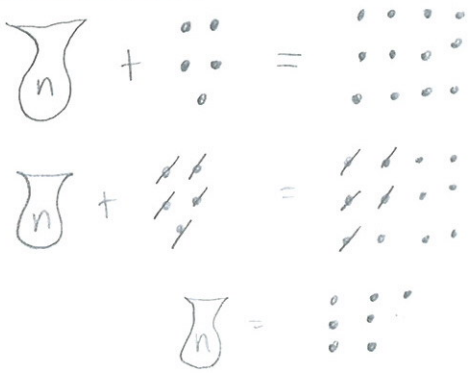
Solving One-step Equations (Addition and Subtraction)

Equation: has an **equal** sign Expression: does NOT have an equal sign

Ex 1: I have a bag with an unknown number of marbles in it.
The marbles in my bag, plus 5 more marbles, is the same as 12 marbles. How many marbles do I have?

Define your variables: Let n represent the # of marbles in a bag

Using pictures:



Using opposite operations:

$n + 5 = 12$

$n + 5 - 5 = 12 - 5$

$n = 7$

Final statement: ∴ The bag has 7 marbles

When solving equations, the goal is to ***isolate the variable***
(which means get your variable by itself on one side of the equal sign)

Ex 2: Solve **x + 13 = 75**

$x + 13 - 13 = 75 - 13$

$x = 62$

Ex 3: Solve **y – 28 = 9**

$y - 28 + 28 = 9 + 28$

$y = 37$

Practice: Solve the following.

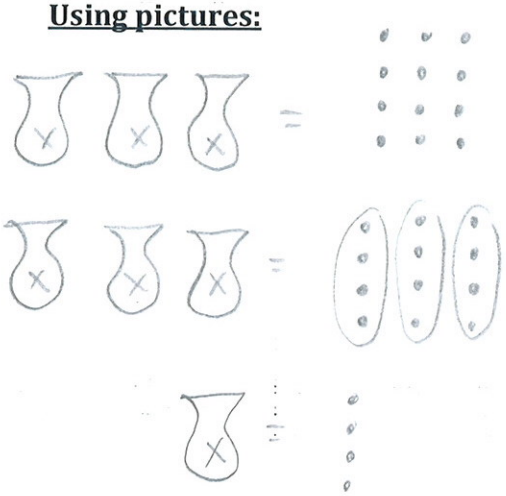
x + 9 = 28 43 + g = 324 d – 20 = 42 f + 34 = 9

× ÷ Solving One-step Equations (Multiplication and Division)

Ex 4: I have a bag with an unknown number of marbles in it.
3 of my bags is the same as 12 marbles. How many marbles are in my bag?

Define your variables: Let x represent the # of marbles in the bag

Using pictures:



Using opposite operations:

$3x = 12$

$\frac{3x}{3} = \frac{12}{3}$

$x = 4$

Final statement: ∴ The bag has 4 marbles

Ex 5: Solve **13x =156**

$\frac{13x}{13} = \frac{156}{13}$

$x = 12$

Ex 6: Solve $\frac{x}{5} = 17$

$5\left(\frac{x}{5}\right) = (17)5$

$x = 35$

Practice: Solve the following by using ***opposite operations***:

$9x = 131$ $\quad -6g = 89$ $\quad -d = 46$ $\quad \frac{x}{-4} = -57$

Solving Two-step Equations

Do the opposite operations for **addition** and **subtraction BEFORE multiplication** and **division**.

Ex 7: Solve $3x + 4 = 10$

$3x + 4 - 4 = 10 - 4$

$\frac{3x}{3} = \frac{6}{3}$

$x = 2$

Check: $3(2) + 4 = 10$

$6 + 4$

10

$LS = RS$ ✓

Ex 8: Solve $\frac{y}{5} - 8 = 31$

$\frac{y}{5} - 8 + 8 = 31 + 8$

$5\left(\frac{y}{5}\right) = (39)5$

$y = 195$

Check: $\frac{195}{5} - 8 = 31$

$39 - 8$

31

$LS = RS$ ✓

****To CHECK your answer, substitute your solution back into the equation, and evaluate EACH side of the equal sign. If the left side equals the right side (LS = RS), then your solution is correct****

Ex 9: Solve $6j - 7 = 10$

$6j - 7 + 7 = 10 + 7$

$\frac{6j}{6} = \frac{17}{6}$

$j = \frac{17}{6}$ or 2.83

Check: $6\left(\frac{17}{6}\right) - 7 = 10$

$17 - 7$

10

$LS = RS$ ✓

Ex 10: Solve $\frac{k}{4} + 7 = 15$

$\frac{k}{4} + 7 - 7 = 15 - 7$

$4\left(\frac{k}{4}\right) = (8)4$

$k = 32$

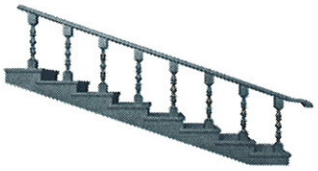
Check:

$\frac{32}{4} + 7 = 15$

$8 + 7$

15

$LS = RS$ ✓



Solving Multi-step Equations

ALWAYS simplify first (and use the distributive property if needed)

Ex 11: Solve $3 + 4m + 5m = 21$

$3 + 9m = 21$

$3 - 3 + 9m = 21 - 3$

$\frac{9m}{9} = \frac{18}{9}$

$m = 2$

Check:

$3 + 4(2) + 5(2) = 21$

$3 + 8 + 10 \mid 21$

$LS = RS$ ✓

Ex 12: Solve $6p - 5 = 8p - 9$

$6p - 6p - 5 = 8p - 6p - 9$

$-5 = 2p - 9$

$-5 + 9 = 2p - 9 + 9$

$\frac{4}{2} = \frac{2p}{2}$

$2 = p$

Check:

$6(2) - 5 = 8(2) - 9$

$12 - 5 \mid 16 - 9$

$7 \mid 7$

$LS = RS$ ✓

Ex 13: Solve $4(2k - 3) = 4$

$8k - 12 = 4$

$8k - 12 + 12 = 4 + 12$

$\frac{8k}{8} = \frac{16}{8}$

$k = 2$

Check:

$4[2(2) - 3] = 4$

$4(4 - 3) \mid$

$4(1) \mid$

$4 \mid$

$LS = RS$ ✓

Ex 14: Solve $3(k - 2) = 2(k + 8)$

$3k - 6 = 2k + 16$

$3k - 2k - 6 = 2k - 2k + 16$

$k - 6 = 16$

$k - 6 + 6 = 16 + 6$

$k = 22$

Check:

$3(22 - 2) = 2(22 + 8)$

$3(20) \mid 2(30)$

$60 \mid 60$

$LS = RS$ ✓

WRITING EXPRESSIONS AND EQUATIONS

There are certain phrases that can help you figure out what you need to do in the word problem (listed in the chart below). **HOWEVER**, you still need to read the question carefully (don't just hunt for keywords) because certain words can mean different things in different situations.

Add	Subtract	Multiply	Divide	Equal to
plus/ sum increased by more than combined, together total of added to gain/raise and in all/altogether additional/extra	decreased by minus, less difference between/of less than, fewer than loss take away reduce fell/dropped	of times, multiplied by product double/triple/etc twice/three times/etc percent of by by a factor of	per, a out of ratio of, quotient of divided by divided/shared equally/equal pieces cut/split each/every average	is, are, was, were, will be gives, yields sold for

Addition phrases	
• the sum of a number and four • four more than a number • a number increased by four	$n+4$
Subtraction phrases	
• the difference between y and five • five less than a number • a number decreased by five • five subtracted from a number	$y-5$
Multiplication phrases	
• the product of seven and x • seven multiplied by x	$7x$
• five percent of x • 5% of x	$0.05x$
Consecutive Integer phrases	
• sum of three consecutive integers	$n+n+1+n+2$
• sum of three consecutive even integers • sum of three consecutive odd integers	$n+n+2+n+4$
• sum of squares of three consecutive even integers • sum of squares of three consecutive odd integers	$n^2+(n+2)^2+(n+4)^2$
• product of two consecutive even integers • product of two consecutive odd integers	$n(n+2)$
Fractional phrases	
• three-fourths of a number	$\frac{3}{4}n$
• one-third the sum of a number and two	$\frac{1}{3}(n+2)$
• half the result of decreasing a number by three	$\frac{1}{2}(n-3)$
• a fraction whose denominator is two more than its numerator	$\frac{n}{n+2}$

Solving Word Problems

5 Steps to solving Word Problems:

1. Read the problem until you know what it is that the problem expects you to find
2. Identify what you're trying to find, and assign it a variable. DEFINE your variable with a "let" statement.
3. Write an equation following the instructions of the word problem. Use your list of math phrases to help you.
4. Solve the equation. This gives you the answer to the problem
5. Write a final "therefore" statement explaining what you've found.

Examples:

Ex 1

The number I'm thinking of plus two is three less than twenty five. What is my number?

Let n represent the number

Equation:

$$n+2 = 25-3$$
$$n+2 = 22$$
$$n+2-2 = 22-2$$
$$n = 20$$

Therefore, my number is 20

Ex 2

When I multiply Sophia's age by 5, I get the same as when I times her age by 2 and add 42. How old is Sophia?

Let s represent Sophia's age

Equation:

$$5s = 2s + 42$$
$$5s - 2s = 2s - 2s + 42$$
$$\frac{3s}{3} = \frac{42}{3}$$
$$s = 14$$

Therefore, Sophia's age is 14

Ex 3

The length of a football field is 30 yards more than its width. If the perimeter is 260m, what is the length and width?

Let w be the width

Equation: $P = 260$

$$260 = w + w + w + 30 + w + 30$$
$$260 = 4w + 60$$
$$260 - 60 = 4w + 60 - 60$$
$$\frac{200}{4} = \frac{4w}{4}$$
$$50 = w$$

length
$w + 30$
$50 + 30$
80

Therefore, the width is 30 yds and the length is 80 yds

Ex 4

In a triangle, the measure of the middle angle is triple the measure of the smallest angle, and the measure of the largest angle is 55°greater than the measure of the smallest angle. Find the measures of the angles.

Let x be the measure of the smallest angle.

$$180 = x + 3x + x + 55$$
$$180 = 5x + 55$$
$$\frac{155}{5} = \frac{5x}{5}$$
$$25 = x$$

middle
$3(25) = 75$

large
$25 + 55 = 80$

∴ The angles are 25°, 75°, and 80°.