For #1-2, simplify the expression (write in standard form), name the expression based on the degree (linear, quadratic, cubic, quartic, quintic) and number of terms (monomial, binomial, trinomial, polynomial). Then list out the coefficients.

1. \(3x^2 - x + 2 - (x + x^2 - 1)\) \(\overline{2x^3 - 2x + 3}\)
   - Name: \textit{quadratic trinomial}
   - Coefficients: \(2, -2, 3\)

2. \(x^4 + x^2 - 4x + (x^3 + x^2 - 2x)\) \(\overline{x^4 + x^3 + 2x^2 - 6x}\)
   - Name: \textit{quartic polynomial}
   - Coefficients: \(1, 1, 2, -6\)

For #3-5 identify the zeros, including any multiplicity. Rewrite the function in standard form.

3. \(2(x + 1)(x - 4)\)
   \[2(x^2 - 3x - 4)\]
   - Zeros: \(0, -1, 4\)
   \[y = 2x^3 - 6x^2 - 8x\]

4. \(x^2(x - 2)(x + 3)\)
   \[x^3(x^2 + x - 4)\]
   - Zeros: \(0, \text{ mult} 2, 2, -3\)
   \[y = x^4 + x^3 - 6x^2\]

5. \((x - 2)(x + 5)(x + 4)\)
   \[(x^3 + 4x + 4)(x + 5)\]
   \[x^3 - 4x^2 + 4x + 5x^3 - 20x + 20\]
   - Zeros: \(x = 2, \text{ mult} 1, -5\)
   \[y = x^3 + x^2 - 16x + 20\]
For #6-9 factor the polynomial. Then identify the zeros.

6. $y = 3x^3 - 3x$
   $3x(x^2 - 1)$
   $y = 3x(x+1)(x-1)$
   Zeros: 0, -1, 1

7. $y = x^3 + 13x^2 + 42x$
   $x(x^2 + 13x + 42)$
   $y = x(x+6)(x+7)$
   Zeros: 0, -6, -7

8. $y = x^3 + 7x^2 - 18x$
   $x(x^2 + 7x - 18)$
   $x(x+9)(x-2)$
   $y = x(x+9)(x-2)$
   Zeros: 0, -9, 2

9. $y = 4x^3 - 100x$
   $4x(x^2 - 25)$
   $y = 4x(x+5)(x-5)$
   Zeros: 0, -5, 5
For #10-13 examine each graph. Decide if it is an even or odd function, and if the lead term is positive or negative. Then match to an equation below.

10. even or odd degree \textit{odd}
Positive or negative lead term \textit{pos}
Equation \( \underline{C} \)

11. even or odd degree \textit{even}
Positive or negative lead term \textit{pos}
Equation \( \underline{D} \)

12. even or odd degree \textit{even}
Positive or negative lead term \textit{neg}
Equation \( \underline{B} \)

13. even or odd degree \textit{odd}
Positive or negative lead term \textit{neg}
Equation \( \underline{A} \)

A. \( y = -(x + 3)^2(x - 1) \)
B. \( y = -(x - 3)^2(x + 1)^2 \)
C. \( y = (x + 3)^2(x - 1) \)
D. \( y = (x - 3)^2(x + 1)^2 \)
The data in the table are quadratic, cubic, or quartic. Calculate the "a" value, identify the y-intercept, and write a function rule. (since you may not use a graphing calculator for these problems, the only terms in the equation are the "a" value and the y-intercept — you do not have to solve a system of equations for any other terms. You're welcome.)

14.

<table>
<thead>
<tr>
<th>x</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-47</td>
<td>-9</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>23</td>
<td>61</td>
</tr>
</tbody>
</table>

Cubic

\[ a = \frac{38}{6} \]

\[ y = ax^3 + b \]

\[ y = \frac{38}{6}x^3 - 2 \]

15.

<table>
<thead>
<tr>
<th>x</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-83</td>
<td>-18</td>
<td>-3</td>
<td>-2</td>
<td>-3</td>
<td>-18</td>
<td>-83</td>
</tr>
</tbody>
</table>

A

\[ y = -x^4 + b \]

\[ y = -x^4 - 2 \]

16.

<table>
<thead>
<tr>
<th>x</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-30</td>
<td>-10</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>-10</td>
<td>-30</td>
</tr>
</tbody>
</table>

A

\[ y = -4x^3 + c \]

\[ y = -4x^3 - 8 \]
Graphing calculator portion:

17. You are not sure if the data in the table are quadratic, cubic, or quartic. Write an equation for each function type. Include the $R^2$ (make sure the “diagnostic” is turned on - go to catalog (2$^{nd}$, 0), scroll until you see “diagnostic on” hit enter twice. You will see the word done.) Round the values to the nearest thousandth.

<table>
<thead>
<tr>
<th>$x$</th>
<th>-4</th>
<th>-2</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>-343.8</td>
<td>-53.8</td>
<td>-7</td>
<td>16.7</td>
<td>114.2</td>
<td>-39.7</td>
</tr>
</tbody>
</table>

Quadratic:

$y = -9.202x^2 + 52.502x + 274.2$  
$r^2 = 0.890$

Cubic:

$y = -3.08x^3 + 1.416x^2 + 36.456x - 2.604$  
$r^2 = 0.903$

Quartic:

$y = -3x^4 + 3x^3 - 4x^2 + x - 7$  
$r^2 = 1$

Which function type fits the data the best? How do you know? **Quartic**  
$r^2 = 1$

Evaluate the best function for $x = 20$  
$-25587$

18. $y = -0.8x^3 - 1.6x^2 + 12x + 28.8$

Graph the above function on your graphing calculator.

What are the: crossing zeros  
4  
touching zeros  
-3  
Relative minimum  
(-3, 0)  
relative maximum  
(1.7, 40.7)

Make a sketch of what you see on your calculator. Label the zeros and the relative min and relative max.

Rewrite this polynomial in factored form based on the zeros and the “a” value:

$y = -0.8(x+3)^3(x-4)$
19. The volume of a box is given by the function $y = x(x-6)(x-10)$. What is the maximum volume of the box? Which value of $x$ gives you this volume?

20. $f(x) = -0.5(x - 3)^2(x + 2)$
   lead coefficient $-0.5$
   degree $3$
   max turning points $2$
   y-intercept $-9$
   end behavior $x \to -\infty f(x) \to \infty$; $x \to \infty f(x) \to -\infty$
   crossing zeros $1$
   touching zeros $2$
   total zeros $3$
   name the zeros: crossing $-3$ touching $3$
   intervals of increase $(-\infty, -3)$ $(-3, 3)$ $(3, \infty)$
   intervals of decrease $(\infty, -3)$
   graph:
   make sure I can tell:
   x-intercepts
   y-intercepts
   rel max
   rel min

Relative max: $(2.4, 15.7)$

x-value max

Relative max

zero

y-int

(-3, -9.3)

Rel min

(3, 0)