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SAMPLE PREREQUISITE PROBLEMS: ALGEBRA II

(no calculators allowed)

Multiplication Tables (through 12)

(You will have two minutes to do the following 24 multiplication problems.)

$$2 \times 6 = \quad 3 \times 7 = \quad 4 \times 9 = \quad 5 \times 2 =$$

$$8 \times 8 = \quad 9 \times 3 = \quad 10 \times 7 = \quad 2 \times 4 =$$

$$5 \times 1 = \quad 6 \times 8 = \quad 7 \times 9 = \quad 8 \times 10 =$$

$$0 \times 10 = \quad 1 \times 11 = \quad 7 \times 3 = \quad 11 \times 9 =$$

$$6 \times 4 = \quad 7 \times 11 = \quad 3 \times 7 = \quad 4 \times 5 =$$

$$9 \times 5 = \quad 10 \times 6 = \quad 12 \times 10 = \quad 9 \times 12 =$$

(Be sure that you can easily do problems like these: arithmetic with whole numbers, decimals, fractions; arithmetic with signed numbers)

$$\frac{0}{7.2} = \quad - \frac{(6)(-2)}{-3} = \quad -3 - (-2) =$$

$$1,000 \times 3.47 = \quad \frac{248.36}{100} = \quad \frac{1}{3} - \frac{1}{5} =$$

$$\frac{1}{3} \cdot \frac{1}{5} = \quad \frac{1}{3} \div \frac{1}{5} = \quad 126 \times 24 =$$

SAMPLE PREREQUISITE PROBLEMS: ALGEBRA II

Problems 1–9 should be done WITHOUT A CALCULATOR.

1. For each expression given below, rename the expression as requested. If the requested name is not possible, so state. A few samples are done for you.

EXPRESSION	RENAME IN THIS FORM	PUT YOUR ANSWER HERE
(sample) 12	a sum of even integers	$2 + 10$ or $4 + 8$ etc.
(sample) 12	xy , where x and y are integers, with $x < 0$	$(-3)(-4)$ or $(-2)(-6)$ etc.
(sample) 12	2^x , where $x \in \{0, 1, 2, 3, \dots\}$	not possible
$\frac{1}{\sqrt{2}}$	a fraction with no radical in the denominator	
7	a quotient of integers, where the numerator is greater than 10	
23,070,000	in scientific notation	
7	$x - y$, where x and y are NCI integers	
7	$\frac{1}{2} \cdot x$	
$(x - 2)(x + 3)$	as a sum (i.e., multiply out)	
$x^2 - y^2$	as a product (i.e., factor)	
$\frac{1}{2}$	$\frac{3}{x}$	
$\frac{1}{x} - \frac{2}{3 + x}$	as a single fraction	
0.25	as a percent	
$\frac{x^4 x^{-1}}{(x^2)^3 x}$	x^k	
300 ft/sec	x mph (there are 5,280 feet in one mile)	
7,036	$x_1 \cdot 1000 + x_2 \cdot 100 + x_3 \cdot 10 + x_4 \cdot 1$	
7,036	$x \cdot 1000$	
7,036	$x \cdot 10$	
$8^{-2/3}$	as a simple fraction	

2. Solve each equation/inequality in one variable. Write a list of equivalent sentences, ending with one that can be solved by inspection. Get EXACT answer(s), not decimal approximations. Graph each solution set on a number line. A sample is done for you.

(sample) $x^2 = x$

Solution:

$$x^2 = x$$

$$x^2 - x = 0$$

$$x(x - 1) = 0$$

$$x = 0 \text{ or } x - 1 = 0$$

$$x = 0 \text{ or } x = 1$$



(a) $3x(1 - 5x)(x^2 - 16) = 0$

(b) $\frac{1}{2}x - 7 = 3x + \frac{x}{5}$

(c) $|x - 3| > 1$

(d) $1 - 2x < 3$

(e) $x^2 = x + 2$

(f) $1 < x \text{ or } x \leq -1$

(g) $0.4(x - 1) = 2x - 3$

(h) $x^2 = 3$

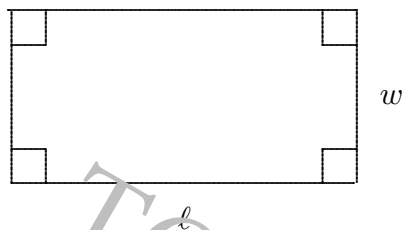
(i) $-1 \leq x < 3$

(j) $x > -1 \text{ and } x \leq 3$

3. Write the equation of the circle with center $(1, -2)$ and radius 5.

4. Find the requested measurement(s) of each geometric figure.

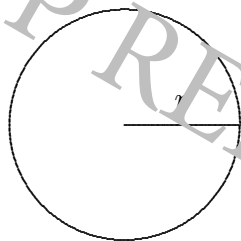
(a) PERIMETER and AREA:



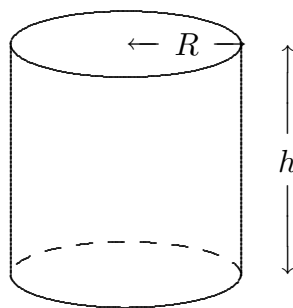
(b) PERIMETER and AREA:



(c) CIRCUMFERENCE and AREA:



(d) VOLUME:



Which of the units below is a unit of length? Of area? Of volume?

cubic feet

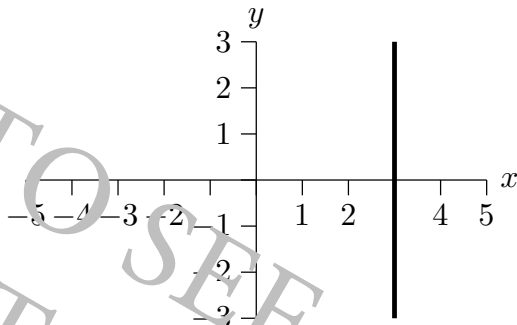
cm^2

meter

5. Graph each of the following equations/inequalities, where each sentence is viewed as a sentence in two variables. (That is, $x = 3$ should be viewed as $x + 0y = 3$.) A sample is done for you.

(sample) $x = 3$

Solution:



- (a) $x > 3$
- (b) $2y - 3 = 0$
- (c) $x = 3$ and $y = 2$
- (d) $x = 3$ or $y = 2$
- (e) $y = 2x - 1$
- (f) $y = \sqrt{x}$
- (g) $|x| = 2$
- (h) $y \leq 2$
- (i) $\frac{y-2}{3} = 2x - 1$
- (j) $(x + 1)^2 + (y - 3)^2 = 25$
6. Write an expression (using the variable x) to represent each sequence of operations.
- (a) take a number, multiply by 2, then subtract 3
- (b) take a number, subtract 3, then multiply by 2
- (c) take a number, multiply it by 2, cube the result, add 1, then divide by the original number

Write the sequence of operations that is being described by each expression.

- (d) $3x - 1$
- (e) $2(x + 1)^3 - 5$
- (f) $\frac{x - 3}{7} - 1$

7. Let $f(x) = x^2 - 2x + 1$. Evaluate each of the following expressions.
- $f(0)$
 - $f(1) - 2$
8. Find the domain of the function $g(x) = \frac{1}{\sqrt{x-3}}$. Report your answer using interval notation.
9. Write the equation of the line, in $y = mx + b$ form, that satisfies the given conditions.
- slope 3, passing through the point $(2, -1)$
 - the horizontal line that crosses the y -axis at 2
 - the line that is perpendicular to $x - 3y = 5$ and passes through the point $(0, 3)$
10. (Your calculator is needed for parts of this question.)
- What is the domain of the function $f(x) = \frac{1-3x}{x-2}$?
 - Use your graphing calculator to graph the function f in the window $-1 < x < 3$ and $-15 < y < 10$.
 - Find the x -intercept of the graph.
 - Use your calculator to estimate a value for x for which $f(x) = 5$. (Zoom, as necessary, to get $f(x)$ within 0.01 of 5.)
11. Estimate (where necessary) each of the following numbers on your calculator. For full credit, each answer must be correct to five decimal places.
- $\frac{1 + \sqrt{2}}{\sqrt[3]{5} - 7}$
 - $3x^2 - 5x + 1$, where $x = -1.8$
 - $|1 - 2x|$, where $x = \sqrt{3}$
 - $(2.03 \times 10^{-9})(-4.1 \times 10^7)$

SOLUTIONS

Multiplication Tables:

12, 6, 36, 10

64, 27, 70, 8

5, 48, 63, 80

0, 11, 21, 99

24, 77, 21, 20

45, 60, 120, 108

0, -4, -1

3,470, 2.4836, $\frac{2}{15}$

$\frac{1}{15}$, $\frac{5}{3}$, 3,024

1. There are many possible correct answers for this problem.

$$\frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{2}$$

$$7 = 7 \cdot \frac{11}{11} = \frac{77}{11}$$

$$23,070,000 = 2.307 \times 10^7$$

$$7 = 7 + .2 - .2 = 7.2 - .2$$

$$7 = 7 \cdot \frac{1}{2} \cdot 2 = \frac{1}{2} \cdot 14$$

$$(x-2)(x+3) = x^2 + 3x - 2x - 6 = x^2 + x - 6$$

$$x^2 - y^2 = (x-y)(x+y)$$

$$\frac{1}{2} = \frac{1}{2} \cdot \frac{3}{3} = \frac{3}{6}$$

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

$$0.25 = \frac{25}{100} = 25 \cdot \frac{1}{100} = 25\%$$

$$\frac{x^4 x^{-1}}{(x^2)^3 x} = \frac{x^3}{x^7} = x^{3-7} = x^{-4}$$

$$300 \frac{\text{ft}}{\text{sec}} = 300 \frac{\text{ft}}{\text{sec}} \cdot \frac{1 \text{ mile}}{5280 \text{ ft}} \cdot \frac{60 \text{ sec}}{1 \text{ min}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \approx 20.45 \frac{\text{miles}}{\text{hr}}$$

$$7,036 = 7 \cdot 1000 + 0 \cdot 100 + 3 \cdot 10 + 6 \cdot 1$$

$$7,036 = 7.036 \cdot 1000$$

$$7,036 = 703.6 \cdot 10$$

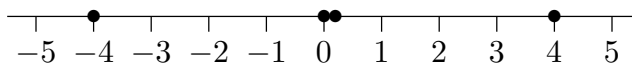
$$8^{-2/3} = \frac{1}{8^{2/3}} = \frac{1}{(8^{1/3})^2} = \frac{1}{2^2} = \frac{1}{4}$$

2.

$$(a) \quad 3x(1-5x)(x^2-16) = 0$$

$$x = 0 \quad \text{or} \quad 1 - 5x = 0 \quad \text{or} \quad x^2 - 16 = 0$$

$$x = 0 \quad \text{or} \quad x = \frac{1}{5} \quad \text{or} \quad x = \pm 4$$

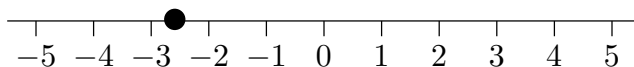


$$(b) \quad \frac{1}{2}x - 7 = 3x + \frac{x}{5}$$

$$5x - 70 = 30x + 2x \quad (\text{clear fractions; multiply by } 10)$$

$$-70 = 27x$$

$$x = \frac{-70}{27}$$



$$(c) \quad |x - 3| > 1$$

solve by inspection; want all #'s whose distance from 3 is greater than 1

$$x < 2 \quad \text{or} \quad x > 4$$



$$(d) \quad 1 - 2x < 3$$

$$-2x < 2$$

$$x > -1$$

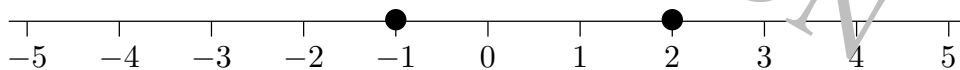


$$(e) \quad x^2 = x + 2$$

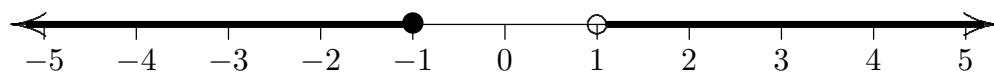
$$x^2 - x - 2 = 0$$

$$(x - 2)(x + 1) = 0$$

$$x = 2 \quad \text{or} \quad x = -1$$



$$(f) \quad 1 < x \quad \text{or} \quad x \leq -1$$



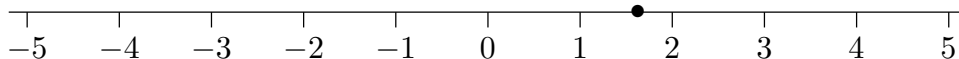
$$(g) \quad 0.4(x - 1) = 2x - 3$$

$$4(x - 1) = 20x - 30 \quad (\text{simplify numbers; multiply by 10})$$

$$4x - 4 = 20x - 30$$

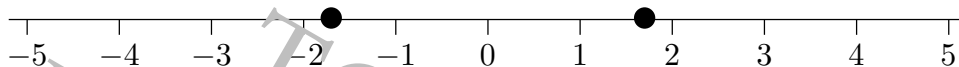
$$26 = 16x$$

$$x = \frac{26}{16} = \frac{13}{8}$$



$$(h) \quad x^2 = 3$$

$$x = \pm\sqrt{3}$$



$$(i) \quad -1 \leq x < 3$$



$$(j) \quad x > -1 \quad \text{and} \quad x \leq 3$$



3.

$$(x - 1)^2 + (y - 2)^2 = r^2$$

$$(x - 1)^2 + (y + 2)^2 = 25$$

4. (a) PERIMETER = $2\ell + 2w$, AREA = ℓw

(b) First triangle: PERIMETER = $2x + y$, AREA = $\frac{1}{2}(x)(\frac{x}{2}) = \frac{1}{4}xy$

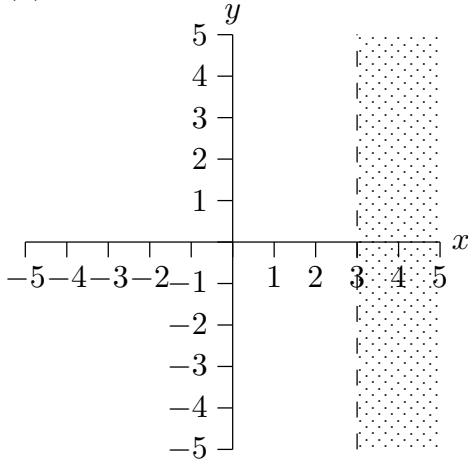
Second triangle: PERIMETER = $3 + 3 + 3\sqrt{2} = 6 + 3\sqrt{2}$, AREA = $\frac{1}{2}(3)(3) = \frac{9}{2}$.

(c) CIRCUMFERENCE = $2\pi r$, AREA = πr^2

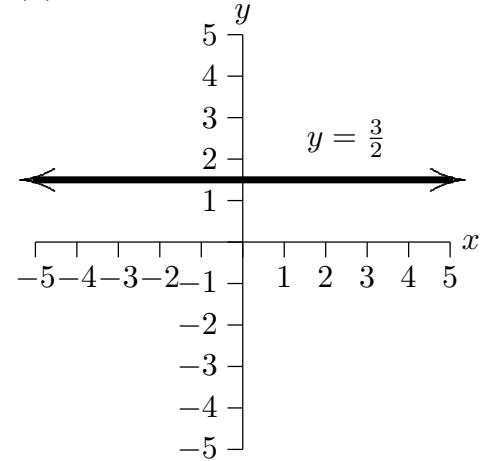
(d) VOLUME = (area of base)(height) = $\pi R^2 h$

Meter is a unit of length; cm^2 is a unit of area; cubic feet is a unit of volume.

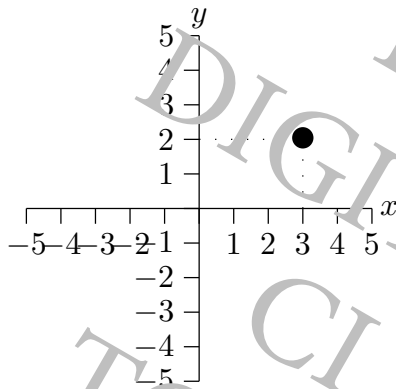
5. (a) $x > 3$



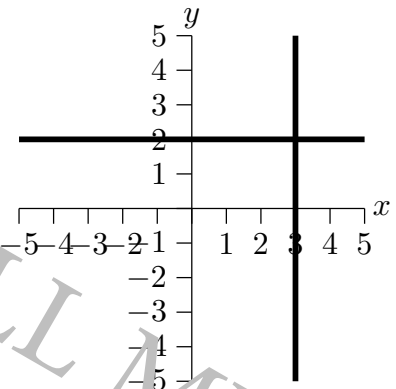
(b) $2y - 3 = 0$



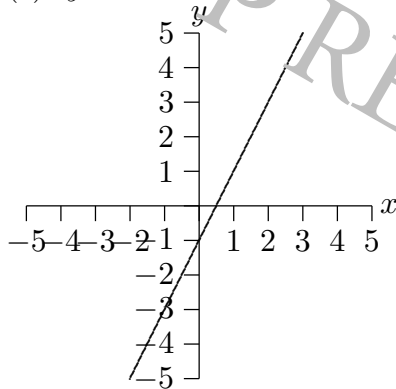
(c) $x = 3$ and $y = 2$



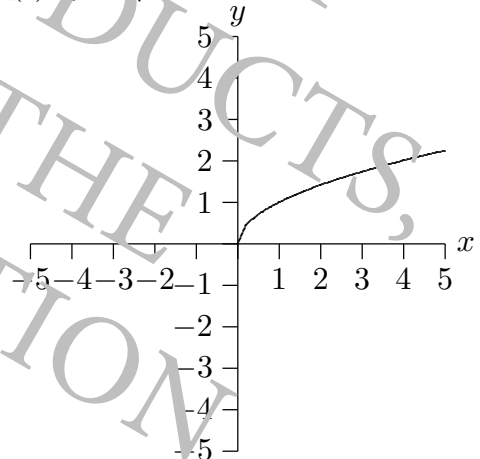
(d) $x = 3$ or $y = 2$



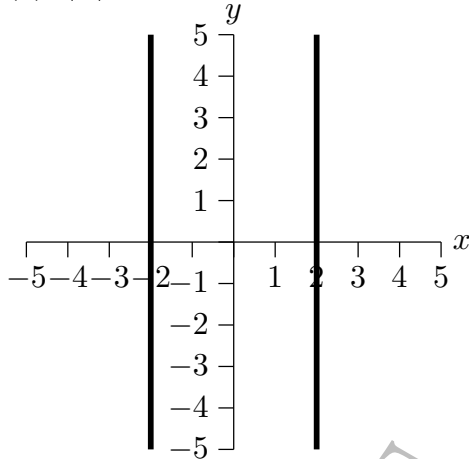
(e) $y = 2x - 1$



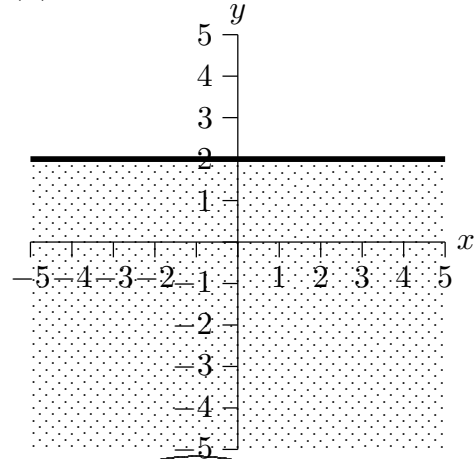
(f) $y = \sqrt{x}$



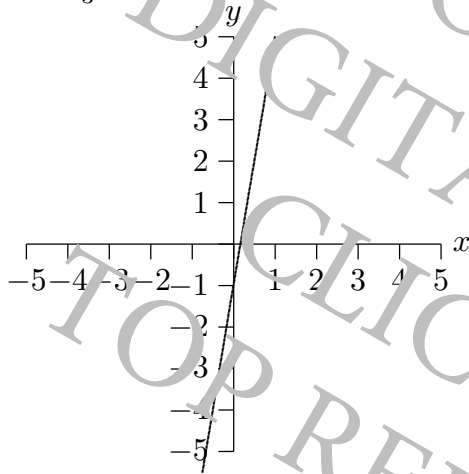
(g) $|x| = 2$



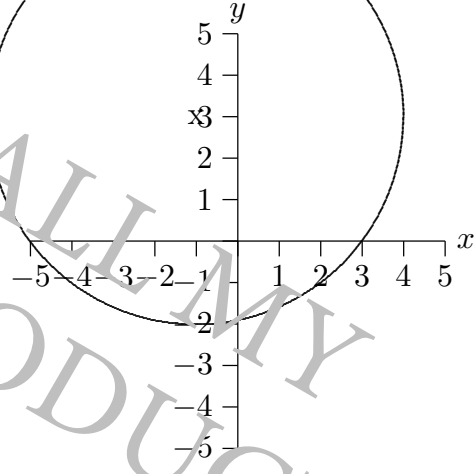
(h) $y \leq 2$



(i) $\frac{y-2}{3} = 2x - 1$ is equivalent to $y = 6x - 1$



(j) $(x + 1)^2 + (y - 3)^2 = 25$



6. (a) $2x - 3$

(b) $2(x - 3)$

(c) $\frac{(2x)^3 + 1}{x}$

(d) take a number, multiply by 3, then subtract 1

(e) take a number, add 1, cube the result, multiply by 2, then subtract 5

(f) take a number, subtract 3, divide by 7, then subtract 1

7. (a) $f(0) = 0^2 - 2(0) + 1 = 1$

(b) $f(1) - 2 = (1^2 - 2 \cdot 1 + 1) - 2 = 0 - 2 = -2$

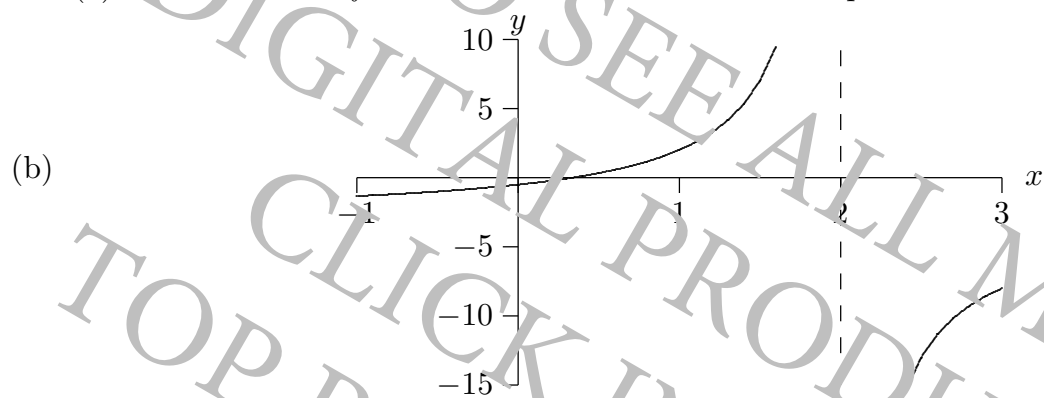
8. The function g is defined whenever $x - 3 > 0$, that is, whenever $x > 3$.
The domain of g is the interval $(3, \infty)$.

9. (a) $y = 3x - 7$

(b) $y = 2$

(c) The line $x - 3y = 5$ has slope $\frac{1}{3}$; a perpendicular line will have slope -3 .
The line with slope -3 passing through $(0, 3)$ has equation $y = -3x + 3$.

10. (a) The domain of f is the set of all real numbers except 2.



(c) The graph crosses the x -axis at $\frac{1}{3}$. (Set $1 - 3x = 0$. Be sure you can get this *exact* answer, not just $x \approx 0.333333$.)

(d) When $x = 1.375$ (exactly), then $f(x) = 5$. (You could check this, if desired, by solving the equation $5 = \frac{1-3x}{x-2}$.)

11. (a) $\frac{1+\sqrt{2}}{\sqrt[3]{5}-7} \approx -0.45637$

(b) 19.72 (this is exact)

(c) $|1 - 2\sqrt{3}| \approx 2.46410$

(d) $(2.03 \times 10^{-9})(-4.1 \times 10^7) = -0.08323$ (this is exact)