

121 E3

1) 10 pts $(x-1)^3 (x-3+i)^2 (x-3-i)^2 (x-2)$

2) 10 pts

3	7	-2	11	1	-173	-4
		21	57	204	615	1326
7	19	68	205	442	1322 = P(3)	

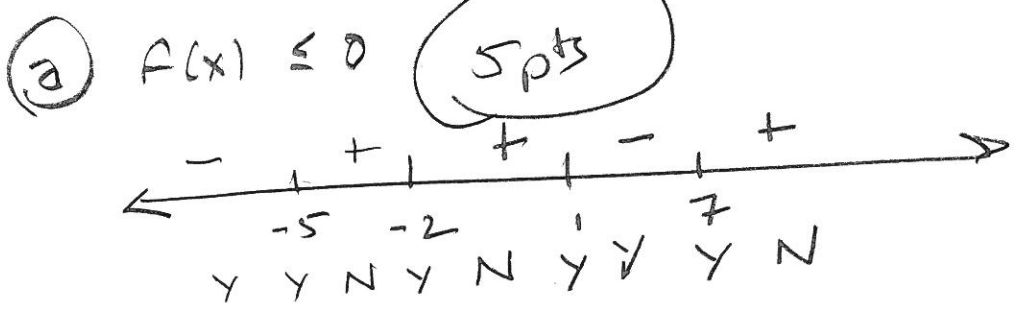
$$\begin{array}{r} 268 \\ 3 \\ \hline 204 \end{array}$$

$$\begin{array}{r} 442 \\ 3 \\ \hline 1326 \end{array}$$

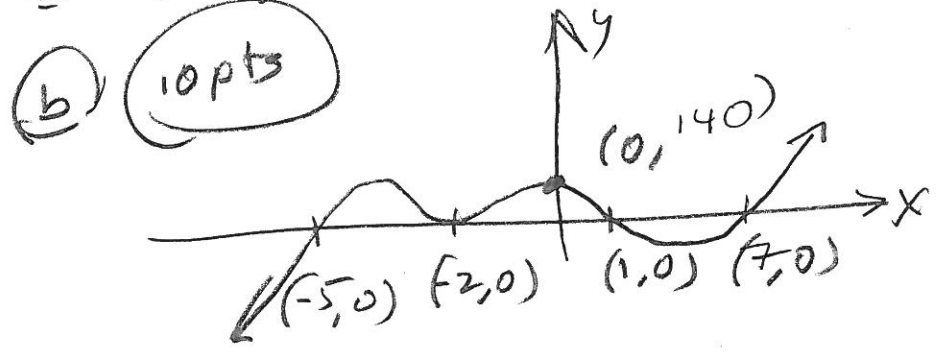
3) 5 pts

$$P(x) = (x-3)(7x^4 + 19x^3 + 68x^2 + 205x + 442) + 1322$$

4) $(x+2)^2 (x-1)^3 (x-7)(x+5) = x^7 + \dots + 140 = P(x)$



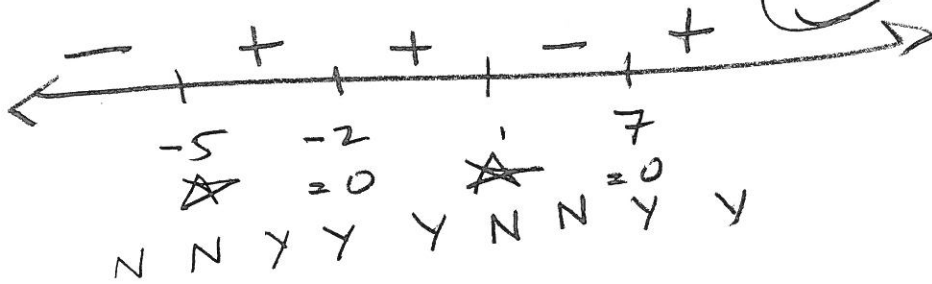
= $(-\infty, -5] \cup \{-2\} \cup [1, 7]$



(4) (c)

$$\frac{(x+2)^3(x-7)}{(x-1)^3(x+5)} \geq 0$$

5pts



$$= (-5, 1) \cup [7, \infty)$$

(5) $f(x) = 4x^5 + 16x^4 + 25x^3 + 23x^2 - 16x - 5^2$

5pts

(a) 1 positive root

$$f(-x) = -4x^5 + 16x^4 - 25x^3 + 23x^2 + 16x - 5^2$$

~~4, 2, or 0~~

4, 2, or 0 negative roots

$$\begin{array}{r} 2 \overline{) 52} \\ 2 \overline{) 26} \\ 13 \end{array}$$

(b) 5pts

$$\pm 1, \pm 2, \pm 4, \pm 13, \pm 26, \pm 52$$

$$\pm \frac{1}{2}, \pm \frac{2}{2}, \pm \frac{4}{2}, \pm \frac{13}{2}, \pm \frac{26}{2}, \pm \frac{52}{2}$$

$$\pm \frac{1}{4}, \pm \frac{2}{4}, \pm \frac{4}{4}, \pm \frac{13}{4}, \pm \frac{26}{4}, \pm \frac{52}{4}$$

10 possibilities.

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Bonus

Spts

$$\begin{array}{r}
 2 \mid 4 \quad 16 \quad 25 \quad 23 \quad -16 \quad -52 \\
 \quad \quad 8 \quad 48 \quad 146 \\
 \hline
 \end{array}$$

All POS \rightarrow 4 24 73 169
 $x=2$ is u. b. on real zeros

$$\begin{array}{r}
 -3 \mid 4 \quad 16 \quad 25 \quad 23 \quad -16 \quad -52 \\
 \quad \quad -12 \quad -12 \\
 \hline
 4 \quad 4 \quad \text{None}
 \end{array}$$

$$\begin{array}{r}
 -4 \mid 4 \quad 16 \quad 25 \quad 23 \quad -16 \quad -52 \\
 \quad \quad -16 \quad 0 \quad -100 \quad 308 \quad -1168 \\
 \hline
 \end{array}$$

Signs Alternate

$$\begin{array}{r}
 \rightarrow 4 \quad 0 \quad 25 \quad -77 \quad 292 \quad -1220
 \end{array}$$

counts as " - " in these

$x=-4$ is l. b. on real zeros.

By later work, we see that $x=-3$ is, too, but this test doesn't show it

6

10/15

$$\begin{array}{r}
 1 \mid 4 \quad 16 \quad 25 \quad 23 \quad -16 \quad -52 \\
 \hline
 \quad 4 \quad 20 \quad 45 \quad 68 \quad 52 \\
 \hline
 -2 \mid 7 \quad 20 \quad 45 \quad 68 \quad 52 \quad 0 \\
 \quad -8 \quad -24 \quad -42 \quad -52 \\
 \hline
 -2 \mid 4 \quad 12 \quad 21 \quad 26 \quad 0 \\
 \quad -8 \quad -8 \quad -26 \\
 \hline
 4 \quad 4 \quad 13
 \end{array}$$

~~10/15~~

$$\begin{array}{r}
 16 \\
 13 \\
 \hline
 48 \\
 16 \\
 \hline
 208 \\
 -16 \\
 \hline
 192
 \end{array}$$

a=4, b=4, c=13

$$b^2 - 4ac = 4^2 - 4(4)(13) = 16 - 208 = -192 \text{ No more roots.}$$

$$\rightarrow f(x) = (x-1)(x+2)^2(4x^2+4x+13)$$

$$\begin{array}{l}
 x=1, m=1 \\
 x=-2, m=2
 \end{array}$$

7

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-4 \pm 8\sqrt{3}i}{2(4)} = \frac{4(-1 \pm 2i\sqrt{3})}{8} = \frac{-1 \pm 2i\sqrt{3}}{2}$$

$$\begin{array}{r}
 2 \mid 192 \\
 2 \mid 96 \\
 2 \mid 48 \\
 2 \mid 24 \\
 2 \mid 12 \\
 2 \mid 6 \\
 3
 \end{array}$$

$$\begin{array}{l}
 \sqrt[3]{192} \\
 = 8\sqrt[3]{3}
 \end{array}$$

$$f(x) = 4(x-1)(x+2)^2 \left(x - \left(\frac{-1+2i\sqrt{3}}{2}\right)\right) \left(x - \left(\frac{-1-2i\sqrt{3}}{2}\right)\right)$$

SPTS

$$\begin{array}{l}
 x=1, m=1 \\
 x=-2, m=2 \\
 x = \frac{-1 \pm 2i\sqrt{3}}{2}, m=1
 \end{array}$$

8 $R(x) = \frac{3x^3 - 14x^2 + 23x - 10}{x^2 - x - 2}$ ϕ B3

$D = \mathbb{R} \setminus \{-1, 2\}$

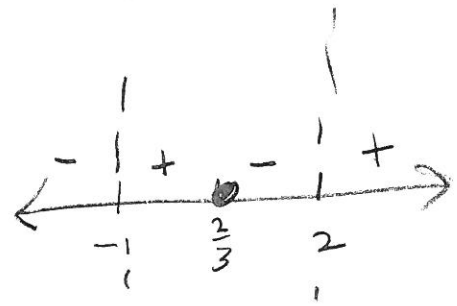
V.A.: $x = -1, x = 2$

$y = 3x - 11$ O.A.

$x^2 - x - 2 \quad \begin{array}{r} 3x^3 - 14x^2 + 23x - 10 \\ - (3x^3 - 3x^2 - 6x) \\ \hline -11x^2 \end{array}$

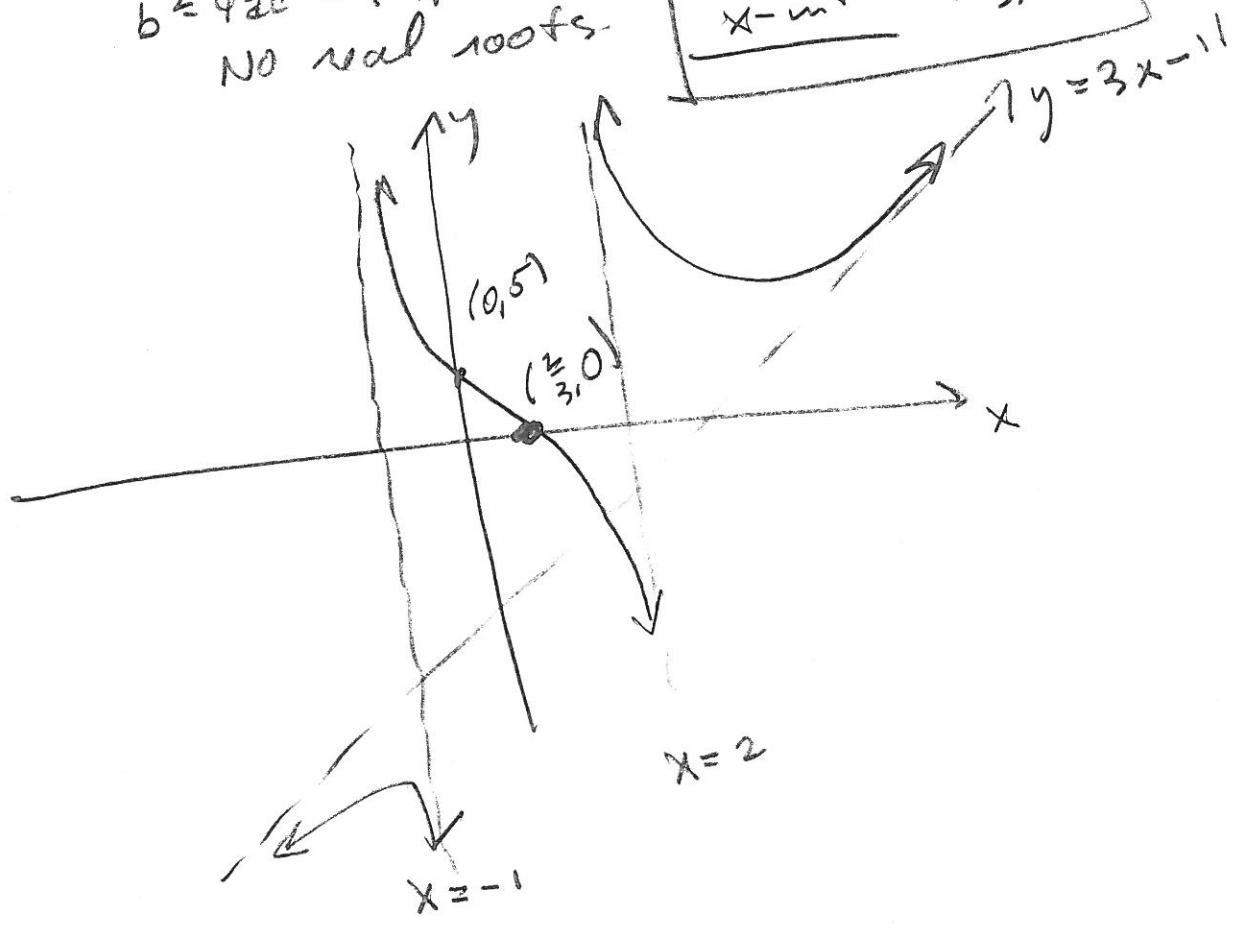
y-int: $(0, 5)$

$\frac{2}{3}$	3	-14	23	-10
		2	-8	10
	3	-12	15	0



$3(x^2 - 4x + 5) = 0$
 $b^2 - 4ac = (-4)^2 - 4(1)(5) = 16 - 20 = -4$
 No real roots.

x-int: $(\frac{2}{3}, 0)$



$$(9) \quad F(x) = \frac{3x^2 - 14x + 15}{x^2 - 5x - 14} = \frac{(3x-5)(x-3)}{(x-7)(x+2)}$$

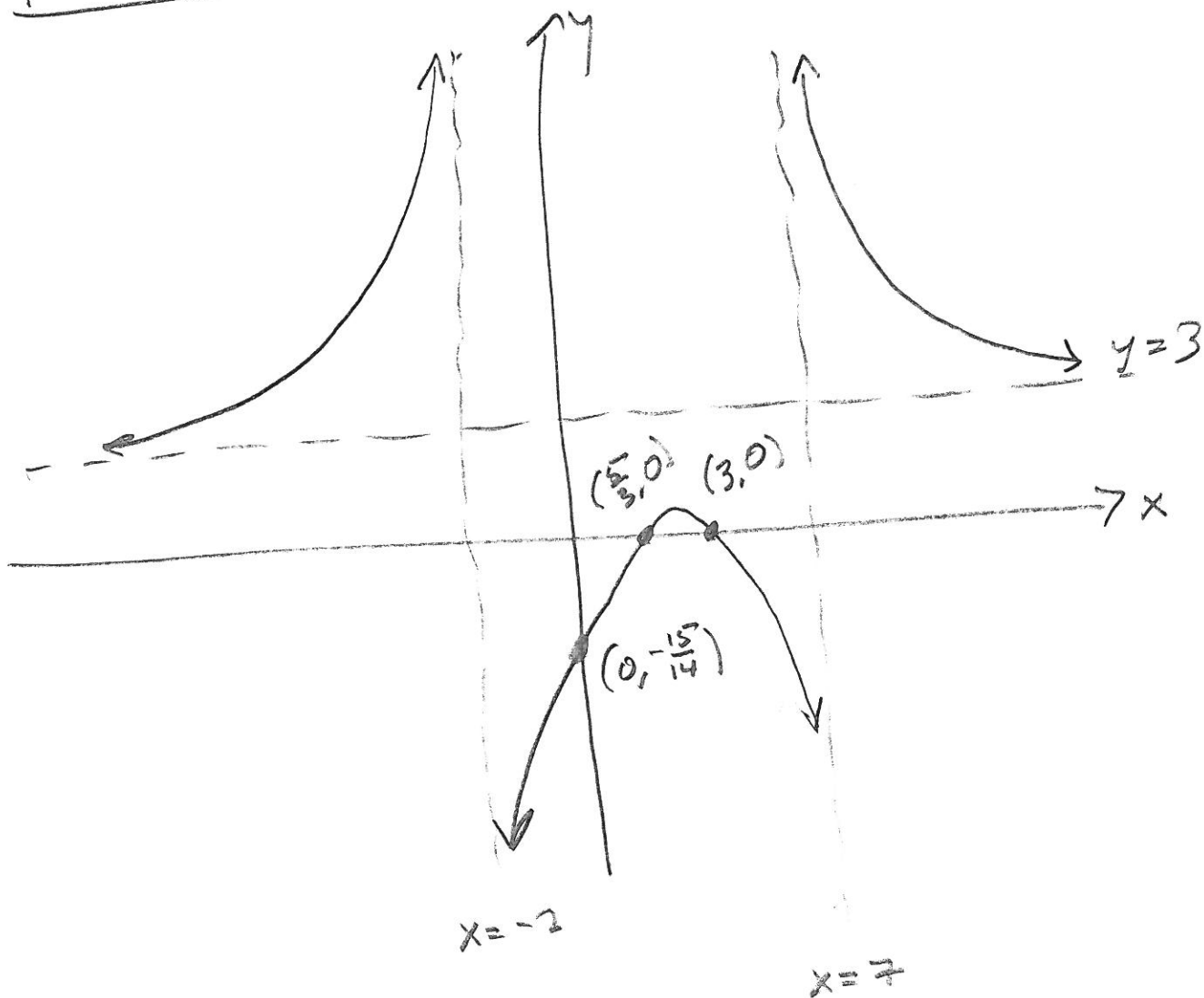
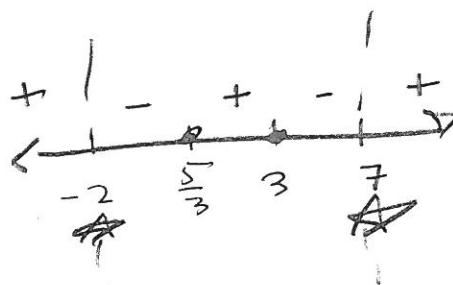
$$D = \mathbb{R} \setminus \{-2, 7\}$$

$$V.A.: \quad x = -2, x = 7$$

$$H.A.: \quad \frac{3x^2}{x^2} = 3 = y$$

$$y\text{-Achse: } (0, -\frac{15}{14})$$

$$x\text{-Achse: } (\frac{5}{3}, 0), (3, 0)$$



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E3

B1

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

B2

$$|2x - 5| + 5 \geq 7$$

$$|2x - 5| \geq 2$$

a

$$2x - 5 \geq 2 \quad \text{OR} \quad 2x - 5 \leq -2$$

$$2x \geq 7 \quad \text{OR} \quad 2x \leq 3$$

$$x \geq \frac{7}{2} \quad \text{OR} \quad x \leq \frac{3}{2}$$

$$(-\infty, \frac{3}{2}] \cup [\frac{7}{2}, \infty)$$

b

$$|2x - 5| + 7 < 5$$

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

$$\emptyset$$

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E3

B4

$$\frac{3x^3 - 5x^2 - 27x + 45}{x^3 - 2x^2 - 29x - 42} = \frac{(3x-5)(x-3)(x-c)}{(x-7)(x+2)(x-c)}$$

Find c:

$$\begin{array}{r|rrrr} 7 & 1 & -2 & -29 & -42 \\ & & 7 & 35 & 42 \\ \hline & 1 & 5 & 6 & \\ -2 & & -2 & -6 & \\ \hline & 1 & 3 & & \end{array}$$

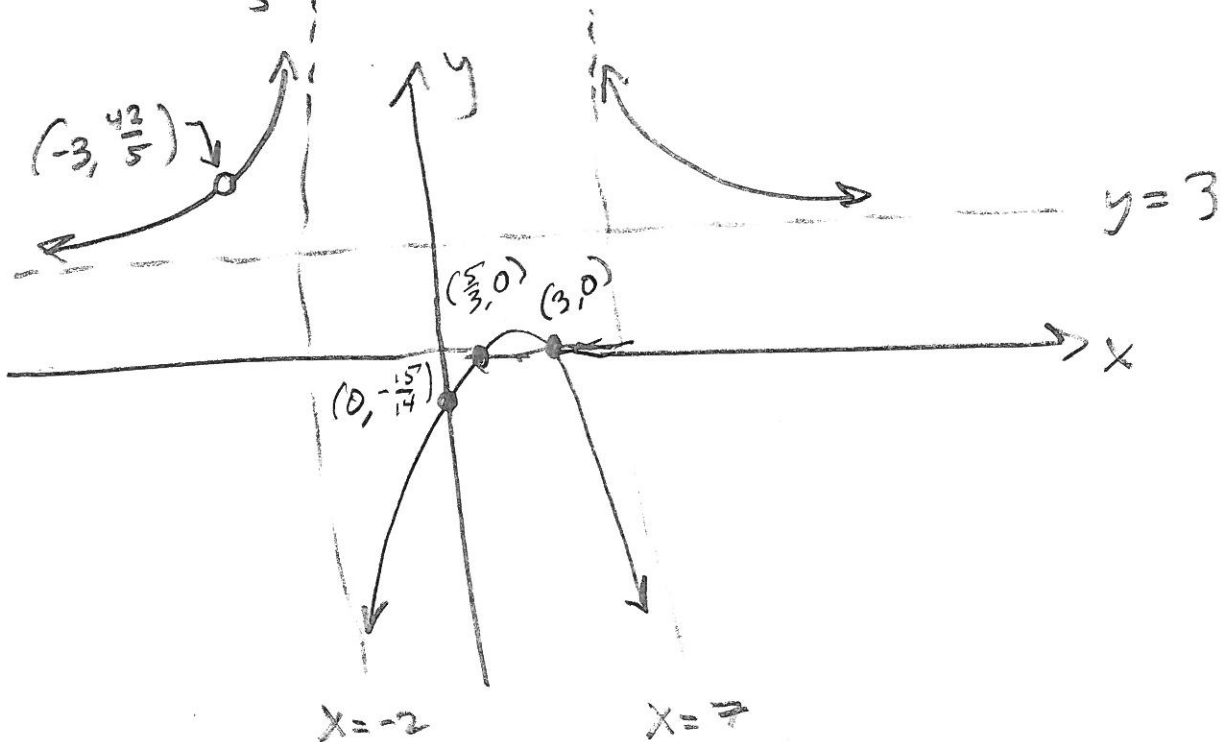
Hole \circlearrowleft
 $x = -3$

$$x - c = x + 3$$

$$-c = 3$$

$$c = -3$$

$$f(-3) = \frac{(3(-3)-5)(-3-3)}{(-3-7)(-3+2)} = \frac{(-14)(-6)}{(-10)(-1)} = \frac{(-7)(-6)}{5}$$

 $\left(-3, \frac{42}{5}\right)$ is hole.


12i E3

(BS)

Let $x = \#$ of hours John works.

Then $\frac{1}{5}x + \frac{1}{8}(x+2) = 1$

$$8x + 5x + 10 = 40$$

$$13x = 30$$

$$x = \frac{30}{13} \text{ for John.}$$

$$x + 2 = \frac{30}{13} + 2 = \frac{30}{13} + \frac{26}{13} = \frac{56}{13} \text{ for Jill}$$

hrs