

70 pts possible

$$\textcircled{1} (x-3)^2 (x-(3-7i))(x-(3+7i))(x+5)^2$$

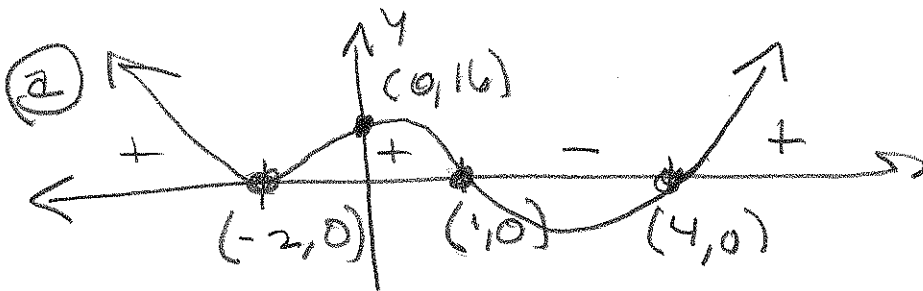
$$x=3, m=2; x=3-7i, m=1; x=-5, m=2$$

$$\textcircled{2} P(x) = 3x^5 - 7x^4 + x^2 - 10x - 5. \text{ we find } P(-2).$$

$$\begin{array}{r} -2 \overline{) 3 \quad -7 \quad 0 \quad 1 \quad -10 \quad -5} \\ \underline{-6 \quad 26 \quad -52 \quad 102 \quad -184} \\ 3 \quad -13 \quad 26 \quad -51 \quad 92 \quad -189 = P(-2) \end{array}$$

$$\textcircled{3} \#2 \Rightarrow P(x) = (x+2)(3x^4 - 13x^3 + 26x^2 - 51x + 92) - 189$$

$$\textcircled{4} f(x) = (x-1)(x+2)^2(x-4) = x^4 - x^3 - 12x^2 - 4x + 16$$



$$\textcircled{b} (x-1)(x+2)^2(x-4) \leq 0$$

$$\Rightarrow x \in \{-2\} \cup [1, 4]$$

$$\textcircled{c} \frac{(x+2)^2}{(x-1)(x-4)} \geq 0$$

$$\Rightarrow x \in (-\infty, 1) \cup (4, \infty)$$

$x=1, x=4$  "bad"

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⑤  $f(x) = 2x^4 - 4x^3 + 3x^2 - x - 10$

$\pm 1, \pm \frac{1}{2}, \pm 2, \pm \frac{2}{2}, \pm 5, \pm \frac{5}{2}, \pm 10, \pm \frac{10}{2}$

$$\begin{array}{r} \underline{1) 2 \quad -4 \quad 3 \quad -1 \quad -10} \\ \phantom{1) 2} \quad 2 \quad -2 \quad 1 \quad 1 \\ \hline 2 \quad -2 \quad 1 \quad 0 \quad \text{NO} \end{array}$$

$$\begin{array}{r} \underline{-1) 2 \quad -4 \quad 3 \quad -1 \quad -10} \\ \phantom{-1) 2} \quad -2 \quad 6 \quad -9 \quad 10 \\ \hline \end{array} \text{Yes!}$$

$$\begin{array}{r} \underline{-1) 2 \quad -6 \quad 9 \quad -10} \\ \phantom{-1) 2} \quad -2 \quad 8 \\ \hline 2 \quad -8 \quad \text{NO} \end{array}$$

$$\begin{array}{r} \underline{2) 2 \quad -6 \quad 9 \quad -10} \\ \phantom{2) 2} \quad 4 \quad -4 \quad 10 \\ \hline 2 \quad -2 \quad 5 \quad 0 \end{array} \text{Yes!}$$

$a=2, b=-2, c=5$

$b^2 - 4ac = (-2)^2 - 4(2)(5) = 4 - 40 = -36$  So,  $2x^2 - 2x + 5$  is Irreducible over  $\mathbb{R}$

Real zeros:  $x = -1, 2$

$$f(x) = (x+1)(x-2)(2x^2 - 2x + 5)$$

⑥  $x = \frac{2 \pm \sqrt{-36}}{2(2)} = \frac{2 \pm 6i}{4} = \frac{1 \pm 3i}{2}$

$$f(x) = 2(x+1)(x-2)\left(x - \left(\frac{1+3i}{2}\right)\right)\left(x - \left(\frac{1-3i}{2}\right)\right)$$

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$$\textcircled{7} R(x) = \frac{x^2 - 3x - 10}{x^2 - x - 6} = \frac{(x-5)(x+2)}{(x-3)(x+2)} = \frac{x-5}{x-3}, x \neq -2$$

$$D = \mathbb{R} \setminus \{-2, 3\}$$

$$\boxed{\text{V.A.: } x=3}$$

$$\text{HOLE: } x=-2$$

$$\frac{-2-5}{-2-3} = \frac{-7}{-5} = \frac{7}{5}$$

$$\boxed{\text{HOLE: } (-2, \frac{7}{5})}$$

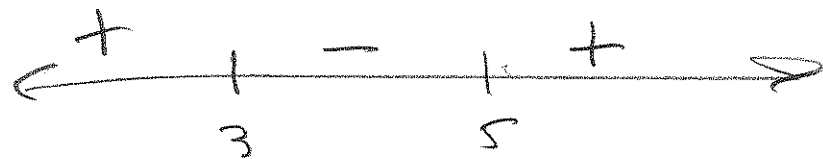
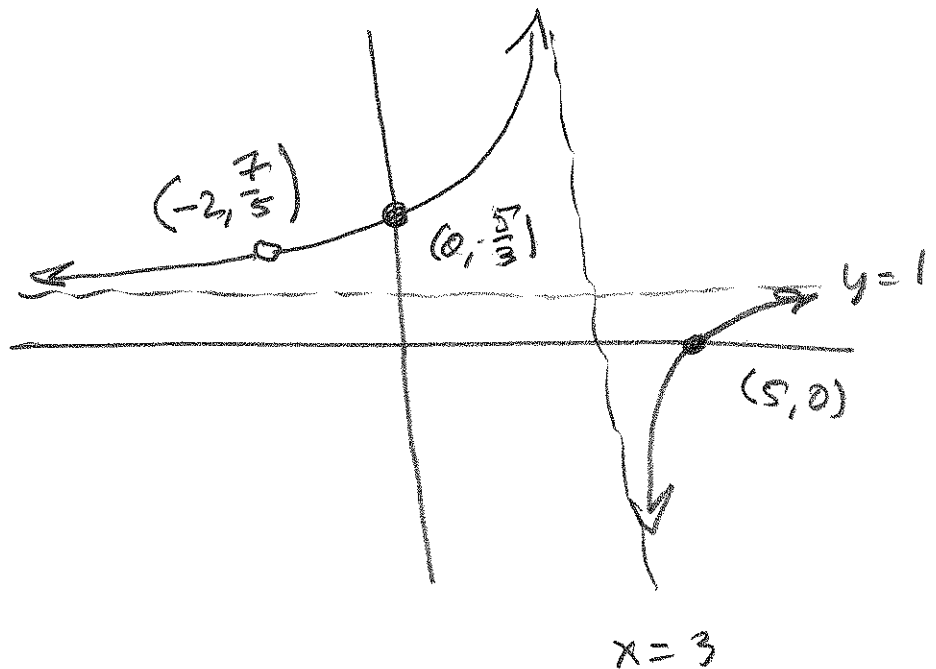
$$\boxed{\text{H.A.: } y = \frac{x^2}{x^2} = 1}$$

$$\boxed{y=1 \text{ H.A.}}$$

$$R(0) = \frac{10}{6} = \frac{5}{3}$$

$$\boxed{(0, \frac{5}{3}) \text{ y-int}}$$

$$\boxed{x\text{-int: } (5, 0)}$$



$$\textcircled{8} (x-3-2i)(x-3+2i)$$

$$= x^2 - 3x + 2ix - 3x + 9 - 6i - 2ix + 6i - 4i^2$$

$$= x^2 - 6x + 9 + 4$$

$$\boxed{x^2 - 6x + 13}$$

B1 We want RATIONAL coefficients.

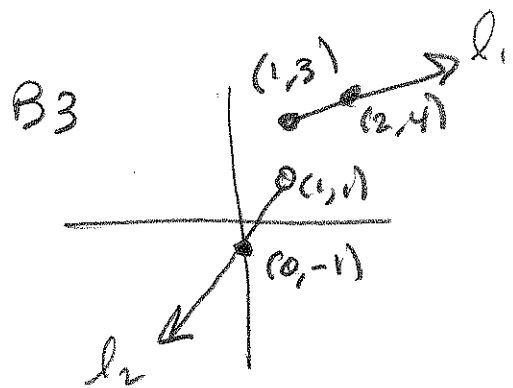
zeros:  $x=2+\sqrt{3}, m=1$ ;  $x=2+3i, m=2$ ;  $x=5, m=17$

$$f(x) = (x - (2 + \sqrt{3}))(x - (2 - \sqrt{3})) (x - (2 + 3i))^2 (x - (2 - 3i))^2 (x - 5)^{17}$$

B2  $B_y \neq \mathbb{C}$ ,  $D = (-\infty, 1) \cup (4, \infty)$  for

$$y = \sqrt{\frac{(x+2)^2}{(x-1)(x-4)}}$$

$$y = m(x - x_1) + y_1 \quad m = \frac{y_2 - y_1}{x_2 - x_1}$$



$$l_1: m = \frac{4-3}{2-1} = \frac{1}{1} = 1$$

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

$$l_2: m = \frac{1 - (-1)}{1 - 0} = \frac{2}{1} = 2$$

$$y = 2(x - 0) - 1 = 2x - 1$$

$$f(x) = \begin{cases} x+2, & x \geq 1 \\ 2x-1, & x < 1 \end{cases}$$

$$B4 \quad \frac{(x-5)(x+2)(x-1)}{(x+2)(x-3)} = \frac{(x-5)(x-1)}{x-3} \quad x \neq -2$$

$$D: \mathbb{R} \setminus \{-2, 3\}$$

V.A.  $x=3$

HOLE:  $x=-2$

$$\frac{(-2-5)(-2-1)}{-2-3}$$

$$= \frac{(-7)(-3)}{-5} = \frac{21}{-5}$$

HOLE:  $(-2, -\frac{21}{5})$

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

$$\begin{array}{r} 3 \overline{) 1 \ -6 \ 5} \\ \underline{3 \ -9} \\ 1 \ -3 \ -4 \end{array}$$

x-intercepts:  
(1, 0), (5, 0)

y-intercept:  
(0, 5/3)

$y = x - 3 \rightarrow$  O.A.