P2-1

Name_____

Target 2A: Complex Numbers

Date_____ Period____

Simplify.

1) $-5i - 7i$

2) $7i - 7i$

3) $-6 - 6i - (4 - 5i)$

4) $-8 - 5i + 6 + 6i$

5) $-8 - 4i - (-7 + 7i)$

6) $-7 + 3i - 7i + 2i$

7) $4 + 5i - 8 - 6i$

8) $-4 - 8i - (-1 + 2i)$

9) $-2 - i - 4i + 2 + 4i$

10) $-5 - 7i - 6 - 4i - (5 + 4i)$

11) $-8i(5 - 5i)$

12) $-7i \cdot -5i$

13) $(-3 + 7i)^2$

14) $(-4 - i)^2$

15) $(2 + 6i)(-6 - 3i)$

16) $(6 - 6i)(-4 + 3i)$

17) $(7 - 7i)(-8 + 6i)$

18) $(7 + 6i)(4 + 2i)$

19) $-5i(-8 - 3i)(1 + 5i)$

20) $-7i(7 + 6i)(-4 + i)$

Answers to Target 2A: Complex Numbers

1) $-12i$
2) 0
3) $-10 - i$
4) $-2 + i$
5) $-1 - 11i$
6) $-7 - 2i$
7) $-4 - i$
8) $-3 - 10i$
9) $-i$
10) $-16 - 15i$
11) $-40 - 40i$
12) -35
13) $-40 - 42i$
14) $15 + 8i$
15) $6 - 42i$
16) $-6 + 42i$
17) $-14 + 98i$
18) $16 + 38i$
19) $-215 - 35i$
20) $-119 + 238i$

P2-2: Operations on Polynomial Functions

Honors Advanced Algebra

Name: _____

Period: _____ Date: _____

Use the given functions to perform the indicated operations.

$f(x) = 2x^2$ $g(x) = 4x - 2$ $h(x) = x^2 + 5x - 1$ $n(x) = 3x + 6$

1. $(f + g)(x)$	2. $(h + f)(x)$	3. $(g + n)(x)$
4. $(f - h)(x)$	5. $(n - g)(x)$	6. $(h - f)(x)$
7. $(f \cdot g)(x)$	8. $(g \cdot n)(x)$	9. $(n \cdot h)(x)$
10. $f(-2)$	11. $g(3a)$	12. $h(2c^2)$

P2-2: Operations on Polynomial Functions

Honors Advanced Algebra

Name: Key

Period: _____ Date: _____

Use the given functions to perform the indicated operations.

$f(x) = 2x^2$ $g(x) = 4x - 2$ $h(x) = x^2 + 5x - 1$ $n(x) = 3x + 6$

1. $(f+g)(x)$ $2x^2+4x-2$	2. $(h+f)(x)$ $3x^2+5x-1$	3. $(g+n)(x)$ $7x+4$
4. $(f-h)(x)$ x^2-5x+1	5. $(n-g)(x)$ $-x+8$	6. $(h-f)(x)$ $-x^2+5x-1$
7. $(f\cdot g)(x)$ $8x^3-4x^2$	8. $(g\cdot n)(x)$ $12x^2+18x-12$	9. $(n\cdot h)(x)$ $3x^3+21x^2+27x-6$
10. $f(-2)$ 8	11. $g(3a)$ $12a-2$	12. $h(2c^2)$ $4c^4+10c^2-1$

Do each of the following for every given function:

a. Sketch the general shape of each function.
b. Describe the end behavior of each function.
c. State the maximum number of turning points the graph can make.
d. State the maximum number of real zeros.
e. Then use the Nspire to check your work.

1. $f(x) = 2x + 7$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

2. $f(x) = 2x^2 + 7x - 1$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

3. $f(x) = 2x^3 + 7x^2 - x - 4$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

4. $f(x) = 2x^4 + 7x^3 - x^2 - 4x + 3$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

5. $f(x) = 2x^5 + 7x^4 - x^3 - 4x^2 + 3x + 6$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

6. $f(x) = -2x + 7$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

7. $f(x) = -2x^2 + 7x - 1$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

8. $f(x) = -2x^3 + 7x^2 - x - 4$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

9. $f(x) = -2x^4 + 7x^3 - x^2 - 4x + 3$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

10. $f(x) = -2x^5 + 7x^4 - x^3 - 4x^2 + 3x + 6$
a. Graph:

b. End behavior:

c. Max. number of turning pts: _____
d. Max. real zeros: _____

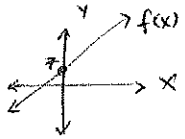
What determines the end behavior of a polynomial function?

Do each of the following for every given function: Solutions to → **P2-3**

a. Sketch the general shape of each function.
b. Describe the end behavior of each function.
c. State the maximum number of turning points the graph can make.
d. State the maximum number of real zeros.
e. Then use the Nspire to check your work.

1. $f(x) = 2x + 7$

a. Graph:



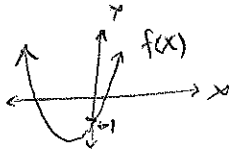
b. End behavior: $\lim_{x\to-\infty} f(x) = -\infty$, $\lim_{x\to\infty} f(x) = \infty$

c. Max. number of turning pts: 0

d. Max. real zeros: 1

2. $f(x) = 2x^2 + 7x - 1$

a. Graph:



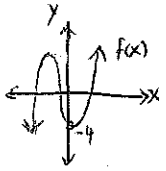
b. End behavior: $\lim_{x\to-\infty} f(x) = \infty$, $\lim_{x\to\infty} f(x) = \infty$

c. Max. number of turning pts: 1

d. Max. real zeros: 2

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

a. Graph:



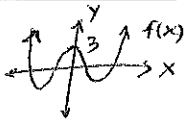
b. End behavior: $\lim_{x\to-\infty} f(x) = \infty$, $\lim_{x\to\infty} f(x) = \infty$

c. Max. number of turning pts: 2

d. Max. real zeros: 3

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

a. Graph:



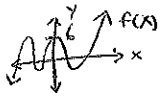
b. End behavior: $\lim_{x\to-\infty} f(x) = \infty$, $\lim_{x\to\infty} f(x) = \infty$

c. Max. number of turning pts: 3

d. Max. real zeros: 4

5. $f(x) = 2x^5 + 7x^4 - x^3 - 4x^2 + 3x + 6$

a. Graph:



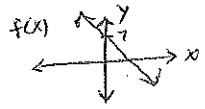
b. End behavior: $\lim_{x\to\infty} f(x) = \infty$, $\lim_{x\to-\infty} f(x) = -\infty$

c. Max. number of turning pts: 4

d. Max. real zeros: 5

6. $f(x) = -2x + 7$

a. Graph:



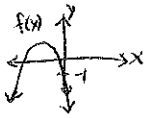
b. End behavior: $\lim_{x\to-\infty} f(x) = \infty$, $\lim_{x\to\infty} f(x) = -\infty$

c. Max. number of turning pts: 0

d. Max. real zeros: 1

7. $f(x) = -2x^2 + 7x - 1$

a. Graph:



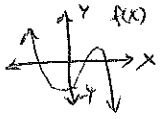
b. End behavior: $\lim_{x\to-\infty} f(x) = -\infty$, $\lim_{x\to\infty} f(x) = -\infty$

c. Max. number of turning pts: 1

d. Max. real zeros: 2

8. $f(x) = -2x^3 + 7x^2 - x - 4$

a. Graph:



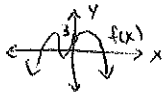
b. End behavior: $\lim_{x\to-\infty} f(x) = \infty$, $\lim_{x\to\infty} f(x) = -\infty$

c. Max. number of turning pts: 2

d. Max. real zeros: 3

9. $f(x) = -2x^4 + 7x^3 - x^2 - 4x + 3$

a. Graph:



b. End behavior: $\lim_{x\to-\infty} f(x) = -\infty$, $\lim_{x\to\infty} f(x) = \infty$

c. Max. number of turning pts: 3

d. Max. real zeros: 4

10. $f(x) = -2x^5 + 7x^4 - x^3 - 4x^2 + 3x + 6$

a. Graph:

b. End behavior: $\lim_{x\to-\infty} f(x) = \infty$, $\lim_{x\to\infty} f(x) = -\infty$

c. Max. number of turning pts: 4

d. Max. real zeros: 5

What determines the end behavior of a polynomial function? The degree and its leading coefficient.

P2-4 & P2-5 Honors Advanced Algebra Name_____

Target 2B

Date_____

Name each polynomial by degree and number of terms. Then state the leading coefficient.

1) $-8k^3 - 6k - 9k^2 + 7k^4$

2) $6 - 2x$

3) $4x^5 - 4x^6$

4) 10

5) $3v^2 - 2v + 4$

6) $9 - 9n^2 + 6n - 9n^3$

Describe the end behavior of each function.

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

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

9) $f(x) = x^2 + 4x + 5$

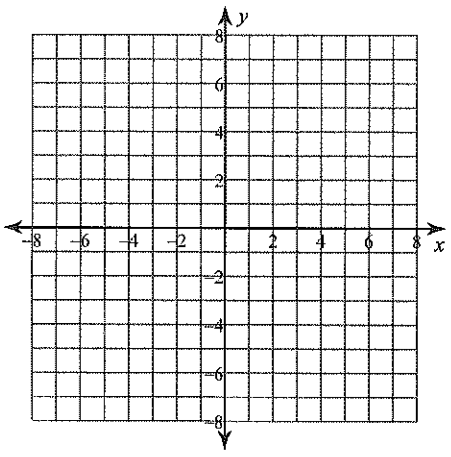
10) $f(x) = x^3 - 9x^2 + 24x - 14$

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

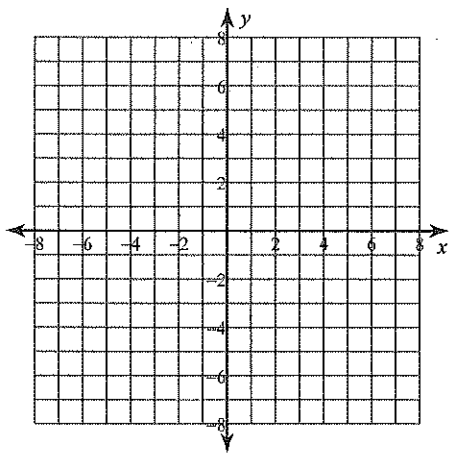
12) $f(x) = -x^5 + 2x^3 + 3$

Sketch the graph of each function. State the number of real zeros. Approximate each zero to the nearest tenth. Approximate the relative minima and relative maxima to the nearest tenth.

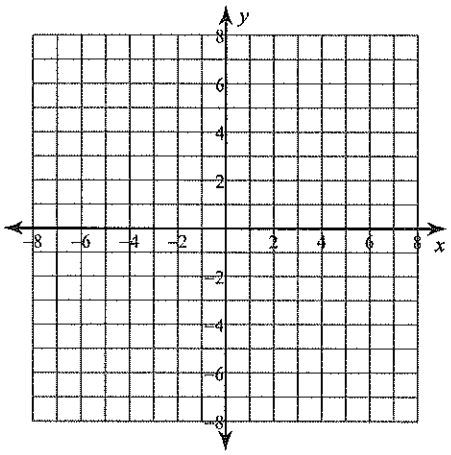
13) $f(x) = x^4 - 4x^2 - x + 5$



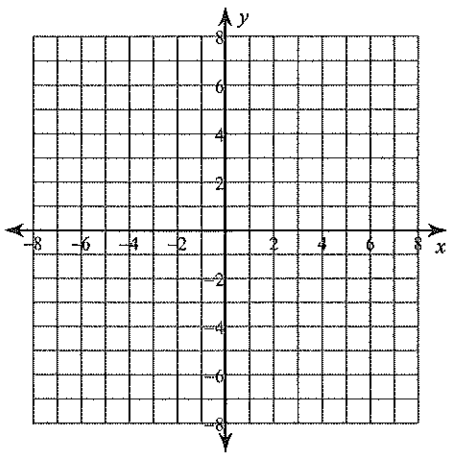
14) $f(x) = -x^3 + 4x^2 - 2$



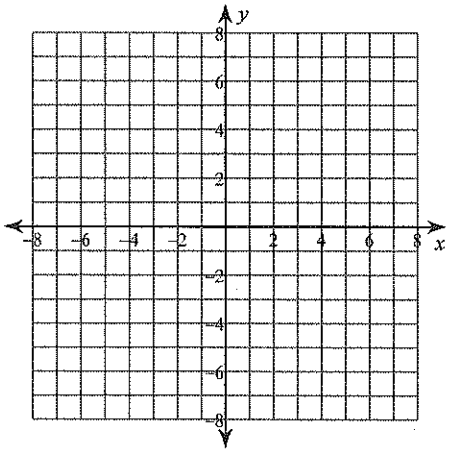
15) $f(x) = x^2 + 8x + 15$



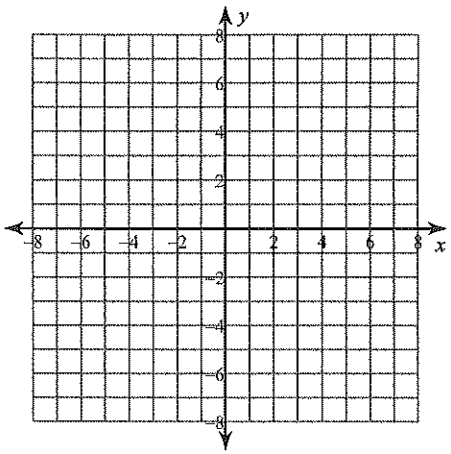
16) $f(x) = -x^2 + 8x - 10$



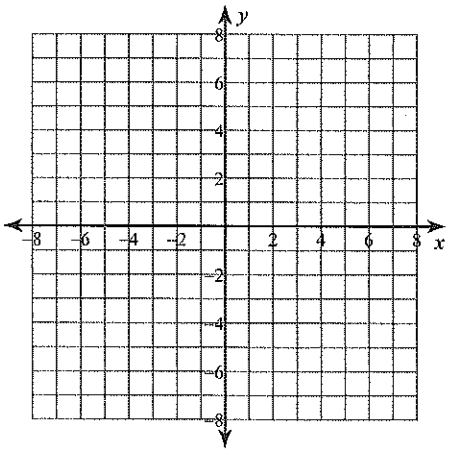
17) $f(x) = -x^3 + 13x^2 - 56x + 83$



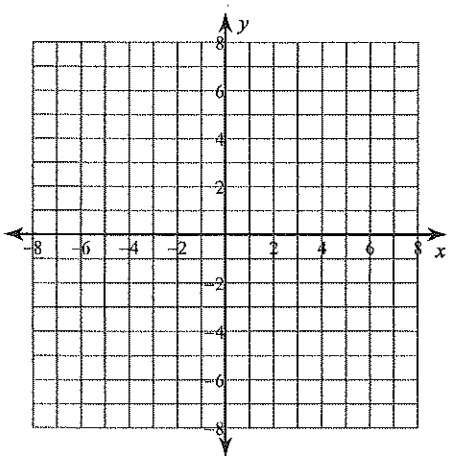
18) $f(x) = x^5 - 3x^3 + 1$



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



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



Answers to Target 2B

1) quartic polynomial with four terms and leading coefficient 7

2) linear binomial with leading coefficient -2

3) sixth degree binomial with leading coefficient -4

4) constant monomial with leading coefficient 10

5) quadratic trinomial with leading coefficient 3

6) cubic polynomial with four terms and leading coefficient -9

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

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

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

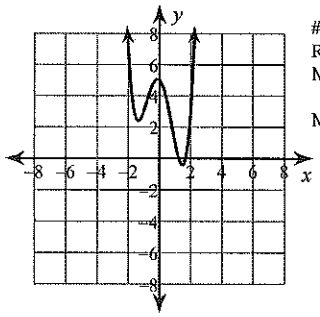
10) $\lim_{x\to\infty} f(x) = -\infty$

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

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

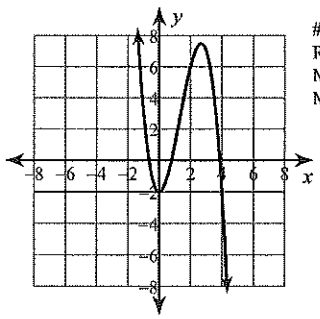
$\lim_{x\to\infty} f(x) = \infty$

13)



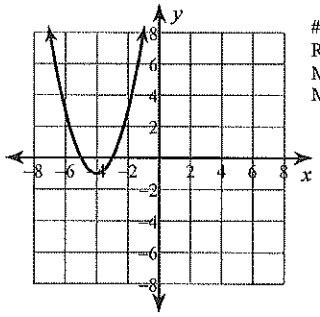
Real Zeros: 2
Real Zeros: 1.2, 1.7
Minima: (–1.3, 2.4)
(1.5, –0.4)
Maxima: (–0.1, 5.1)

14)



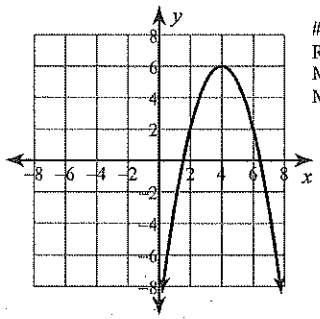
Real Zeros: 3
Real Zeros: –0.7, 0.8, 3.9
Minima: (0, –2)
Maxima: (2.7, 7.5)

15)



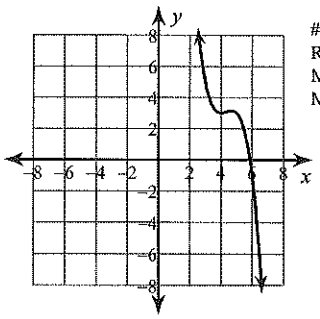
Real Zeros: 2
Real Zeros: –5, –3
Minima: (–4, –1)
Maxima: None

16)



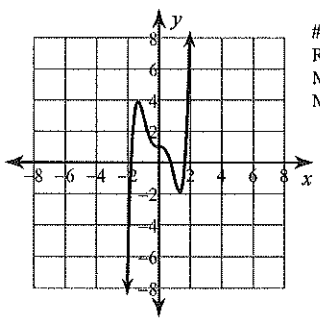
Real Zeros: 2
Real Zeros: 1.6, 6.4
Minima: None
Maxima: (4, 6)

17)



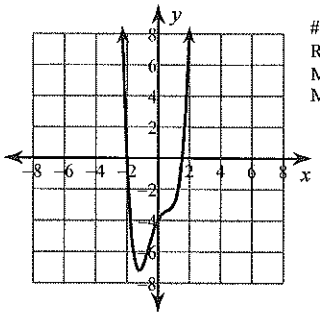
Real Zeros: 1
Real Zeros: 5.9
Minima: (4, 3)
Maxima: (4.7, 3.1)

18)



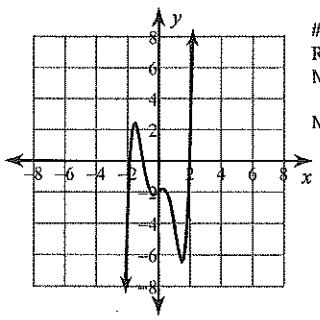
Real Zeros: 3
Real Zeros: –1.8, 1.7, 0.7
Minima: (1.3, –1.9)
Maxima: (–1.3, 3.9)

19)



Real Zeros: 2
Real Zeros: –2, 1.5
Minima: (–1.2, –7.2)
Maxima: None

20)



Real Zeros: 3
Real Zeros: –1.8, –1, 2
Minima: (–0.3, –2.2)
(1.5, –6.4)
Maxima: (–1.5, 2.4)
(0.3, –1.8)

P2-6 Name:_____

Directions: For problems 1-6, show your work on a separate sheet of paper.

Write a cubic polynomial function in standard form with zeros:

1. 1, -2, 3

2. -3, -2, 4

Write a polynomial of least degree with zeros: (write answers without imaginary numbers)

3. 3i, 2

4. 0, i

5. -1, 2i, 3

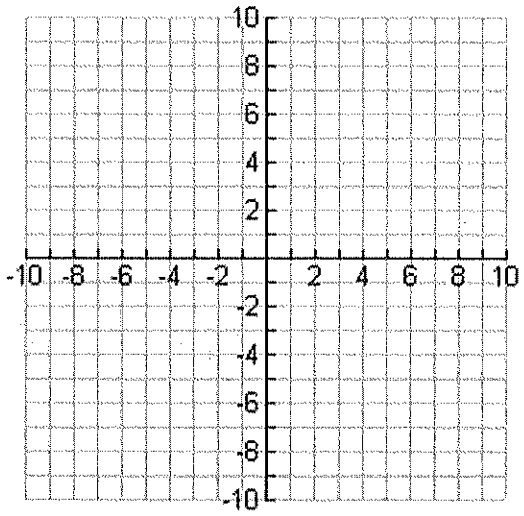
6. 1+i, 2

Sketch a graph of a polynomial with the following infor

7. Zeros: 6, -7
   Minima: (1, -5)

   $\lim_{x\to\infty} f(x) = \infty$

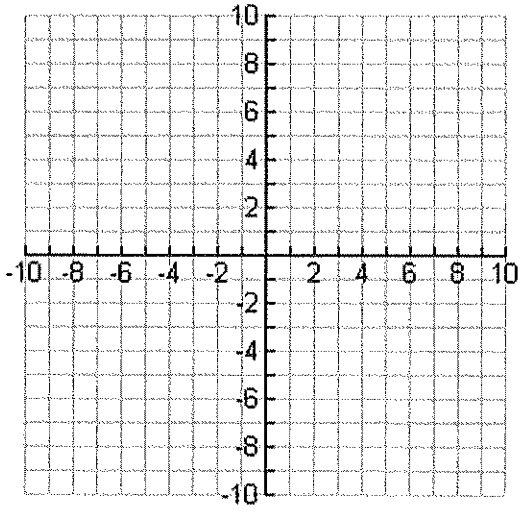
   $\lim_{x\to-\infty} f(x) = \infty$



8. Zeros: -1, 3, 5
   Minima: (4, -1)
   Maxima: (1, 6)

   $\lim_{x\to\infty} f(x) = \infty$

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



Honors Advanced Algebra
Multiplicity Discovery

Name:_____

Essential question: How do multiple zeros affect the graph of a polynomial function?

1. Graph $f(x) = x(x-2)(x+2)(x-1)$ on a graphing calculator.
   a. What are the zeros of the function (menu, analyze graph, zero) ?

   b. For what value(s) of *x* does the graph of the function cross the *x*-axis?

   c. For what value(s) of *x* does the graph of the function touch but not cross the *x*-axis?

   d. What degree is the polynomial?

2. Graph each function in the table. For each function, answer the questions asked in Question 1. Use the table below to record your results.

#	Function	Zeros	Cross	Touch	Degree
1	$f(x) = (x+1)^2(x-2)(x-1)$				
2	$f(x) = (x-2)^2(x+1)(x-1)$				
3	$f(x) = (x+2)^2(x-1)^2$				
4	$f(x) = (x+1)^3(x-1)(x-2)$				
5	$f(x) = (x-2)^2(x-1)(x+1)^2$				

3. How are the zeros of a polynomial function related to the factors of a polynomial function?

4. How do the exponents in each term in the factored form of the polynomial function affect its graph? When does the graph cross the x-axis and when does the graph touch the x-axis?

5. Revisit graphs **#1–#5,** and observe the end behavior for the polynomial functions. What does the degree of the polynomial function tell you about its end behavior?

6. When a polynomial has a repeated linear factor, it has a multiple zero. Write the factored form of a polynomial function that crosses the x-axis at $x = -2$ and $x = 5$ and touches the x-axis at $x = 3$. Which of the zeros of the function must have a multiplicity greater than 1? Explain your reasoning.

7. Write two additional polynomial functions that meet the same conditions as described in Question 6. Explain what is different from your function in Question 6, and how you determined your polynomial functions.

Examples:

- State the degree and list the zeros of the polynomial function. State the multiplicity of each zero and whether the graph crosses the x-axis at the corresponding x-intercept. Then sketch the graph of the polynomial function by hand.

1. $f(x) = x(x+4)^2(x-6)$

2. $g(x) = (x-5)^3(x+6)(x+2)^2$

- Write a polynomial function based upon the information below. Then sketch the graph of the polynomial by hand.

3. The function has a zero with multiplicity of 2 at $x = 3$ and a zero with multiplicity of 1 at $x = -5$.

4. The function has a zero with multiplicity of 2 at $x = -1$ and a zero with multiplicity of 2 at $x = 3$.

P2-8:You try it!

4) $x^2 - 2x = -7x + 24$

5) $x^3 = 8x - 2x^2$

6) $x^3 + 6x = 6x^2$

7) $3x^4 + 12x^2 = 6x^3$ (Challenge)

You try it!

Answers:

4) $x^2 - 2x = -7x + 24$

$x = -8$ or $x = 3$

5) $x^3 = 8x - 2x^2$

$x = -4$ or $x = 0$ or $x = 2$

6) $x^3 + 6x = 6x^2$

$x = 0$ or $x = 3 + \sqrt{3}$ or $x = 3 - \sqrt{3}$

7) $3x^4 + 12x^2 = 6x^3$ (Challenge)

$x = 0$ or $x = 1 + i\sqrt{3}$ or $x = 1 - i\sqrt{3}$

$x = 0$: repeated zero

$x = 1 + i\sqrt{3}$ or $x = 1 - i\sqrt{3}$: complex solutions

Synthetic Division
P2-9

Name: _____
Period:

1) $(3c^4 - 34c^3 + 71c^2 + 78c - 47) \div (c - 8)$

2) $(3u^3 + 16u^2 + 72) \div (u + 6)$

3) $(10j^3 - 46j^2 + 96) \div (j - 4)$

4) $(7a^3 + 8 - 7a + 55a^2) \div (a + 8)$

5) $(4f^4 + 24f^3 - 29f^2 + 47) \div (f + 7)$

6) $(8n^4 + 13n^3 + n^2 - 4n + 6) \div (n + 1)$

7) $(4a^4 - 39a^3 + 53a^2 + 182) \div (a - 8)$

8) $(5y^3 + 14y^2 + 9) \div (y + 3)$

9) $(9w^4 + 30w^3 - 15w^2 + 16 + 40w) \div (w + 4)$

10) $(p^3 - 16p^2 + 600) \div (p - 10)$

11) $(4f^3 - 18f^2 + 45) \div (f - 2)$

12) $(2q^3 - 27q^2 + 77q + 42) \div (q - 9)$

13) $(3m^4 + 15m^3 + 4m^2 - 93) \div (m + 5)$

14) $(9v^3 - 22v^2 - 19v + 12) \div (v - 3)$

15) $(5z^4 - 42z^3 + 58z^2 - 64z + 7) \div (z - 7)$

16) $(2t^3 + 17t^2 + 26t - 55) \div (t + 5)$

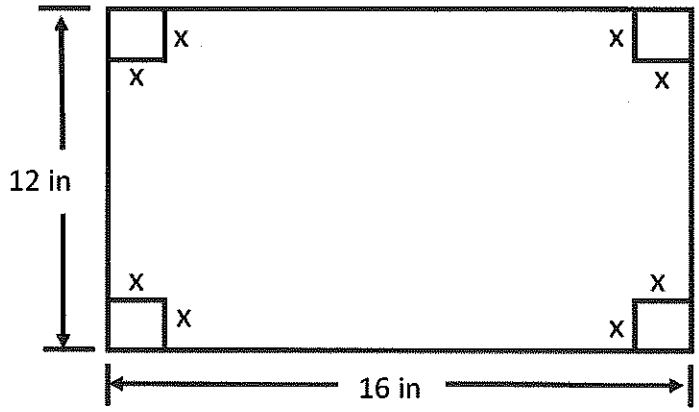
Solutions:

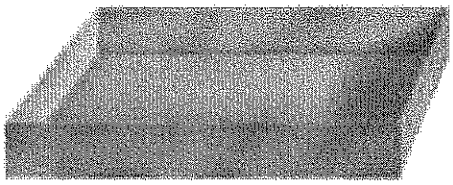
1. $(3c^4 - 34c^3 + 71c^2 + 78c - 47) \div (c - 8)$
$3c^3 - 10c^2 - 9c + 6 + {}^{1}/_{(c-8)}$
2. $(3u^3 + 16u^2 + 72) \div (u + 6)$
$3u^2 - 2u + 12$
3. $(10j^3 - 46j^2 + 96) \div (j - 4)$
$10j^2 - 6j - 24$
4. $(7a^3 + 8 - 7a + 55a^2) \div (a + 8)$
$7a^2 - a + 1$
5. $(4f^4 + 24f^3 - 29f^2 + 47) \div (f + 7)$
$4f^3 - 4f^2 - f + 7 - {}^{2}/_{(f+7)}$
6. $(8n^4 + 13n^3 + n^2 - 4n + 6) \div (n + 1)$
$8n^3 + 5n^2 - 4n + {}^{6}/_{(n+1)}$
7. $(4a^4 - 39a^3 + 53a^2 + 182) \div (a - 8)$
$4a^3 - 7a^2 - 3a - 24 - {}^{10}/_{(a-8)}$
8. $(5y^3 + 14y^2 + 9) \div (y + 3)$
$5y^2 - y + 3$
9. $(9w^4 + 30w^3 - 15w^2 + 16 + 40w) \div (w + 4)$
$9w^3 - 6w^2 + 9w + 4$
10. $(p^3 - 16p^2 + 600) \div (p - 10)$
$p^2 - 6p - 60$
11. $(4f^3 - 18f^2 + 45) \div (f - 2)$
$4f^2 - 10f - 20 + {}^{5}/_{(f-2)}$
12. $(2q^3 - 27q^2 + 77q + 42) \div (q - 9)$
$2q^2 - 9q - 4 + {}^{6}/_{(q-9)}$
13. $(3m^4 + 15m^3 + 4m^2 - 93) \div (m + 5)$
$3m^3 + 4m - 20 + {}^{7}/_{(m+5)}$
14. $(9v^3 - 22v^2 - 19v + 12) \div (v - 3)$
$9v^2 + 5v - 4$
15. $(5z^4 - 42z^3 + 58z^2 - 64z + 7) \div (z - 7)$
$5z^3 - 7z^2 + 9z - 1$
16. $(2t^3 + 17t^2 + 26t - 55) \div (t + 5)$
$2t^2 + 7t - 9 - {}^{10}/_{(t+5)}$

Honors Advanced Algebra
Target 2F

DATE _____

A metalworker wants to make an open box from a sheet of metal, by cutting equal squares from each corner as shown.





a. Write expressions that will represent the length, width, and height of the open box.

L = _____ W= _____ H= _____

b. Use your expressions from part (a) to write a function in factored form for the volume of the box.

$f(x) =$ _____

c. Draw the graph of the function.

d. Find the maximum volume of the box and the side length of the cut out squares that generate this volume. Round answers to the nearest hundredth.

P2-10

Repeat parts a-d using different dimensions: length 12 inches and width 8 inches

P 2-11

Name: Answer Key online Period:

Honors Advanced Algebra
Study Guide Key Concept 2—Polynomials

Use the given functions to perform the operations.

$h(x)=3x-4$ $g(x)=-2x^2+7x-8$ $f(x)=8-3i$ $b(x)=12-i$ $d(x)=-3+4i$

1) Find $(h-g)(x)$

2) Find $(h\cdot g)(x)$

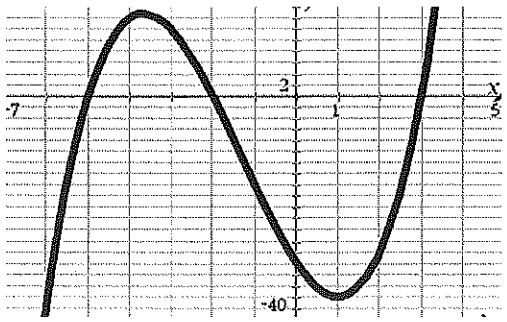
3) Find $(f+2b-d)(x)$

Write the following in standard form.

4) $(3-8i)^2$

Determine the factors of the graphed polynomial

5)



Create a polynomial of least degree in factored form using the information given below.

6) $x=8$ $x=-6$ $x=-13$

7) $x=-2$ $x=-9i$

Solve using algebra AND check your work using a graphing calculator.

8) $x^3-81x=0$

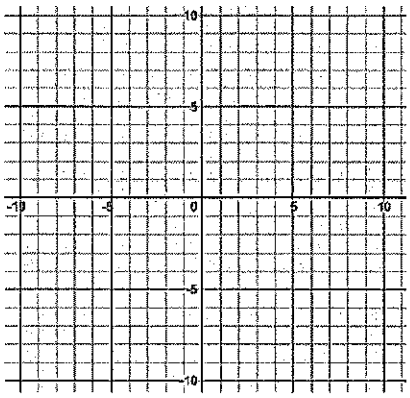
9) $2x^3+20x^2=48x$

10) You know that $2x^3-17x^2+19x+14$ has a factor of $(x-2)$. What are the other two factors?

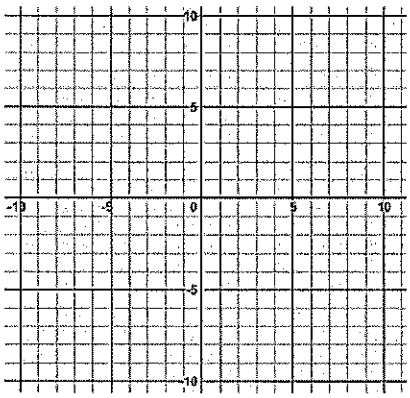
11) Multiplying $(x+4)$ by what quadratic expression gives us $x^3-2x^2-15x+36$?

Sketch a polynomial with the following features.

12) Zeros: { -5, -1, 7 }
Min of y = -8 at (-3,-8)
Max of y = 4 at (3,4)



13) Factors: (x+4), x, (x-6)
Min of y = -5 at (3,-5)
Max of y = 7 at (-2,7)



State the intervals that contain the relative min and relative max.

14)

x	f(x)
-6	-27
-5	0
-4	7
-3	0
-2	-15
-1	-32
0	-45
1	-48
2	-35
3	0
4	63
5	160

Describe the end behavior in limit notation. Also state the domain and range.

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

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

$\lim_{x\to\infty} f(x) =$

Domain:

Range:

16) $g(x)=-x^3+x^2+5x+1$

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

$\lim_{x\to\infty} f(x) =$

Domain:

Range:

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

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

$\lim_{x\to\infty} f(x) =$

Domain:

Range:

18) $h(x)=-x^4+4x^2+3x-4$

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

$\lim_{x\to\infty} f(x) =$

Domain:

Range:

19). The height of a box is 3 cm less than the width. The length is 2 cm less than the width. The volume is 50 cm cubed. What is the width of the box? Also determine the height and length.

20) A box has the dimensions of x, 10-2x, and 12-2x. Find the maximum value of the box and the value of x that generates that volume.

Extra Practice: Factor (one of these is NOT factorable)

A) $14x^2-7x$ B). x^2-36 C) x^2+16 D) $x^2-5x-36$ E). $2x^2+3x-20$