

Question 1:

[10 marks]

- (a) Simplify
- (i) $2\sqrt{125} - 4\sqrt{80}$ [1]
- (ii) $(3\sqrt{2} - 1)^2$ [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 for (d):
 $0.027 = \frac{27}{1000} = \frac{3^3}{10^3} = \frac{3^3}{2^3 \cdot 5^3} = \frac{3^3}{(2 \cdot 5)^3} = \frac{3^3}{10^3}$

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

$\frac{9}{10}$

$\frac{1}{1}$

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

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

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

$\frac{2}{2}$

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

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

$$1000x = 27.2\dot{7}$$

$$10x = 0.2\dot{7}$$

$$990x = 27$$

$\frac{2}{2}$

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

Q 2

a) ~~8a³~~ $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

2/2

$$(2a+b)^3 = 8a^3 + 3 \times 4a^2 \times b + 3 \times 2a \times b^2 + b^3$$

$$= 8a^3 + 12a^2b + 6ab^2 + b^3 \quad \checkmark$$

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

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

~~~~~~~~~

$$4x + 8 + 3x = 84$$

$$7x = 76$$

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

10/10

Feb

(except ...)

2/2

ii) Either  $2x - 3 = 3x - 7$   
 $4 = x \quad \checkmark$

or

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

$$2x - 3 = -3x + 7$$

$$5x = 10 \quad \checkmark$$

$$x = 2$$

check answers

3/3

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

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

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

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

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

3/3

# Q3

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

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

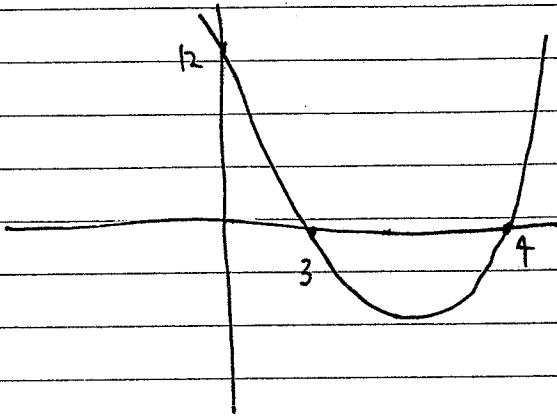
$-x + 5 \leq 1$

$4 \leq x$

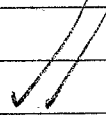


$\frac{9}{10}$

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



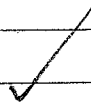
$3 < x < 4$



iii) Either

$5 + 2x < 3x - 1$

$6 < x$

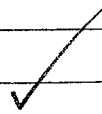


or  $-(5 + 2x) < 3x - 1$

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

$-4 < 5x$

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



check solns

??



$\frac{2}{3}$

~~3x - 2x~~

Q3

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

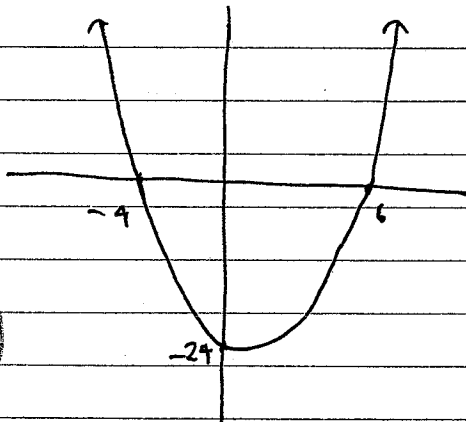
$$\frac{3x-2-x-4}{x+4} < 0$$

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

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

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

CAB! oops!



$\frac{3}{3}$

$$-4 < x < \frac{6}{3}$$

Q4

a) Domain:  $x-1 > 0$   
 $x > 1$  ✓

$\frac{2}{2}$

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

$\frac{10}{10}$

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

Fab!

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

$$\frac{x^3}{x^2-1} = \frac{-x^3}{x^2-1} \quad \times \text{ False}$$

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

$\frac{2}{2}$

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

$f(a)$

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

∴  $f(x)$  is odd ✓

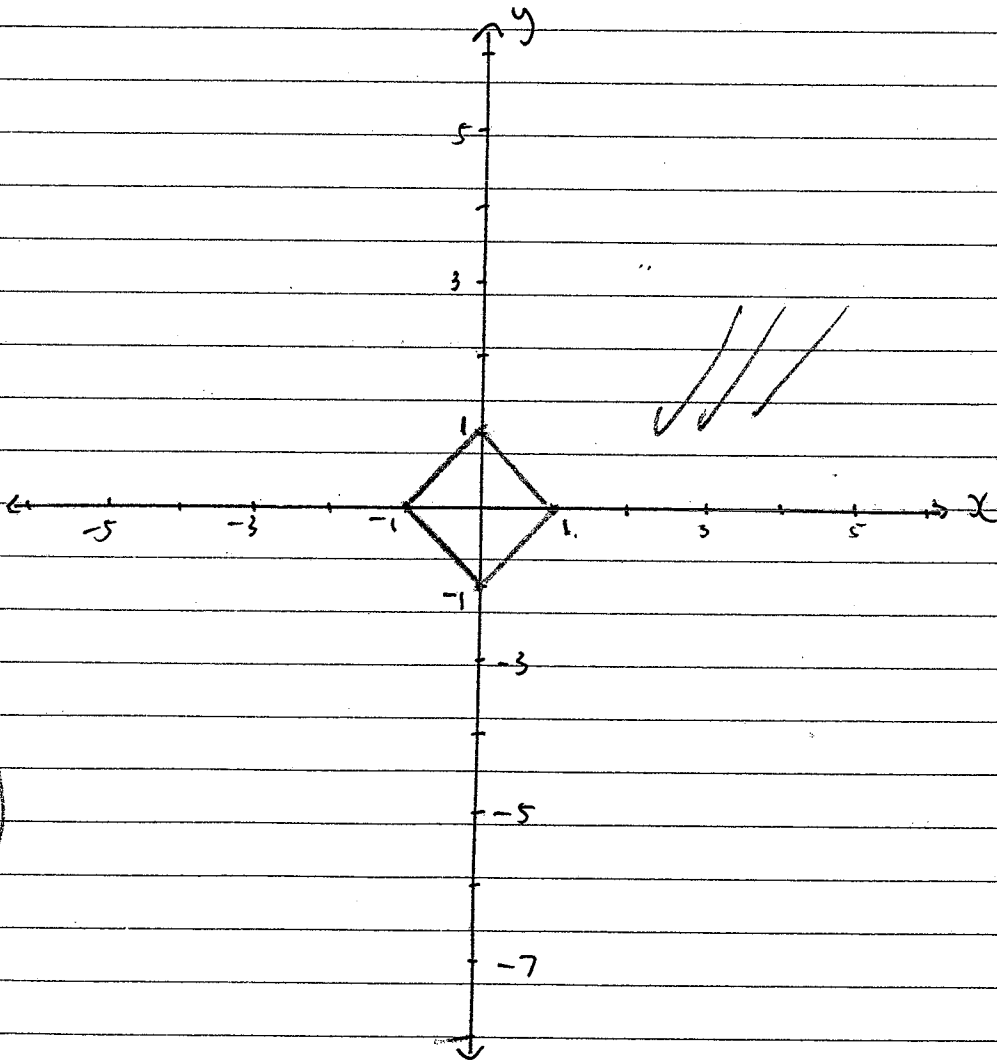
# Q4

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

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

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

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

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

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

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

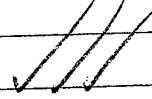
$$2(u^2 + 3u - 4) = 0$$

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

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

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

$$x = 1$$



3  
3

stic