1. a) i) Prove the De Morgan's laws

$$(A \cup B)' = A' \cap B'.$$

ii) Show that

$$X = (X \cap Y) \cup (X \cap Y')$$

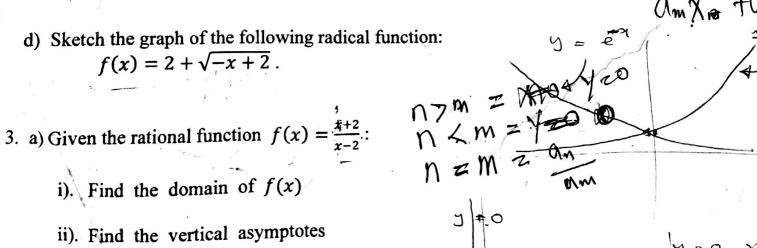
- b) i) Express the following in the form of $\frac{a}{b}$ where a and b are intergers, $b \neq 0$.
 - ii) Given that $\sqrt{5}$ is an irrational number, prove that $\sqrt{5} + 1$ is an irrational number.
- c) Determine whether the function f is even, odd or neither.

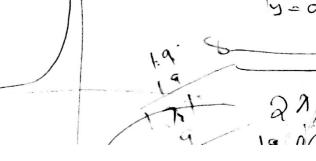
$$f(x) = x^3 + x.$$

- (a) Express $\frac{\sqrt{x}}{2\sqrt{x}-1}$ in the form $a+b\sqrt{x}$, where a and b are real numbers.
 - b) i) Express $1 + 4i + \frac{5}{2-i}$ in form a + bi and find its absolute value(modulus).
 - ii) Solve for x and y given that: $\frac{x+iy}{2+i} = 5 - i$
 - c) Let '*' be a binary operation on the set of real numbers defined by $a * b = 2^{b-a}$, where a and b are real numbers.
 - Is * commutative on real numbers? Justify your answer.
 - ii). Find -1*(4*9).
 - d) Sketch the graph of the following radical function:

d) Sketch the graph of the following radical function:
$$f(x) = 2 + \sqrt{-x + 2}$$
.

- - ii). Find the vertical asymptotes
 - iii). Find the horizontal asymptotes
 - iv). Sketch the graph of f(x).





b) Given the universal set U = [1,12] where $A = \{1,2,3,4,5,6,7,8,9\}$ and B = [1,5]. Find

i)
$$A \cap B$$

ii)
$$A - B$$

c) i) Verify that the two given functions are inverses of each other

$$f(x) = x^3 + 1$$
 and $g(x) = \sqrt[3]{x - 1}$.

ii) Determine the domain of functions:

$$f(x) = x + \sqrt{x^2 + 4x - 12} \ .$$

4. a). Use the Rational root theorem to solve the following equation:

$$3x^4 + 5x^3 - 5x^2 - 5x + 2 = 0.$$

b). i) Solve each of the following equation $\begin{vmatrix} x+1 \\ z \end{vmatrix} = 2$

ii). Redefine
$$k(x) = |2x - 1| - |x + 2|$$
 by removing the modulus, hence sketch the graph of function:

c) Let $f(x) = 3x^2 + 12x + 5$ be a quadratic function.

i) By completing the square, express
$$f(x)$$
 in the form $f(x) = a(x+p)^2 + q$ where a , p and q are constants.

iii) Sketch the graph of the function
$$f(x) = 3x^2 + 12x + 5$$

d) i) Find the values of k if the equation
$$x^2 + (k-2)x + 10 - k = 0$$
 has equal roots.

ii) The roots of the equation
$$2x^2 + 6x - 15 = 0$$
 are α and β . Find the value of $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$. Hence find the quadratic equation whose roots are

$$\sim \frac{1}{\alpha^2}$$
 and $\frac{1}{\beta^2}$.