Chemistry 11

Mole II

Name:
Date:
Block:

1. Unit Conversions

Unit Conversions

- You **must** follow the same method shown below.
- We can convert from one unit to another by using relationships that are equivalent to each other then arranged as a ratio. The ratio is called the **conversion factor.**
- For example, with time we know the following relationships:

Relationship	Conversion Factor
1 min = 60 s	$\frac{1\,\text{min}}{60s}$ and $\frac{60s}{1\,\text{min}}$
1 hour = 60 min	$\frac{1hour}{60\,\text{min}}$ and $\frac{60\,\text{min}}{1hour}$
24 hours = 1 day	$\frac{1day}{24hours}$ and $\frac{24hours}{1day}$

* don't count toward sig figs!

Note that the values in the ratios are equal to each other (i.e. 1min = 60 s). Therefore, the ratio really has a value equal to 1. Multiplying any factor by the conversion factor is equivalent to multiplying by 1 and will not change the value of the expression.

The general formula for solving problems using the conversion factor method:

Unknown Amount = (initial amount given in the problem) x (conversion factor)

Examples:

1. How many seconds are there in 49.56 minutes?

$$49.56\ \text{minutes} \times \frac{60\ \text{seconds}}{1\ \text{minute}} = 2973.6\ \text{seconds} = 2974\ \text{seconds (4 sig figs)}$$

2. How many hours are there in 448.2 minutes?

$$448.2\ \text{min} \times \frac{1\ \text{hr}}{60\ \text{min}} = 7.470\ \text{hr}$$

3. How many minutes are there in 44 days? (2 steps)

$$44\ \text{days} \times \frac{24\ \text{hr}}{1\ \text{day}} \times \frac{60\ \text{min}}{1\ \text{hr}} = 63\,000\ \text{min}$$

4. How many seconds are there in 3 days? (3 steps)

$$3\,\text{days} \times \frac{24\,\text{hrs}}{1\,\text{day}} \times \frac{60\,\text{min}}{1\,\text{hr}} \times \frac{60\,\text{sec}}{1\,\text{min}} = 259,200\,\text{s} = 3 \times 10^5\,\text{s}$$

5. How old are you in seconds?

$$16\,\text{years} \times \frac{365.25\,\text{day}}{1\,\text{year}} \times \frac{24\,\text{hr}}{1\,\text{day}} \times \frac{60\,\text{min}}{1\,\text{hr}} \times \frac{60\,\text{sec}}{1\,\text{min}} = 5.0 \times 10^8\,\text{sec}$$

Note:

- *All the units cancel each other except the desired unit (s).*
- *The expression " 3 days" is multiplied by three conversion factors that are all equivalent to "1". The final answer changed because the "expression" has a different unit, but the actual* ***value*** *is still the same.*

6. If the density of sea water is 1.2 g/mL, calculate the volume of 45g of sea water.

$$45\text{g} \times \frac{1\text{mL}}{1.2\text{g}} = 37.5\text{ mL} = 38\text{ mL (2 sig figs)}$$

7. If a car is moving at 50.0 km/h, calculate how far (in metres) the car moves in 5.00 seconds.

$$5.00\,\text{sec} \times \frac{50.0\,\text{km}}{\text{hr}} \times \frac{1\,\text{hr}}{60\,\text{min}} \times \frac{1\,\text{min}}{60\,\text{sec}} \times \frac{1000\,\text{m}}{1\,\text{km}} = 69.4\,\text{m}$$

ALWAYS INCLUDE THE UNITS FOR ALL THE CALCULATIONS WE DO IN CHEMISTRY. DO NOT BE TEMPTED TO EXCLUDE THEM!

More Examples:

8. How many minutes are there in 1.67 week?

$$1.67\,\text{week} \times \frac{7\,\text{days}}{1\,\text{week}} \times \frac{24\,\text{hr}}{1\,\text{day}} \times \frac{60\,\text{min}}{1\,\text{hr}} = 1.68 \times 10^4\,\text{min}$$

9. How many centimeters are in 21.598 km?

$$21.598\,\text{km} \times \frac{1000\,\text{m}}{1\,\text{km}} \times \frac{100\,\text{cm}}{1\,\text{m}} = 2.1598 \times 10^6\,\text{cm}$$

10. If you have 45 dozen eggs, how many eggs do you have?

$$45\,\text{doz.} \times \frac{12\,\text{eggs}}{1\,\text{doz.}} = 540\,\text{egg}$$

11. If a car can move 50.0 km/h, how far can the car go in 3.2675 hours?

$$3.2675\,\text{hr} \times \frac{50.0\,\text{km}}{\text{hr}} = 163\,\text{km}$$

12. One molecule of phosphorus has 4 atoms. How many molecules are there in 448 atoms of phosphorus?

$$448 \text{ atoms} \times \frac{1 \text{ molecule}}{4 \text{ atoms}} = 112 \text{ molecules.}$$

13. If one mole of carbon has a mass of 12.0 g, what is the mass of 4.7 moles of carbon?

$$4.7 \text{ mole} \times \frac{12.0 \text{ g}}{1 \text{ mole}} = 56 \text{ g}$$

14. The density of aluminum is 2.7 g/mL. What is the volume of 7.4 g of aluminum?

$$7.4 \text{ g} \times \frac{1 \text{ mL}}{2.7 \text{ g}} = 2.7 \text{ mL}$$

15. If a car averages 60.0 km/h, how long will it take to cover 57 km?

$$57 \text{ km} \times \frac{1 \text{ hr}}{60.0 \text{ km}} = 0.95 \text{ hr}$$

> **"Only those who have the patience to do simple things perfectly will acquire the skill to do difficult things easily."**
>
> ~ Johann von Schiller (German philosopher)

B. Multiple Unit Conversions

16. How many minutes are there in 3 days?

$$3 \text{ days} \times \frac{24 \text{ hours}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 4320 \text{ min} = 4 \times 10^3 \text{ min}$$

17. The energy needed to melt 1 kg of ice requires 334 kJ. The largest known iceberg has a volume of about 3.1×10^{13} m^3. How much heat was required to melt the iceberg if 1.0 m^3 of ice has a mass of 917 kg?

$$3.1 \times 10^{13} \text{ m}^3 \times \frac{917 \text{ kg}}{1.0 \text{ m}^3} \times \frac{334 \text{ kJ}}{1 \text{ kg}} = 9.5 \times 10^{18} \text{ kJ}$$

18. How far does a car go in 10.00 seconds if it is moving at 50.00 km/h?

$$10.00 \text{ sec} \times \frac{50.00 \text{ km}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 0.1389 \text{ km}$$

19. If 1 yard = 3 feet, 1 foot = 12 inches, and 1 inch = 2.54 cm, how many meters are in 50.00 yards?

$$50.00\,\text{yards} \times \frac{3\,\text{ft}}{1\,\text{yard}} \times \frac{12\,\text{inches}}{1\,\text{ft}} \times \frac{2.54\,\text{cm}}{1\,\text{inch}} \times \frac{1\,\text{m}}{100\,\text{cm}} = 45.72\,\text{m}$$

20. A sprinter can run 100. metres in 10.0 seconds. How fast is the sprinter moving in km/h?

$$\frac{100.\,\text{m}}{10.0\,\text{s}} \times \frac{1\,\text{km}}{1000\,\text{m}} \times \frac{60\,\text{sec}}{1\,\text{min}} \times \frac{60\,\text{min}}{1\,\text{hr}} = 36.0\,\text{km/hr}$$

21. A chicken farmer wished to purchase a gift for his wife. The gift was worth 2 horses. At the local market, 3 horses were worth 5 cows, 1 cow was worth 4 hogs, 3 hogs were worth 4 goats, and 1 goat cost 9 chickens. How much was the gift going to cost the farmer who had to pay in chickens?

$$2\,\text{horses} \times \frac{5\,\text{cows}}{3\,\text{horses}} \times \frac{4\,\text{hogs}}{1\,\text{cow}} \times \frac{4\,\text{goats}}{3\,\text{hogs}} \times \frac{9\,\text{chickens}}{1\,\text{goat}}.$$

$$= 160\,\text{chickens}$$

22. **Try this this challenging conversion!**

Suppose 1 dip = 6 dops, 1 dop = 8 daps, 1 tick = 13 tocks, and 1 tock = 10 tacks.

Convert 21.1 dips/tack^2 into dops/tock^2.

a) $$\frac{21.1\,\text{dips}}{\text{tack}^2} \times \frac{6\,\text{dops}}{1\,\text{dip}} \times \frac{10\,\text{tack}}{1\,\text{tock}} \times \frac{10\,\text{tack}}{1\,\text{tock}} = 1.27\times10^4\,\frac{\text{dops}}{\text{tocks}^2}$$

b) $$\frac{21.1\,\text{dips}}{\text{tack}^2} \times \frac{6\,\text{dops}}{1\,\text{dip}} \times \frac{(10\,\text{tack})^2}{(1\,\text{tock})^2} = 1.27\times10^4\,\frac{\text{dops}}{\text{tock}^2}.$$

1) 2974 sec 2) 7.470 hr 3) 63,000 min 4) 259,200 sec 5) 9.2×10^8 sec 6) 38 mL 7) 69.4 m
8) 1.68×10^4 min 9) 2.1598×10^6 cm 10) 540 eggs 11) 163 km 12) 112 molecules 13) 56 g
14) 2.7 mL 15) 0.95 hr 16) 4×10^3 min 17) 9.5×10^{18} J 18) 0.1389 km 19) 45.72 m 20) 36.0 km/h
21) 160 chickens 22) 1.27×10^4 dops/tocks^2