Name _____ Math Analysis
Date _____ Chapter 4 Worksheet
Period _____

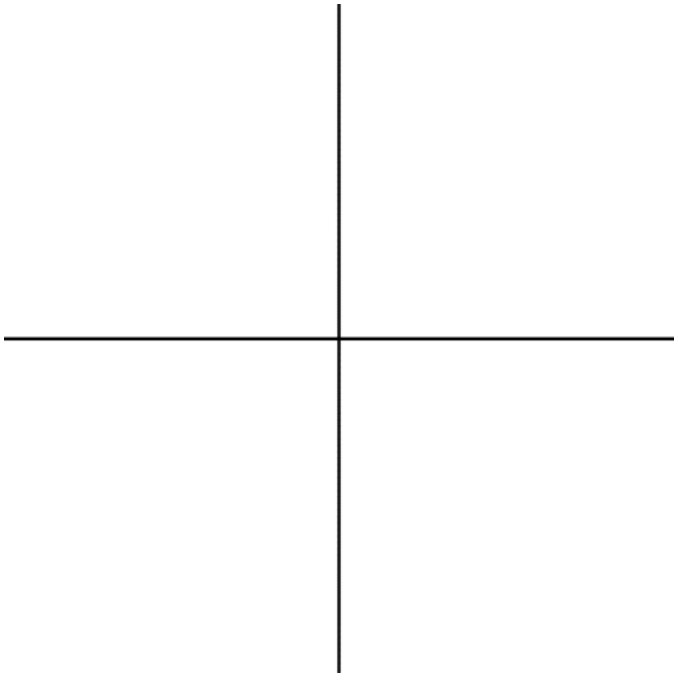
Given $P(x) = 5x^2 - 10x + 2$

1. Find the zeros of $P(x)$.

2. Find the y-intercept of $P(x)$. Please express the y-intercept as an *ordered pair*.

3. Find the vertex of $P(x)$.

4. Using the answers you got from #1-3, graph $P(x)$ below.



More on the back→

5. Given $M(x) = x^3 - 2x^2 - 33x + 10$, is ($x$+5) a factor? Is ($x$-1) a factor?

6. Given $Q(x) = x^4 - 2x^3 - 4x^2 + 11x - 6$. Thanks to Descartes' Rule of Signs, we can tell the number of possible *positive* real zeros and *negative* real zeros of $Q(x)$. Demonstrate below (showing arrows, etc.) how we can tell.

7. How many roots are there in $Q(x)$?

8. Please list all the possible rational roots of $Q(x)$. (There should be eight of them.)

9. Testing the possible rational roots from #8, find which ones are actually roots.

10. You found rational roots in #9. Let's call them r_1 and r_2. We want to find the other roots. Here's what we can do: divide $Q(x)$ by $(x - r_1)$ to get a cubic. Then divide the cubic by $(x - r_2)$ to get a quadratic. Finally, use the quadratic formula to find the last two roots of $Q(x)$.

Name_____ Math Analysis
Period_____ Chapter 4 Review

Show all work and be neat! ☺

In #1-5, find the zeros of each polynomial

1. $P(x) = 2x^2 - 11x - 156$

2. $Q(x) = 4x^2 + 5x - 4$

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

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

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

6. Given the roots -2, 3, and 4, write the polynomial of least degree.

7. Given the roots 5i, -5i, and 2, write the polynomial of least degree.

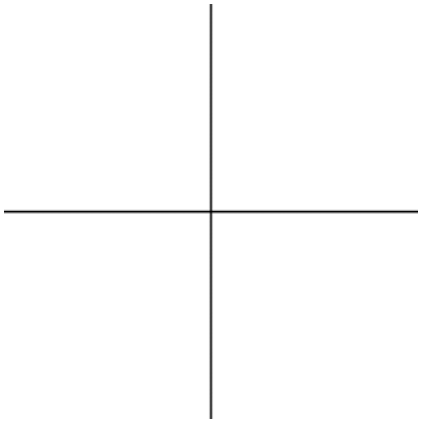
8. Find the discriminant of $U(x) = 5x^2 - 3x + 2$. What does this tell you about the roots?

9. If the discriminant of a quadratic function is greater than zero, what do we know about the function's roots?

10. Find the remainder of $(x^3 - 5x^2 - 3) \div (x - 1)$, using synthetic division. Is $(x - 1)$ a factor? How do you know?

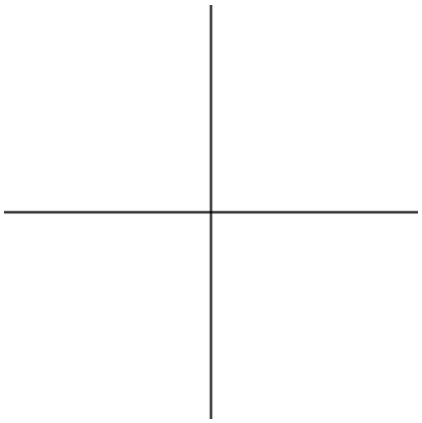
11. Find the remainder of $(x^3 + 4x^2 - 6x + 1) \div (x - 1)$, using synthetic division. Is $(x - 1)$ a factor? How do you know?

12. Find the roots of $f(x) = -3x^2 - 12x + 8$ by completing the square. Plus, find the coordinates of the vertex and the y-intercept. Then graph it.

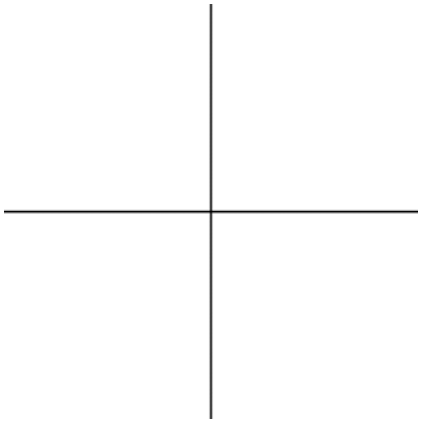


13. Continuing from the previous problem, **describe** the transformations that have taken place to produce $f(x)$ from the parent graph $y = x^2$.

14. Find the roots of $g(x) = 14 - 6x - x^2$ by any method. Plus, find the coordinates of the vertex and the y-intercept. Then graph it.



15. You are given a polynomial $V(x)$ that has a degree of 3, and has only one real root. Sketch a graph of what $V(x)$ could possibly look like.



For problems #16-20, consider $W(x) = 4x^3 - 3x^2 - 25x - 6$.

16. How many zeros are there?

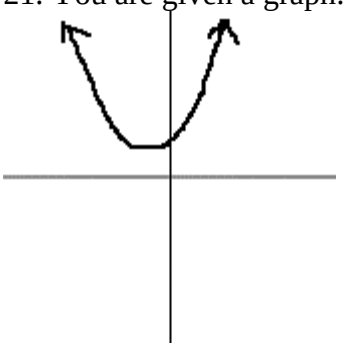
17. How many possible positive real zeros are there?

18. How many possible negative real zeros are there?

19. What are the possible rational zeros?

20. Find all the zeros. (Show that you can use the shortened form of synthetic division.)

21. You are given a graph:



Choose which of the following two equations could fit the graph. **Explain** why you chose that equation. (Your explanation should include something about the nature of roots...)

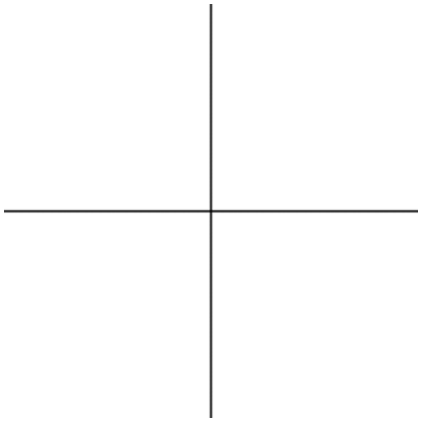
a) $f(x) = 2x^2 + x + 1$

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

22. Given $h(x) = x^4 + 2x^3 - 6x - 4$ use the location principle to find where the approximate locations of all the real zeros are. (Use **integral** steps.)

23. Given $j(x) = 4x^3 - 2x^2 - 12x + 1$, use the location principle to find where the approximate locations of all the real zeros are. (Use steps of **one-tenth**.)

24. Sketch a nice graph of $j(x)$.

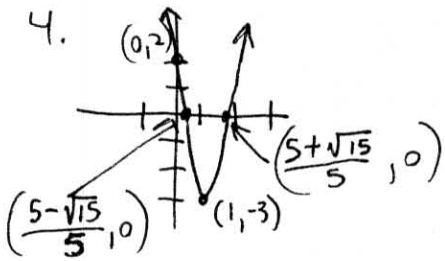


WORKSHEET KEY

1. $x = \frac{5 \pm \sqrt{15}}{5}$

2. $(0, 2)$

3. $(H, K) = (1, -3)$

4. 

5. $M(-5) = 0$ YES, A FACTOR.
   $M(+1) \neq 0$ NO, NOT A FACTOR

6. 3 OR 1 POSITIVE IR ZEROS
   1 NEGATIVE IR ZERO

7. FOUR

8. $\frac{P}{q} = \pm 1, \pm 2, \pm 3, \pm 6$

9.

r	1	2	-4	-11	-6	
1	1	3	-1	-12	-18	
-1	1	1	-5	-6	0	(-1 IS A ROOT)
2	1	4	+4	-3	-12	
-2	1	0	-4	-3	0	(-2 IS A ROOT)
3						
-3						
6						
-6						

10.
$$\begin{array}{r|rrrrr} -1 & 1 & 2 & -4 & -11 & -6 \\ & & -1 & -1 & 5 & 6 \\ \hline & 1 & 1 & -5 & -6 & 0 \end{array} \rightarrow x^3 + x^2 - 5x - 6$$

$$\begin{array}{r|rrrr} -2 & 1 & 1 & -5 & -6 \\ & & -2 & 2 & 6 \\ \hline & 1 & -1 & -3 & 0 \end{array} \rightarrow x^2 - x - 3$$

$A = 1$, $B = -1$, $C = -3$

$$x = \frac{1 \pm \sqrt{1 - 4(1)(-3)}}{2}$$

$$x = \frac{1 \pm \sqrt{13}}{2}$$

REVIEW KEY

1. $x = 12, -6\frac{1}{2}$

2. $x = \frac{-5 \pm \sqrt{89}}{8}$

3. $x = 0, 0, -3, 1$

4. $x = -3, 1.5$

5. $x = 0, 1, 2$

6. $x^3 - 5x^2 - 2x + 24$

7. $x^3 - 2x^2 + 25x - 50$

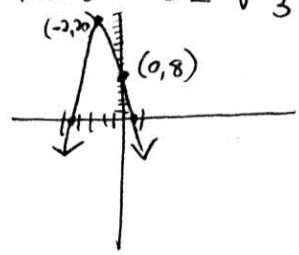
8. $\sqrt{-31}$. ROOTS ARE IMAGINARY.

9. TWO REAL ROOTS.

10.
$$\begin{array}{r|rrrr} 1 & 1 & -5 & 0 & -3 \\ & & 1 & -4 & -4 \\ \hline & 1 & -4 & -4 & -7 \end{array}$$
NOT A FACTOR. REMAINDER $\neq 0$.

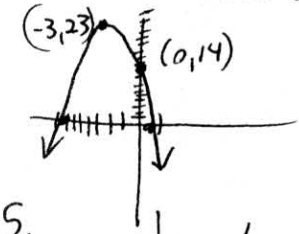
11.
$$\begin{array}{r|rrrr} 1 & 1 & 4 & -6 & 1 \\ & & 1 & 5 & -1 \\ \hline & 1 & 5 & -1 & 0 \end{array}$$
YES, A FACTOR. REMAINDER $= 0$.

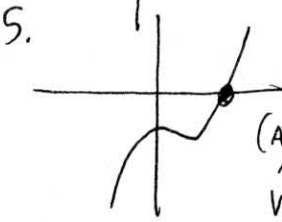
12. VERTEX $= (-2, 20)$
    Y-INT $= (0, 8)$
    ROOTS $= -2 \pm \sqrt{\frac{20}{3}}$



13. SHIFT LEFT 2;
    SHIFT UP 20;
    STRETCH VERTICALLY BY ● FACTOR OF 3;
    REFLECT OVER X-AXIS

14. VERTEX $= (-3, 23)$
    Y-INT $= (0, 14)$
    ROOTS $= -3 \pm \sqrt{23}$



15. 
(ANSWERS MAY VARY.)

16. THREE

17. ONE

18. TWO OR ZERO

19. $\frac{P}{q} = \pm 1, \pm\frac{1}{2}, \pm\frac{1}{4}, \pm 2, \pm 3, \pm\frac{3}{2}, \pm\frac{3}{4}, \pm 6$

20. $x = -\frac{1}{4}, \bullet 3, -2$

21. EQUATION (a)
    BECAUSE ITS DISCRIMINANT IS LESS THAN 0, SO IMAGINARY ROOTS.

22. BETWEEN: -1 AND 0
    1 AND 2

23. BETWEEN: -1.6 AND -1.5
    0 AND .1
    1.9 AND 2

24.