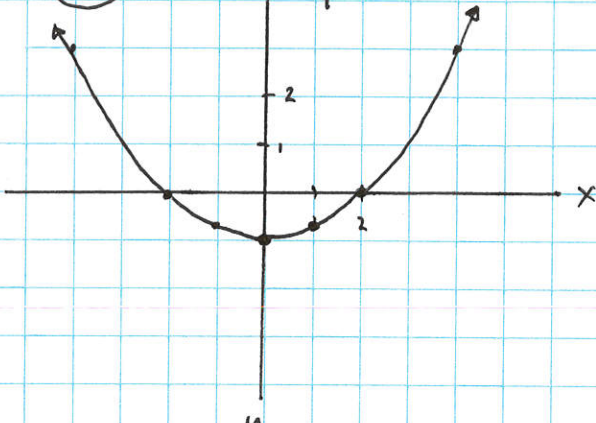




#20

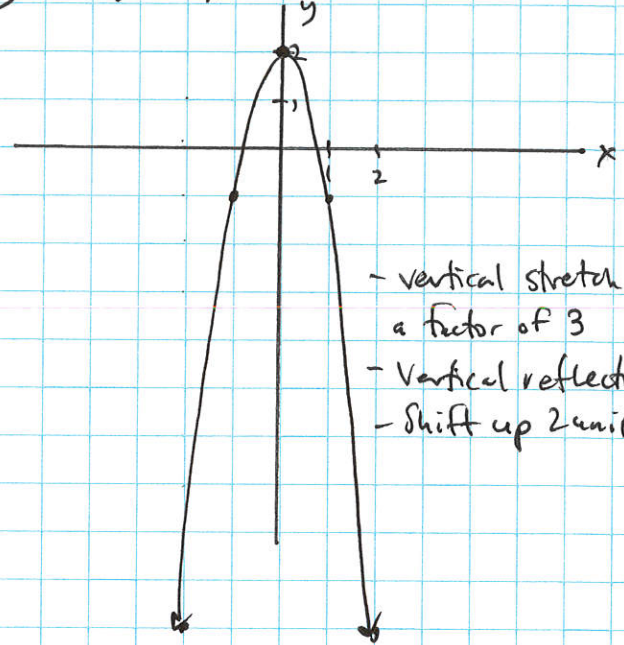
$$h(x) = \frac{1}{4}x^2 - 1$$



- vertical shrink by a factor of  $\frac{1}{4}$ ;
- shift down 1 unit

#22

$$h(x) = -3x^2 + 2$$



- vertical stretch by a factor of 3
- vertical reflection
- shift up 2 units

#24

$$g(x) = -3(x+2)^2 - 1$$

$$v(-2, -1)$$

axis of symmetry

$$x = -2$$

just goes through the vertex

#26

$$g(x) = 2(x-\sqrt{3})^2 + 4$$

$$v = (\sqrt{3}, 4)$$

axis of symmetry

$$x = \sqrt{3}$$

2.1  
(day 2)

p. 169 27-43 (odd)

#27

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

$$x_v = \frac{-5}{2(3)} = \frac{-5}{6}$$

$$y_v = f\left(\frac{-5}{6}\right) = 3\left(\frac{-5}{6}\right)^2 + 5\left(\frac{-5}{6}\right) - 4$$

$$= 3\left(\frac{25}{36}\right) - \frac{25}{6} - 4$$

$$= \frac{75}{36} - \frac{150}{36} - \frac{144}{36} = \frac{-219}{36} = \frac{-73}{12}$$

$$\boxed{v\left(\frac{-5}{6}, \frac{-73}{12}\right); x = \frac{-5}{6}; f(x) = 3\left(x + \frac{5}{6}\right)^2 - \frac{73}{12}}$$

$$f(x) = a(x-h)^2 + k$$



#29  $f(x) = 8x - x^2 + 3$   
 $= -x^2 + 8x + 3$

$x_v = \frac{-8}{2(-1)} = \frac{-8}{-2} = 4$

$y_v = f(4) = 8(4) - (4)^2 + 3$   
 $= 32 - 16 + 3 = 19$

$v(4, 19); x=4; f(x) = -(x-4)^2 + 19$

#31  $g(x) = 5x^2 + 4 - 6x$   
 $= 5x^2 - 6x + 4$

$x_v = \frac{6}{2(5)} = \frac{6}{10} = \frac{3}{5}$

$y_v = f(\frac{3}{5}) = 5(\frac{3}{5})^2 + 4 - 6(\frac{3}{5})$   
 $= 5(\frac{9}{25}) + 4 - \frac{18}{5}$   
 $= \frac{9}{5} + \frac{20}{5} - \frac{18}{5} = \frac{11}{5}$

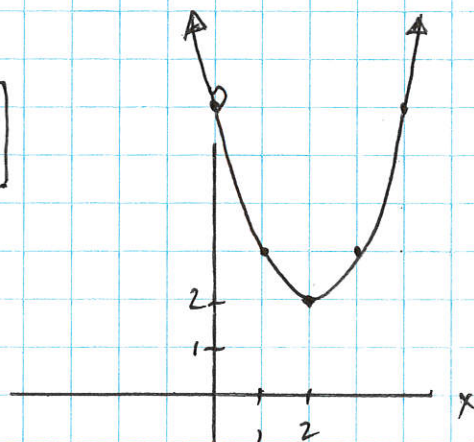
$v(\frac{3}{5}, \frac{11}{5}); x=\frac{3}{5}; f(x) = 5(x-\frac{3}{5})^2 + \frac{11}{5}$

#33  $f(x) = x^2 - 4x + 6$   
 $= (x^2 - 4x + 4) + 6 - 4$   
 $\frac{-4}{2} = -2$   
 $(-2)^2 = 4$

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

$v(2, 2)$

opens up  
 No change to shape  
 No x intercepts



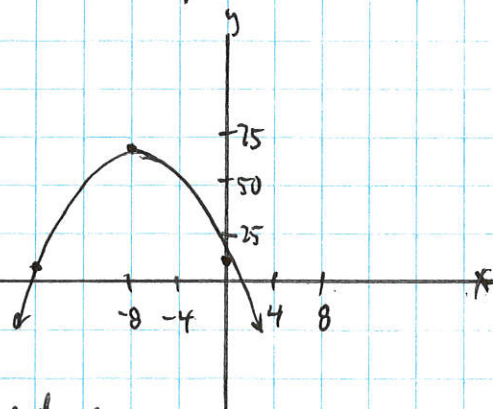
#35  $f(x) = 10 - 16x - x^2$   
 $= -x^2 - 16x + 10$   
 $= -(x^2 + 16x + 64) + 10 + 64$   
 $\frac{16}{2} = 8$   
 $8^2 = 64$

because of, actually subtracting, so add to account

$f(x) = -(x+8)^2 + 74$

$v(-8, 74)$

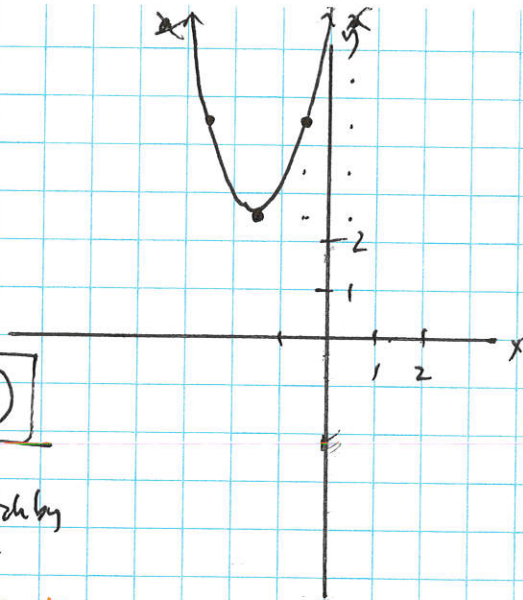
opens down  
 No change to shape y-intercept @ (0, 10)



#37  $f(x) = 2x^2 + 6x + 7$   
 $= 2(x^2 + 3x + \frac{9}{4}) + 7 - 2(\frac{9}{4})$   
 $\frac{3}{2} = \frac{3}{2}$   
 $(\frac{3}{2})^2 = \frac{9}{4}$

$f(x) = 2(x + \frac{3}{2})^2 + 2\frac{1}{2}$        $V(-\frac{3}{2}, 2\frac{1}{2})$

- opens up  
 - vertical stretch by a factor of 2



#39  $V(-1, -3)$        $(1, 5)$   
 need to find  $a$  so plug into vertex form  
 $y = a(x+1)^2 - 3$   
 $5 = a(1+1)^2 - 3$   
 $5 = 4a - 3$   
 $+3$        $+3$       So  
 $8 = 4a$   
 $4$        $4$   
 $2 = a$

$f(x) = 2(x+1)^2 - 3$

#41  $V(1, 11)$        $(4, -7)$   
 $y = a(x-1)^2 + 11$   
 $-7 = a(4-1)^2 + 11$   
 $-7 = a(3)^2 + 11$   
 $-11$        $-11$   
 $-18 = 9a$   
 $9$        $9$   
 $-2 = a$

$f(x) = -2(x-1)^2 + 11$

#43  $V(1, 3)$        $(0, 5)$   
 $y = a(x-1)^2 + 3$   
 $5 = a(0-1)^2 + 3$   
 $5 = a + 3$   
 $-3$        $-3$   
 $2 = a$

$f(x) = 2(x-1)^2 + 3$



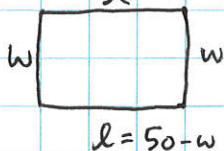
2.1

(day 3)

54, 61-63, 73-76

#54 Perimeter 100 feet  
Maximize Area!

$$l = 50 - w$$



$$P = 2w + 2l$$

$$\frac{100}{2} = \frac{2w + 2l}{2}$$

$$50 = w + l$$

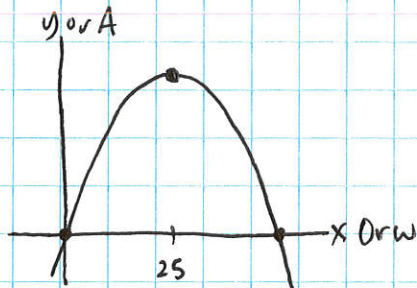
$$\begin{array}{r} 50 = w + l \\ -w \quad -w \\ \hline 50 - w = l \end{array}$$

$$50 - w = l$$

$$\text{Area} = lw$$

$$A = (50 - w)(w)$$

$$= 50w - w^2$$



Maximum Area  
width is 25 feet and  
length is 25 feet.  
Max Area is 625 feet<sup>2</sup>

#61

#62

a)  $h = -16t^2 + 48t + 3.5$

2ND TRACE

b) max height is 39.5 feet at about 1.5 seconds  
graph it out on calculator and use maximum to find

#62

#61

a)  $h = -16t^2 + 92t + 83$

2ND TRACE

max height is 215.25 feet

b) in the air about 6.543 seconds use Zero!

c)  $v(t) = -gt + v_0$

$= -32t + 92$

Hits ground 6.543 seconds after

Formula on pg. 167 in your book

~~hits ground~~  
oops

gravity force initial velocity

Have you read your section?

$$v(t) = -32(6.543) + 92 = -117.376$$

The ball is traveling 117.376 feet/second downward when it hits the ground.

#63 a)  $h = -16t^2 + 80t - 10$  graph in calculator

2ND TRACE CALC MAX!

b) The max height will be 90 feet at 2.5 seconds

#73  $f(-2) = 3$   $f(4) = 1$

E

$$m = \frac{3-1}{-2-4} = \frac{2}{-6} = -\frac{1}{3}$$

#74  $y - 3 = -\frac{1}{3}(x + 2)$

$$\begin{array}{r} y - 3 = -\frac{1}{3}x - \frac{2}{3} \\ +3 \qquad +3 \end{array}$$

$$2\frac{1}{3} = \frac{7}{3} \quad \text{C}$$

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

#75  $f(x) = 2(x+3)^2 - 5$

$$x = -3$$

B


#76  $v(-3, -5)$


E




#9 c cubic function  
 positive leading coefficient end behavior is 

#10 b cubic function  
 negative leading coefficient end behavior is 

#11 a 5<sup>th</sup> degree polynomial  
 positive LC EB is 


#12 d 5<sup>th</sup> degree polynomial  
 negative LC EB is 

#18  $f(x) = (x-1)(x+2)(x+3)$




$\lim_{x \rightarrow -\infty} f(x) = -\infty$      $\lim_{x \rightarrow \infty} f(x) = \infty$

#20  $f(x) = x^3 - 2x^2 - 41x + 42$




$\lim_{x \rightarrow -\infty} f(x) = -\infty$      $\lim_{x \rightarrow \infty} f(x) = \infty$

#22  $f(x) = (2x+1)(x-4)^3$



$\lim_{x \rightarrow -\infty} f(x) = -\infty$      $\lim_{x \rightarrow \infty} f(x) = \infty$

#24  $f(x) = -3x^4 - 5x^3 + 15x^2 - 5x + 19$



$\lim_{x \rightarrow -\infty} f(x) = -\infty$      $\lim_{x \rightarrow \infty} f(x) = -\infty$

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

$\lim_{x \rightarrow -\infty} f(x) = \infty$      $\lim_{x \rightarrow \infty} f(x) = \infty$

#26  $f(x) = -x^3 + 7x^2 - 4x + 3$

$\lim_{x \rightarrow -\infty} f(x) = \infty$      $\lim_{x \rightarrow \infty} f(x) = -\infty$



#27  $f(x) = 7x^2 - x^3 + 3x - 4$

$$\lim_{x \rightarrow -\infty} f(x) = \infty \quad \lim_{x \rightarrow \infty} f(x) = -\infty$$

#28  $f(x) = x^3 - x^4 + 3x^2 - 2x + 7$

$$\lim_{x \rightarrow -\infty} f(x) = -\infty \quad \lim_{x \rightarrow \infty} f(x) = -\infty$$

#29  $f(x) = 20x^3 + 8x^2 - 83x + 55$

(+) y-intercept  
opposite end behavior

a

#30  $f(x) = 35x^3 - 134x^2 + 93x - 18$

(-) y-intercept  
opposite end behavior

b

#31  $f(x) = 44x^4 - 65x^3 + x^2 + 17x + 3$

(+) y-intercept  
Same end behavior

c

#32  $f(x) = 4x^4 - 8x^3 - 19x^2 + 23x - 6$

(-) y-intercept  
Same end behavior

d

process of elimination!

2.3 p. 193 33-38, 39-40 (odd), 53-59 (odd)  
day 2 67, 68

#33  $f(x) = x^2 + 2x - 8$

$$0 = (x+4)(x-2)$$

$$\boxed{x = -4} \quad \boxed{x = 2}$$

#34  $f(x) = 3x^2 + 4x - 4$

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

$$\boxed{x = \frac{2}{3}} \quad \boxed{x = -2}$$

#35  $f(x) = 9x^2 - 3x - 2$

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

$$\boxed{x = -\frac{1}{3}} \quad \boxed{x = \frac{2}{3}}$$

#36  $f(x) = x^3 - 25x$

$$0 = x(x^2 - 25)$$

$$0 = (x)(x+5)(x-5)$$

$$\boxed{x = 0} \quad \boxed{x = -5} \quad \boxed{x = 5}$$

#37  $f(x) = 3x^3 - x^2 - 2x$

$$0 = x(3x^2 - x - 2)$$

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

$$\boxed{x = 0} \quad \boxed{x = -\frac{2}{3}} \quad \boxed{x = 1}$$

#38  $f(x) = 5x^3 - 5x^2 - 10x$

$$0 = 5x(x^2 - x - 2)$$

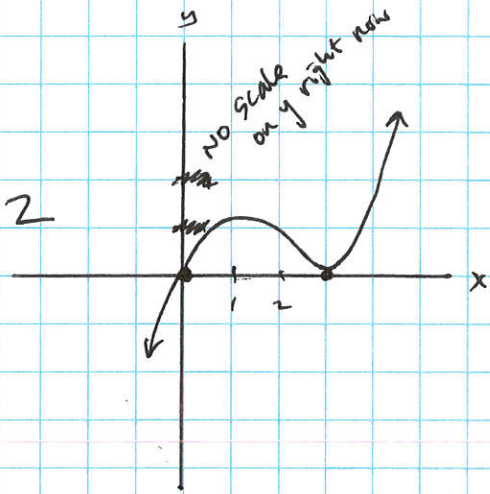
$$0 = 5x(x-2)(x+1)$$

$$\boxed{x = 0} \quad \boxed{x = 2} \quad \boxed{x = -1}$$



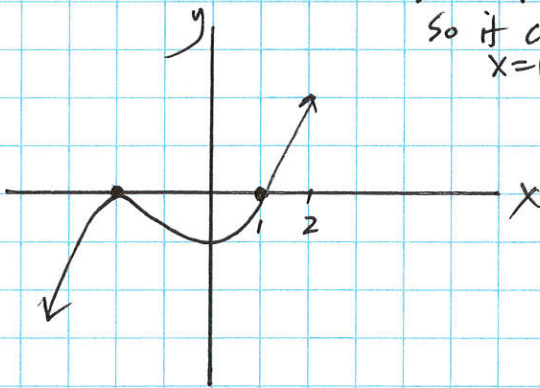
#39  $f(x) = x(x-3)^2$

3rd degree  
 zeroes at  $x=0$  |  $x=3$  w/ multiplicity 2  
 crosses | so it kisses



#40  $f(x) = (x-1)^3(x+2)^2$

5th degree  
 zeroes at  $x=1$  w/ multiplicity 3 |  $x=-2$  w/ multiplicity 2  
 so it crosses at  $x=1$  | so it kisses at  $x=-2$



#43  $x = -2.432 \quad x = -0.738 \quad x = 1.67$

#45  $x = -2.473 \quad x = -1.463 \quad x = 1.935$

~~#47~~

#53  $3, -4, 6$   
 $x=3 \quad x=-4 \quad x=6$   
 $x-3=0 \quad x+4=0 \quad x-6=0$

$f(x) = (x-3)(x+4)(x-6)$

#55  $\sqrt{3}, -\sqrt{3}, 4$   
 $x = \sqrt{3} \quad x = -\sqrt{3} \quad x = 4$   
 $x^2 = 3$   
 $x^2 - 3 = 0 \quad x - 4 = 0$

$f(x) = (x^2 - 3)(x - 4)$

#57  $f(x) = .25x^3 - 1.25x^2 - 6.75x + 19.75$

#59  $f(x) = -2.21x^4 + 45.75x^3 - 339.79x^2 + 107.25x - 1231$

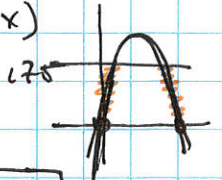
#67  $V = (10 - 2x)(25 - 2x)(x)$

$175 \geq (10 - 2x)(25 - 2x)(x)$

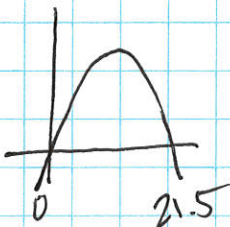
$x = 0.929, 3.644$

Practical Domain  $(0, 5)$

$x = (0, .929) \cup (3.644, 5)$



#68  $V = 2666x - 210x^2 + 4x^3$



$(0, 215)$



#4 
$$\begin{array}{r} 2x^2 - 5x + \frac{7}{2} \\ \underline{2x+1} \phantom{+} \\ 4x^3 - 8x^2 + 2x - 1 \\ \underline{-4x^3 + 2x^2} \phantom{-1} \\ -10x^2 + 2x - 1 \\ \underline{+10x^2 + 5x} \phantom{-1} \\ 7x - 1 \\ \underline{7x + \frac{7}{2}} \\ -4\frac{1}{2} \end{array}$$

Switch signs →  
Switch signs →  
Switch signs →

$$\frac{f}{d} = 2x^2 - 5x + \frac{7}{2} + \frac{4\frac{1}{2}}{2x+1}$$

Be ready for a long division problem needing a place holder on the test

#5 
$$\begin{array}{r} x^2 - 4x + 12 \\ \underline{x^2+2x-1} \phantom{+} \\ x^4 - 2x^3 + 3x^2 - 4x + 6 \\ \underline{-x^4 + 2x^3 + x^2} \phantom{+} \\ -4x^3 + 4x^2 - 4x + 6 \\ \underline{+4x^3 + 8x^2 + 4x} \phantom{+} \\ 12x^2 - 8x + 6 \\ \underline{-12x^2 + 24x + 12} \\ -32x + 18 \end{array}$$

$$\frac{f}{d} = x^2 - 4x + 12 + \frac{-32x+18}{x^2+2x-1}$$

#6 
$$\begin{array}{r} x^2 - 3x + 5 \\ \underline{x^2+0x+1} \phantom{+} \\ x^4 - 3x^3 + 6x^2 - 3x + 5 \\ \underline{-x^4 + 0x^3 + x^2} \phantom{+} \\ -3x^3 + 5x^2 - 3x + 5 \\ \underline{+3x^3 + 0x^2 + 3x} \phantom{+} \\ 0 + 5x^2 + 0x + 5 \\ \underline{-5x^2 + 0x + 5} \\ 0 \end{array}$$

$$\frac{f}{d} = x^2 - 3x + 5$$

#7 
$$\begin{array}{r|rrrrr} -1 & 1 & -5 & 3 & -2 & \\ & & -1 & 6 & -9 & \\ \hline & 1 & -6 & 9 & -11 & \end{array}$$

$$= x^2 - 6x + 9 + \frac{-11}{x+1}$$

#9 
$$\frac{9x^3 + 7x^2 - 3x}{x-10} \Rightarrow$$

10	9	7	-3	0	
	90	70	96	70	
	9	97	967	9670	

$$= 9x^2 + 97x + 967 + \frac{9670}{x-10}$$

#11 
$$\frac{5x^4 - 3x + 1}{4-x} \Rightarrow$$

(x-4)

4	5	0	0	-3	1	
	20	80	320	1268		
	5	20	80	317	1269	

$$= -5x^3 + 20x^2 - 80x - 317 + \frac{-1269}{4-x}$$



#13  $f(x) = 2x^2 - 3x + 1$   $k=2$   
 $f(2) = 2(2)^2 - 3(2) + 1$   
 $= \boxed{3}$  remainder

#15  $-3 \left| \begin{array}{cccc|c} 1 & -1 & 2 & -1 & \\ & -3 & 12 & -42 & \\ \hline 1 & -4 & 14 & -43 & \end{array} \right.$   $k=-3$   
 $\boxed{f(-3) = -43}$

#17  $2 \left| \begin{array}{cccc|c} 2 & -3 & 4 & -7 & \\ & 4 & 2 & 12 & \\ \hline 2 & 1 & 6 & 5 & \end{array} \right.$   $k=2$   
 $\boxed{f(2) = 5}$

#19  $x-1; x^3 - x^2 + x - 1$   
 $1 \left| \begin{array}{cccc|c} 1 & -1 & 1 & -1 & \\ & 1 & 0 & 1 & \\ \hline 1 & 0 & 1 & 0 & \end{array} \right.$   $\boxed{\text{yes!}}$

#21  $x-2; x^3 + 3x - 4$   $\boxed{\text{No!}}$   
 $2 \left| \begin{array}{ccc|c} 1 & 0 & 3 & -4 \\ & 2 & 4 & 14 \\ \hline 1 & 2 & 7 & 10 \end{array} \right.$

#23  $x+2; 4x^3 + 9x^2 - 3x - 10$   $\boxed{\text{yes!}}$   
 $-2 \left| \begin{array}{ccc|c} 4 & 9 & -3 & -10 \\ & -8 & -2 & 10 \\ \hline 4 & 1 & -5 & 0 \end{array} \right.$

2.4 p. 205 25-31 (odd),  
 (day 2) 33-36, 50, 53, 54,  
 65-68

#25  $f(x) = 5x^3 - 7x^2 - 49x + 51$

$$\begin{array}{r|rrrr} -3 & 5 & -7 & -49 & 51 \\ & & -15 & 66 & -51 \\ \hline & 5 & -22 & 17 & 0 \end{array}$$

$$f(x) = (x+3)(5x^2 - 22x + 17)$$

$$f(x) = (x+3)(5x-17)(x-1)$$

#27 Degree 3  $x = -2, 1, 4$   $LC = 2$

$$f(x) = 2(x+2)(x-1)(x-4)$$

$$x^2 - x + 2x - 2$$

$$2(x^2 + x - 2)(x - 4)$$

$$x^3 + x^2 - 2x$$

$$-4x^2 - 4x + 8$$

$$f(x) = 2(x^3 - 3x^2 - 6x + 8)$$

$$f(x) = 2x^3 - 6x^2 - 12x + 16$$

#29 Degree 3  $x = 2, \frac{1}{2}, \frac{3}{2}$   $LC = 2$

$$x=2 \quad x=\frac{1}{2} \quad x=\frac{3}{2}$$

$$f(x) = 2(x-2)(2x-1)(2x-3)$$

$$(2)(2x^2 - x - 4x + 2)(2x-3)$$

$$(2x^2 - 5x + 2)(2x-3)$$

$$4x^3 - 10x^2 + 4x$$

$$-6x^2 + 15x - 6$$

$$= (2)(4x^3 - 16x^2 + 19x - 6)$$

$$f(x) = 8x^3 - 32x^2 + 38x - 12$$

#31  $x \mid -4 \quad 0 \quad 3 \quad 5$

$$y \mid 0 \quad 180 \quad 0 \quad 0$$

$$x = -4 \quad x = 3 \quad x = 5$$

$$f(x) = a(x+4)(x-3)(x-5)$$

$$= a(x^2 + x - 12)(x-5)$$

$$x^3 + x^2 - 12x$$

$$-5x^2 - 5x + 60$$

$$f(x) = a(x^3 - 4x^2 - 17x + 60)$$

$$180 = a((0)^3 - 4(0)^2 - 17(0) + 60)$$

$$\frac{180}{60} = \frac{a(60)}{60}$$

$$3 = a$$

$$f(x) = 3x^3 - 12x^2 - 51x + 180$$



#33  $f(x) = 6x^3 - 5x - 1$

$PZ = \pm \frac{1}{1}, \pm \frac{1}{2}, \pm \frac{1}{3}, \pm \frac{1}{6}$

#34  $f(x) = 3x^3 - 7x^2 + 6x - 14$  1, 2, 7, 14  
3

$PZ = \pm 1, \pm 2, \pm 7, \pm 14, \pm \frac{1}{3}, \pm \frac{2}{3}, \pm \frac{7}{3}, \pm \frac{14}{3}$

#35  $f(x) = 2x^3 - x^2 - 9x + 9$  1, 3, 9  
1, 2

$PZ = \pm 1, \pm 3, \pm 9, \pm \frac{1}{2}, \pm \frac{3}{2}, \pm \frac{9}{2}$

#36  $f(x) = 6x^4 - x^3 - 6x^2 - x - 12$  1 2 3 4 6 12  
1 2 3 6

$PZ = \pm 1, \pm 2, \pm 3, \pm 4, \pm 6, \pm 12, \pm \frac{1}{2}, \pm \frac{3}{2}, \pm \frac{1}{3}, \pm \frac{2}{3}, \pm \frac{4}{3}, \pm \frac{1}{6}$

#50  $f(x) = x^3 + 3x^2 - 3x - 9$

$$\begin{array}{r|rrrr} -3 & 1 & 3 & -3 & -9 \\ & & -3 & 0 & 9 \\ \hline & 1 & 0 & -3 & 0 \end{array}$$

$f(x) = (x+3)(x^2-3)$

$x^2 - 3 = 0$   
 $\sqrt{x^2} = \sqrt{3}$   
 $x = \pm\sqrt{3}$

$x = -3$   
 $x = \sqrt{3}$   
 $x = -\sqrt{3}$

#53  $f(x) = x^4 - 3x^3 - 6x^2 + 6x + 8$

$$\begin{array}{r|rrrrr} 4 & 1 & -3 & -6 & 6 & 8 \\ & & 4 & 4 & -8 & -8 \\ \hline -1 & 1 & 1 & -2 & -2 & 0 \\ & & -1 & 0 & 2 & \\ \hline & 1 & 0 & -2 & 0 & \end{array}$$

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

$x^2 - 2 = 0$   
 $\sqrt{x^2} = \sqrt{2}$   
 $x = \pm\sqrt{2}$

$x = 4$   
 $x = -1$   
 $x = \sqrt{2}$   
 $x = -\sqrt{2}$

#54  $f(x) = x^4 - x^3 - 7x^2 + 5x + 10$

$$\begin{array}{r|rrrrr} -1 & 1 & -1 & -7 & 5 & 10 \\ & & -1 & 2 & +5 & -10 \\ \hline 2 & 1 & -2 & -5 & 10 & 0 \\ & & 2 & 0 & -10 & \\ \hline & 1 & 0 & -5 & 0 & \end{array}$$

$x^2 - 5 = 0$   
 $\sqrt{x^2} = \sqrt{5}$   
 $x = \pm\sqrt{5}$

$x = -1$   
 $x = 2$   
 $x = \sqrt{5}$   
 $x = -\sqrt{5}$

#65

A

$$f(3) = 0 \quad B-E \text{ are all true!}$$

$$(3, 0)$$

#66

$$f(x) = 2x^3 + 7x^2 + 2x - 3$$

poss P.Z. =  $\pm 1, \pm 3, \pm \frac{3}{2}, \pm \frac{1}{2}$

E

Not a part

#67

B

$$A \quad f(x) = \frac{(x+2)(x^2+x-1) - 3}{(x+2)} = x^2 + x - 1 - \frac{3}{x+2}$$

reduces here but not here

$$B \quad \frac{(x+2)(x^2+x-1) - 3}{(x^2+x-1)} = x+2 - \frac{3}{x^2+x-1}$$

reduces here but not here

D and E are the same

#68

E

Similar to #67



#1  $f(x) = (x-3i)(x+3i)$   
*Standard form*      *zeros*      *x-int*  
 $f(x) = x^2 + 9$ ;  $x = \pm 3i$ ; No x-intercepts

#3  $f(x) = (x-1)(x-1)(x+2i)(x-2i)$   
 $f(x) = (x^2 - 2x + 1)(x^2 + 4)$   
 $x^4 - 2x^3 + x^2 + 4x^2 - 8x + 4$   
 $f(x) = x^4 - 2x^3 + 5x^2 - 8x + 4$ ;  $x = 1$  w/multiplicity 2,  $\pm 2i$ ;  $x = 1$

#5  $i$  and  $-i$        $x=i$      $x=-i$   
 $x-i=0$      $x+i=0$   
 $(x-i)(x+i) = f(x)$   
 $x^2 + 1 = f(x)$

#7  $1, 3i, \text{ and } -3i$      $(x-1)(x-3i)(x+3i)$   
 $(x-1)(x^2+9)$   
 $x^3 + 9x$   
 $-x^2 - 9$   
 $f(x) = x^3 - x^2 + 9x - 9$

#9  $2, 3, \text{ and } i$  AND  $-i$       ← \* Test Question like this!  
 $(x-2)(x-3)(x-i)(x+i)$   
 $(x^2-5x+6)(x^2+1)$   
 $x^4 - 5x^3 + 6x^2 + x^2 - 5x + 6$   
 $f(x) = x^4 - 5x^3 + 7x^2 - 5x + 6$   
 AND THIS

#11  $5, 3+2i, 3-2i$       Not given but must be! Imaginary's always come in pairs!  
 $(x-5)(x-(3+2i))(x-(3-2i))$   
 $(x-5)(x-3-2i)(x-3+2i)$   
 $x^2 - 3x + 2xi$   
 $-3x$        $+9 - 6i$   
 $-2xi$        $+6i - 4i^2$       ←  $=(-1)$   
 $x^2 - 6x + 9 + 4$   
 $f(x) = x^2 - 6x + 13$



#13  $1, 1, -2, -2, -2$

$$f(x) = (x-1)^2 (x+2)^3 \quad (x+2)(x+2) = (x^2 + 4x + 4)(x+2)$$

$$\begin{array}{r} (x^2 - 2x + 1)(x^3 + 6x^2 + 12x + 8) \\ \hline x^5 + 6x^4 + 12x^3 + 8x^2 \\ - 2x^4 - 12x^3 - 24x^2 - 16x \\ \hline x^5 + 4x^4 + 12x^3 + 8x^2 - 16x \\ + x^3 + 6x^2 + 12x + 8 \\ \hline x^5 + 4x^4 + x^3 + 10x^2 - 4x + 8 \end{array}$$

$$f(x) = x^5 + 4x^4 + x^3 + 10x^2 - 4x + 8$$

#15  $2, 2, 3+i, 3-i$

$$(x-2)(x-2)(x-(3+i))(x-(3-i))$$

$$(x^2 - 4x + 4)(x-3-i)(x-3+i)$$

$$\begin{array}{r} x^2 - 3x + x(-i) \\ - 3x + 9 - 3i \\ \hline x^2 - 6x + 10 \end{array}$$

$$(x^2 - 4x + 4)(x^2 - 6x + 10)$$

$$\begin{array}{r} x^4 - 6x^3 + 10x^2 \\ - 4x^3 + 24x^2 - 40x \\ \hline x^4 - 10x^3 + 38x^2 - 40x + 40 \end{array}$$

$$f(x) = x^4 - 10x^3 + 38x^2 - 40x + 40$$

#17 (b)  $-3$  (multiplicity 2)  $2$  (multiplicity 3)  
 $\uparrow$  kisses  $\uparrow$  crosses

#19 (d)  $-1$  (multiplicity 4)  $3$  (multiplicity 3)  
 $\uparrow$  kisses  $\uparrow$  crosses

#27  $f(x) = x^3 + 4x - 5$

$$\begin{array}{r|rrrr} 1 & 1 & 0 & 4 & -5 \\ & & 1 & 1 & 5 \\ \hline & 1 & 1 & 5 & 0 \end{array}$$

$$x = \frac{-1 \pm \sqrt{1 - 4(1)(5)}}{2} = \frac{-1 \pm \sqrt{-19}}{2}$$

$$= \frac{-1 \pm i\sqrt{19}}{2}$$

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

$$f(x) = (x-1)\left(x - \left(\frac{-1 + i\sqrt{19}}{2}\right)\right)\left(x - \left(\frac{-1 - i\sqrt{19}}{2}\right)\right)$$



#30  $f(x) = 3x^4 + 8x^3 + 6x^2 + 3x - 2$

$$\begin{array}{r|rrrrr} -2 & 3 & 8 & 6 & 3 & -2 \\ & & -6 & -4 & -4 & 2 \\ \hline \frac{1}{3} & 3 & 2 & 2 & -1 & 0 \\ & & 1 & 1 & 1 & \\ \hline & 3 & 3 & 3 & 0 & \end{array}$$

$$f(x) = (x+2)(3x-1)(3x^2+3x+3)$$

#33  $f(x) = x^4 - 2x^3 - x^2 + 6x - 6$

$$\begin{array}{r|rrrrr} 1+i & 1 & -2 & -1 & 6 & -6 \\ & & 1+i & -2 & -3-3i & 6 \\ \hline 1-i & 1 & -1+i & -3 & 3-3i & 0 \\ & & 1-i & 0 & -3+3i & \\ \hline & 1 & 0 & -3 & 0 & \end{array}$$

$(1+i)(-1+i) = -1+i-i+i^2 = -1-1 = -2$   
 $(1+i)(3-3i) = 3-3i+3i-3i^2 = 3+3 = 6$

$$x^2 - 3 = 0$$

$$\sqrt{x^2} = \sqrt{3}$$

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

$$f(x) = (x - (1+i))(x - (1-i))(x + \sqrt{3})(x - \sqrt{3})$$

#36  $f(x) = x^4 - 2x^3 + 5x^2 + 10x - 50$

$$\begin{array}{r|rrrrr} 1+3i & 1 & -2 & 5 & 10 & -50 \\ & & 1+3i & -10 & -5-15i & 50 \\ \hline 1-3i & 1 & -1+3i & -5 & 5-15i & 0 \\ & & 1-3i & 0 & -5+15i & \\ \hline & 1 & 0 & -5 & 0 & \end{array}$$

$(1+3i)(-1+3i) = -1+9i^2 = -1-9 = -10$   
 $(1+3i)(5-15i) = 5-15i-15i+45i^2 = 5-30i-45 = -40-30i$

$$x^2 - 5 = 0$$

$$\sqrt{x^2} = \sqrt{5}$$

$$x = \pm\sqrt{5}$$

$$f(x) = (x - (1+3i))(x - (1-3i))(x + \sqrt{5})(x - \sqrt{5})$$

#39  $f(x) = 2x^3 - x^2 + 2x - 3$

$$\begin{array}{r|rrrr} 1 & 2 & -1 & 2 & -3 \\ & & 2 & 1 & 3 \\ \hline & 2 & 1 & 3 & 0 \end{array}$$

$$f(x) = (x-1)(2x^2+x+3)$$

#42  $f(x) = x^4 - 2x^3 + x^2 - 8x - 12$

$$\begin{array}{r|rrrrr} 3 & 1 & -2 & 1 & -8 & -12 \\ & & 3 & 3 & 12 & 12 \\ \hline -1 & 1 & 1 & 4 & 4 & 0 \\ & & -1 & 0 & -4 & \\ \hline & 1 & 0 & 4 & 0 & \\ & & x^2 + 4 = 0 & & & \\ & & \sqrt{x^2} = \sqrt{4} & & & \\ & & x = \pm 2i & & & \end{array}$$

$$f(x) = (x-3)(x+1)(x^2+4)$$

(#49) Degree 4  $x=3$   $x=-1$   $x=2-i$   $x=2+i$   $f(0)=30$

$$\begin{array}{l} (x-3)(x+1)(x-(2-i))(x-(2+i)) \\ (x^2-2x-3)(x^2-4x+5) \\ \begin{array}{r} x^2-2x-3 \\ -2x \quad +4 \quad +2i \\ \hline x^2-4x+5 \end{array} \end{array}$$

$$\begin{array}{r} (x^2-2x-3)(x^2-4x+5) \\ x^4-4x^3+5x^2 \\ -2x^3+8x^2-10x \\ \hline -3x^2+12x-15 \end{array}$$

$$f(x) = a(x^4 - 6x^3 + 10x^2 + 2x - 15)$$

$$30 = a(-15)$$

$$-2 = a$$

$$f(x) = -2x^4 + 12x^3 - 20x^2 - 4x + 30$$

(#50) Degree 4  $x=1-2i$   $x=1+2i$   $x=1+i$   $x=1-i$   $f(0)=20$

$$\begin{array}{l} (x-(1-2i))(x-(1+2i))(x-(1+i))(x-(1-i)) \\ (x-1+2i)(x-1-2i)(x-1-i)(x-1+i) \\ \begin{array}{r} x^2-x-2xi \\ -x \quad +1 \quad +2i \\ \hline x^2-x+xi \end{array} \end{array}$$

$$\begin{array}{r} (x^2-2x+5) \\ (x^2-2x+2) \end{array}$$

$$\begin{array}{r} x^4-2x^3+2x^2 \\ -2x^3+4x^2-4x \\ \hline 5x^2-10x+10 \end{array}$$

$$f(x) = a(x^4 - 4x^3 + 11x^2 - 14x + 10)$$

$$20 = a(10)$$

$$2 = a$$

$$f(x) = 2x^4 - 8x^3 + 22x^2 - 28x + 20$$