Name: ________________________________ Period: ____________

Submission Date: ________________

Score:______________

Welcome to Precalculus!

Please bring this completed packet to the first day of school. The entire packet is designed to be completed without a calculator or DESMOS! The packet contains review topics from Algebra II and Geometry that are essential to success in this course. The items in this packet may be reviewed in a series of warm-ups in the first few weeks school. Do not expect there to be time in class for ALL questions to be resolved. **You are responsible for understanding all the material in this packet.** The content of the warm-ups will be assessed in a series of mini-quizzes throughout the first unit of study. This packet serves as additional, advance preparation for Unit 1 of Precalculus and reviews fundamental concepts presented in prior math courses.

The packet is arranged into five sections:

I.	Fundamental Arithmetic	60 questions
II.	Right Triangles, Trigonometric Ratios, and Inverses	5 questions
III.	Factoring Polynomials	10 questions
IV.	Fraction Arithmetic & Algebra	8 questions
V.	Graphs of Parent Functions	6 questions

Please see your teacher at the beginning of the school year if any of this material is unfamiliar, or if you encounter difficulty while completing any individual topics. This is a review of essential skills and foundational knowledge that will be built upon throughout the school year.

We are looking forward to a successful and productive year with you in Precalculus starting in the fall.

Have a great summer!

Precalculus Team
Mathematics Department
Centreville High School

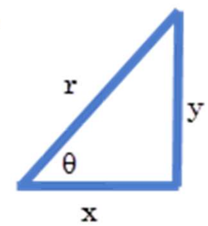
I. Multiplication & Division Facts, Evaluating Squares, Cubes and Radicals

It is expected that the problems on this page and similar ones can be completed rapidly, from memory & without a calculator.

1. 3×4 ______
2. 5×6 ______
3. 7×8 ______
4. 12×4 ______
5. 3×13 ______
6. 7×9 ______
7. -2×8 ______
8. 16×3 ______
9. 6×9 ______
10. $8\times(-3)$ ______
11. $81\div9$ ______
12. $27\div3$ ______
13. $36\div9$ ______
14. $21\div7$ ______
15. $96\div8$ ______
16. $64\div4$ ______
17. $49\div(-7)$ ______
18. $-42\div3$ ______
19. $18\div3$ ______
20. $28\div7$ ______
21. 2^3 ______
22. 3^3 ______
23. $(-3)^2$ ______
24. -4^2 ______
25. 7^{-2} ______
26. 8^2 ______
27. 12^2 ______
28. 13^2 ______
29. 3^4 ______
30. 5^3 ______
31. $(-4)^3$ ______
32. 2^5 ______
33. 15^{-2} ______
34. -16^2 ______
35. 20^2 ______
36. 25^2 ______
37. 5^4 ______
38. 6^{-2} ______
39. $(-1)^5$ ______
40. -1^2 ______
41. $(-3)^{-2}$ ______
42. $(-17)^2$ ______
43. 11^{-2} ______
44. $\sqrt{256}$ ______
45. $\sqrt{81}$ ______
46. $\sqrt{144}$ ______
47. $\sqrt{64}$ ______
48. $\sqrt{50}$ ______
49. $\sqrt{32}$ ______
50. $\sqrt[3]{8}$ ______
51. $\sqrt[3]{64}$ ______
52. $\sqrt[3]{-27}$ ______
53. $\sqrt{-49}$ ______
54. $\sqrt{-100}$ ______
55. $\sqrt[3]{125}$ ______
56. $25^{\frac{1}{2}}$ ______
57. $27^{-\frac{1}{3}}$ ______
58. $16^{\frac{3}{2}}$ ______
59. $125^{\frac{2}{3}}$ ______
60. $16^{\frac{3}{4}}$ ______

II. Right Triangles: Pythagorean Theorem, Trigonometric Functions & Inverses

The triangle pictured is a right triangle with the angle θ, theta, being acute.



- If any two of the sides are known the third can be determined by solving the Pythagorean Theorem for the unknown length: $x^2 + y^2 = r^2$.

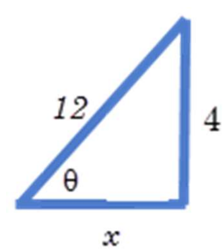
Sine, *Cosine*, and *Tangent* are three trigonometric functions:

- The *sine* of the angle theta is the ratio of the opposite side to the hypotenuse, expressed: $\sin\theta = \frac{y}{r}$.
- The *cosine* of the angle theta is the ratio of the adjacent side to the hypotenuse, expressed: $\cos\theta = \frac{x}{r}$.
- The *tangent* of the angle theta is the ratio of the opposite side to the adjacent, expressed: $\tan\theta = \frac{y}{x}$.
- There exists an inverse to each of these trigonometric functions that is used to determine an angle when given side lengths. $\theta = \sin^{-1}\left(\frac{y}{r}\right)$, or $\theta = \cos^{-1}\left(\frac{x}{r}\right)$

These relationships from geometry are expected to be memorized and easily recalled. In addition, it is expected that they can be applied to the following problems.

Example 1:

Consider the right triangle pictured at right.



First, determine the missing side length using the Pythagorean Theorem:

$$x^2 + 4^2 = 12^2$$
$$x^2 = 144 - 16$$
$$x^2 = 128$$
$$x = \pm\sqrt{128} = \pm\sqrt{16 \cdot 4 \cdot 2} = \pm 8\sqrt{2}$$

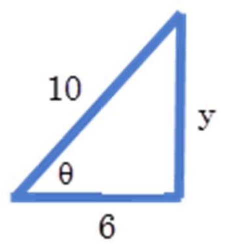
$x = +8\sqrt{2}$, since a triangle's side length can only be positive

Next, evaluate each of the three trigonometric ratios:

$$\sin\theta = \frac{y}{r} = \frac{4}{12} = \frac{1}{3} \qquad \cos\theta = \frac{x}{r} = \frac{8\sqrt{2}}{12} = \frac{2\sqrt{2}}{3} \qquad \tan\theta = \frac{y}{x} = \frac{4}{8\sqrt{2}} = \frac{1}{2\sqrt{2}}$$

II. Right Triangles: Practice Problems

Determine the missing length using the Pythagorean Theorem, then use this to find the value for each of the three trigonometric ratios. Do not use a calculator, leave your answer in exact, radical form if necessary.

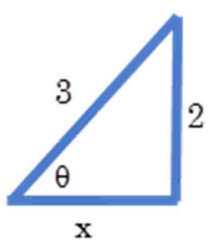


1. $y =$ ____________

   $\sin\theta =$ __________

   $\cos\theta =$ __________

   $\tan\theta =$ __________

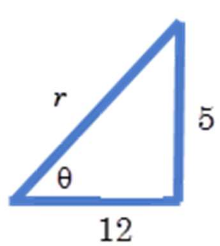


2. $x =$ ____________

   $\sin\theta =$ __________

   $\cos\theta =$ __________

   $\tan\theta =$ __________



3. $r =$ ____________

   $\sin\theta =$ __________

   $\cos\theta =$ __________

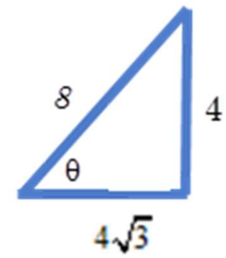
   $\tan\theta =$ __________

II. Right Triangles

Example 2:

Consider the right triangle pictured at right

Write three expressions in simplest form for the measure of the angle θ using inverse trigonometric functions:



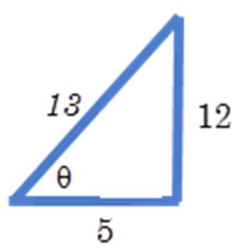
$$\theta = \sin^{-1}\left(\frac{y}{r}\right) = \sin^{-1}\left(\frac{4}{8}\right) = \sin^{-1}\left(\frac{1}{2}\right)$$

$$\theta = \cos^{-1}\left(\frac{x}{r}\right) = \cos^{-1}\left(\frac{4\sqrt{3}}{8}\right) = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{4}{4\sqrt{3}}\right) = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$$

II. Right Triangles: Additional Practice Problems

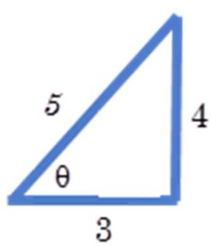
Write three expressions in simplest form for the measure of the angle θ using inverse trigonometric functions:



4. $\theta =$ ____________________

$\theta =$ ____________________

$\theta =$ ____________________



5. $\theta =$ ____________________

$\theta =$ ____________________

$\theta =$ ____________________

III. Factoring Quadratics & Special Forms for Cubes

Special Factoring Forms:

$a^2 - b^2 = (a+b)(a-b)$

$a^2 + 2ab + b^2 = (a+b)(a+b) = (a+b)^2$

$a^2 - 2ab + b^2 = (a-b)(a-b) = (a-b)^2$

$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

Example 1: $x^2 + 2x - 8$

$(x \quad)(x \quad)$	Identify factors that will multiply to create the first term.
$(x \quad 2)(x \quad 4)$	Identify factors that will multiply to create the last term and add or subtract to make the middle term
$(x-2)(x+4)$	Apply the correct signs
$x^2 + 4x - 2x - 8 = x^2 + 2x - 8$	Check by FOIL.

Example 2: $3x^2 - 8x + 5$

$(3x \quad)(x \quad)$	Identify factors that will multiply to create the first term.
$(3x \quad 5)(x \quad 1)$	Identify factors that will multiply to create the last term and add or subtract to make the middle term
$(3x-5)(x-1)$	Apply the correct signs
$3x^2 - 3x - 5x + 5 = x^2 - 8x + 5$	Check by FOIL.

III. Factoring Practice Problems

1. $x^2 - 4x + 4$ ____________________
2. $x^2 - 7x + 10$ ____________________
3. $2x^2 + 5x - 3$ ____________________
4. $2x^2 - x - 3$ ____________________
5. $4x^2 - 1$ ____________________
6. $x^2 - 4x - 12$ ____________________
7. $x^2 - 10x + 25$ ____________________
8. $3x^2 + 11x - 4$ ____________________
9. $2x^2 - 5x + 3$ ____________________
10. $x^2 - 5x - 14$ ____________________

IV. Fraction Arithmetic & Algebra

Given $\frac{a}{b}$ and $\frac{c}{d}$ are rational expressions where $b \neq 0$ and $d \neq 0$:

Multiply	*Divide*	*Add*	*Subtract*
$\frac{a}{b}\cdot\frac{c}{d}=\frac{ac}{bd}$	$\frac{a}{b}\div\frac{c}{d}=\frac{a}{b}\cdot\frac{d}{c}=\frac{ad}{bc}$	$\frac{a}{b}+\frac{c}{d}=\frac{ad+cb}{bd}$	$\frac{a}{b}-\frac{c}{d}=\frac{ad-cb}{bd}$

Examples:

Fractions are reduced by canceling a common factor. When completing a problem, it is not necessary to show all the steps shown in the example: they are written to emphasize the correct method.

a) $\frac{12}{9}=\frac{3\times 4}{3\times 3}=\frac{3}{3}\cdot\frac{4}{3}=1\cdot\frac{4}{3}=\frac{4}{3}$

b) $\frac{4x^2-16}{8x-16}=\frac{4\left(x^2-4\right)}{8(x-2)}=\frac{4(x-2)(x+2)}{8(x-2)}=\frac{4}{2\cdot 4}\cdot\frac{(x-2)}{(x-2)}\cdot\frac{(x+2)}{1}=\frac{1}{2}\cdot(x+2)=\frac{x}{2}+\frac{2}{2}=\frac{1}{2}x+1$

For addition and subtraction, find a common denominator, combine like terms on the numerator, leave the denominator factored, and reduce if possible.

a) $\frac{1}{2}+\frac{3}{5}=\frac{1\times 5}{2\times 5}+\frac{3\times 2}{5\times 2}=\frac{5+6}{10}=\frac{11}{10}$

b) $\frac{1}{x+1}+\frac{2}{x}=\frac{(1)(x)}{(x+1)(x)}+\frac{(2)(x+1)}{(x)(x+1)}=\frac{(x)+(2x+2)}{x(x+1)}=\frac{3x+2}{x(x+1)}$

c) $\frac{2}{x-2}-\frac{1}{x+1}=\frac{(2)(x+1)}{(x-2)(x+1)}-\frac{(1)(x-2)}{(x+1)(x-2)}=\frac{(2x+2)-(x-2)}{(x-2)(x+1)}=\frac{2x+2-x+2}{(x-2)(x+1)}=\frac{x+4}{(x-2)(x+1)}$

For multiplication, multiply the numerator to the numerator and denominator to denominator, then reduce if possible:

a) $\frac{1}{2}\times\frac{3}{5}=\frac{1\times 3}{2\times 5}=\frac{3}{10}$

b) $\frac{2x}{x+1}\cdot\frac{x^2-1}{x+2}=\frac{2(x)\left(x^2-1\right)}{(x+1)(x+2)}=\frac{2x(x-1)(x+1)}{(x+1)(x+2)}=\frac{2x(x-1)}{(x+2)}$

IV. Fraction Arithmetic & Algebra Practice Problems

For each problem, write work legibly on the right side of the page and write your final answer in the space provided.

Evaluate and Simplify:

1. $\frac{1}{2}-\frac{3}{2}$ ____________________

2. $\frac{2}{3}-\frac{1}{2}$ ____________________

3. $\frac{3}{4}+\frac{1}{2}-\frac{5}{3}$ ________________

Factor and reduce each rational expression.

4. $\frac{3x+9}{x^2-9}$ ____________________

5. $\frac{24x^2}{12x^2-6x}$ ________________

6. $\frac{x-x^2}{x^2+x-2}$ ________________

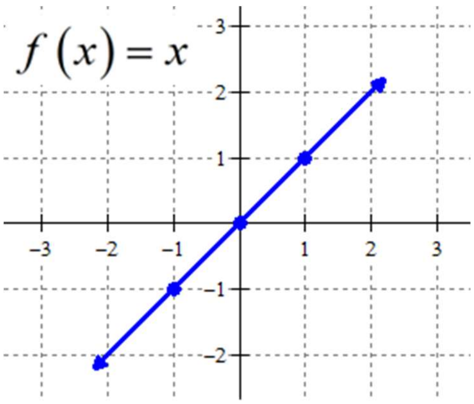
Perform the indicated operation and write your answer in simplest, reduced form.

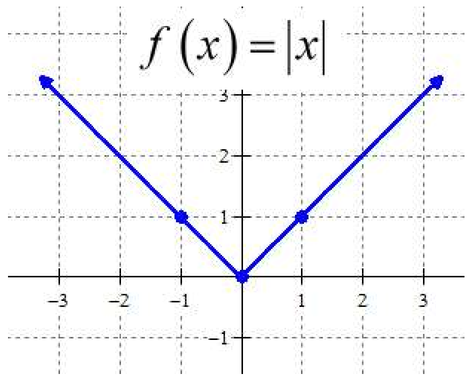
7. $\frac{3x+6}{5x^2}\cdot\frac{x}{x^2-4}$ ____________________

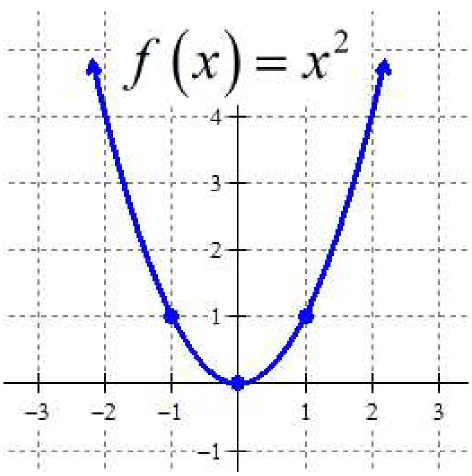
8. $\frac{12}{x^2-x}\cdot\frac{x^2-1}{4x-2}$ ____________________

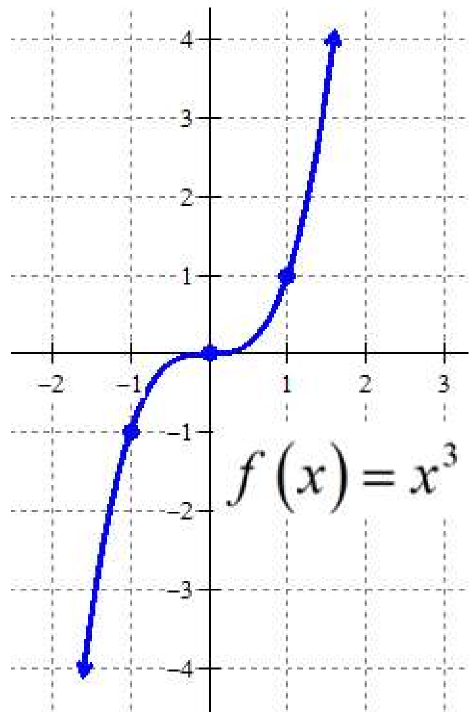
V. Graphs of Parent Functions

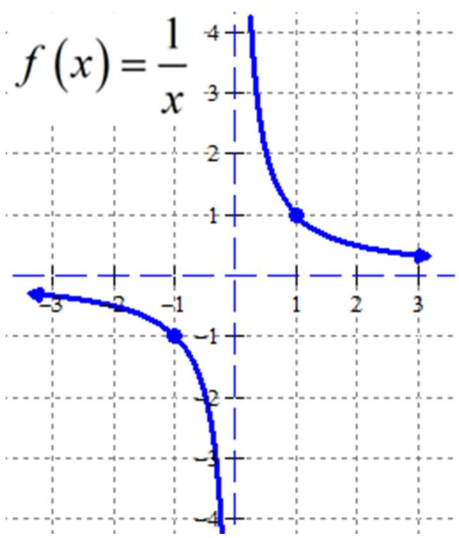
The basic parent functions from Algebra 2 are shown. This is a reference page. You are responsible for being able to graph each function quickly without aid of a calculator, clearly marking the key points and indicating end behavior with arrows.

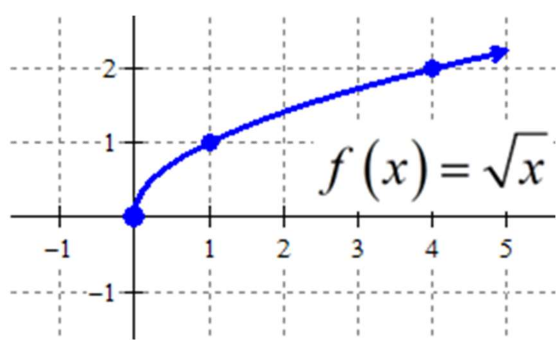












V. Graphs of Parent Functions Practice

Graph each indicated parent function including key points, arrows to indicate end behavior, and asymptotes (with equations) if applicable.