# Modeling with expressions

- An expression is a mathematical phrase that contains numbers or variables.
- Terms are the parts being added.

Coefficient is the number in front of the variable.

- A constant is a term without a variable.

Ex.1 identify the terms and coefficients of the expression.

a) $8x+2y+7z$

terms: $8x, 2y, 7z$

Coefficients: $8, 2, 7$

b) $2x+3y-4z+10$

terms: $2x, 3y, -4z, 10$

Coefficient: $2, 3, -4, \boxed{10}$

**Ex.2** Curtis is buying supplies for his school. He buys p packages of crayons at $1.49 per package and q packages of markers at $3.49 per package. What does the expression 1.49p + 3.49q represent?

1.49p price of p crayons

3.49q price of q markers

1.49p + 3.49q total of crayons & markers

**<u>Modeling expressions.</u>**

**Words that mean…**

**Addition:** sum, add, more than, increased by, total, altogether.

**Subtraction:** less than, minus, subtracted from, difference, take away, taken from, reduced by.

**Multiplication:** times, multiplied by, product, percent of.

**Division:** divided by, division of, quotient of, divided into, ratio of.

Ex.3 write an algebraic expression in simplest form.

a) a number increased by 2.

$x+2$

b) the difference of a number and 2.

$x-2$

c) the product of 0.6 and a number.

$0.6x$

d) a number divided by 5.

$\frac{x}{5}$

e) the price of an item plus 6% sales tax.

$1p + .06p = \boxed{1.06p}$

f) the price of a car plus 8.5% sales tax.

$c + .085c = \boxed{1.085c}$

88

# Understanding Polynomial Expressions

- A monomial is an expression with one term that cannot have a variable in the denominator and must have whole number exponents.

$.25x^3$, $-4xy$, $\frac{xy}{4}$, $\cancel{\frac{y}{x^3}}$, $\cancel{4x^{-3}}$

- Degree of polynomial - the largest exponent value of the terms.
- Polynomial - has one or more terms, written in decreasing degree.

$4x^3+x^2-5$ $\quad\quad$ $5x^2\cancel{-3x^4}+7$

not proper

- Binomial - two terms.
- Trinomial - three terms.
- Leading coefficient - the number in front of the first term.

Ex.1 Write the polynomial in standard form. Then state the leading coefficient and the degree.

a) $10-3x^2+x^5+4x^3$ degree 5

$\rightarrow 1x^5+4x^3-3x^2+10$

leading coefficient constant

b) $10x^1 + 13 - 15x^2$ degree 2

LC $-15x^2 + 10x + 13$

**Ex.2 Simplifying polynomials (Like terms have the same variable and power).**

a) $\cancel{-2y^3} - 8y^2 + y^2 \cancel{+2y^3}$

$\boxed{-7y^2}$

b) $ab - a^2 + 4^2 - 5ab + 3a^2 + 10$

16

$-4ab + 2a^2 + 26$

$\boxed{2a^2 - 4ab + 26}$

Pg. 637 #1-14

# Addicting and Subtracting Polynomials

## Ex.1 vertically

a) $(5x^2+2x-1) + (4x^2-x+2)$

$$\begin{array}{r} 5x^2+2x-1 \\ +\ 4x^2-x+2 \\ \hline \boxed{9x^2+x+1} \end{array}$$

b) $(y^2+y-1)-(-2y^2+y+1)$

$(y^2+\cancel{y}-1)+(2y^2-y-1)$

$$\begin{array}{r} 2y^2-\cancel{y}-1 \\ \hline \boxed{3y^2-2} \end{array}$$

## Ex.2 Horizontally

a) $(5x^2+2x+1) + (-4x^2-x-2)$

$5x^2-4x^2+2x-x+1-2$

$\boxed{x^2+x-1}$

b) $(2m^2-m-8)-(2m^2+m-4)$

$(2m^2-m-8)+(-2m^2-m+4)$

$\cancel{2m^2}-\cancel{2m^2}-m-m-8+4$

$\boxed{-2m-4}$

pg. 646 #3-12 odd, pg. 654 #3-10 odd

# Multiplying Polynomials

## Ex.1 Monomials

a) $(6x^3)(-4x^4) = \boxed{-24x^7}$ $\quad x^a \cdot x^b = x^{(a+b)}$

$x \cdot x \cdot x$ $\quad x \cdot x \cdot x \cdot x$

b) $(5xy^2)(7xy) = 35x^2y^3$

$y \cdot y \cdot y$

c) $3x^1(3x^2+6x^1-5) = 9x^3+18x^2-15x$

## Ex.2 binomials

a) $(x+5)(x+2)$

$x^2+2x+5x+10$

$\boxed{x^2+7x+10}$

First
Outside
Inside
Last

$x \cdot x$

b) $(x^2+3)(x+2)$

| | $x^2$ | $3$ |
|---|---|---|
| $x$ | $x^3$ | $3x$ |
| $2$ | $2x^2$ | $6$ |

$\boxed{x^3+2x^2+3x+6}$

c) $(3x-4)(-2x^2+5x-6)$

| | $-2x^2$ | $5x$ | $-6$ |
|---|---|---|---|
| $3x$ | $-6x^3$ | $15x^2$ | $-18x$ |
| $-4$ | $8x^2$ | $-20x$ | $24$ |

$\boxed{-6x^3+23x^2-38x+24}$

pg. 667 #1-11 odd #17 pg. 674 #1-17 odd

# Special Products of Binomials

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

  $(x+6)(x-6)$

  $\boxed{x^2-36}$

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

  $(x+4)^2$

  $\boxed{x^2+8x+16}$

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

  $(x-5)^2$

  $\boxed{x^2-10x+25}$

# Simplify Radical Expressions

**A radical expression is in simplest form if the following are true.**

1. **No perfect square factors**

   $\sqrt{8} = \sqrt{4} \cdot \sqrt{2} = 2\sqrt{2}$

2. **No fractions in the radical**

   $\sqrt{\frac{5}{16}} = \frac{\sqrt{5}}{\sqrt{16}} = \frac{\sqrt{5}}{4}$

3. **No radicals in the denominator**

   $\frac{1}{\sqrt{4}} = \frac{1}{2}$

# Perfect squares

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$

**Product Property** - $\sqrt{ab} = \sqrt{a}\sqrt{b}$

**Quotient Property** - $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

## Ex.1 simplify the radical expression

a) $\sqrt{49} = \boxed{7}$

$7 \quad 7$

$\cancel{\sqrt{7^2}}$

b) $\sqrt{400} = \boxed{20}$

$20 \quad 20$

$\sqrt{20^2}$

$\sqrt{4 \cdot 100}$

$\sqrt{4} \cdot \sqrt{100}$

$2 \cdot 10$

$\boxed{20}$

c) $\frac{1}{2}\sqrt{72}$

$\frac{1}{2}\sqrt{36 \cdot 2}$

$\frac{1}{2}\sqrt{36}\sqrt{2}$

$\frac{1}{2}(6)\sqrt{2}$

$\boxed{3\sqrt{2}}$

d) $\sqrt{\frac{9}{125}} = \frac{\sqrt{9}}{\sqrt{125}} = \frac{3}{\sqrt{25 \cdot 5}} = \frac{3}{\sqrt{25} \cdot \sqrt{5}} = \frac{3}{5\sqrt{5}}$

$= \frac{3}{5\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{5}}{5\sqrt{25}} = \frac{3\sqrt{5}}{5(5)} = \boxed{\frac{3\sqrt{5}}{25}}$

e) $\sqrt{\frac{10}{2}} = \boxed{\sqrt{5}}$

f) $\sqrt{x^4y^2} = \sqrt{x^4}\sqrt{\cancel{y^2}} = \boxed{yx^2}$

$x \cdot x \cdot x \cdot x$

g) $\sqrt{25x^2y^3} = \sqrt{25}\sqrt{x^2}\sqrt{y^3}$

$y \cdot y \cdot y$

$= \boxed{5xy\sqrt{y}}$

# Adding and Subtracting Radicals

- The number inside the radical has to be the same in order to add/subtract.

$\cancel{2\sqrt{3}+\sqrt{5}}$ $\qquad$ $3\sqrt{2}+\sqrt{2}$

**Ex.1 perform the indicated operation**

a) $5\sqrt{7}+2\sqrt{7}$

$\boxed{7\sqrt{7}}$

b) $11\sqrt{3}-12\sqrt{3}$

$\boxed{-1\sqrt{3}}$

c) $\sqrt{32}+\sqrt{2}$

$\sqrt{16}\sqrt{2} + \sqrt{2}$

$4\sqrt{2} + \sqrt{2}$

$\boxed{5\sqrt{2}}$

d) $4\sqrt{5} + \sqrt{125} + \sqrt{45}$

25 5 9 5

$4\sqrt{5} + \sqrt{25}\sqrt{5} + \sqrt{9}\sqrt{5}$

$4\sqrt{5} + 5\sqrt{5} + 3\sqrt{5}$

$\boxed{12\sqrt{5}}$

## Multiplying and Dividing Radical Expressions

- **Multiply numbers that are both outside the radical.**
- **Multiply numbers that are both inside the radical.**

$$a\sqrt{b} \cdot c\sqrt{d} = ac\sqrt{bd}$$

a) $\sqrt{2}\,\sqrt{8} = \sqrt{16} = \boxed{4}$

b) $5\sqrt{3} \cdot 7\sqrt{2} = 35\sqrt{6}$

c) $\sqrt{2}\left(5-\sqrt{3}\right) = \boxed{5\sqrt{2}-\sqrt{6}}$

d) $\left(1+\sqrt{5}\right)^2 = \left(1+\sqrt{5}\right)\left(1+\sqrt{5}\right)$

$$\begin{array}{c|c|c|}
 & 1 & \sqrt{5} \\ \hline
1 & 1 & \sqrt{5} \\ \hline
\sqrt{5} & \sqrt{5} & \sqrt{25} \\ \hline
\end{array}$$

$$1+\sqrt{5}+\sqrt{5}+\sqrt{25}$$
$$1+2\sqrt{5}+5$$
$$\boxed{6+2\sqrt{5}}$$

e) $\dfrac{2}{\sqrt{2}}\cdot\dfrac{\sqrt{2}}{\sqrt{2}}=\dfrac{2\sqrt{2}}{\sqrt{4}}=\dfrac{\cancel{2}\sqrt{2}}{\cancel{2}}=\boxed{\sqrt{2}}$

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# Irrational verse Rational

- Rational numbers can be written as a ratio of two integers.
- Rational numbers have repeating or terminating decimals.
- Irrational numbers cannot be written as a ratio with integers.

Ex.1 Determine if the numbers are rational or irrational.

a) $-\frac{5}{2}=-2.5$ rational

irrational

b) $\pi = 3.14....$

c) $\frac{1}{3} = .\overline{3}$ rational

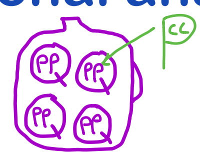
d) $\sqrt{7} = 2.64575....$ irrational

e) $\frac{2\sqrt{3}}{5}$ irrational

## Using ratios and proportions to solve problems

- A ratio is a comparison of two number by division.
- A proportion is an equation where two ratios are equal.

Ex.1 use dimensional analysis to convert the measurements.



a) An adult male human has 12 pints of blood. Convert to gallons.

$$\frac{12\ \cancel{pts}}{1} \cdot \frac{1\ \cancel{qts}}{2\ \cancel{pts}} \cdot \frac{1\ gal}{4\ \cancel{qts}} = \frac{12}{8}gal = \frac{3}{2}gal$$

$$\boxed{1.5\ gal}$$

b) The length of a building is 720 in. Convert to yards.

$$\frac{720\,\cancel{in}}{1}\cdot\frac{1\,\cancel{ft}}{12\,\cancel{in}}\cdot\frac{1\,yd}{3\,\cancel{ft}}=\frac{720}{36}\,yd=\boxed{20\,yd}$$

c) 7500 seconds = _______ hours

$$\frac{7500\,sec}{1}\cdot\frac{1\,min}{60\,sec}\cdot\frac{1\,hr}{60\,min}=\frac{7500}{3600}\,hrs$$

$$\boxed{2.1\,hrs}$$

d) 4 inches = ________ yards

$$\frac{4\,in}{1}\cdot\frac{1\,ft}{12\,in}\cdot\frac{1\,yd}{3\,ft}=\frac{4}{36}\,yd=\boxed{\frac{1}{9}\,yd}$$

Ex.2 Amanda traveled 105 kilometers in 4.2 hours and Brenda traveled at a rate of 0.2 miles per minute. Which girl traveled at a faster rate? (1 mile = 1.61 km)

$$\frac{105\,\cancel{km}}{4.2\,\cancel{hrs}}\cdot\frac{1\,mi}{1.61\,\cancel{km}}\cdot\frac{1\,\cancel{hr}}{60\,min}=\frac{105}{405.72}=.26$$

Amanda

# Reporting with Precision and Accuracy

- Precision is the level of detail of a measurement, determined by the smallest unit.
- Accuracy is the closeness of a given measurement. You can find the accuracy of the measurement by finding that absolute value of the difference.

Ex.1 which measurement is more precise?

| Measurement 1 | Measurement 2 |
|---|---|
| 4g | 4.3g |
| 5.71 oz | 5.7 oz |
| 4.2 m | 422 cm |
| 7ft 2in. | 7.2 in |

Ex.2 which measurement is more accurate if it is known the weight is 8 g?

| Scale | Mass |
|---|---|
| scale 1 | 8.02g |
| scale 2 | 7.9g |
| scale 3 | 8.029g |

$|8-8.02| = .02$

$|8-7.9| = .1$

$|8-8.029| = .971$

# <u>Identifying significant digits</u>

- **Significant digits are the digits in measurements that carry meaning about the precision of the measurement.**

**All nonzero digits are significant**

55.98 4 SD 115 3 SD

**Zeros between two other significant digits are significant**

102 3SD, 0.4000008 7 SD

**Zeros at the end of a number to the right of the decimal point are significant.**

3.900 4 SD, 0.1230 4 SD

**Zeros to the left of the first nonzero digit in a decimal are not significant.**

0.00035 2 SD, 0.0806 3 SD

**Zeros at the end of a number without a decimal point are assumed to be NOT significant.**

60,600 3 SD 77,000,000 2SD

**Ex.1 Determine the number of significant digits.**

a) 0.052 kg

2 SD

b) 10,000 ft

1 SD

c) 10.000 ft

5 SD