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 $\frac{24hours}{1day}$

* put what you want at the top

* doesn't count towards 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?

want ← seconds

given ← 49.56 minutes

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

4 sf

2. How many hours are there in 448.2 minutes?

$$448.2\ \text{minutes} \times \frac{1\ \text{hours}}{60\ \text{minutes}} = 7.470\ \text{hours}$$

4 sf 4 sf

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

$$44\ \text{days} \times \frac{24\ \text{hours}}{1\ \text{day}} \times \frac{60\ \text{min}}{1\ \text{hours}} = 63360 = 63000\ \text{min} = 6.3 \times 10^4\ \text{min}$$

2 sf

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

$$\frac{3\ \text{days}}{1\text{sf}} \times \frac{24\ \text{hours}}{1\ \text{day}} \times \frac{60\ \text{mins}}{1\ \text{hour}} \times \frac{60\ \text{sec}}{1\ \text{min}} = 259200 = \boxed{300\,000\ \text{sec} \quad 3 \times 10^5\ \text{sec}}$$

5. How old are you in seconds?

$$\frac{16\ \text{years}}{2\text{sf}} \times \frac{365\ \text{days}}{1\ \text{year}} \times \frac{24\ \text{hours}}{1\ \text{day}} \times \frac{60\ \text{min}}{1\ \text{hour}} \times \frac{60\ \text{sec}}{1\ \text{min}} = \boxed{5.0 \times 10^8\ \text{sec}}$$

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.

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

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

$$5.00\text{s} \times \left(\frac{1\ \text{min}}{60\ \text{sec}}\right) \times \left(\frac{1\ \text{hr}}{60\ \text{min}}\right) \times \left(\frac{50.0\ \text{km}}{1\ \text{hr}}\right) \times \frac{1000\ \text{m}}{1\ \text{km}} = \boxed{69.4\ \text{m}}$$

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?

$$1.67\ \text{week} \times \frac{7\ \text{days}}{1\ \text{week}} \times \frac{24\ \text{hrs}}{1\ \text{day}} \times \frac{60\ \text{mins}}{1\ \text{hr}} = \boxed{1.68 \cdot 10^4\ \text{min}} = \boxed{16800\ \text{min}}$$

9. How many centimeters are in 21.598 km?

$$21.598\ \text{km} \times \frac{1000\ \text{m}}{1\ \text{km}} \times \frac{100\ \text{cm}}{1\ \text{m}} = \boxed{2.1598 \cdot 10^6\ \text{cm}} = \boxed{2159800\ \text{cm}}$$

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

$$45\ \text{dozen} \times \frac{12\ \text{egg}}{1\ \text{dozen}} = \boxed{540\ \text{eggs}}$$

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

$$3.2675\ \text{hrs} \times \frac{50.0\ \text{km}}{1\ \text{hr}} = \boxed{163.38\ \text{km}}$$

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

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

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?

$3 \text{ days} \times \frac{24 \text{ hours}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hour}} = 4320 \text{ min} = 4000 \text{ min} \text{ or } 4 \cdot 10^3 \text{ min}$

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?

$1 \text{ kg} = 334 \text{ kJ}$

$1.0 \text{ m}^3 = 917 \text{ kg}$

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

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

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

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

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

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

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

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?

$$2\,\text{horses} \times \frac{5\,\text{cows}}{3\,\text{horses}} \times \frac{4\,\text{hogs}}{1\,\text{cow}} \times \frac{4\,\text{goats}}{3\,\text{hogs}} \times \frac{9\,\text{chickens}}{1\,\text{goat}} = 160\,\text{chickens}$$

Counting numbers → no sig figs!

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.

because of the ^{2}

$$\frac{21.1\,\text{dips}}{\text{tack}^2} \times \frac{6\,\text{dops}}{1\,\text{dip}} \times \frac{10\,\text{tacks}}{1\,\text{tock}} \times \frac{10\,\text{tacks}}{1\,\text{tock}} = 1.27 \cdot 10^4\,\text{dops/tock}^2$$

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

11) 163.38 km