

#6

$$f(x) = x^4 - x$$

$$x(x^3 - 1)$$

pull out GCF

$$x(x-1)(x^2+x+1)$$

difference of
cubes

$$x(x-1)(x^2+x+1) = 0$$

ZPP

$$x=0 \text{ or } x-1=0 \text{ or } x^2+x+1=0$$

$$x=1$$

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

$$= \frac{-1 \pm \sqrt{-3}}{2}$$

zeros

$$x = \frac{-1 \pm \sqrt{3}i}{2}$$

$$\textcircled{\#20} \quad \underbrace{3x^3 - 2x^2}_{x^2(3x - 2)} - \underbrace{300x + 200}_{-100(3x - 2)}$$

$$x^2(\cancel{3x} - \cancel{2}) - 100(\cancel{3x} - \cancel{2})$$

$$(3x - 2)(x^2 - 100)$$

↖ $x^2 - 10^2$ diff of squares

$$(3x - 2)(x - 10)(x + 10) = 0$$

$$\boxed{x = \frac{2}{3} \quad x = \pm 10}$$

$$\textcircled{\#17} \quad \underbrace{x^4 - x^3} - \underbrace{27x + 27}$$

$$x^3(\underline{x-1}) - 27(\underline{x-1}) \quad \left. \vphantom{x^3} \right\} \text{grouping}$$

$$(x-1)(x^3-27) \quad \text{diff of cubes } x^3-3^3$$

$$(x-1)(x-3)(x^2+3x+9) = 0$$

$$\downarrow \quad \downarrow$$
$$\boxed{x=1} \quad \boxed{x=3}$$

$$\downarrow$$
$$x = \frac{-3 \pm \sqrt{9-36}}{2}$$

$$\sqrt{-27} = \sqrt{(-1)(9)(3)}$$
$$= \downarrow \quad \downarrow \quad \downarrow$$
$$= i \quad 3\sqrt{3}$$

$$\boxed{x = \frac{-3 \pm 3\sqrt{3}i}{2}}$$

$$\boxed{\#33} \quad X^3 + X^2 - 21X - 45$$

Guess + check for zeros
possible rational roots $\frac{\pm 1, \pm 3, \pm 5, \pm 9, \pm 15, \pm 45}{\pm 1, \pm 3, \pm 5, \pm 9, \pm 15, \pm 45}$

$$1^3 + 1^2 - 21(1) - 45 \neq 0$$

$$\cancel{(-1)^3} + \cancel{(-1)^2} - 21(-1) - 45 = 21 - 45 \neq 0$$

$$\begin{array}{r|rrrr} 3 & 1 & 1 & -21 & -45 \\ & & 3 & 12 & -27 \\ \hline & 1 & 4 & -9 & \end{array}$$

$$\begin{array}{r|rrrr} -3 & 1 & 1 & -21 & -45 \\ & & -3 & 6 & +45 \\ \hline & & -2 & -15 & \underline{0} \\ & \downarrow & \downarrow & \downarrow & \\ & & -2 & -15 & \end{array}$$

$$(X+3)(X^2 - 2X - 15) = 0$$

$$(X+3)(X+3)(X-5) = 0$$

$$\boxed{X = -3} \quad \boxed{X = 5}$$

double root

#36

$$x^4 + 4x^3 - 60x^2 - 256x - 256$$

possible rational roots $\pm 1, \pm 2, \pm 4, \pm 8, \dots$

$$\begin{array}{r|rrrrr} 2 & 1 & 4 & -60 & -256 & -256 \\ & & 2 & 12 & -96 & \\ \hline & 1 & 6 & -48 & & \end{array}$$

$$\begin{array}{r|rrrrr} -2 & 1 & 4 & -60 & -256 & -256 \\ & & -2 & -4 & 128 & 256 \\ \hline & 1 & 2 & -64 & -128 & 0 \end{array}$$

$$(x+2)(x^3 + 2x^2 - 64x - 128)$$

$$\begin{array}{r|rrrr} -2 & 1 & 2 & -64 & -128 \\ & & -2 & 0 & 128 \\ \hline & 1 & 0 & -64 & 0 \end{array}$$

$$(x+2)^2 (x^2 - 64)$$

$$(x+2)^2 (x-8)(x+8) = 0$$

Zeros

-2 (done)
 ± 8

HW

1-15 odd

18, 19

34, 37