Introduction to the mole – numeracy worksheet answers

Education in Chemistry
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Chemical equations are like recipes, and moles tell us about the ratio of the ingredients

The mole is a unit of measurement in chemistry used to ensure that the appropriate ratio of reacting particles can be used for any particular reaction. Moles can also be used to work out how much product will be generated by any reaction.

This is very similar to cooking, where recipes are used to mix ingredients in the right ratios to make the correct quantities of food. The 'cup' is used in American cooking as a standard measurement. You can think of the elements from the periodic table as the ingredients in a recipe and the cup as equivalent to the chemistry unit of the mole. In this analogy, the mass of each cup represents the atomic mass of an element.

Try it yourself

This table shows approximate weights for a cup of different ingredients. Use the table to answer the questions below, and don't forget to show your working.

Ingredient number ***(atomic number)***	**Ingredient** ***(element)***	**Ingredient symbol** ***(element symbol)***	**Mass of 1 cup (g)** ***(gram formula mass)***
1	cocoa	C	75
2	oats	O	85
3	flour	F	128
4	brown sugar	Sb	150
5	granulated sugar	Sg	200
6	butter	B	227
7	honey	H	300

1. A cake shop owner likes to use American recipes for cooking. These recipes use 'cups' as a measure of ingredients. For example, 1 cup of flour weighs 128 g, which means they can convert American recipes into British weights.

   How many cups of the following ingredients do they have?

   a) 256 g flour — 2 cups of flour

   b) 450 g granulated sugar — 2.25 cups of granulated sugar

   c) 75 g of brown sugar — 0.5 cups of brown sugar

2. An amateur baker is practising for the BBC Bake Off competition. They are making a cake. The recipe is written out below:

3 cups of flour + 2 eggs + 1 cup of sugar → 1 cake

a) The baker is very flustered as they need to make eight cakes, enough for all their friends. How many cups of flour should they use if they want to make 8 cakes?

To make 8 cakes they will need 24 cups of flour.

b) If they have 6 eggs, how many cakes can they make?

6 eggs means they can make 3 cakes.

c) If they have 6 cups of flour, 2 eggs and 2 cups of sugar, how many cakes could they make?

Despite having 6 cups of flour and 2 cups of sugar, they only have 2 eggs so can only make 1 cake. This would be a limiting reagent. The other reagents (ingredients) are in excess. In a chemical reaction they would of course be left unreacted in the reaction vessel, however, if added to a cake mixture you would just have a dry cake!

3. A TikTok influencer is making flapjacks – their favourite high-energy food for when they are making their extreme sports videos. The recipe (taken from Nigella Lawson's website) is written out below:

3 cups of oats + 1 cup honey + 1 cup of brown sugar → 1 tray of flapjacks

a) What mass of oats do they need to make one tray of flapjacks? (1 tray = 6 flapjacks)

1 tray of flapjacks requires 3 cups of oats, which is 3 x 85 g, which is 255 g.

b) They get their ingredients ready, only to find that while they have 3 cups of oats, they only have ½ cup of honey. How many cups of flapjacks can they make?

If they only have ½ cup of honey, they can only make ½ a tray, or 3 flapjacks.

c) If they have 50 g of honey and plenty of oats and sugar, how many flapjacks can they make?

50 g of honey is conveniently $^1/_6$ of a cup so only makes $^1/_6$ of a tray, or 1 flapjack. The honey is a limiting reagent.

4. A Nigella Lawson fan loves to write down their favourite Nigella recipes, but they don't like writing the recipes out in full because they are quite long.

a) Can you help them write out the recipe for making flapjacks using the symbols for each ingredient? You'll have to create a 'formula' for the flapjacks yourself.

Using the symbols in the table pupils can make up formulae for this 'equation' using cups ('moles'). Make sure to remind them that a formula is a ratio of the constituent elements.

3 cups of oats + 1 cup honey + 1 cup of brown sugar → 1 tray of flapjacks
3O + H + Sb → O_3HSb

b) If they use 150g of honey, how many cups of flapjacks are they intending to make?

Assuming enough of the other ingredients, 150g of honey would be 2 cups, which equates to 2 trays.

c) How much does one cup of flapjack weigh?

The formula mass must be conserved, so 1 tray weighs 705 g and makes 6 flapjacks, so 1 flapjack would be 117.5 g.