Rutgers
New Jersey Agricultural Experiment Station

Eastern Regional Radon Training Center
Office of Continuing Professional Education
New Jersey Agricultural Experiment Station
Rutgers, The State University of New Jersey
102 Ryders Lane
New Brunswick, NJ 08901-8519

www.errtc.rutgers.edu
ocpe@njaes.rutgers.edu

Tel: 848-932-9271
Fax: 732-932-1187

Basic Math Review
For Radon Professionals

Math for radon exams is nothing more than addition, subtraction, multiplication and division. In many cases, you will be given two of three numbers and asked to calculate the unknown variable. For many of us, we had pimples and braces the last time someone asked us to calculate a value for X, so here's some middle school math to take us back to those days.

Equations

An equation is a combination of numbers and mathematical symbols separated into left and right sides. The two sides are separated by an equal sign, which, not surprisingly, means that both sides are equal!

LEFT	=	RIGHT
2 + 3	=	5

Equations with Unknown Values

Normally we use "X" to symbolize the unknown value. Here are some examples of equations using "X" as the unknown value.

1.) Two plus (addition) some number (unknown) equals five.	X + 2 = 5	
2.) Five minus (subtraction) some number equals ten.	X – 5 = 10	
3.) Five times some number equals 25.	5 * X = 25 or 5X = 25	* means multiply by
4.) Ten divided by some number equals five.	10/X = 5	/ means divided by
5.) Two plus five times some number equals twelve.	5X + 2 = 12	5X means X is multiplied by 5

RUTGERS
New Jersey Agricultural
Experiment Station

Solving for X

To find the value of the unknown variable X, we must now isolate it on one side of the equation. When isolating X, we must always live by this rule: **Whatever we do to one side of the equation must be done to the other side as well.**

Let's practice applying this rule as we solve some equations.

EXAMPLE 1

Let's solve this equation: $X + 2 = 5$

To isolate X, we must subtract 2 from the left side; and therefore, we must subtract 2 from the right side as well:

$$X + 2 - 2 = 5 - 2$$
$$\Downarrow$$
$$X = 3$$

EXAMPLE 2

Now let's solve this equation: $X - 5 = 10$

To isolate X, we must add 5 to the left side, and therefore, we must add 5 to the right side as well:

$$X - 5 + 5 = 10 + 5$$
$$\Downarrow$$
$$X = 15$$

EXAMPLE 3

Now let's solve this equation: $5X = 25$

In this case, to isolate X on the left side, we must divide by 5; and therefore, we must divide by 5 on the right side as well:

$$5X / 5 = 25 / 5$$
$$\Downarrow$$
$$X = 5$$

CHECK YOUR WORK!

We can (and should!) verify the solution to any of these equations by going back to the original equation and replacing the unknown value with our answer. The result should be true!

For Example 3, we would replace X with the number 5 (our answer). It would look like this:

Original Equation: $5X = 25$ ⇒ Verify: $5 * 5 = 25$ ⇒ Is it True? Yes!

Solving for X in More Complicated Equations

To solve more complicated equations, you will need to take steps that will simplify the equation. And remember to always follow the rule for each step you take: **Whatever we do to one side of the equation must be done to the other side as well.**

EXAMPLE 1

Here's a slightly more complicated equation: $5X + 5 = 15$

First we need to simplify the equation by subtracting 5 from both sides:

$$5X + 5 - 5 = 15 - 5$$
$$\downarrow$$
$$5X = 10$$

Now we can proceed with our simpler equation by dividing both sides by 5:

$$5X\ (/5) = 10\ (/5)$$
$$\downarrow$$
$$X = 2$$

Check Your Work:

$5X + 5 = 15$ → $5\,(2) + 5 = 15$ → $10 + 5 = 15$ → TRUE!

EXAMPLE 2

Let's try another one:

$$12 = \frac{X + 2}{4}$$

First, we will simplify the equation by multiplying both sides by 4:

$$12\ (*4) = \frac{X + 2}{4}\ (*4)$$
$$\downarrow$$
$$48 = X + 2$$

→ Note: Right side of equation could also be written like this:

$$\frac{X + 2}{4}\left(\frac{4}{1}\right)$$

Multiplying by 4/1 is the same as multiplying by 4, but some find it easier to use this format when dealing with fractions.

Next, we will subtract 2 from both sides:

$$48 - 2 = X + 2 - 2$$
$$\downarrow$$
$$46 = X$$
$$\downarrow$$
$$X = 46$$

Check Your Work:

$12 = \frac{X + 2}{4}$ → $12 = \frac{46 + 2}{4}$ → $12 = \frac{48}{4}$ → TRUE!

RUTGERS
New Jersey Agricultural Experiment Station

Radon Exam Prep

For the exam, it will help to memorize this formula:

$$\boxed{WL = \frac{ER * (pCi/L)}{100}}$$

WL = Working Level
ER = Equilibrium Ratio
pCi/L = picocuries per liter

That formula means that the Working Level (WL) is equal to the Equilibrium Ratio (ER) times the X radon concentration (measured in picocuries per liter) divided by 100.

By working both sides of the equation, we can express the same relationship by isolating the Equilibrium Ratio:

$$\boxed{ER = \frac{WL * 100}{pCi/L}}$$

The radon exam may include questions where any two of those three variables are provided. If the equilibrium ratio is not given, for the purposes of the exam, you can assume it to be 0.5.

EXAMPLE

Here is an example of the kind of question **you might commonly see on the exam**:

> What is WL (working level) when the equilibrium ratio is 0.5 and the radon concentration is 50 pCi/L?

First, set up your equation: *Next, solve for 0.5 x 50:* *Last, divide both sides by 100 to get your answer:*

$$WL = \frac{0.5 * 50}{100} \Rightarrow WL = \frac{25}{100} \Rightarrow WL = 0.25$$

Check Your Work:

$$WL = \frac{0.5 * 50}{100} \Rightarrow 0.25 = \frac{0.5 * 50}{100} \Rightarrow 0.25 = \frac{25}{100} \Rightarrow \text{TRUE!}$$