

# AP Precalculus Summer Packet

**Teachers:** Mr. Chelmecki and Mrs. Hutchinson

This assignment is designed to be a review of topics covered in Advanced Algebra. The skills presented in this packet are necessary foundational skills for success in AP Precalculus. Individual sections will be labeled as calculator and non-calculator skills. It is in your best interest to respect the classifications.

Please complete the packet *prior* to the first day of school. This will be included as a **homework grade** for Semester 1. An answer key has been provided at the end and sample work has been given as needed.

Understand that you are responsible for all of the information in the packet and these skills WILL be used in AP Precalculus on a consistent basis. If you struggle with any of these topics, it is in your best interest to find resources (like Khan Academy videos or your previous school years' notes) to help you re-learn the skills. We will discuss some of these skills as we work through Precalculus but you should not expect any of them to be explicitly re-taught in as much depth as you received in previous classes.

Questions regarding the packet will be addressed in the first week of school. You should write your questions down as you go so that that first week can be as beneficial to you as possible.

***Showing your work and making your thinking process clear is extremely important for this course and for the AP Exam. You will NOT receive full credit for this assignment if your work is not clearly shown.***

## Final Suggestions

- Advanced Algebra notes related to graphing parent functions, transformation rules, and properties of exponents and logarithms should be kept as a reference guide for this coming year.
- [Khan Academy](#) is a great resource that can provide you with additional instruction on many topics if needed, just be careful to check it isn't in Precalc or Calc level examples.
- If you lose this packet, you can reprint it from the [Math Department](#) or [Guidance Department](#) pages on the Willowbrook website.
- You should complete the entire packet before school starts. It is recommended to work through one section at a time so as not to feel too overwhelmed by the length of the packet. If you complete this packet at the beginning of the summer, revisit the work the week before school starts to make sure it is still fresh in your mind.
- If you have any questions you can email Mr. Chelmecki or Mrs. Hutchinson. Please allow at least 1 business day for a response over the summer.
  - [bchelmecki@dupage88.net](mailto:bchelmecki@dupage88.net)
  - [ehutchinson@dupage88.net](mailto:ehutchinson@dupage88.net)

Good luck and welcome to AP Precalculus! We're going to have a blast!

## Part 1 - Solve Linear Equations (No Calc)

<p>1) <math>x + 3(x + 5) = -33 - 2x</math>  <math>x + 3x + 15 = -33 - 2x</math>  <math>4x + 15 = -33 - 2x</math>  <math>6x = -48</math>  <math>x = -8</math></p>	<p>2) <math>17 + 6x = -5 + 8(-7 + 4x)</math></p>
<p>3) <math>4x - \frac{1}{3} = 3x + \frac{2}{5}</math>  <math>x - \frac{1}{3} = \frac{2}{5} + \frac{1}{3}</math>  <math>x = \frac{6}{15} + \frac{5}{15} = \frac{11}{15}</math></p>	<p>4) <math>11x - \frac{2}{7} = 6x + \frac{4}{9}</math></p>
<p>5) <math>2x - \frac{\pi}{4} = 5x + \frac{\pi}{3}</math>  <math>-\frac{\pi}{4} - \frac{\pi}{3} = 3x + \frac{\pi}{3}</math>  <math>-\frac{7\pi}{12} = 3x + \frac{\pi}{3}</math>  <math>-\frac{7\pi}{12} - \frac{4\pi}{12} = 3x</math>  <math>-\frac{11\pi}{12} = 3x</math>  <math>x = -\frac{11\pi}{36}</math></p>	<p>6) <math>9x - \frac{\pi}{2} = 7x + \frac{\pi}{6}</math></p>

## Part 2 - Solve each equation by factoring (No Calc)

<p>7) <math>7x^2 = 14x</math>  <math>7x^2 - 14x = 0</math>  <math>7x(x - 2) = 0</math>  <math>7x = 0</math> or <math>x - 2 = 0</math>  <math>x = 0</math> or <math>x = 2</math>  <math>\{0, 2\}</math></p>	<p>8) <math>9x^2 - 10x = 7x</math></p>
<p>9) <math>21x^2 + 9 = -66x</math>  <math>21x^2 + 66x + 9 = 0</math>  <math>7x^2 + 22x + 3 = 0</math>  <math>(7x + 1)(x + 3) = 0</math>  <math>x = -3</math> or <math>x = -\frac{1}{7}</math>  <math>\{-3, -\frac{1}{7}\}</math></p>	<p>10) <math>11x^2 + 5 = 12x + 4x^2</math></p>
<p>11) <math>15x^2 - 20x = -8x + 27</math>  <math>15x^2 - 12x - 27 = 0</math>  <math>5x^2 - 4x - 9 = 0</math>  <math>(5x - 9)(x + 1) = 0</math>  <math>x = \frac{9}{5}</math> or <math>x = -1</math>  <math>\{-1, \frac{9}{5}\}</math></p>	<p>12) <math>3x^2 + 2x = -5x + 6</math></p>

**Part 3 - Solve each quadratic using Quadratic Formula (Calc)**

<p>13) <math>15x^2 + 7 = 7x^2 + 57x</math></p> $\begin{array}{r} 15x^2 + 7 \\ -7x^2 - 57x \\ \hline 8x^2 - 57x + 7 = 0 \end{array}$ $x = \frac{57 \pm \sqrt{(57)^2 - 4(8)(7)}}{2(8)}$ $x = \frac{57 \pm \sqrt{3025}}{16} = \frac{57 \pm 55}{16}$ <p><math>x = \left\{ \frac{1}{8}, 7 \right\}</math></p>	<p>14) <math>43x^2 + 3x - 9 = x^2</math></p>
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**Part 4 - Use properties of exponents to solve for the missing value (No Calc)**

<p>15) <math>36^{(-x-1)} = 216^{(3x)}</math></p> $(6^2)^{(-x-1)} = (6^3)^{(3x)}$ $2(-x-1) = 3(3x)$ $-2x - 2 = 9x$ $-2 = 11x$ <p><math>x = \frac{-2}{11}</math></p>	<p>16) <math>81^{(x-3)} = 27</math></p>
<p>17) <math>64^x = \frac{1}{16}</math></p> $(4^3)^x = 4^{-2}$ $3x = -2$ <p><math>x = \frac{-2}{3}</math></p>	<p>18) <math>125^{(-3x-1)} = \frac{1}{5}</math></p>

**Part 5 - Use properties of exponents and logs to solve for the missing values (Calc)**

<p>19) <math>4^{(-7x)} + 10 = 13</math></p> $\begin{array}{r} 4^{(-7x)} + 10 \\ -10 \quad -10 \\ \hline 4^{(-7x)} = 3 \end{array}$ $\log_4(3) = -7x$ $x = \frac{\log_4(3)}{-7} \approx -0.113$	<p>20) <math>20^{(-5x)} + 3 = 60</math></p>
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$$21) e^{(3x)} + 7 = 93$$

$$\frac{-7 \quad -7}{e^{(3x)} = 86}$$

$$\ln(86) = 3x$$

$$x = \frac{\ln(86)}{3} \approx \boxed{1.485}$$

$$22) -4 \cdot e^{(x-10)} = -69$$

**Part 6 - Use properties of logs to solve for the missing value (No Calc)**

$$23) \log_{18}(-4x-9) = \log_{18}(-3x)$$

$$\begin{array}{r} -4x-9 = -3x \\ +4x \quad \quad +4x \\ \hline -9 = x \end{array}$$

$$24) \log_{20}(-5n) = \log_{20}(-4n+4)$$

$$25) \log_2(x+7) = 4 \text{ exponent}$$

$$2^4 = x+7$$

$$16 = x+7$$

$$\boxed{9 = x}$$

$$26) \log_3(2x+1) = 2$$

**Part 7 - Solve for the missing value. Check for extraneous solutions (No Calc)**

$$27) (\sqrt{7r+65})^2 = (r+5)^2$$

$$7r+65 = r^2+10r+25$$

$$0 = r^2+3r-40$$

$$0 = (r+8)(r-5)$$

$$r+8=0 \quad r-5=0$$

$$r \neq -8$$

$$\boxed{r=5}$$

$$\sqrt{7(-8)+65} = \sqrt{9} = 3 \quad \sqrt{7(5)+65} = 10$$

$$-8+5 = -3$$

$$5+5 = 10 \checkmark$$

$$28) n-4 = \sqrt{3n-14}$$

$29) \left( \sqrt[3]{\frac{n}{8}} \right)^3 = \left( \sqrt[3]{3n-46} \right)^3$ $\frac{n}{8} = (3n-46)8$ $n = 24n - 368$ $-23n = -368$ $\boxed{n = 16}$	$30) \sqrt[4]{2p-1} = \sqrt[4]{7-2p}$
$31)  x  = \sqrt{-24+10x}^2$ $x^2 = -24 + 10x$ $x^2 - 10x + 24 = 0$ $(x-4)(x-6) = 0$ $x-4=0 \quad x-6=0$ $x=4 \quad x=6$ $\sqrt{-24+10(4)} = 4 \quad \sqrt{-24+10(6)} = 6 \quad \checkmark$ $\boxed{\{4, 6\}}$	$32) \sqrt[3]{16x-6x^2} = x$

**Part 8 - Parent Functions (No Calc but check with Desmos)**

**Directions:** For the next few questions, there will be no work shown by us because the work itself is relatively straight forward. It is meant to be an easy section but a necessary one.

You will be expected to see any of these functions (with manipulations) and know what their parent graphs look like within the first unit of AP Precalculus. This is the most important sections.

First, fill in the table for the given parent function. Then, graph the function. Finally, describe the key features of the graph.

The first example is not until the next page because we want you to read these directions carefully. You should check your work using Desmos before moving on.

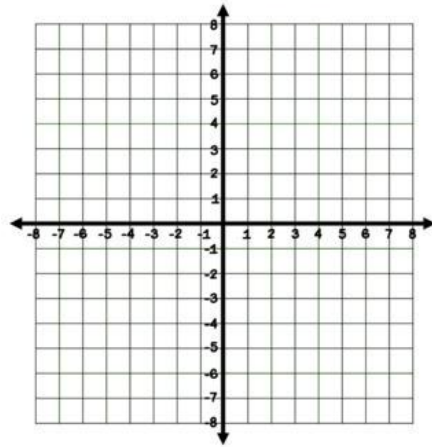
Pay attention to the name, powers, and shape of each graph so that you can easily discuss them when you return.

**33) Parent Graph:  
Linear**

$$f(x) = x$$

x	$f(x)$
-2	
-1	
0	
1	
2	

**Graph:**



**Key Features:**

Domain:

Range:

Interval of Increase:

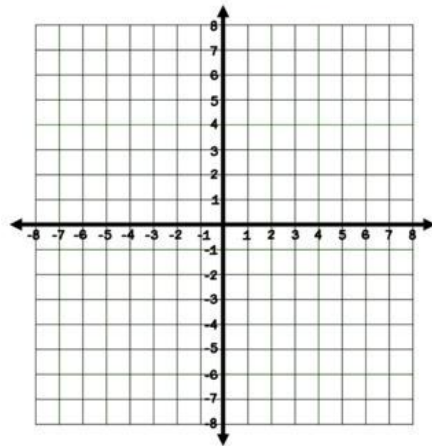
Interval of Decrease:

**34) Parent Graph:  
Quadratic**

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

x	$f(x)$
-2	
-1	
0	
1	
2	

**Graph:**



**Key Features:**

Domain:

Range:

Interval of Increase:

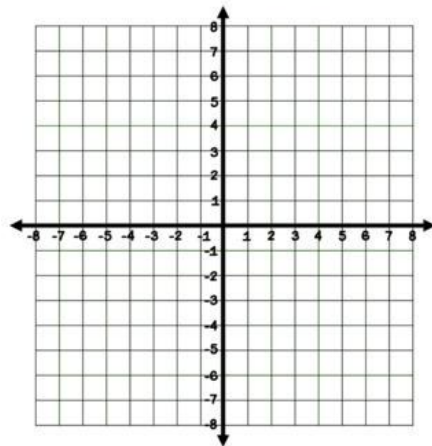
Interval of Decrease:

**35) Parent Graph:  
Cubic**

$$f(x) = x^3$$

x	$f(x)$
-2	
-1	
0	
1	
2	

**Graph:**



**Key Features:**

Domain:

Range:

Interval of Increase:

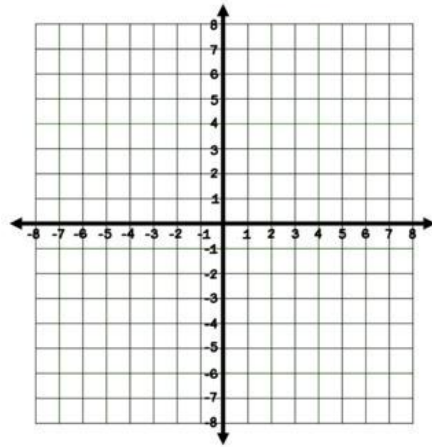
Interval of Decrease:

**36) Parent Graph:  
Square Root**

$$f(x) = \sqrt{x}$$

x	f(x)
0	
1	
4	
9	

**Graph:**



**Key Features:**

Domain:

Range:

Interval of Increase:

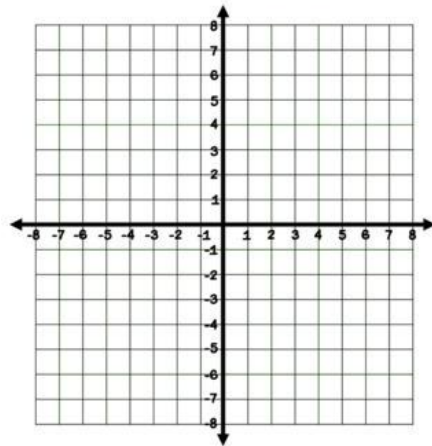
Interval of Decrease:

**37) Parent Graph:  
Absolute Value**

$$f(x) = |x|$$

x	f(x)
-2	
-1	
0	
1	
2	

**Graph:**



**Key Features:**

Domain:

Range:

Interval of Increase:

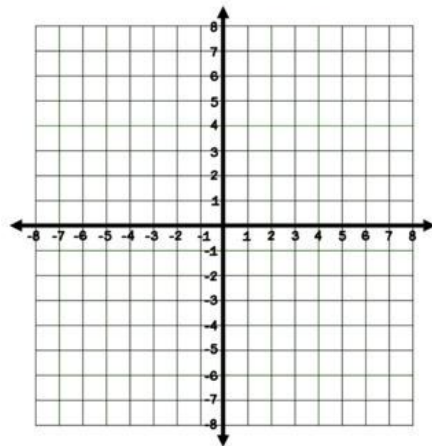
Interval of Decrease:

**38) Parent Graph:  
Rational**

$$f(x) = \frac{1}{x}$$

x	f(x)
-2	
-1	
0	
1	
2	

**Graph:**



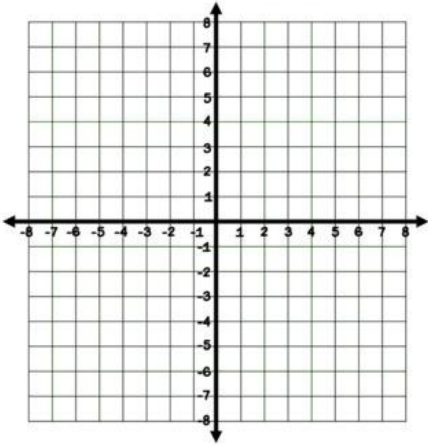
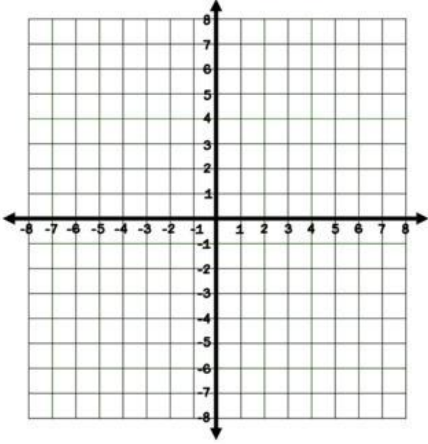
**Key Features:**

Domain:

Range:

Interval of Increase:

Interval of Decrease:

<p><b>39) Parent Graph: Exponential</b></p> $f(x) = 2^x$ <table border="1" data-bbox="110 281 557 615"> <thead> <tr> <th>x</th> <th>f(x)</th> </tr> </thead> <tbody> <tr> <td>-2</td> <td></td> </tr> <tr> <td>-1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> </tbody> </table>	x	f(x)	-2		-1		0		1		2		<p><b>Graph:</b></p> 	<p><b>Key Features:</b></p> <p>Domain:</p> <p>Range:</p> <p>Interval of Increase:</p> <p>Interval of Decrease:</p>
x	f(x)													
-2														
-1														
0														
1														
2														
<p><b>40) Parent Graph: Logarithmic</b></p> $f(x) = \log_2(x)$ <table border="1" data-bbox="110 856 557 1264"> <thead> <tr> <th>x</th> <th>f(x)</th> </tr> </thead> <tbody> <tr> <td><math>\frac{1}{4}</math></td> <td></td> </tr> <tr> <td><math>\frac{1}{2}</math></td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>4</td> <td></td> </tr> </tbody> </table>	x	f(x)	$\frac{1}{4}$		$\frac{1}{2}$		1		2		4		<p><b>Graph:</b></p> 	<p><b>Key Features:</b></p> <p>Domain:</p> <p>Range:</p> <p>Interval of Increase:</p> <p>Interval of Decrease:</p>
x	f(x)													
$\frac{1}{4}$														
$\frac{1}{2}$														
1														
2														
4														

**Part 9 - Perform the indicated operations with the functions (No Calc)**

<p><math>f(x) = x^2 - 5 + 2x</math></p> <p>41) <math>g(x) = 3x + 5</math></p> <p>Find <math>2f(x) - g(x)</math></p> $2(x^2 - 5 + 2x) - (3x + 5)$ $2x^2 - 10 + 4x - 3x - 5$ $2f(x) - g(x) = \boxed{2x^2 + x - 15}$	<p><math>h(x) = x^2 + 13x - 2</math></p> <p>42) <math>g(x) = x - 15</math></p> <p>Find <math>h(x) - 3g(x)</math></p>
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$$g(x) = 2x + 1$$

43)  $h(x) = x^3 + 5$

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

$$(2x+1)(x^3+5)$$
$$2x^4 + 10x + x^3 + 5$$

$$g(x) \cdot h(x) = 2x^4 + x^3 + 10x + 5$$

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

44)  $h(x) = x^2 - 7$

Find  $f(x) \cdot h(x)$

$$g(x) = -2x^2 + 5x$$

45)  $h(x) = 3x - 3$

Find  $g(h(x))$

$$-2(3x-3)^2 + 5(3x-3)$$
$$-2(9x^2 - 18x + 9) + 15x - 15$$
$$-18x^2 + 36x - 18 + 15x - 15$$

$$g(h(x)) = -18x^2 + 51x - 33$$

$$g(x) = x^2 + 5x$$

46)  $f(x) = -4x - 3$

Find  $g(f(x))$

$$h(x) = -3x - 3$$

47)  $j(x) = x^3 + 5x^2$

Find  $(h \circ j)(x) = h(j(x))$

$$-3(x^3 + 5x^2) - 3$$
$$-3x^3 - 15x^2 - 3$$

$$(h \circ j)(x) = -3x^3 - 15x^2 - 3$$

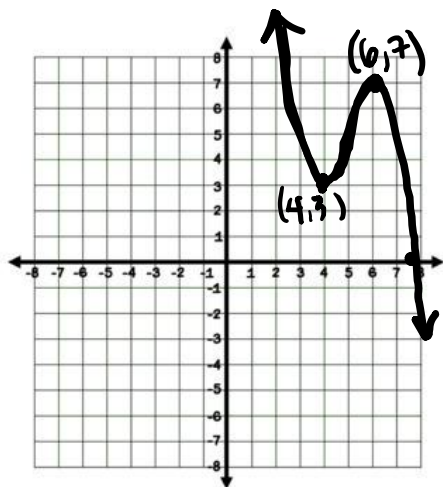
$$k(x) = 4x - 1$$

48)  $m(x) = 2x^3 - 2x^2$

Find  $(k \circ m)(x)$

**Part 10 – Sketch a graph for each function and identify all local/absolute maximums, minimums, and zeros of the function. Round answers to the nearest thousandths when needed. (CALCULATOR)**

49)  $f(x) = -x^3 + 15x^2 - 72x + 115$



Identify critical points. State N/A when not applicable for the function.

Absolute Max: N/A

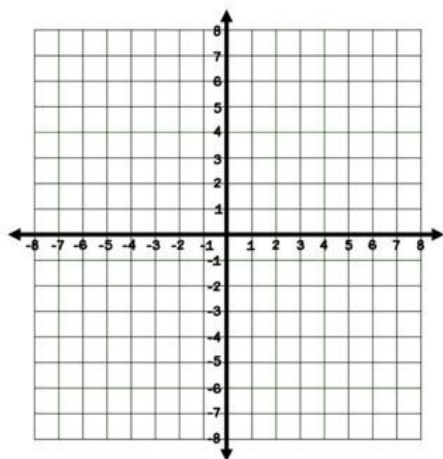
Local Max(s): (6, 7)

Absolute Min: N/A

Local Min(s): (4, 3)

Zero(s): (7.279, 0)

50)  $f(x) = x^3 + 14x^2 + 60x + 78$



Identify critical points. State N/A when not applicable for the function.

Absolute Max:

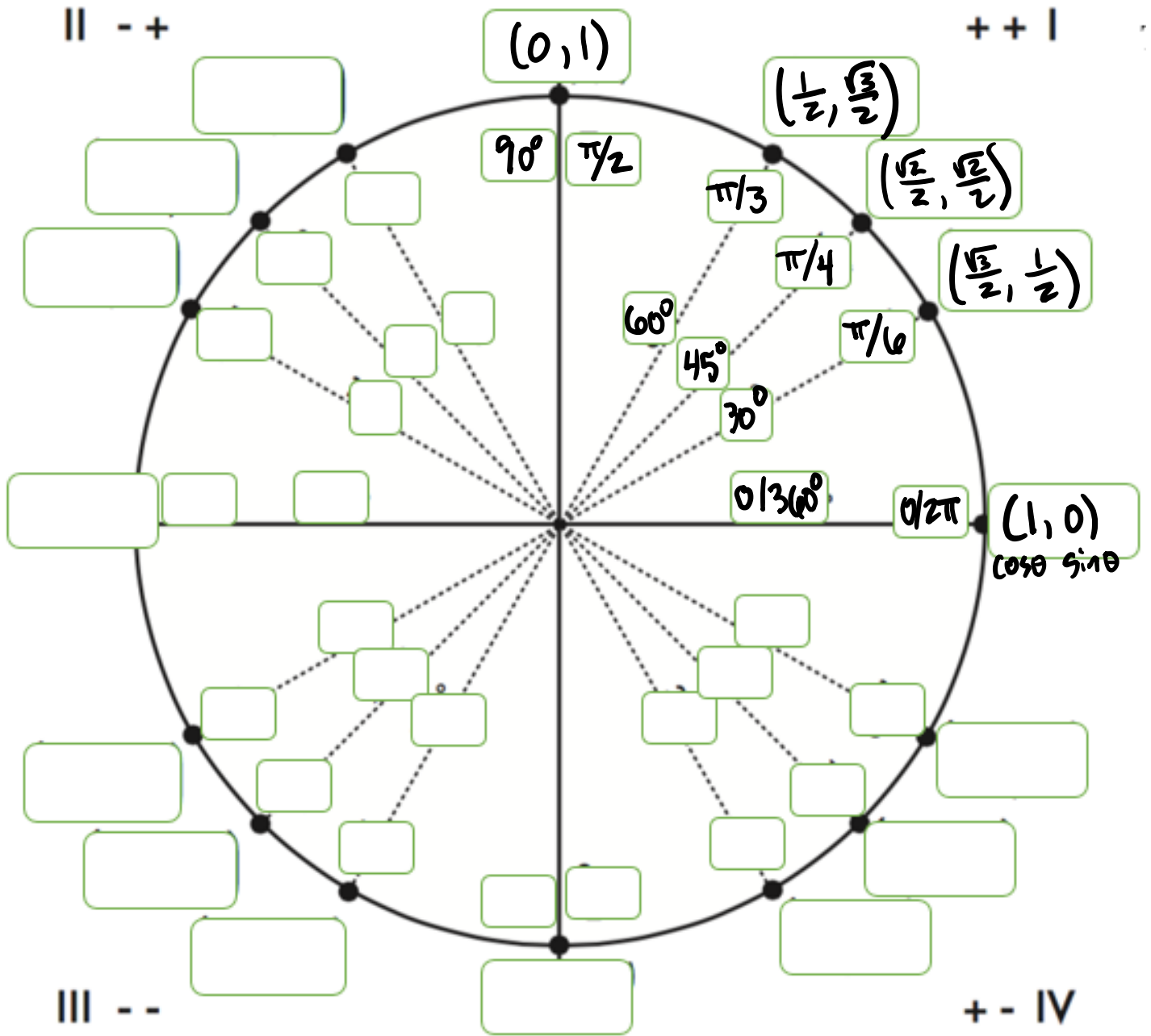
Local Max(s):

Absolute Min:

Local Min(s):

Zero(s):

**Part 11 - Fill in the Unit Circle with degrees, radians, cosine and sine values (No Calc)**



**Part 12 - Evaluating Trig Functions (No Calc)**

51) $\tan(300^\circ) = \frac{-\sqrt{3}/2}{1/2} = -\sqrt{3}$	52) $\cos(135^\circ)$
53) $\cos\left(\frac{4\pi}{3}\right)$	54) $\sin\left(-\frac{5\pi}{6}\right)$
55) $\tan\left(-\frac{3\pi}{4}\right)$	56) $\sin\left(\frac{2\pi}{3}\right)$

## Answer Bank

### Part 1:

1. $x = -8$	2. $x = 3$	3. $x = 11/15$
4. $x = 46/315$	5. $x = \frac{-7\pi}{36}$	6. $x = \frac{\pi}{3}$

### Part 2:

7. $\{0, 2\}$	8. $\{0, 17/9\}$	9. $\{-3, -1/7\}$
10. $\{5/7, 1\}$	11. $\{-1, 9/5\}$	12. $\{-3, 2/3\}$

### Part 3:

13. $\{1/8, 7\}$	14. $\{-1/2, 3/7\}$
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### Part 4:

15. $x = -2/11$	16. $x = 15/4$	17. $x = -2/3$	18. $x = -2/9$
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### Part 5:

19. $x \approx -0.113$	20. $x \approx -0.270$	21. $x \approx 1.485$	22. $x \approx 12.848$
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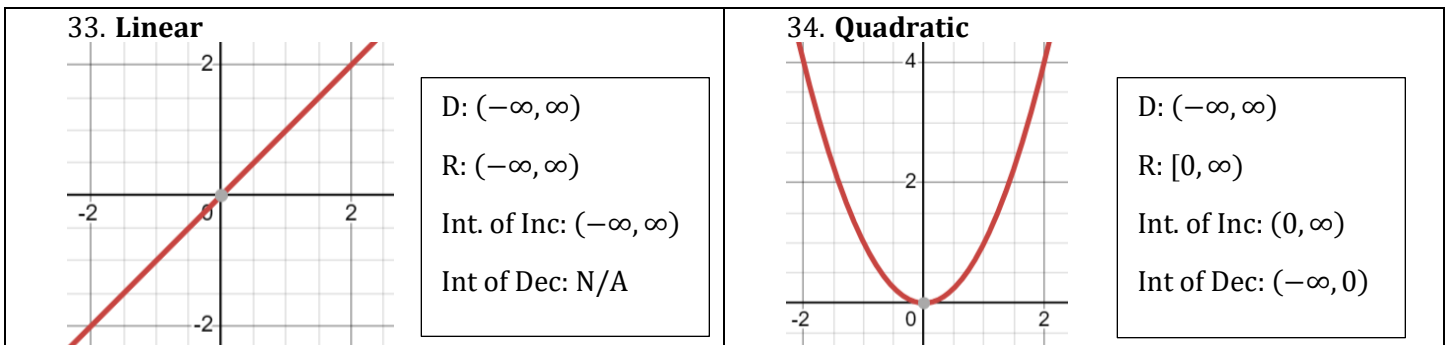
### Part 6:

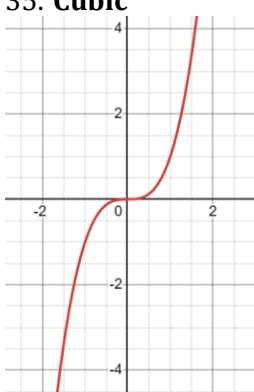
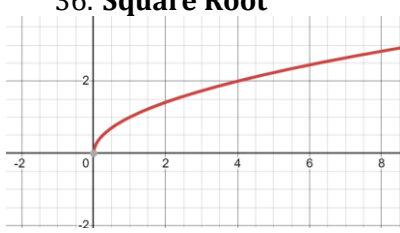
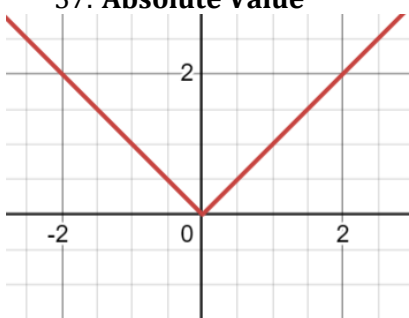
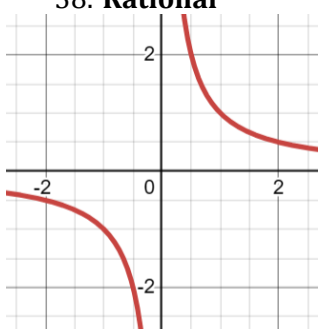
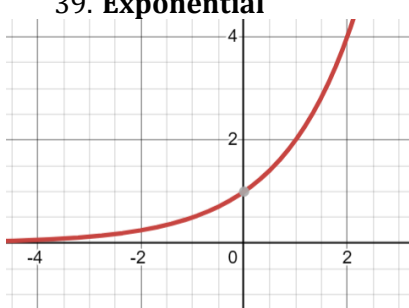
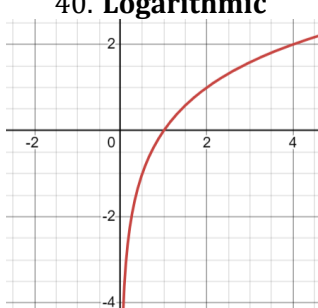
23. $x = -9$	24. $n = -4$	25. $x = 9$	26. $x = 4$
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### Part 7:

27. $r = 5$	28. $\{5, 6\}$	29. $n = 16$
30. $p = 2$	31. $\{4, 6\}$	32. $\{-8, 0, 2\}$

### Part 8:

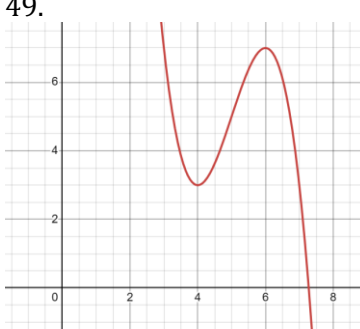


<p><b>35. Cubic</b></p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>D: <math>(-\infty, \infty)</math>  R: <math>(-\infty, \infty)</math>  Int. of Inc: <math>(-\infty, \infty)</math>  Int of Dec: N/A</p> </div>	<p><b>36. Square Root</b></p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>D: <math>[0, \infty)</math>  R: <math>[0, \infty)</math>  Int. of Inc: <math>(0, \infty)</math>  Int of Dec: N/A</p> </div>
<p><b>37. Absolute Value</b></p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>D: <math>(-\infty, \infty)</math>  R: <math>[0, \infty)</math>  Int. of Inc: <math>(0, \infty)</math>  Int of Dec: <math>(-\infty, 0)</math></p> </div>	<p><b>38. Rational</b></p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>D: <math>(-\infty, 0) \cup (0, \infty)</math>  R: <math>(-\infty, 0) \cup (0, \infty)</math>  Int. of Inc: N/A  Int of Dec: <math>(-\infty, 0) \cup (0, \infty)</math></p> </div>
<p><b>39. Exponential</b></p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>D: <math>(-\infty, \infty)</math>  R: <math>(0, \infty)</math>  Int. of Inc: <math>(-\infty, \infty)</math>  Int of Dec: N/A</p> </div>	<p><b>40. Logarithmic</b></p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>D: <math>(0, \infty)</math>  R: <math>(-\infty, \infty)</math>  Int. of Inc: <math>(0, \infty)</math>  Int of Dec: N/A</p> </div>

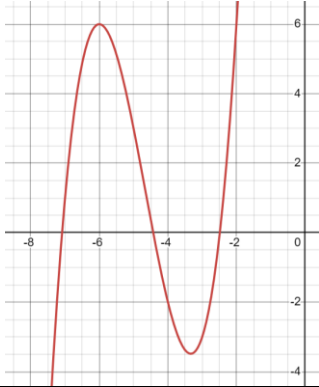
**Part 9:**

41. $2x^2 + x - 15$	42. $x^2 + 10x + 43$
43. $2x^4 + x^3 + 10x + 5$	44. $3x^3 + 2x^2 - 7x - 14$
45. $-18x^2 + 51x - 33$	46. $16x^2 + 4x - 6$
47. $-3x^3 + 15x^2 - 3$	48. $8x^3 - 8x^2 - 1$

**Part 10:**

<p>49.</p> 	<p>Absolute Max: N/A  Local Max: (6, 7)  Absolute Min: N/A  Local Min: (4, 3)  Zero: (7.279, 0)</p>
--	---

50.



Absolute Max: N/A

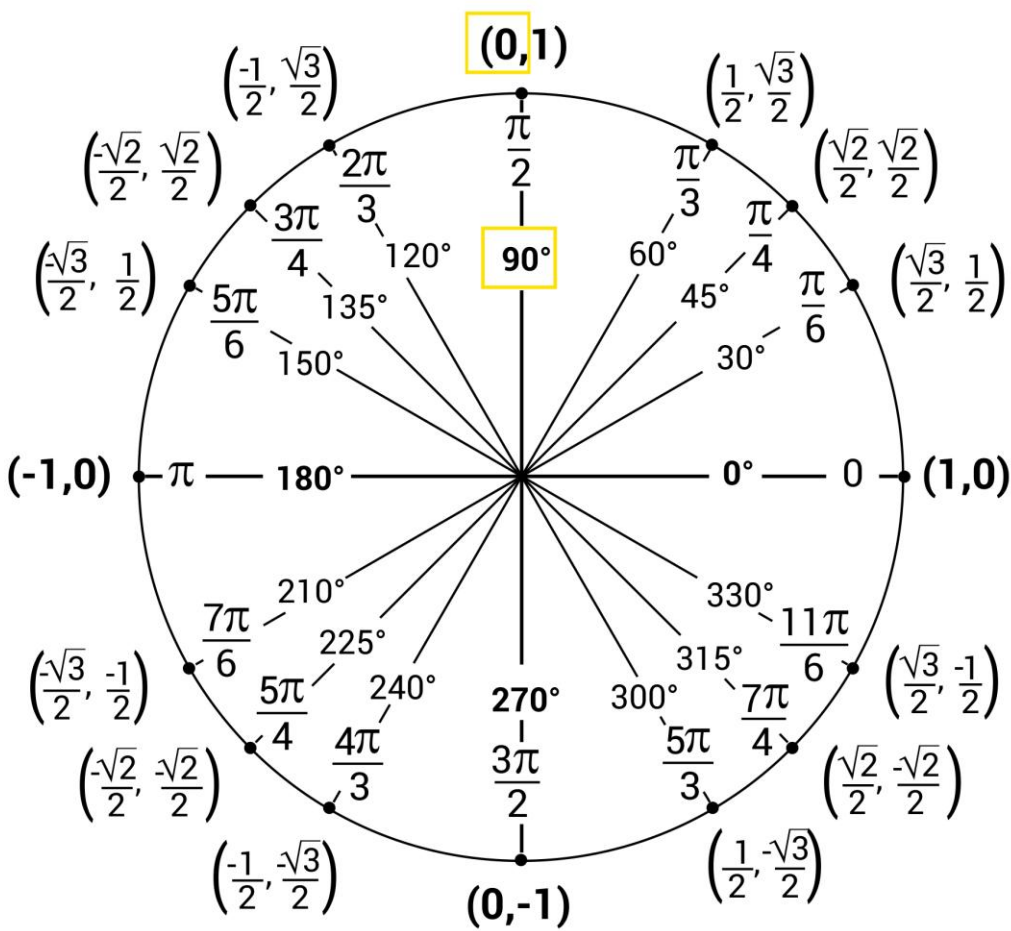
Local Max: (-6,6)

Absolute Min: N/A

Local Min: (-3.333, -3.481)

Zero: (-7.086,0); (-4.428, 0); (-2.486, 0)

**Part 11:**



**Part 12:**

51. $-\sqrt{3}$	52. $-\frac{\sqrt{2}}{2}$	53. $-\frac{1}{2}$
54. $-\frac{1}{2}$	55. 1	56. $\frac{\sqrt{3}}{2}$