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VCE Specialist Mathematics $\frac{1}{2}$
Modulus & Partial Fractions [1.1]
Homework Solutions

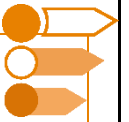
Homework Outline:

Compulsory Questions	Pg 2 - Pg 18
Supplementary Questions	Pg 19 - Pg 30



Section A: Compulsory Questions

Sub-Section: Solving Simple Modulus Equations and Inequalities



Question 1



Evaluate:

a. $|-5|$

5

b. $-|-16|$

-16

c. $|3^2 - 3 \times 2 + 9|$

$$|9 - 6 + 9| = |12| = 12$$


Question 2

Solve the following equations for x .

a. $|x - 2| = 4$

$$\begin{aligned} x - 2 &= 4 \implies x = 6 \\ x - 2 &= -4 \implies x = -2 \\ \text{Therefore, } x &= -2 \text{ or } x = 6. \end{aligned}$$

b. $|2x - 3| = 5$

$$\begin{aligned} 2x - 3 &= 5 \implies 2x = 8 \implies x = 4 \\ 2x - 3 &= -5 \implies 2x = -2 \implies x = -1 \\ \text{Therefore, } x &= -1 \text{ or } x = 5. \end{aligned}$$

c. $|1 - \sqrt{x}| = 5$

$$\begin{aligned} 1 - \sqrt{x} &= 5 \implies \text{no real solution since } \sqrt{x} \geq 0 \\ 1 - \sqrt{x} &= -5 \implies \sqrt{x} = 6 \implies x = 36 \\ \text{Therefore } x &= 36 \text{ only.} \end{aligned}$$


Question 3

Solve the following equations for x .

a. $|x| < 3$

The distance between x and 0 is $< 3 \implies -3 < x < 3$

b. $|2x - 1| > 1$

$$\begin{aligned} 2x - 1 > 1 &\implies 2x > 2 \implies x > 1 \\ 2x - 1 < -1 &\implies 2x < 0 \implies x < 0 \\ \text{Therefore, } x < 0 &\text{ or } x > 1 \end{aligned}$$

c. $|3x| + 1 > 10$

$$\begin{aligned} |3x| > 9 &\implies |x| > 3 \\ \text{Therefore, } x < -3 &\text{ or } x > 3. \end{aligned}$$

Question 4 Tech-Active.


Solve the following equality for x .

$$|\sqrt{2x} - 1| = 3$$

$x = 8$ only.

TI:

`solve(|sqrt(2*x)-1|=3,x)`

$x=8$

Mathematica:

```
In[74]:= Solve[Abs[Sqrt[2] x - 1] == 3, x]
Out[74]:= {{x -> 8}}

In[80]:= Reduce[Abs[Sqrt[2] x - 1] == 3, x, Reals]
Out[80]:= x == 8
```

Casio:

`solve(abs(sqrt(2x)-1)=3, x)`

$\{x=8\}$

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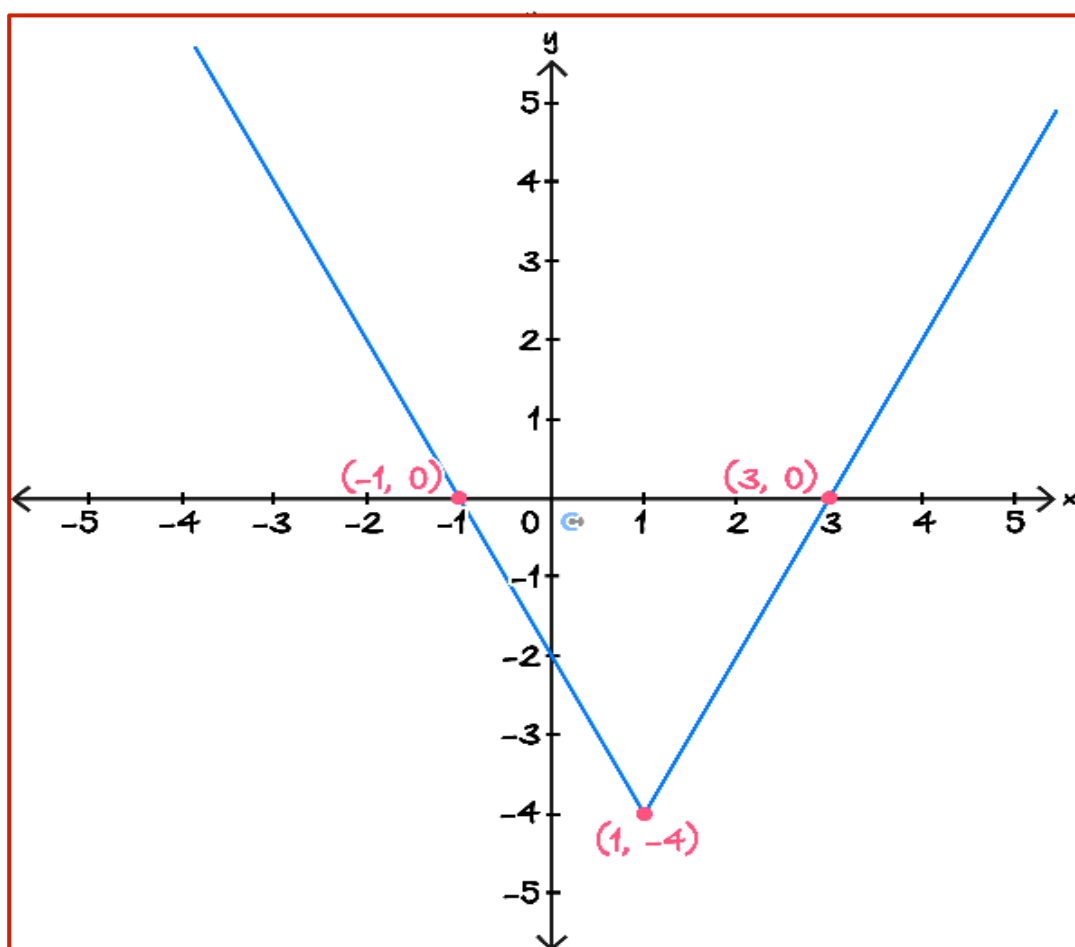
Sub-Section: Graphing Modulus Functions and Composite Modulus Functions



Question 5



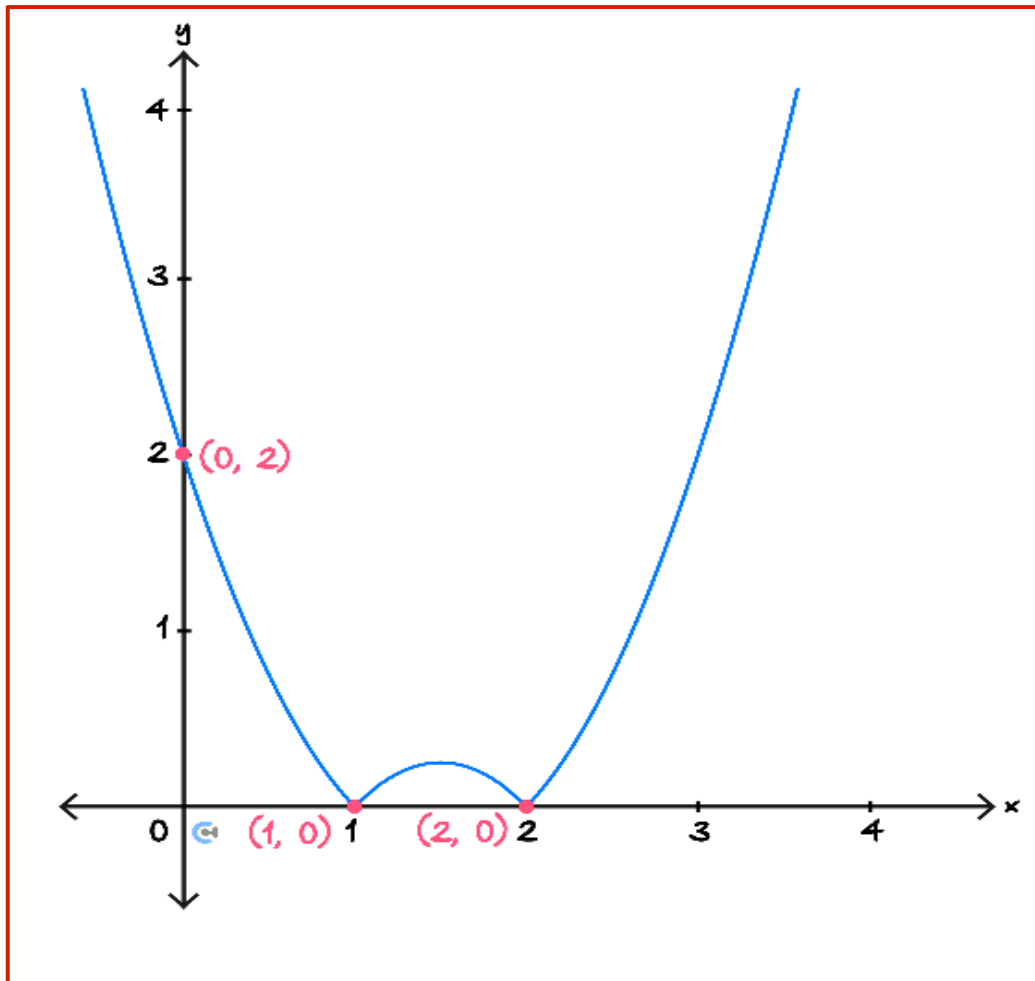
Sketch the graph of the function $f(x) = 2|x - 1| - 4$ on the axes below. Label the axis intercepts and the vertex of the graph.





Question 6

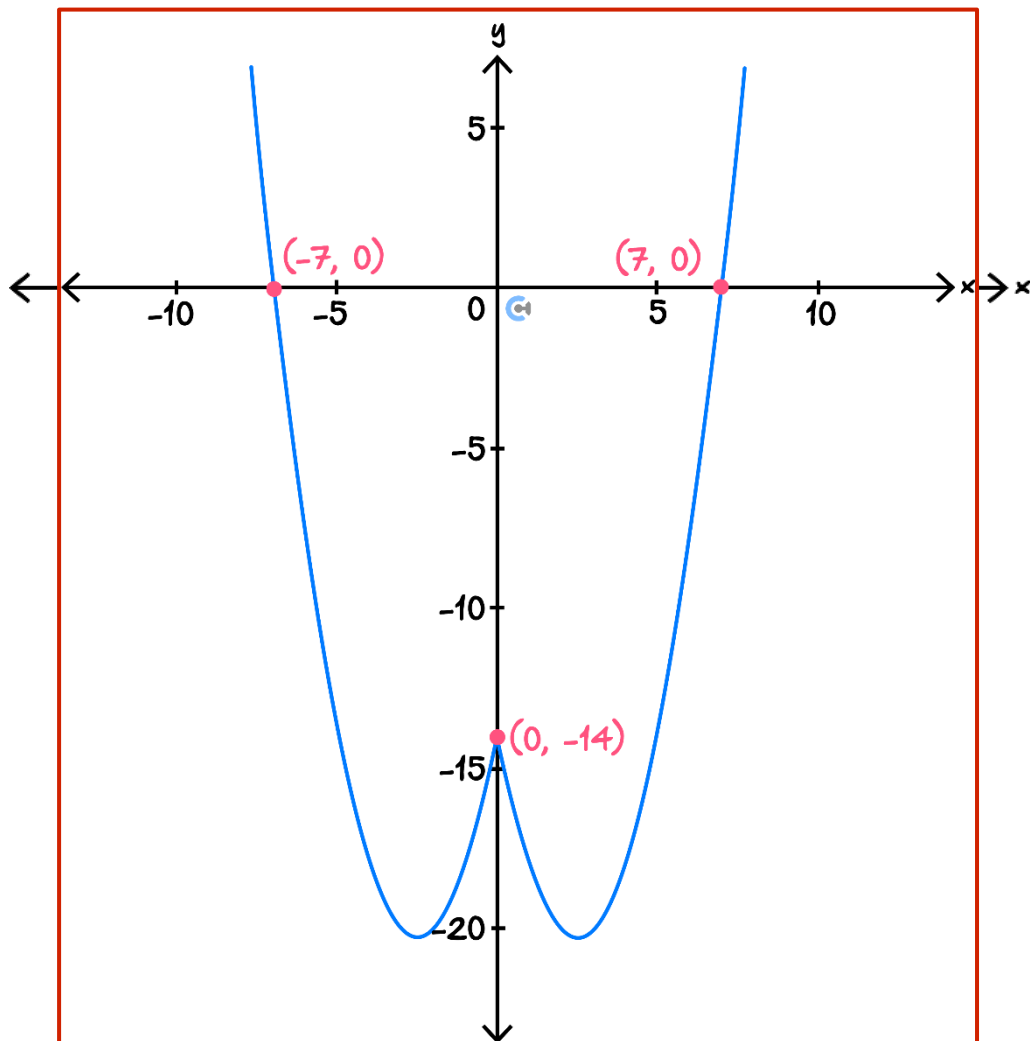
Sketch the graph of the function $f(x) = |(x - 2)(x - 1)|$. Label any axis intercepts.





Question 7

Sketch the graph of the function $y = f(|x|)$ where $f(x) = x^2 - 5x - 14$. Label any axis intercepts.

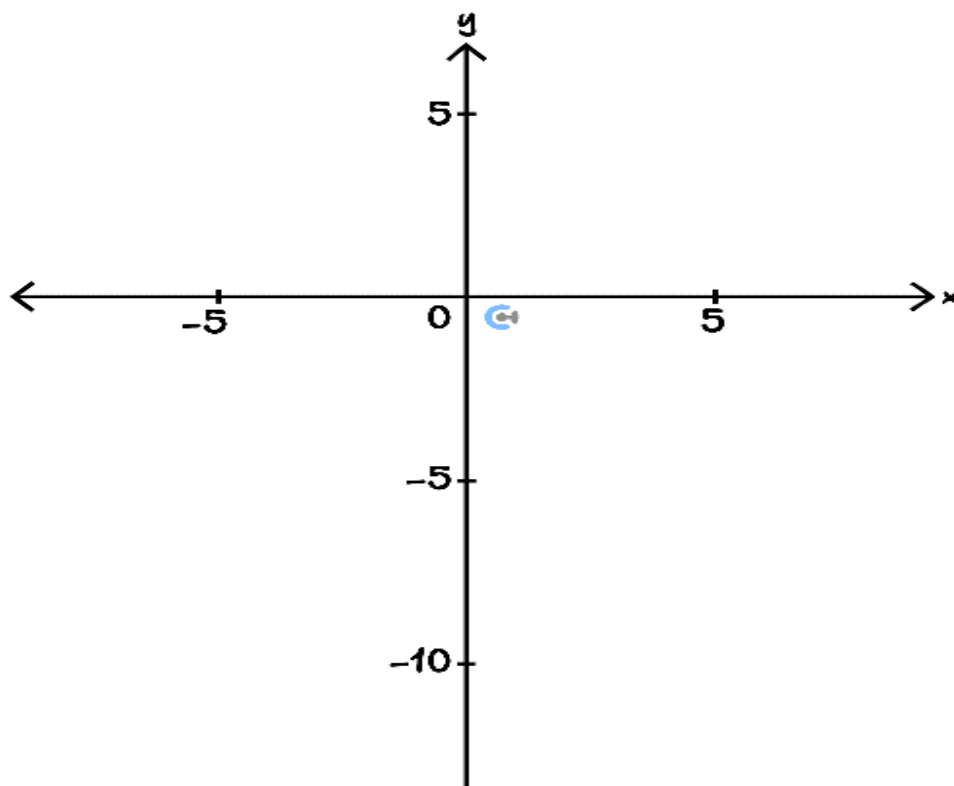


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Question 8 Tech-Active.

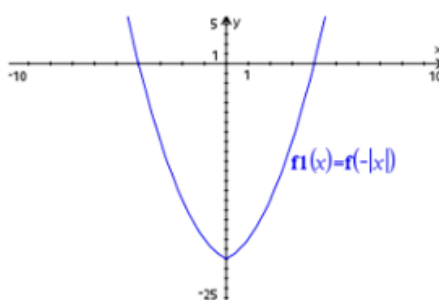
Sketch the graph of the function $y = f(-|x|)$ where $f(x) = (x - 5)(x + 4)$.



TI:

Define $f(x) = (x-5) \cdot (x+4)$ Done

$f(-|x|)$ $(|x|-4) \cdot (|x|+5)$



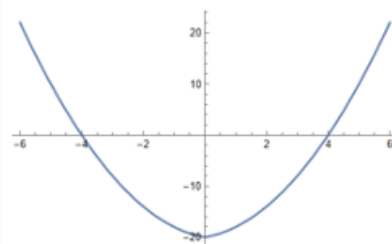
solve($f(-|x|) = 0, x$) $x = -4$ or $x = 4$

$f(0)$ -20

Mathematica:

$f[x_] := (x - 5) (x + 4)$

Plot[$f[-\text{Abs}[x]]$, {x, -6, 6}]



$f[0]$

-20

Solve[$f[-\text{Abs}[x]] == 0, x, \text{Reals}$]

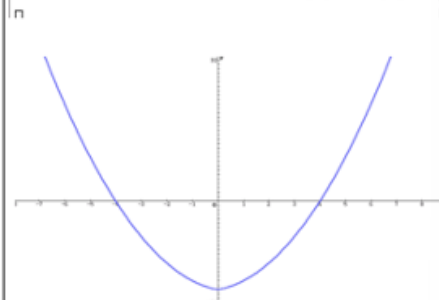
{{x -> -4}, {x -> 4}}

Casio:

define $f(x) = (x-5)(x+4)$

$f(-\text{abs}(x))$

done $(|x|+5) \cdot (|x|-4)$



solve($f(-\text{abs}(x)) = 0, x$)

$f(0)$

{x=-4, x=4}

-20



Sub-Section: Apply Partial Fractions to Find a Decomposed Form

Question 9



Perform partial fraction decomposition to write the following functions in the form specified below.

a. $\frac{7x-8}{(x-1)(x-2)} = \frac{A}{x-1} + \frac{B}{x-2}$

$$A(x-2) + B(x-1) = 7x-8$$

$$x=2 \Rightarrow B=14-8=6$$

$$x=1 \Rightarrow -A=-1 \Rightarrow A=1$$

$$\frac{7x-8}{(x-1)(x-2)} = \frac{1}{x-1} + \frac{6}{x-2}$$

b. $\frac{x^2-6}{(x-3)(x-2)^2} = \frac{A}{x-3} + \frac{B}{x-2} + \frac{C}{(x-2)^2}$

$$A(x-2)^2 + B(x-3)(x-2) + C(x-3) = x^2-6$$

$$x=2 \Rightarrow -C=-2 \Rightarrow C=2$$

$$x=3 \Rightarrow A=3$$

$$\text{Then } 3x^2 + Bx^2 = x^2 \Rightarrow B=-2$$

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

c. $\frac{9x+5}{(x+1)(x^2+3)} = \frac{A}{x+1} + \frac{Bx+C}{x^2+3}$

$$A(x^2 + 3) + (Bx + C)(x + 1) = 9x + 5$$

$$x = -1 \implies 4A = -4 \implies A = -1$$

$$-x^2 + Bx^2 = 0x^2 \implies B = 1$$

$$-3 + C = 5 \implies C = 8$$

$$\frac{9x + 5}{(x + 1)(x^2 + 3)} = -\frac{1}{x + 1} + \frac{x + 8}{x^2 + 3}$$

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Question 10

Perform partial fraction decomposition to the following functions.

a. $\frac{11x+19}{x^2+4x-5}$

$$x^2 - 4x - 5 = (x - 5)(x + 1) \text{ so therefore}$$

$$\frac{11x + 19}{x^2 - 4x - 5} = \frac{A}{x - 1} + \frac{B}{x + 5}$$

$$A(x + 5) + B(x - 1) = 11x + 19$$

$$x = -5 \implies -6B = -36 \implies B = 6$$

$$x = 1 \implies 6A = 30 \implies A = 5$$

$$\frac{11x + 19}{x^2 - 4x - 5} = \frac{5}{x - 1} + \frac{6}{x + 5}$$

b. $\frac{6x^2+x-2}{x^3-2x^2}$

$$\text{We have } \frac{6x^2 + x - 2}{x^2(x - 2)} = \frac{A}{x^2} + \frac{B}{x} + \frac{C}{x - 2}$$

$$A(x - 2) + Bx(x - 2) + Cx^2 = 6x^2 + x - 2$$

$$x = 2 \implies 4C = 24 \implies C = 6$$

$$x = 0 \implies -2A = -2 \implies A = 1$$

$$Bx^2 + 6x^2 = 6x^2 \implies B = 0$$

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

c. $\frac{7x^2+x-2}{x^3-x^2}$

We have $\frac{7x^2+x-2}{x^2(x-1)} = \frac{A}{x-1} + \frac{B}{x} + \frac{C}{x^2}$

$$Ax^2 + Bx(x-1) + C(x-1) = 7x^2 + x - 2$$

$$x = 0 \implies -C = -2 \implies C = 2$$

$$x = 1 \implies A = 6$$

$$6x^2 + Bx^2 = 7x^2 \implies B = 1$$

$$\frac{7x^2+x-2}{x^3-x^2} = \frac{6}{x-1} + \frac{1}{x} + \frac{2}{x^2}$$

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Question 11

Perform partial fraction decomposition to the following functions.

a. $\frac{x^3-1}{x^2+2x-3}$

We factor to obtain $\frac{x^3-1}{x^2+2x-3} = \frac{(x-1)(x^2+x+1)}{(x+3)(x-1)} = \frac{x^2+x+1}{x+3}$

Then note that by comparing coefficients we obtain $\frac{x^2+x+1}{x+3} = \frac{(x-2)(x+3)+7}{x+3}$

$$\frac{x^3-1}{x^2+2x-3} = x-2 + \frac{7}{x+3}$$

b. $\frac{2x^4-3x^3+5x^2-3x-2}{x^3-2x^2}$

$x^3-2x^2 = x^2(x-2)$ then by comparing coefficients/polynomial long division we have

$$\begin{aligned} \frac{2x^4-3x^3+5x^2-3x-2}{x^3-2x^2} &= \frac{(x^3-2x^2)(2x+1)+7x^2-3x-2}{x^2(x-2)} \\ &= 2x+1 + \frac{7x^2-3x-2}{x^2(x-2)} \end{aligned}$$

Now, $\frac{7x^2-3x-2}{x^2(x-2)} = \frac{A}{x^2} + \frac{B}{x} + \frac{C}{x-2}$

$$A(x-2) + Bx(x-2) + Cx^2 = 7x^2-3x-2$$

$$x=2 \implies 4C=20 \implies C=5$$

$$x=0 \implies -2A=-2 \implies A=1$$

$$Bx^2+5x^2=7x^2 \implies B=2$$

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

c. $\frac{2x^3 - x^2 + 5}{(x-1)^2}$

By polynomial long division/comparing coefficients we have

$$\begin{aligned}\frac{2x^3 - x^2 + 5}{(x-1)^2} &= \frac{(x^2 - 2x + 1)(2x + 3) + 4x + 2}{(x-1)^2} \\ &= 2x + 3 + \frac{4x + 2}{(x-1)^2}\end{aligned}$$

$$\begin{aligned}\text{Now, } \frac{4x + 2}{(x-1)^2} &= \frac{A}{(x-1)^2} + \frac{B}{x-1} \\ A + B(x-1) &= 4x + 2 \implies B = 4, A = 6\end{aligned}$$

$$\frac{2x^3 - x^2 + 5}{(x-1)^2} = 2x + 3 + \frac{6}{(x-1)^2} + \frac{4}{x-1}$$

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Question 12 Tech-Active.

Perform partial fraction decomposition to the function $f(x) = \frac{x^4+3x^3+11x^2+9x+11}{(x-1)(x^2+2x+4)}$.

$$\frac{x^4 + 3x^3 + 11x^2 + 9x + 11}{(x - 1)(x^2 + 2x + 4)} = x + 2 + \frac{5}{x - 1} + \frac{2x + 1}{x^2 + 2x + 4}$$

Ti:

$$\text{expand}\left(\frac{x^4+3\cdot x^3+11\cdot x^2+9\cdot x+11}{(x-1)\cdot (x^2+2\cdot x+4)},x\right)$$

$$\frac{2\cdot x}{x^2+2\cdot x+4} + \frac{1}{x^2+2\cdot x+4} + \frac{5}{x-1} + x + 2$$

Mathematica:

$$\text{In[102]:= Apart}\left[\frac{x^4 + 3 x^3 + 11 x^2 + 9 x + 11}{(x - 1) (x^2 + 2 x + 4)}\right]$$

$$\text{Out[102]:= } 2 + \frac{5}{-1 + x} + x = \frac{1 + 2 x}{4 + 2 x + x^2}$$

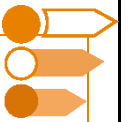
Casio:

$$\text{expand}\left(\frac{x^4+3x^3+11x^2+9x+11}{(x-1)(x^2+2x+4)},x\right)$$

$$x + \frac{2\cdot x + 1}{x^2 + 2\cdot x + 4} + \frac{5}{x - 1} + 2$$

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Sub-Section: The 'Final Boss'



Question 13

Consider the function $f(x) = x^2 - 5x + 6$.

- a. Evaluate $|f(-2)|$ and $f(|-2|)$.

```
In[31]:= f[x_] := x^2 - 5 x + 6
```

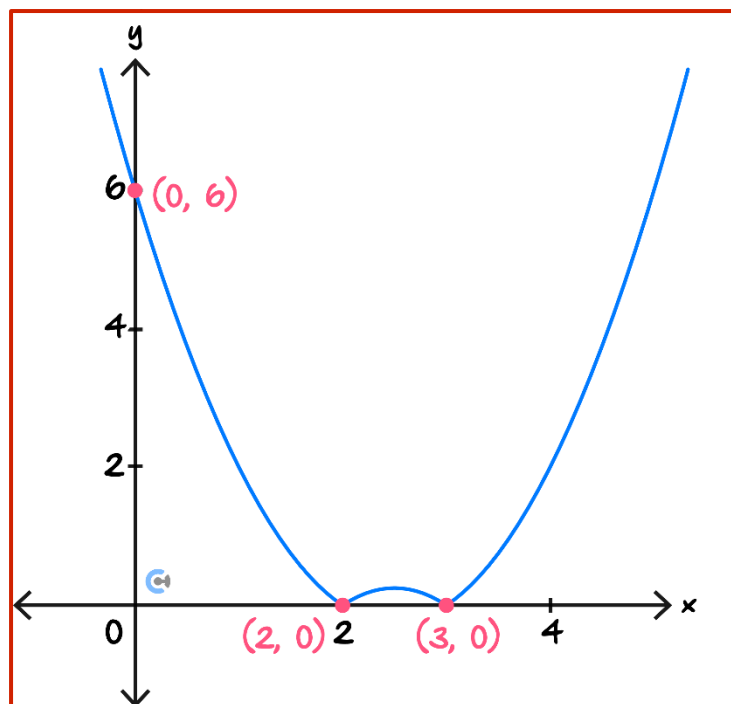
```
In[32]:= Abs[f[-2]]
```

```
Out[32]= 20
```

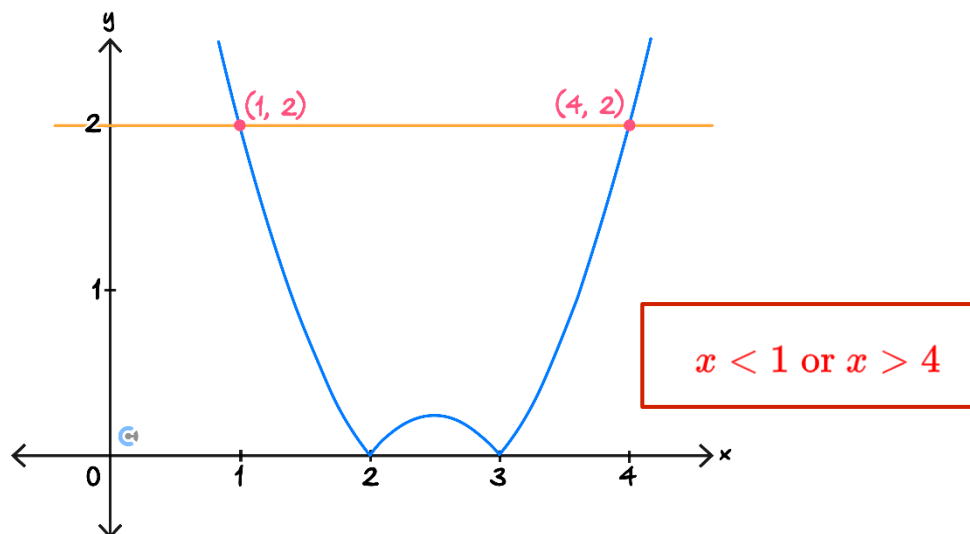
```
In[33]:= f[Abs[-2]]
```

```
Out[33]= 0
```

- b. Sketch the graph of $y = |f(x)|$.



- c. Solve for the values of x that satisfy the inequality $|f(x)| < 2$.



- d. State the value of k , so that the equation $|f(x)| = k$ has three solutions.

$$f(x) = \left(x - \frac{5}{2}\right)^2 - \frac{1}{4}, \text{ so } f(x) \text{ has a turning point at } \left(\frac{5}{2}, -\frac{1}{4}\right).$$

Therefore, $|f(x)|$ has a turning point at $\left(\frac{5}{2}, \frac{1}{4}\right)$

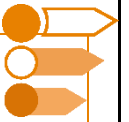
By looking at the graph from **part b.** we see that $|f(x)| = \frac{1}{4}$ has 3 solutions.

Therefore $k = \frac{1}{4}$.

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Section B: Supplementary Questions

Sub-Section: Solving Simple Modulus Equations and Inequalities



Question 14



Evaluate:

a. $-|-4|$

-4

b. $|5| + |-6|$

11

c. $|-8|^2$

64


Question 15

Solve the following equations for x .

a. $|3 - 2x| = 1$

$$\begin{aligned} 3 - 2x = 1 &\implies 2x = 2 \implies x = 1 \\ 3 - 2x = -1 &\implies 2x = 4 \implies x = 2 \\ \text{Therefore, } x &= 1 \text{ or } x = 2 \end{aligned}$$

b. $|x^2| = 2$

$$x^2 = 2 \implies x = -\sqrt{2} \text{ or } x = \sqrt{2}$$

c. $|x^2 + 1| = 2$

$$x^2 + 1 = 2 \implies x^2 = 1 \implies x = -1 \text{ or } x = 1$$


Question 16

Solve the following equations for x .

a. $|-x| < 2$

$$x < 2$$

$$x > -2$$

$$\text{Therefore } -2 < x < 2$$

b. $|2x - 1| > 5$

$$2x - 1 > 5 \implies 2x > 6 \implies x > 3$$

$$2x - 1 < -5 \implies 2x < -4 \implies x < -2$$

$$\text{Therefore } x < -2 \text{ or } x > 3$$

c. $|2x - 5| + 3 < 4$

$$|2x - 5| < 1$$

$$2x - 5 < 1 \implies 2x < 6 \implies x < 3$$

$$2x - 5 > -1 \implies 2x > 4 \implies x > 2$$

$$\text{Therefore } 2 < x < 3$$


Question 17

Consider the following equation $|x|^2 - 7|x| + 10 = 0$.

- a. Before solving the equation, how many solutions do you expect this equation will have? Why?

There is no correct answer for this part, but one might expect four solutions.

- b. Solve the equation.

$$x^2 - 7|x| + 10 = 0$$

when $x > 0$ we have $|x| = x$

$$x^2 - 7x + 10 = 0$$

$$x = \frac{7 \pm \sqrt{49 - 40}}{2}$$

$$x = \frac{7 \pm 3}{2}$$

$$x = 2, 5$$

when $x < 0$ we have $|x| = -x$

$$x^2 + 7x + 10 = 0$$

$$x = \frac{-7 \pm \sqrt{49 - 40}}{2}$$

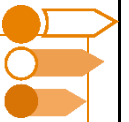
$$x = \frac{-7 \pm 3}{2}$$

$$x = -2, -5$$

Therefore $x = \pm 2$ or $x = \pm 5$

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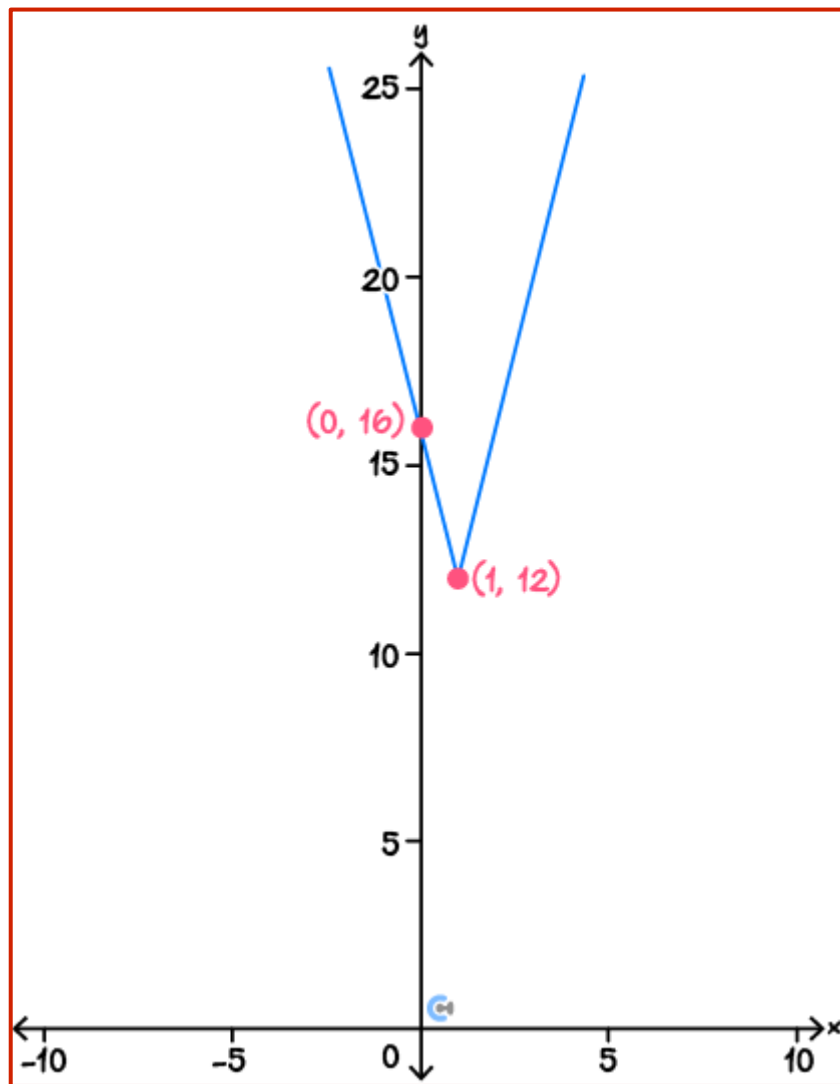
Sub-Section: Graphing Modulus Functions and Composite Modulus Functions



Question 18



Sketch the graph of the function $f(x) = 4|x - 1| + 12$ on the axes below. Label the axis intercepts and the vertex of the graph.

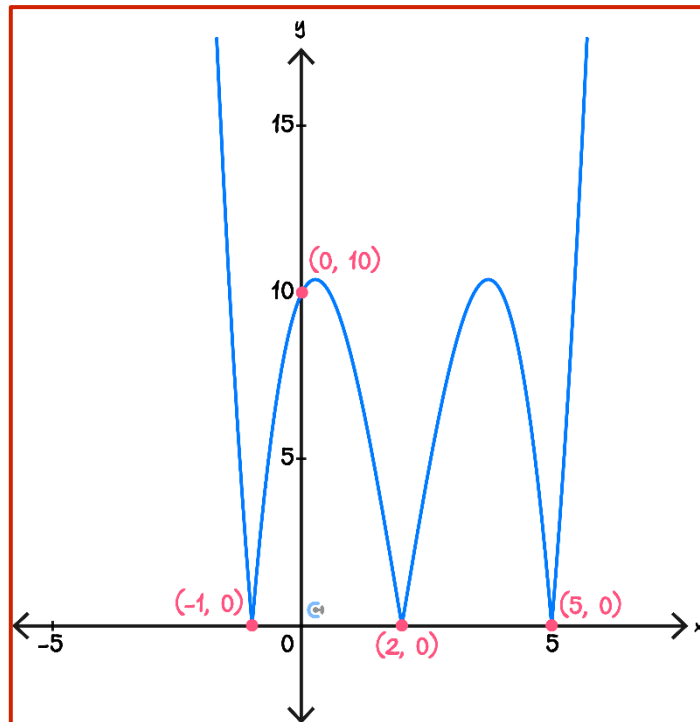


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Question 19



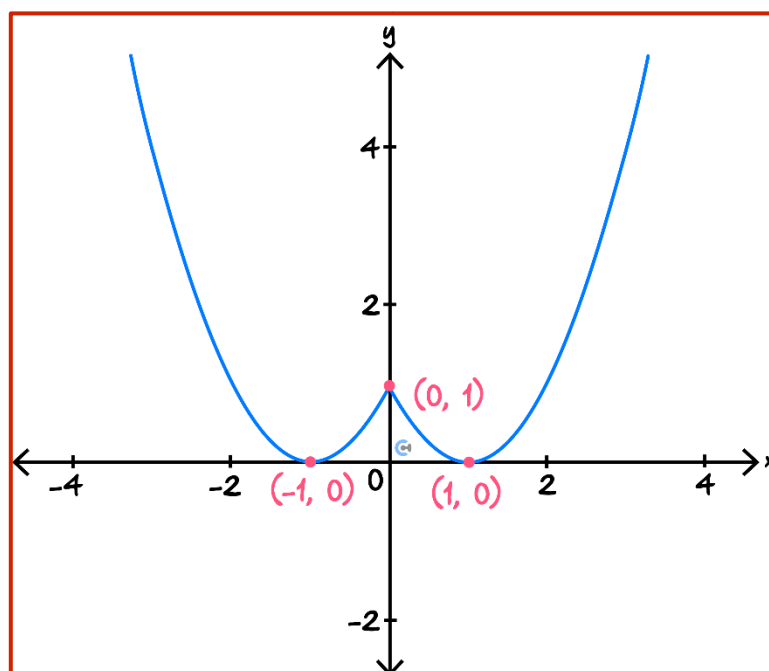
Sketch the graph of the function $f(x) = |(x - 2)(x + 1)(x - 5)|$. Label any axis intercepts.



Question 20



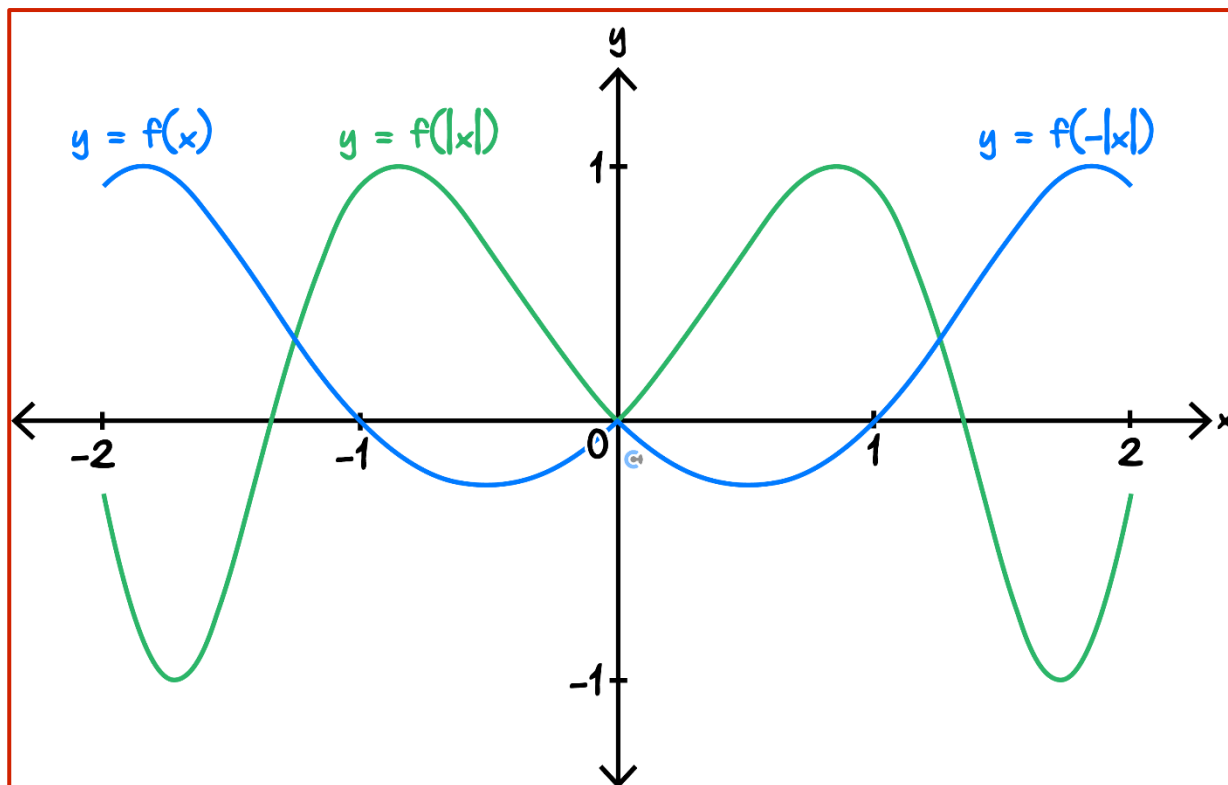
Sketch the graph of the function $y = f(|x|)$ where $f(x) = (x - 1)^2$. Label any axis intercepts.



Question 21



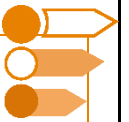
Sketch the graphs of the functions $y = f(|x|)$ and $y = f(-|x|)$ in the interval $-2 < x < 2$ where the graph of $y = f(x)$ is shown below.



$y = f(|x|)$ is the right (positive) side of the graph reflected in the y -axis
 $y = f(-|x|)$ is the left (negative) side of the graph reflected in the y -axis

Space

Sub-Section: Apply Partial Fractions to Find a Decomposed Form



Question 22



Perform partial fraction decomposition to write the following functions in the form specified below.

a. $\frac{6x+2}{(x-3)(x+1)} = \frac{A}{x-3} + \frac{B}{x+1}$

$$A(x+1) + B(x-3) = 6x+2$$

$$x=3 \implies 4A=20 \implies A=5$$

$$x=-1 \implies -4B=-4 \implies B=1$$

$$\frac{6x+2}{(x-3)(x+1)} = \frac{5}{x-3} + \frac{1}{x+1}.$$

b. $\frac{5x^2-24x+29}{(x-3)^2(x-2)} = \frac{A}{x-3} + \frac{B}{(x-3)^2} + \frac{C}{x-2}$

$$A(x-3)(x-2) + B(x-2) + C(x-3)^2 = 5x^2 - 24x + 29$$

$$x=3 \implies B=2$$

$$x=2 \implies C=1$$

$$Ax^2 + x^2 = 5x^2 \implies A=4$$

$$\frac{5x^2 - 24x + 29}{(x-3)^2(x-2)} = \frac{4}{x-3} + \frac{2}{(x-3)^2} + \frac{1}{x-2}$$

c. $\frac{7x^2-3x+14}{(x-1)(x^2+3x+5)} = \frac{A}{x-1} + \frac{Bx+C}{x^2+3x+5}$

$$A(x^2 + 3x + 5) + (Bx + C)(x - 1) = 7x^2 - 3x + 14$$

$$x = 1 \implies 9A = 18 \implies A = 2$$

$$10 - C = 14 \implies C = -4$$

$$2x^2 + Bx^2 = 7x^2 \implies B = 5$$

$$\frac{7x^2 - 3x + 14}{(x - 1)(x^2 + 3x + 5)} = \frac{2}{x - 1} + \frac{5x - 4}{x^2 + 3x + 5}$$

Question 23



Perform partial fraction decomposition to the following functions.

a. $\frac{8x-12}{x^2-2x-3}$

$$\frac{8x - 12}{x^2 - 2x - 3} = \frac{A}{x + 1} + \frac{B}{x - 3}$$

$$A(x - 3) + B(x + 1) = 8x - 12$$

$$x = 3 \implies 4B = 12 \implies B = 3$$

$$x = -1 \implies -4A = -20 \implies A = 5$$

$$\frac{8x - 12}{x^2 - 2x - 3} = \frac{5}{x + 1} + \frac{3}{x - 3}$$

b. $\frac{7x^2+6x-8}{x^3+2x^2}$

$$\frac{7x^2+6x-8}{x^3+2x^2} = \frac{7x^2+6x-8}{x^2(x+2)} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x+2}$$

$$Ax(x+2) + B(x+2) + Cx^2 = 7x^2+6x-8$$

$$x = -2 \implies 4C = 8 \implies C = 2$$

$$x = 0 \implies 2B = -8 \implies B = -4$$

$$Ax^2 + 2x^2 = 7x^2 \implies A = 5$$

$$\frac{7x^2+6x-8}{x^3+2x^2} = \frac{5}{x} - \frac{4}{x^2} + \frac{2}{x+2}$$

c. $\frac{6x^3-x-6}{x^4-2x^3}$

$$\frac{6x^3-x-6}{x^4-2x^3} = \frac{6x^3-x-6}{x^3(x-2)} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x^3} + \frac{D}{x-2}$$

$$Ax^2(x-2) + Bx(x-2) + C(x-2) + Dx^3 = 6x^3-x-6$$

$$x = 2 \implies 8D = 40 \implies D = 5$$

$$x = 0 \implies -2C = -6 \implies C = 3$$

$$Ax^3 + 5x^3 = 6x^3 \implies A = 1$$

$$-2x^2 + Bx^2 = 0x^2 \implies B = 2$$

$$\frac{6x^3-x-6}{x^4-2x^3} = \frac{1}{x} + \frac{2}{x^2} + \frac{3}{x^3} + \frac{5}{x-2}$$

Space for Personal Notes



Question 24

Perform partial fraction decomposition to the following functions.

a. $\frac{x^3 - 4x^2 + 18}{x^2 + x - 2}$

Perform polynomial long division/compare coefficients to obtain

$$\begin{aligned}\frac{x^3 - 4x^2 + 18}{x^2 + x - 2} &= \frac{(x^2 + x - 2)(x - 5) + 8 + 7x}{x^2 + x - 2} \\ &= x - 5 + \frac{8 + 7x}{x^2 + x - 2} \\ &= x - 5 + \frac{8 + 7x}{(x + 2)(x - 1)} \\ &= x - 5 + \frac{A}{x + 2} + \frac{B}{x - 1}\end{aligned}$$

$$A(x - 1) + B(x + 2) = 7x + 8$$

$$x = 1 \implies 3B = 15 \implies B = 5$$

$$x = -2 \implies -3A = -6 \implies A = 2$$

$$\frac{x^3 - 4x^2 + 18}{x^2 + x - 2} = x - 5 + \frac{2}{x + 2} + \frac{5}{x - 1}$$

b. $\frac{x^4 + x^3 - x^2 - x - 3}{x^2 - x - 2}$

Perform polynomial long division/compare coefficients to obtain

$$\begin{aligned}\frac{x^4 + x^3 - x^2 - x - 3}{x^2 - x - 2} &= \frac{(x^2 - x - 2)(x^2 + 2x + 3) + 3 + 6x}{x^2 - x - 2} \\ &= x^2 + 2x + 3 + \frac{3 + 6x}{(x - 2)(x + 1)} \\ &= x^2 + 2x + 3 + \frac{A}{x - 2} + \frac{B}{x + 1}\end{aligned}$$

$$A(x + 1) + B(x - 2) = 6x + 3$$

$$x = -1 \implies -3B = -3 \implies B = 1$$

$$x = 2 \implies 3A = 15 \implies A = 5$$

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

c. $\frac{7x^4+10x^3+24x^2-38x-35}{(x-1)(x^2+2x+5)}$

Perform polynomial long division/compare coefficients to obtain

$$\begin{aligned}\frac{7x^4+10x^3+24x^2-38x-35}{(x-1)(x^2+2x+5)} &= \frac{(x^3+x^2+3x-5)(7x+3)-20-12x}{x^3+x^2+3x-5} \\ &= 7x+3 + \frac{-20-12x}{(x-1)(x^2+2x+5)} \\ &= 7x+3 + \frac{A}{x-1} + \frac{Bx+C}{x^2+2x+5}\end{aligned}$$

$$A(x^2+2x+5) + (Bx+C)(x-1) = -12x-20$$

$$x=1 \implies 8A = -32 \implies A = -4$$

$$-4x^2 + Bx^2 = 0x^2 \implies B = 4$$

$$-20 - C = -20 \implies C = 0$$

$$\frac{7x^4+10x^3+24x^2-38x-35}{(x-1)(x^2+2x+5)} = 7x+3 - \frac{4}{x-1} + \frac{4x}{x^2+2x+5}$$

Question 25



Perform partial fraction decomposition to the function $f(x) = \frac{x^6+4x^5-x^4+x^3-27x^2-9x+22}{(x-2)(x^2+x+4)}$.

Perform polynomial long division/compare coefficients to obtain

$$\begin{aligned}\frac{x^6+4x^5-x^4+x^3-27x^2-9x+22}{(x-2)(x^2+x+4)} &= \frac{(x^3-x^2+2x-8)(x^3+5x^2+2x+1)+30+5x+10x^2}{x^3-x^2+2x-8} \\ &= x^3+5x^2+2x+1 + \frac{30+5x+10x^2}{(x-2)(x^2+x+4)} \\ &= x^3+5x^2+2x+1 + \frac{A}{x-2} + \frac{Bx+C}{x^2+x+4}\end{aligned}$$

$$A(x^2+x+4) + (Bx+C)(x-2) = 10x^2+5x+30$$

$$x=2 \implies 10A = 40+10+30 \implies A = 8$$

$$8x^2 + Bx^2 = 10x^2 \implies B = 2$$

$$32 - 2C = 30 \implies C = 1$$

$$\frac{x^6+4x^5-x^4+x^3-27x^2-9x+22}{(x-2)(x^2+x+4)} = x^3+5x^2+2x+1 + \frac{8}{x-2} + \frac{2x+1}{x^2+x+4}$$



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