STUDY GUIDE FOR SOME BASIC INTERMEDIATE ALGEBRA SKILLS

The intermediate algebra skills illustrated here will be used extensively and regularly throughout the semester. Thus, mastering these skills is an important first step to begin the study of precalculus.

Simplifying polynomials

A (simple) term is the product of real numbers and variables (with non-negative exponents). The numerical factor is the coefficient of the term. The degree of the term is the sum of the exponents which have variable bases.

A polynomial is a single term or the indicated sum of two or more terms.

The operations involving polynomials are illustrated below.

EXAMPLES: (see Chapter 1.2, pages 10- 12)

1, Simplify: $(3x - 2y) - 4x(7 + 3y - x) = 3x - 2y - 28x - 12xy + 4x^2 = -25x - 2y - 12xy + 4x^2$

2. Multiply: $(8x + 7)(2x - 3) = 16x^2 - 10x - 21$

Recall that the method is:
multiply the first terms of each binomial
add (mentally if possible) the products of the outside and inside terms
multiply the second terms in each binomial.

A special case of multiplication is squaring a binomial. Squaring should be practiced until the product can be written down with no intermediate steps (unless the coefficients are large).

3. $(3x + 5)^2 = 9x^2 + 30x + 25$ where $9x^2 = (3x)^2$; $30x = 2(3x)(5)$; $25 = (5)^2$

The trinomial $9x^2 + 30x + 25$ is called a perfect square trinomial and can be recognized as such because the first and third terms are perfect squares and the middle term is double the product of 3x and 5.

4. Simplify: $\dfrac{24a^2b^3 - 3ab + 9a^3b^4}{3ab} = 8ab^2 - 1 + 3a^2b^3$

Factoring Polynomials

Factoring means to write a polynomial as a product of expressions. The goal is to factor completely so that each factor is prime, that is, each factor cannot be factored further.

Always look first for a common monomial factor. Then try the other factoring possibilities listed below.

i) Common monomial factoring (ALWAYS CHECK FOR A COMMON FACTOR FIRST!)

ii) Trinomial factoring (trial and error method)

iii) Difference of two squares: $a^2 - b^2 = (a + b)(a - b)$

iv) Difference of two cubes: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

v) Sum of two cubes: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

(The last three formulas above can be checked by multiplication.)

EXAMPLES : (see Chapter 1.2, pages 12- 14) Factor completely.

5. $40x^2y - 14xy - 6y = 2y(20x^2 - 7x - 3)$ common factor of 2y

$= 2y(?x \quad)(?x \quad)$ possibilities are x & 20x; 2x & 10x: 4x & 5x

$= 2y(4x \quad ?)(5x \quad ?)$ possibilities are: 1 & -3; -1 & 3; 3 & -1; -3 & 1

$= 2y(4x + 1)(5x - 3$ checked by multiplication

6. $8a^6 - 27 = (2a^2 - 3)(4a^4 + 6a^2 + 9)$ the difference of two cubes, see formula iv) above

7. $32a^3b - 98ab^3 = 2ab(16a^2 - 49b^2)$ common factor of 2ab

$= 2ab(4a + 7b)(4a - 7b)$ using the difference of two squares formula

The Factor of (-1):
It is always possible to factor out a (-1) from any polynomial, resulting in every sign of the polynomial being reversed.

If the polynomial is a binomial such as 5x - y then

$$5x - y = (-1)(-5x + y) = (-1)(y - 5x).$$

Thus, if two terms are being subtracted, factoring out (-1) merely reverses the order of the terms of the binomial.

EXAMPLES:

8. a) $-3x^2y + x = x(-3xy + 1)$ OR $(-x)(3xy - 1)$ 8.b) $3a - 5b = (-1)(5b - 3a)$

Factoring by Grouping: (See Chapter 1.2, page 13)

Grouping may work to factor a polynomial of 4 or more terms. The goal is to group terms to create a common factor, a difference of two squares or some other familiar factoring form.

EXAMPLES:

9. $a^2 - x^2 - 2x - 1 = a^2 - (x^2 + 2x + 1) = a^2 - (x + 1)^2$ difference of two squares

$= [a + (x + 1)][a - (x + 1)]$

$= (a + x + 1)(a - x - 1)$

10. $15x^3 - 10x^2 - 9x + 6 = 5x^2(3x - 2) - 3(3x - 2)$ common factor of (3x - 2)

$= (3x - 2)(5x^2 - 3)$

A Least Common Multiple (LCM) is the quantity used:
1) as a lowest common denominator (LCD) when adding fractions;
2) to clear fractions occurring in equations and some inequalities;
3) to simplify complex fractions.

To find the LCM first factor each polynomial. Then for each distinct factor pick the largest exponent. (See Chapter 1.2, page 14)

EXAMPLES:

11. Find the LCM of the following: $x^2 - 9 = (x + 3)(x - 3)$

$x^2 + x - 12 = (x - 3)(x + 4)$

$3x^2 + 24x + 48 = 3(x^2 + 8x + 16) = 3(x + 4)^2$

The LCM is: $3(x + 3)(x - 3)(x + 4)^2$

Polynomial Fractions or Rational Expressions (See Chapter 1.3, pages 16 - 19)

Factoring is a key skill when working with rational expressions.

EXAMPLES

12. Reduce: $\dfrac{15x^2 - 40x - 15}{9 - x^2}$ first factor numerator and denominator completely

$$= \frac{5(3x^2 - 8x - 3)}{(3 + x)(3 - x)} = \frac{5\overset{(-1)}{\cancel{(x - 3)}}(3x + 1)}{(3 + x)\underset{(1)}{\cancel{(3 - x)}}}$$ cancel any like factors

Note that (x - 3) = (-1)(3 - x)!

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

A fraction such as $\dfrac{a - 2}{2 - a}$ can always be reduced by factoring out a (-1), namely,

$$\frac{a - 2}{2 - a} = \frac{(-1)(2 - a)}{2 - a} = -1.$$

Equivalently, canceling leaves a factor of (-1) in the numerator and of 1 in the denominator.

13. Divide: $\dfrac{3 - x}{2x^2 - x - 1} \div \dfrac{x^2 - 9}{4x - 4}$ Invert the divisor and multiply

$$\frac{3 - x}{2x^2 - x - 1} \cdot \frac{4x - 4}{x^2 - 9}$$ Factor top and bottom completely

$$\frac{(3 - x) \cdot 4(x - 1)}{(2x + 1)(x - 1) \cdot (x + 3)(x - 3)}$$ cancel any like factors

$$\frac{\overset{(-1)}{\cancel{(3 - x)}} \cdot 4 \overset{(1)}{\cancel{(x - 1)}}}{(2x + 1)\underset{(1)}{\cancel{(x - 1)}} \cdot (x + 3)\underset{(1)}{\cancel{(x - 3)}}} = \frac{-4}{(2x + 1)(x + 3)}$$

14. Add (or subtract): $\dfrac{3}{2a - 4} - \dfrac{a - 7}{4 - a^2} = \dfrac{3}{2a - 4} + \dfrac{7 - a}{4 - a^2}$ Find the LCD

$$= \frac{3}{2(a - 2)} + \frac{7 - a}{(2 + a)(2 - a)}$$ Do not include both (a - 2) & (2 - a) in the LCD

$$= \frac{3}{2(a - 2)} \cdot \frac{-1}{-1} + \frac{7 - a}{(2 + a)(2 - a)}$$

$$= \frac{-3}{2(2 - a)} + \frac{7 - a}{(2 + a)(2 - a)}$$ LCD: 2(2 - a)(2 + a)

$$= \frac{-3}{2(2 - a)} \cdot \frac{2 + a}{2 + a} + \frac{7 - a}{(2 + a)(2 - a)} \cdot \frac{2}{2} = \frac{-3(2 + a) + 2(7 - a)}{2(2 - a)(2 + a)}$$

$$= \frac{-6 - 3a + 14 - 2a}{2(2 - a)(2 + a)} = \frac{8 - 5a}{2(2 - a)(2 + a)}$$

COMPLEX FRACTIONS (See Chapter 1.3, pages 19 - 20)

A complex fraction is a fraction that has fractions in the numerator or in the denominator or both.

Complex fractions will occur frequently throughout this course. A recommended method of simplifying is to multiply by a carefully selected name for one, that is, simplify by multiplying top and bottom by the same expression.

EXAMPLES:

15. Simplify: $\dfrac{\frac{1}{2}+\frac{5}{3}}{\frac{7}{4}-2}$. The 2, 3 & 4 are the "extra" denominators of the complex fraction.

The LCM of 2, 3 & 4 is 12. Multiply by $\dfrac{12}{12}$ to simplify this complex fraction.

$$\frac{\frac{1}{2}+\frac{5}{3}}{\frac{7}{4}-2}\cdot\frac{\frac{12}{1}}{\frac{12}{1}}=\frac{\frac{1}{2}\left(\frac{12}{1}\right)+\frac{5}{3}\left(\frac{12}{1}\right)}{\frac{7}{4}\left(\frac{12}{1}\right)-\frac{2}{1}\left(\frac{12}{1}\right)}=\frac{6+20}{21-24}=\frac{26}{-3}=-\frac{26}{3}$$

With practice the second step above can be eliminated.

16. Simplify: $\dfrac{\frac{3}{2x+1}-\frac{3}{5}}{x-2}\cdot\dfrac{\frac{5(2x+1)}{1}}{\frac{5(2x+1)}{1}}=\dfrac{15-3(2x+1)}{5(2x+1)(x-2)}$

$$=\frac{15-6x-3}{5(2x+1)(x-2)}=\frac{12-6x}{5(2x+1)(x-2)}$$

$$=\frac{6(2-x)}{5(2x+1)(x-2)}=\frac{-6}{5(2x+1)}\quad\text{OR}\quad-\frac{6}{5(2x+1)}$$

Simplifying Radicals: (See Chapter 1.4, pages 24 - 27)

The radicand of $\sqrt[3]{29}$ is 29 and the order of the radical is 3. Simplifying radicals means to change to an equivalent form:

i) with no perfect nth power factors in the radicand (order n radicals), and
ii) with an integer radicand (or sometimes no radical in the denominator).

EXAMPLES: Simplify.

17. a) $2\sqrt{147}=2\sqrt{49\cdot3}=2\cdot\sqrt{49}\cdot\sqrt{3}=2\cdot7\sqrt{3}=14\sqrt{3}$

b) $\dfrac{5}{8}\sqrt[3]{56}=\dfrac{5}{8}\sqrt[3]{8}\sqrt[3]{7}=\dfrac{5}{8}\cdot2\sqrt[3]{7}=\dfrac{5\cdot2}{8}\sqrt[3]{7}=\dfrac{5}{4}\sqrt[3]{7}$

Remember to cancel like factors before multiplying!

18. a) $\sqrt{\frac{5}{18}} = \frac{\sqrt{5}}{\sqrt{18}} = \frac{\sqrt{5}}{3\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{10}}{3\cdot 2} = \frac{\sqrt{10}}{6}$ OR $\frac{1}{6}\sqrt{10}$

b) $4\sqrt[3]{\frac{5}{2}} = 4 \cdot \frac{\sqrt[3]{5}}{\sqrt[3]{2}} \cdot \frac{\sqrt[3]{4}}{\sqrt[3]{4}} = 4 \cdot \frac{\sqrt[3]{20}}{\sqrt[3]{8}} = \frac{4\cdot\sqrt[3]{20}}{2} = 2\cdot\sqrt[3]{20}$

Operations with Radicals: (See Chapter 1.4, pages 25 - 27)

Radicals with the same radicand and same order are like radicals. Add or subtract coefficients of like radicals.

Radicals of the same order can be multiplied by multiplying the radicands.

Similarly, radicals of the same order can be divided by dividing the radicands.

EXAMPLES: Perform the indicated operations.

19. $\sqrt{\frac{3}{2}} - \frac{1}{3}\sqrt{24} = \frac{\sqrt{3}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} - \frac{1}{3}\sqrt{4\cdot 6}$ First simplify each radical

$= \frac{\sqrt{6}}{2} - \frac{1}{3} \cdot 2\sqrt{6} = \frac{\sqrt{6}}{2} - \frac{2}{3}\sqrt{6} = \left(\frac{1}{2} - \frac{2}{3}\right)\sqrt{6}$

$= \left(\frac{3-4}{6}\right)\sqrt{6} = -\frac{1}{6}\sqrt{6}$

20. $(3 + \sqrt{2})(5 - \sqrt{6}) = 15 - 3\sqrt{6} + 5\sqrt{2} - \sqrt{12}$ (Similar to polynomial multiplication!)

$= 15 - 3\sqrt{6} + 5\sqrt{2} - 2\sqrt{3}$

21. $\sqrt[3]{75} \div \sqrt[3]{3} = \frac{\sqrt[3]{75}}{\sqrt[3]{3}} = \sqrt[3]{25}$

If the denominator has two or more terms, the simplified form will be an equivalent form with a rational number denominator (actually the denominator will become an integer). Multiply top and bottom by the conjugate to simplify.

22. $\frac{3\sqrt{6}}{4 - \sqrt{3}} \cdot \frac{4 + \sqrt{3}}{4 + \sqrt{3}} = \frac{12\sqrt{6} + 3\sqrt{18}}{16 - 3} = \frac{12\sqrt{6} + 9\sqrt{2}}{13}$

Note that $(4 - \sqrt{3})(4 + \sqrt{3})$ has the form of multiplying $(a + b)(a - b) = a^2 - b^2$.

Imaginary or Complex Numbers (See Chapter 1.4, pages 27 - 28)

Expressions such as $\sqrt{-27}$ do not represent real numbers since no real number squared equals -27. In this case,

$\sqrt{-27} = \sqrt{9\cdot 3\cdot(-1)} = 3\sqrt{3}\ i$ where $i^2 = -1$, an imaginary number.

EXAMPLES: Simplify

23. $\dfrac{24 - \sqrt{-72}}{16} = \dfrac{24 - \sqrt{36 \cdot 2}\, i}{16} = \dfrac{24 - 6\sqrt{2}\, i}{16} = \dfrac{6(4 - \sqrt{2}\, i)}{16}$

$= \dfrac{3(4 - \sqrt{2}\, i)}{8}$ OR $\dfrac{12 - 3\sqrt{2}\, i}{8}$

Radicals and Exponents (See Chapter 1.4, pages 28 - 31)

Recall that: $b^0 = 1, b \neq 0$; $5^{-1} = \dfrac{1}{5}$; $7^{1/2} = \sqrt{7}$; $11^{3/4} = \left(\sqrt[4]{11}\right)^3$

Also, for $x \neq 0$, $x^a \cdot x^b = x^{a+b}$ $\qquad (xy)^a = x^a y^a$

$\dfrac{x^a}{x^b} = x^{a-b}$ $\qquad \left(\dfrac{x}{y}\right)^a = \dfrac{x^a}{y^a}$

$(x^a)^b = x^{ab}$

As noted previously it is not possible to multiply $\sqrt{7} \cdot \sqrt[4]{7}$ because the orders are different. However, using exponential forms sometimes allows some simplifying.

EXAMPLES: Perform the indicated operations

24. $\sqrt{7} \cdot \sqrt[4]{7} = 7^{1/2} \cdot 7^{1/4} = 7^{1/2+1/4} = 7^{3/4}$ or $\left(\sqrt[4]{7}\right)^3$ or $\sqrt[4]{7^3}$

25. $\left(3^{-2} + 9^{-3/2}\right)^{-1} = \left(\dfrac{1}{3^2} + \dfrac{1}{9^{3/2}}\right)^{-1} = \left(\dfrac{1}{9} + \dfrac{1}{27}\right)^{-1} = \left(\dfrac{3+1}{27}\right)^{-1} = \left(\dfrac{4}{27}\right)^{-1} = \dfrac{27}{4}$

26. $\dfrac{x^{-1} + y^{-2}}{xy^{-1}} = \dfrac{\frac{1}{x} + \frac{1}{y^2}}{\frac{x}{y}} \cdot \dfrac{\frac{xy^2}{1}}{\frac{xy^2}{1}} = \dfrac{y^2 + x}{x^2 y}$

Note that this was merely a complex fraction!

27. Simplify and write the answer without negative or zero exponents.

$\left(\dfrac{8\, x^{5/4}\, y^{-11/6}}{x^{1/2}\, y^{-1/3}}\right)^{1/3}$ Simplify inside the parentheses first

Subtract exponents of like bases: $\left(\dfrac{8\, x^{5/4-1/2}\, y^{-11/6 - (-1/3)}}{1}\right)^{1/3}$

(Note: $\dfrac{5}{4} - \dfrac{1}{2} = \dfrac{5-2}{4} = \dfrac{3}{4}$ AND $\dfrac{-11}{6} - \left(-\dfrac{1}{3}\right) = \dfrac{-11+2}{6} = \dfrac{-9}{6} = \dfrac{-3}{2}$)

So, $\left(\dfrac{8\, x^{5/4}\, y^{-11/6}}{x^{1/2}\, y^{-1/3}}\right)^{1/3} = \left(\dfrac{8\, x^{3/4}\, y^{-3/2}}{1}\right)^{1/3} = 8^{1/3}\, x^{3/4 \cdot 1/3}\, y^{-3/2 \cdot 1/3}$

$= 2\,x^{1/4}\,y^{-1/2} = \dfrac{2x^{1/4}}{y^{1/2}}$

Linear Equations and Inequalities (See Chapter 1.5, pages 34 - 36, Chapter 1.6, page 46)

EXAMPLES: Solve.

28. $\dfrac{x}{10} + \dfrac{7}{5} = 3x - \dfrac{11}{15}$

Clear fractions by multiplying each side by 30, the LCM of the denominators

$$30\left[\frac{x}{10} + \frac{7}{5} = 3x - \frac{11}{15}\right] \Rightarrow 3x + 42 = 90x - 22$$

Get all terms with the variable on one side and everything else on the other side.

$42 + 22 = 90x - 3x \Rightarrow 64 = 87x$

So, $\dfrac{64}{87} = x$ and the solution set is $S = \left\{\dfrac{64}{87}\right\}$

29. $-\dfrac{7}{4} \le x + \dfrac{1}{2} \le 4$

Recall that statements of the form $a \le x \le b$ are implied "AND" statements and mean that $a \le x$ AND AT THE SAME TIME $x \le b$. It is shortest to solve both at once as shown below.

$$4\left[-\frac{7}{4} \le x + \frac{1}{2} \le 4\right] \Rightarrow -7 \le 4x + 2 \le 16$$

Clear fractions first (unless the denominators contain variables!)

Add -2 to each part of the inequality to isolate the x term.

$-9 \le 4x \le 14$ Divide each part by 4 to solve for x.

$$\frac{-9}{4} \le x \le \frac{14}{4} \Rightarrow \frac{-9}{4} \le x \le \frac{7}{2}$$

IF YOU MULTIPLY OR DIVIDE AN INEQUALITY BY A NEGATIVE NUMBER, REMEMBER THAT THE INEQUALITY REVERSES!

30. Solve for c: $3abc = 5bc - 8ab$ Isolate all terms that contain "c".

$8ab = 5bc - 3abc$ Factor out "c' from the right side

$8ab = c(5b - 3ab)$ Divide each side by the coefficient of "c"

$$\frac{8ab}{5b - 3ab} = c = \frac{8ab}{b(5 - 3a)} = \frac{8a}{5 - 3a}$$

Completing the Square (See Chapter 1.5, page 38)

In addition to deriving the quadratic formula from $ax^2 + bx + c = 0$, $a \neq 0$, completing the square has other important uses which will be encountered this semester as well as in future courses.

31. $x^2 - \dfrac{2}{3}x + __ =$: To complete the square, add $\left(\dfrac{1}{2} \cdot -\dfrac{2}{3}\right)^2 = \left(-\dfrac{1}{3}\right)^2 = \dfrac{1}{9}$

So, $x^2 - \frac{2}{3}x + \frac{1}{9} = \left(x - \frac{1}{3}\right)^2$

Quadratic Equations (See Chapter 1.5, pages 37 - 40)

Quadratic equations have the form $ax^2 + bx + c = 0$, $a \neq 0$.

EXAMPLES: Solve

32. $(3x + 5)(x - 2) = x - 9$ Remove parentheses;

$3x^2 - x - 10 = x - 9$ Get a zero on one side

$3x^2 - 2x - 1 = 0$ Factor the nonzero side

$(3x + 1)(x - 1) = 0$ Set each factor containing a variable equal to zero

$3x + 1 = 0$ OR $x - 1 = 0$

$x = -\frac{1}{3}$ OR $x = 1$ The solution set $S = \left\{-\frac{1}{3}, 1\right\}$

If the nonzero side cannot be factored using integers, then use the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$ and simplify.

33. $3x^2 - 4x - 1 = 0$ The left side does not factor

Use the quadratic formula with $a = 3$, $b = -4$, $c = -1$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(3)(-1)}}{2(3)} = \frac{4 \pm \sqrt{16 + 12}}{6} = \frac{4 \pm \sqrt{28}}{6} = \frac{4 \pm 2\sqrt{7}}{6}$$

$$= \frac{2(2 \pm \sqrt{7})}{6} = \frac{2 \pm \sqrt{7}}{3}$$

Equations of the form $x^2 = k$ for any real number k.

A special case of quadratic equations occurs when $b = 0$, that is, the quadratic equation has the form $x^2 = k$ for any real number k. The most efficient method for solving these equations is to use the following.

$$x^2 = k \quad \text{then } x = \pm\sqrt{k}$$

Notice that the square root is only on the right side!! In fact, $\sqrt{x^2} \neq x$ for all real numbers x!

34. $3x^2 = 7$ Special case of a quadratic equation

$x^2 = \frac{7}{3}$ Solve for x^2

$$x = \pm\sqrt{\frac{7}{3}} = \pm\frac{\sqrt{7}}{\sqrt{3}} = \pm\frac{\sqrt{7}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \pm\frac{\sqrt{21}}{3} \quad \text{OR} \quad \pm\frac{1}{3}\sqrt{21}$$

Equations with rational or radical expressions (See Chapter 1.5, 41 - 43)

The goal is to convert to an equivalent equation that is either a familiar linear or quadratic form.

EXAMPLES: Solve

35. $\frac{2}{x+3} + \frac{6}{x(x+3)} = \frac{1}{x}$ The LCM of the denominators is $x(x+3)$, $x \neq 0, -3$

$x(x+3)\left[\frac{2}{x+3} + \frac{6}{x(x+3)} = \frac{1}{x}\right]$ Clear fractions

$2x + 6 = x + 3$ A linear equation; solve for x

$x = -3$

However, x = -3 makes the LCM and a denominator equal to zero. So, x = -3 cannot be a solution and x = -3 is called an extraneous root.

The solution set is the empty set, namely, $S = \varnothing$.

36. $\sqrt{2x-3} + x = 3$ Isolate the radical; if there are two radicals, isolate one of them

$\sqrt{2x-3} = 3 - x$ Square each side. This could result in extra solutions!

$(\sqrt{2x-3})^2 = (3-x)^2$

$2x - 3 = 9 - 6x + x^2$ A quadratic equation

$0 = x^2 - 8x + 12 = (x-6)(x-2)$

x = 6 OR x = 2 are POSSIBILITIES ONLY.

Each must be checked using the original equation.

Check x = 6:

Does $\sqrt{12-3} + 6 = 3$?

$\sqrt{9} + 6 \neq 3$

x = 6 is NOT a solution

Check x = 2:

Does $\sqrt{4-3} + 2 = 3$?

$\sqrt{1} + 2 = 3$

x = 2 is a solution

The solution set is S = {2}.

Systems of Two Equations (See Chapter 1.8, pages 64 - 68)

Systems of two or more equations can be solved by the Addition (Elimination) Method or by Substitution. Each method is illustrated below.

EXAMPLES: Solve

37. Use the Addition or Elimination Method

$\begin{cases} 2x + 3y = 2 \\ 3x - 4y = 20 \end{cases}$ Multiply the first equation by 4 and the second equation by 3.

$\begin{cases} 8x + 12y = 8 \\ 9x - 12y = 60 \end{cases}$ Add the equations to eliminate the y terms.

$17x = 68 \Rightarrow x = 4$ Substitute into either equation to find y.

Using the first equation $\Rightarrow$ $2(4) + 3y = 2 \Rightarrow 3y = -6 \Rightarrow y = -2$

The solution is the ordered pair (4, -2)

The above system could be solved by substitution as well.

38. Use the Substitution Method

$\begin{cases} y - x = 4 \\ 2y = x^2 \end{cases}$ Solve the first equation for y and substitute into the second equation.

$y = x + 4 \Rightarrow 2(x + 4) = x^2$, a quadratic equation in one variable.

$2x + 8 = x^2 \Rightarrow 0 = x^2 - 2x - 8 = (x + 2)(x - 4)$

So, $x = -2$ OR $x = 4$

Find the corresponding y value for each x value.

$x = -2 \Rightarrow y = -2 + 4 = 2$. So, one solution is the ordered pair (-2, 2)

$x = 4 \Rightarrow y = 4 + 4 = 8$. So, another solution is the ordered pair (4, 8)

The solution set S = {(-2, 2), (4, 8)}