

- 1.) What is the remainder when $p(x) = x^6 - 2x^3 + x - 1$ is divided by $(x + 1)$?
- a.) -3
 - b.) -1
 - c.) 1
 - d.) 3
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- 2.) If $p(x) = x^3 - 2x^2 + 9x - 2$, which of the following statement(s) is/are true?
- i. $x - 3$ is a factor of $p(x)$
 - ii. $x = 3$ is a root of $p(x) = 0$
 - iii. $p(3) = 34$
 - iv. $p(-3) = 34$
- a.) i only
 - b.) iii only
 - c.) i and ii only
 - d.) i and iii only
 - e.) i and iv only
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- 3.) How many real roots must the following equation have?

$$x^4(x^2 - 4) + 9(x^2 - 4) = 0$$

- a.) 1
 - b.) 2
 - c.) 4
 - d.) none
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- 4.) Determine the quotient when $x^3 - 2x^2 - 9$ is divided by $(x - 3)$?

- a.) $x^2 + 5x + 15$
 - b.) $x^2 + x - 6$
 - c.) $x^2 - 5x + 6$
 - d.) $x^2 + x + 3$
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- 5.) What are the zeros of the polynomial function $f(x) = 2x^3 - 8x^2 + 6x$?

- a.) $x = 0, 1, 3$
- b.) $x = 1, 2, 3$
- c.) $x = 0, -1, -3$
- d.) $x = 0, 1, -4$

6.) If $(x + 2)$ is a root of $3x^3 + kx^2 - 31x - 54$. What is the value of k ?

- a.) -8
 - b.) -4
 - c.) -51
 - d.) 4
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7.) Find the remainder when $f(x) = x^6 + 5x^5 - x^3 + x - 6$ is divided by $(x + 1)$.

- a.) 0
 - b.) -10
 - c.) -1
 - d.) -12
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8.) Given that a function $f(x)$ has a zero at $x = 3$ with multiplicity 2, then we know that...

- a.) the graph of $f(x)$ crosses the y - axis at 3.
 - b.) as $x \rightarrow \infty, f(x) \rightarrow \infty$
 - c.) the graph of $f(x)$ crosses the x - axis at 3.
 - d.) the graph of $f(x)$ touches but does not cross the x - axis at 3.
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9.) The polynomials $p(x) = x^4 + 5x^3 - 2x^2 - 24x$ has a zero at $x = 2$. Factor p completely.

- a.) $p(x) = x(x + 2)(x + 3)(x + 4)$
 - b.) $p(x) = (x - 2)(x - 3)(x - 4)$
 - c.) $p(x) = x(x + 2)(x - 3)(x - 4)$
 - d.) $p(x) = x(x - 2)(x + 3)(x + 4)$
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10.) For the given polynomials function, $f(x) = -5x^2(x - 8)(x + 2)^3$, find the zeros of the function and state the multiplicity of each.

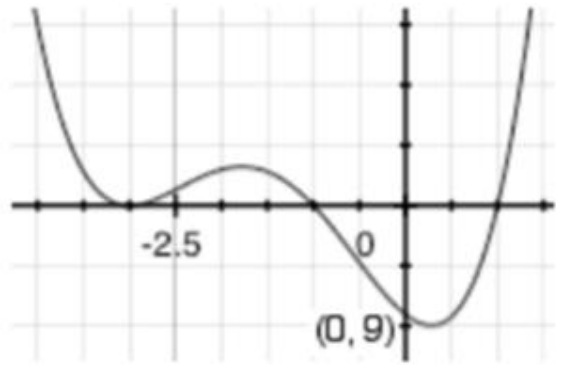
- a.) -2 , multiplicity 1; 2 , multiplicity 1; 8 , multiplicity 1
 - b.) -2 , multiplicity 3; 0 , multiplicity 2; 8 , multiplicity 1; 2 , multiplicity 1
 - c.) -2 , multiplicity 1; 0 , multiplicity 2; 8 , multiplicity 1
 - d.) -2 , multiplicity 3; 0 , multiplicity 2; 8 , multiplicity 1
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11.) For the given polynomials function, $f(x) = x^3 + 6x^2 - x - 6$, find the zeros of the function and state the multiplicity of each.

- a.) -1 , multiplicity 1; 1 , multiplicity 1; 6 , multiplicity 1
- b.) -6 , multiplicity 2; 1 , multiplicity 1
- c.) -6 , multiplicity 1; -1 , multiplicity 2
- d.) -6 , multiplicity 3; -1 , multiplicity 1; 1 , multiplicity 1

12.) The equation that would best model the following graph is:

- a.) $f(x) = (x + 3)^2(x^2 - 1)$
- b.) $f(x) = (x + 3)(x - 1)(x + 1)$
- c.) $f(x) = x^4 + 6x^3 + 9x^2 - 6x - 9$
- d.) $f(x) = -(x + 3)^2(x^2 - 1)$



13.) The function $f(x)$ has a zero of 2 with a multiplicity 3. We know...

- a.) Since 3 is an odd number, the graph touches but does not cross the x - axis.
- b.) Since 3 is an odd number, the graph crosses the x - axis.
- c.) Since 2 is an even number, the graph touches but does not cross the x - axis.
- d.) Since 2 is an even number, the graph crosses the x - axis.

14.) The function $f(x)$ has a zero of 3 with a multiplicity 2. We know...

- a.) Since the zero is 3, the graph crosses the y - axis at 3.
- b.) Since the zeros is 3, the graph goes up to the right.
- c.) Since the multiplicity is 2, the graph crosses the x - axis.
- d.) Since the multiplicity is 2, the graph touches but does not cross the x - axis.

15.) Using a graphing calculator, find the relative minimum, relative maximum, and zeros of $f(x) = 3x^3 + 15x^2 - 12x - 60$. If necessary, round to the nearest hundredth.

- a.) *relative minimum:* $(-62.24, 0.36)$, *relative maximum:* $(37.79, -3.69)$, *zeros:* $x = 5, -2, 2$
- b.) *relative minimum:* $(0.36, -62.24)$, *relative maximum:* $(-3.60, 37.79)$, *zeros:* $x = -5, -2, 2$
- c.) *relative minimum:* $(0.36, -62.24)$, *relative maximum:* $(-3.60, 37.79)$, *zeros:* $x = 5, -2$
- d.) *relative minimum:* $(-62.24, 0.36)$, *relative maximum:* $(37.79, -3.69)$, *zeros:* $x = -5, -2$

16.) Using the polynomial, $f(x) = -2x^3 + 4x - 8$, explain how the degree and leading coefficient will effect the end behavior.

- a.) Because the degree is odd, the ends will point in opposite direction, and because the leading coefficient is negative the graph will increase from right to left.
- b.) Because the degree is odd, the ends will point in opposite direction, and because the leading coefficient is negative the graph will decrease from right to left.
- c.) Because the degree is odd, the ends will point in the same direction, and because the leading coefficient is negative the graph will increase from right to left.
- d.) Because the degree is odd, the ends will point in the same direction, and because the leading coefficient is negative the graph will decrease from right to left.

17.) Suppose $f(x) = x^2 + 4x - 7$. Evaluate each of the following:

a.) $f(x + h) =$

b.) $2f(m) + f(3m + 2)$

18.) Find ALL zeros of the given function.

a.) $f(x) = x^3 + 4x^2 + 14x + 20$

Total # of Zeros: _____

| Number of Positive Real Zeros | Number of Negative Real Zeros | Number of Imaginary Zeros |
|-------------------------------|-------------------------------|---------------------------|
| | | |
| | | |

Zeros: _____

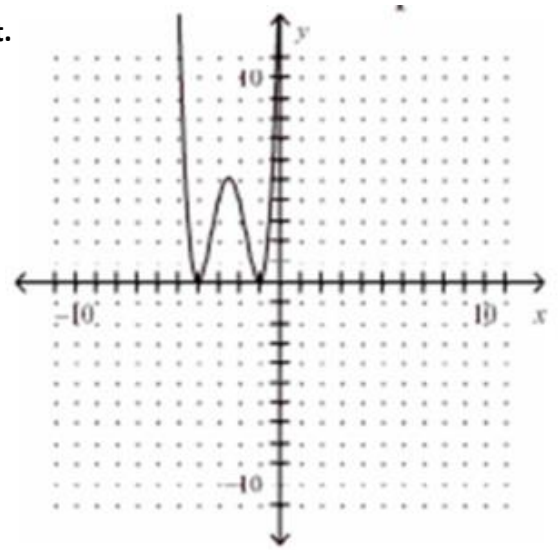
b.) $f(x) = x^4 - 6x^3 + 25x^2 - 96x + 144$

Total # of Zeros: _____

| Number of Positive Real Zeros | Number of Negative Real Zeros | Number of Imaginary Zeros |
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Zeros: _____

19.) A complete graph of a polynomial function g is shown at the right.



a.) Is the degree of $g(x)$ even or odd? _____.

Explain: _____

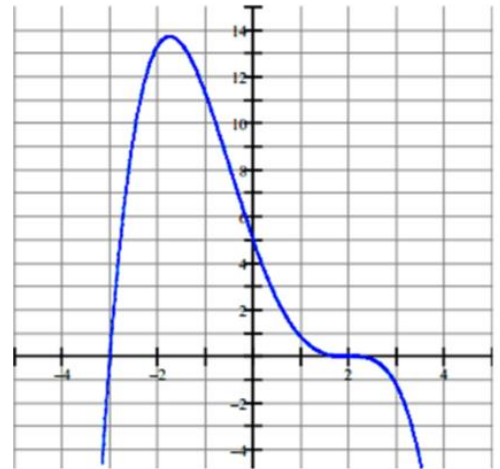
b.) Is the leading coefficient of $g(x)$ positive or negative? _____.

Explain: _____

c.) Where do the real zeros of $g(x)$ appear to be? _____

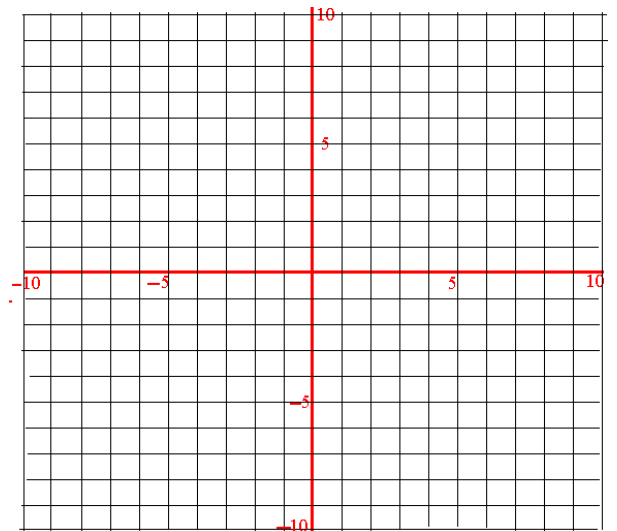
d.) What is the smallest possible degree of $g(x)$? _____. Explain: _____

20.) Determine the polynomial function of the following graph in factored form.



21.) Using what you know about zeros, multiplicity, and end behavior draw a sketch of the graph of the following function:

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



22.) Find all roots for $f(x) = x^3 + x^2 - 4x + 6$ given $(x + 3)$ is a factor of the polynomial.

23.) Sketch $f(x) = x^3 + 6x^2 - x - 6$.

Degree: _____

Lead Coefficient: _____

End Behavior: as $x \rightarrow \infty, f(x) \rightarrow$ _____

as $x \rightarrow -\infty, f(x) \rightarrow$ _____

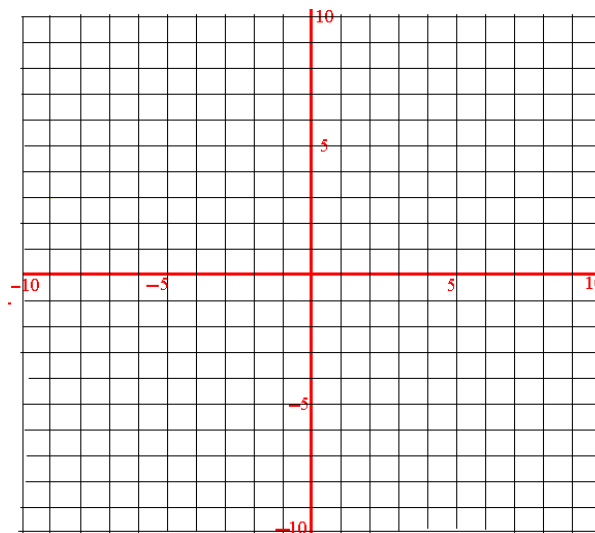
Zero(s): _____

Relative Max: _____

Relative Min: _____

Intervals Increasing: _____

Intervals Decreasing: _____



24.) Given $f(x) = x^7 + 4x^6 - 2x^5 + x^4 - 2x^3 - 2x^2 - 3x + 5$ complete the table below.

| Positive Real Zeros | Negative Real Zeros | Complex Zeros | Total Zeros |
|---------------------|---------------------|---------------|-------------|
| | | | |

25.) If you needed to predict the equation of a polynomial function from a graph and were only allowed to ask three questions about the function, what questions would you ask to help you the most?

Question 1: _____

Question 2: _____

Question 3: _____

- 26.) A florist delivers flowers to anywhere in town. d is the distance from the delivery address to the florist shop in miles. The cost to deliver flowers, based on the distance d , is given by $C(d) = 0.04d^3 - 0.65d^2 + 3.5d + 9$. Evaluate $C(d)$ for $d = 6$ and $d = 11$, and describe what the values of the function represent.

$C(6) = \underline{\hspace{2cm}}$.

$C(11) = \underline{\hspace{2cm}}$.

- 27.) A jewelry box has a length that is 2 inches longer than the width and a height that is 1 inch smaller than the width. The volume of the box is 140 cubic inches. What is the width of the jewelry box? (Hint: $V = lwh$)

Length:

Width:

Height:

- 28.) The profit P (in millions of dollars) for a T-shirt manufacturer can be modeled by $P(x) = -x^3 + 4x^2 + x$ where x is the number of T-shirts produced (in millions). Currently, the company produced 4 million T-shirts and makes a profit of \$4,000,000. What lesser number of T-shirts could the company produce and still make the same profit?

29.) During soccer practice, Jill decided to see how high she can kick a soccer ball straight-up in the air. Her teammate, Jordan, who loves math, calculated that the path of the soccer ball can be modeled by the equation $h(t) = -3t^2 + 24t + 3$, for t seconds.

a.) What was the initial height of the soccer ball when Jill's foot struck the ball? _____

b.) When will the soccer ball reach its maximum height? _____

c.) What will be the maximum height of the soccer ball? _____

d.) When will the soccer ball hit the ground? _____

e.) When would the soccer ball reach a height of 30 feet? _____