Give the SMALLEST degree polynomial with the given roots. Write the conjugates, if any.

1. $5,\ \frac{1}{2},\ 3i,\ 2-\sqrt{7}$

$-3i$ $2+\sqrt{7}$

(6)

2. $-\frac{8}{5},\ 1-13i,\ i$

$1+13i, -i$

(5)

3. $5-\sqrt{2},\ \frac{1+3i}{2},\ 3i,\ 2-\sqrt{7}$

$5+\sqrt{2}$, $\frac{1-3i}{2}$, $-3i$, $2+\sqrt{7}$

(8)

4. $-4,\ \frac{3}{7},\ 3,\ 2$

(4)

PRR- Possible Rational Roots. Cross out the roots that CANNOT be a root of the polynomial. $\frac{P}{Q}$: List factors. Every combination

Q P

5. $P(x)=6x^5-4x^4+x^2-2x+1$ $\frac{\pm 1}{\pm 6}$; $\frac{\pm 1}{1,2,3,6}$ $\pm 1, \pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{1}{6}$

1/6 ✓	-1/2 ✓	~~1/4~~	1/3 ✓	~~3~~
~~6~~	-1	~~$\sqrt{6}$~~	~~12~~	~~2~~

6. $P(x)=2x^5-4x^4+x^2-2x-5$ $\frac{5}{2}$; $\frac{1,5}{1,2}$; $\pm 1, \pm\frac{1}{2}, \pm 5, \pm\frac{5}{2}$

~~2/5~~	-1/2 ✓	-5 ✓	5 ✓	1 ✓
~~2~~	~~$\sqrt{5}$~~	~~10~~	~~-4~~	~~-2~~

7. $P(x)=12x^6-4x^4+x^2-2x+4$ $\frac{\pm 1,2,4}{\pm 1,2,3,4,6,12}$

2/3 ✓	-1/2 ✓	1/4 ✓	1/3 ✓	-4 ✓
~~6~~	-1 ✓	1/12 ✓	~~-12~~	-2 ✓

8. $P(x)=7x^5-4x^4+x^2-2x+8$ $\frac{\pm 1,2,4,8}{\pm 1,7}$

~~7/8~~	~~7~~	~~1/4~~	~~7/4~~	~~7/2~~
-1/7 ✓	-1 ✓	-4/7 ✓	8 ✓	-2 ✓

Find ALL Roots. You may need to use synthetic division and the quadratic formula.

1. $P(x) = 7x^3 + 18x^2 - 97x - 60$ $-5, 3$

-5	7	18	-97	-60
		-35	85	60
	7	-17	-12	0 ✓
3		21	12	
	7	4	0	

$7x + 4 = 0$

$x = \frac{-4}{7}$

Roots: $-5, 3, \frac{-4}{7}$

2. $P(x) = 6x^3 + 5x^2 - 44x - 15$

-3	6	5	-44	-15
		-18	39	15
	6	-13	-5	0 ✓

A B C

$6x^2 - 13x - 5$

$x = \frac{13 \pm \sqrt{(13)^2 - 4(6)(-5)}}{2(6)}$

$x = \frac{13 \pm \sqrt{289}}{12}$

$x = \frac{13 \pm 17}{12} = \frac{13+17}{12} = \frac{5}{2}$ or $\frac{13-17}{12}$

Roots: $-3, \frac{5}{2}, \frac{-1}{3}$

Find ALL Roots. You may need to use synthetic division and the quadratic formula.

3. $P(x) = x^4 - 6x^3 - 7x^2 + 68x - 76$

2	1	-6	-7	68	-76
		2	-8	-30	76
	1	-4	-15	38	0
2		2	-4	-38	
	1	-2	-19	0 ✓	

Quad

$$X = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-19)}}{2(1)}$$

$$X = \frac{2 \pm \sqrt{72}}{2} = \frac{2 \pm 6\sqrt{2}}{2} = 1 \pm 3\sqrt{2}$$

Roots: 2 (double), $1 \pm 3\sqrt{2}$

4. $P(x) = 5x^4 + 82x^3 + 240x^2 + 254x + 91$

-1	5	82	240	254	91
		-5	-77	-163	-91
	5	77	163	91	0
-13		-65	-156	-90	
	5	12	7	0	

$$X = \frac{-12 \pm \sqrt{12^2 - 4(5)(7)}}{2(5)}$$

$$X = \frac{-12 \pm \sqrt{4}}{10} = \frac{-12 \pm 2}{10} = \frac{-12+2}{10} = -1$$

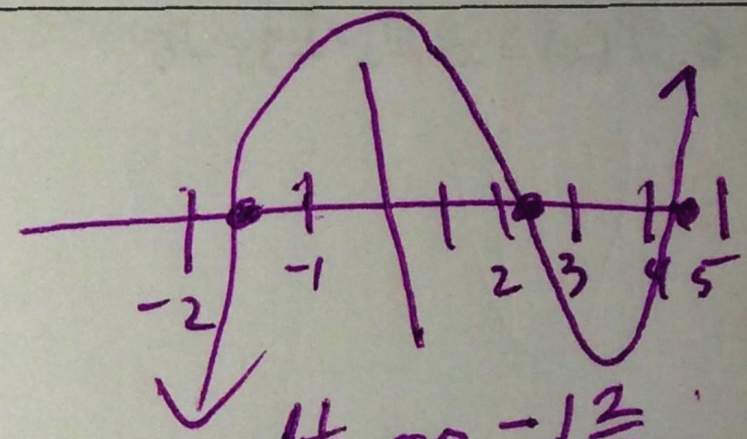
$$\frac{-12-2}{10} = \frac{-14}{10} = \frac{-7}{5}$$

Roots: $-1, -13, -1, -\frac{7}{5}$

Find ALL Roots. You may need to use synthetic division and the quadratic formula.

5. $P(x) = 3x^3 - 19x^2 + 2x + 70$

$\pm \frac{70}{\pm 3}$ 1, 3 ± 3



$-1\frac{1}{3}$ or $-1\frac{2}{3}$

$-\frac{4}{2}$. $-\frac{5}{3}$

$-\frac{5}{3}$ | 3   -19   2 | 70

    -5   ~~0~~ | -70

3. -24   ~~2~~ | 0

$$x = \frac{24 \pm \sqrt{(-24)^2 - 4(3)(42)}}{2(3)}$$

$$x = \frac{24 \pm \sqrt{72}}{6} = \frac{24 \pm 6\sqrt{2}}{6} = 4 \pm \sqrt{2}$$

Roots: $-\frac{5}{3}, 4 \pm \sqrt{2}$

Find ALL Roots. You may need to use synthetic division and the quadratic formula.

* 6. $P(x) = x^4 - x^3 - 3x - 6$

+x²

-1 | 1 -1 0 -3 | -6
-1 2 -3 | 6

2 | 1 -2 3 | -6 | 0
2 4 | 6

2 | 1 0 3 | 0

$x^2 + 3 = 0$

$x = \pm i\sqrt{3}$

Roots: $-1, 2, \pm i\sqrt{3}$

7. $P(x) = x^4 + 4x^3 - 3x^2 + 40x + 208$

-4 | 1 4 -3 40 | 208
-4 0 12 | -208

-4 | 1 0 -3 | 52 | 0
-4 16 | -50

1 -4 13 | 0
A B C

$x = \frac{4 \pm \sqrt{(-4)^2 - 4(1)(13)}}{2(1)}$

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

Roots: -4 (double), $2 \pm 3i$

Find ALL Roots. You may need to use synthetic division and the quadratic formula.

8. $P(x)=2x^4+11x^3+2x^2-65x-100$

-4	2	11	2	-65	-100
		-8	-12	40	100
	2	3	-10	-25	0
$\frac{5}{2}$		5	20	25	
	2	8	10	0	
	A	B	C		

$$x=\frac{-8\pm\sqrt{8^2-4(2)(10)}}{2(2)}$$

$$x=\frac{-8\pm\sqrt{-16}}{4}=\frac{-8\pm4i}{4}=-2\pm i$$

Roots:

$-4, \frac{5}{2}, -2\pm i$

9. Determine the remaining solutions given one solution is $3+2i$.

$P(x)=x^4-8x^3+21x^2-2x-52$

$3+2i$	1	-8	21	-2	-52
		$3+2i$	$(-19-4i)$	$(14-8i)$	52
$3-2i$	1	$(-5+2i)$	$(2-4i)$	$(12-8i)$	0
		$(3-2i)$	$(-6+4i)$	$-12+8i$	
	1	-2	-4	0	
	A	B	C		

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

$$x=\frac{2\pm\sqrt{20}}{2}=\frac{2\pm2\sqrt{5}}{2}=1\pm\sqrt{5}$$

Roots:

$3\pm2i, 1\pm\sqrt{5}$

$(3+2i)(-10+2i)-4$
$-30-16i+4i^2$

$(3+2i)(-28-16i)$
$-84-104i+32$

$(3+2i)(-179-104i)$