

$-f(x) = f(-x) = \frac{-x^3}{x^2-1}$

$f(a)$

$f(-a)$  to see ...

∴  $f(x)$  is odd ✓

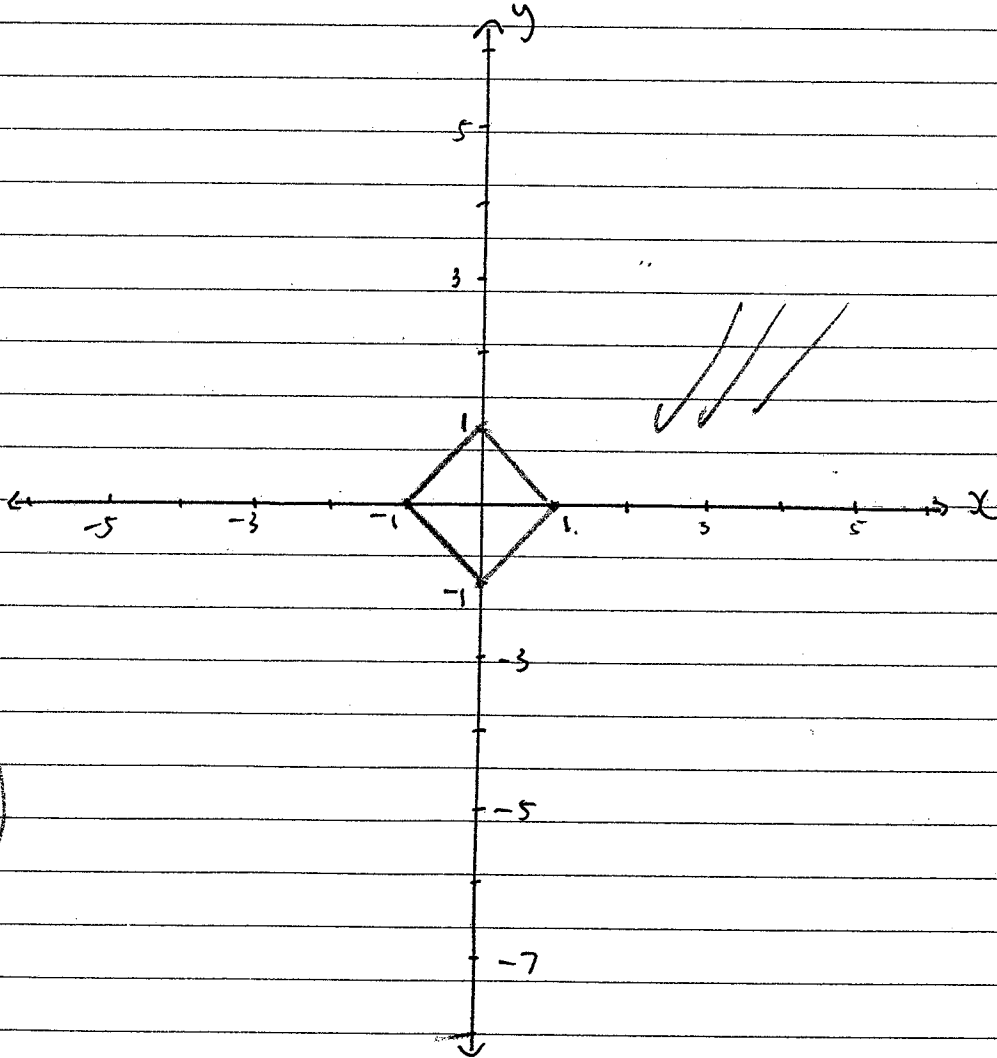
# Q4

c) If  $x \geq 0, y \geq 0$   
 $x + y = 1, y = 1 - x$  ✓

If  $x < 0, y \geq 0$   
 $-x + y = 1, y = 1 + x$  ✓

If  $x \geq 0, y < 0$   
 $x - y = 1, x - 1 = y$  ✓

If  $x < 0, y < 0$   
 $-x - y = 1$   
 $x + y = -1$   
 $y = -x - 1$





Q4

$$d) \sqrt{x} + \sqrt{3x+1} = 3$$
$$\sqrt{3x+1} = 3 - \sqrt{x}$$

$$3x+1 = 9 - 6\sqrt{x} + x$$

$$2x = 8 - 6\sqrt{x}$$

$$2x - 8 + 6\sqrt{x} = 0$$

$$\text{Let } \sqrt{x} = u$$

$$2u^2 + 6u - 8 = 0$$

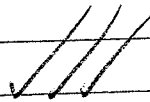
$$2(u^2 + 3u - 4) = 0$$

$$2(u+4)(u-1) = 0$$

$$u = -4 \text{ or } 1$$

$$\sqrt{x} = \cancel{-4} \text{ or } 1$$

$$x = 1$$



3  
/ 3

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