Chemistry:
Transition from GCSE to AS level

Part 6 - Solutions

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(iii) moles and solutions

For solutions, there are two variables:

- **volume**
- **concentration**

  i.e. the moles of solute in one dm^3 of solution

moles = volume in dm^3 x concentration

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concentration in mol dm^{-3} = $\frac{\text{moles}}{\text{volume in } dm^3}$

LEARN THIS

(i) Find the no of moles of sodium hydroxide in $200cm^3$ of 0.40 mol dm^{-3} solution

moles = vol in dm^3 x concentration

$$= \frac{200}{1000} \times 0.40 = \textbf{0.080 moles}$$

(ii) Find the concentration of a solution of 7.30 g hydrogen chloride in 250 cm^3 solution

$$\text{no moles of HCl} = \frac{7.30}{36.5} = 0.20$$

0.20 mol in 250 cm^3 i.e. in 0.25 dm^3

$$\text{Concentration} = \frac{\text{moles}}{\text{volume in } dm^3} = \frac{0.20}{0.25}$$

$$= \mathbf{0.80\ mol\ dm^{-3}}$$

Summary

(i) For all pure substances

$$\text{moles} = \frac{\text{mass given}}{\text{mass of one mole}}$$

(ii) For gases

$$n = \frac{pV}{RT}$$

(iii) For solutions

moles = volume in dm^3 x concentration

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*
							1.0 **H** hydrogen 1										4.0 **He** helium 2
6.9 **Li** lithium 3	9.0 **Be** beryllium 4											10.8 **B** boron 5	12.0 **C** carbon 6	14.0 **N** nitrogen 7	16.0 **O** oxygen 8	19.0 **F** fluorine 9	20.2 **Ne** neon 10
23.0 **Na** sodium 11	24.3 **Mg** magnesium 12											27.0 **Al** aluminium 13	28.1 **Si** silicon 14	31.0 **P** phosphorus 15	32.1 **S** sulfur 16	35.5 **Cl** chlorine 17	39.9 **Ar** argon 18
39.1 **K** potassium 19	40.1 **Ca** calcium 20	45.0 **Sc** scandium 21	47.9 **Ti** titanium 22	50.9 **V** vanadium 23	52.0 **Cr** chromium 24	54.9 **Mn** manganese 25	55.8 **Fe** iron 26	58.9 **Co** cobalt 27	58.7 **Ni** nickel 28	63.5 **Cu** copper 29	65.4 **Zn** zinc 30	69.7 **Ga** gallium 31	72.6 **Ge** germanium 32	74.9 **As** arsenic 33	79.0 **Se** selenium 34	79.9 **Br** bromine 35	83.8 **Kr** krypton 36
85.5 **Rb** rubidium 37	87.6 **Sr** strontium 38	88.9 **Y** yttrium 39	91.2 **Zr** zirconium 40	92.9 **Nb** niobium 41	96.0 **Mo** molybdenum 42	[97] **Tc** technetium 43	101.1 **Ru** ruthenium 44	102.9 **Rh** rhodium 45	106.4 **Pd** palladium 46	107.9 **Ag** silver 47	112.4 **Cd** cadmium 48	114.8 **In** indium 49	118.7 **Sn** tin 50	121.8 **Sb** antimony 51	127.6 **Te** tellurium 52	126.9 **I** iodine 53	131.3 **Xe** xenon 54
132.9 **Cs** caesium 55	137.3 **Ba** barium 56	138.9 **La** * lanthanum 57	178.5 **Hf** hafnium 72	180.9 **Ta** tantalum 73	183.8 **W** tungsten 74	186.2 **Re** rhenium 75	190.2 **Os** osmium 76	192.2 **Ir** iridium 77	195.1 **Pt** platinum 78	197.0 **Au** gold 79	200.6 **Hg** mercury 80	204.4 **Tl** thallium 81	207.2 **Pb** lead 82	209.0 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac** † actinium 89	[267] **Rf** rutherfordium 104	[270] **Db** dubnium 105	[269] **Sg** seaborgium 106	[270] **Bh** bohrium 107	[270] **Hs** hassium 108	[278] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[281] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[294] **Ts** tennessine 117	[294] **Og** oganesson 118

Key

relative atomic mass
symbol
name
atomic (proton) number

140.1 **Ce** cerium 58	140.9 **Pr** praseodymium 59	144.2 **Nd** neodymium 60	[145] **Pm** promethium 61	150.4 **Sm** samarium 62	152.0 **Eu** europium 63	157.3 **Gd** gadolinium 64	158.9 **Tb** terbium 65	162.5 **Dy** dysprosium 66	164.9 **Ho** holmium 67	167.3 **Er** erbium 68	168.9 **Tm** thulium 69	173.0 **Yb** ytterbium 70	175.0 **Lu** lutetium 71
232.0 **Th** thorium 90	231.0 **Pa** protactinium 91	238.0 **U** uranium 92	[237] **Np** neptunium 93	[244] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96	[247] **Bk** berkelium 97	[251] **Cf** californium 98	[252] **Es** einsteinium 99	[257] **Fm** fermium 100	[258] **Md** mendelevium 101	[259] **No** nobelium 102	[262] **Lr** lawrencium 103

* **58 – 71** Lanthanides

† **90 – 103** Actinides

Use this for the task on the next page

CONCENTRATION CALCULATIONS - SOLUTIONS

1. How many moles are there in each of the following solutions?
   (a) 1000 cm^3 of 0.5 mol dm^{-3} copper (II) sulphate solution.
   (b) 500 cm^3 of 0.1 mol dm^{-3} sulphuric acid.
   (c) 2 dm^3 of 1.0 mol dm^{-3} ammonia solution.
   (d) 100 cm^3 of 0.001 mol dm^{-3} nitric acid.
   (e) 5 cm^3 of 2.0 mol dm^{-3} copper (II) chloride solution.

2. What is the concentration of each of the following solutions?
   (a) 500 cm^3 sodium chloride solution containing 0.4 moles.
   (b) 250 cm^3 ammonium chloride solution containing 0.1 moles.
   (c) 2 dm^3 citric acid solution containing 4 moles.
   (d) 10 cm^3 barium hydroxide solution containing 0.0001 moles.
   (e) 50 cm^3 potassium hydroxide solution containing 0.002 moles.

3. What is the concentration of the following solutions?
   (a) 2 g sodium hydroxide dissolved in 200 cm^3 water.
   (b) 6.37 g concentrated sulphuric acid dissolved in 100 cm^3 water.
   (c) 6.4 g sulphur dioxide gas dissolved in 250 cm^3 water.
   (d) 5.05 g potassium nitrate dissolved in 10 cm^3 water.
   (e) 480 cm^3 ammonia gas (measured at rtp) dissolved in 100 cm^3 water.

4. Work out the number of moles of solute contained in:
   (a) 200 cm^3 of 0.1 mol dm^{-3} ethanoic acid solution
   (b) 30 cm^3 of a solution containing 20 g of sodium hydroxide per litre.
   (c) 25 cm^3 of a solution containing 9.8 g of concentrated sulphuric acid per 500 cm^3 of solution.
   (d) 25 cm^3 of a solution of potassium hydroxide containing 1.4 g per 500 cm^3 of solution.
   (e) 500 cm^3 of a solution of ammonium sulphate containing 2.64 g per 25 cm^3 of solution.

Equations:

Solid No. moles = mass / A_r

Gas

No. moles = volume (in litres or dm^3) / 24 No. moles = volume (in cm^3) / 24,000

Solution

No. moles = concentration (mol dm^{-3}) x volume (cm^3) / 1000

Pause this presentation while you complete the exercise on the previous page.

When complete move to the next page where you can check your answers.

Answers: Concentrations - solutions

1 (a) 0.5 (b) 0.05 (c) 2 (d) 0.0001 (e) 0.01

2 (a) 0.8 mol dm^{-3} (b) 0.4 mol dm^{-3} (c) 2 mol dm^{-3}

(d) 0.01 mol dm^{-3} (e) 0.04 mol dm^{-3}

3 (a) 0.25 mol dm^{-3} (b) 0.65 mol dm^{-3} (c) 0.4 mol dm^{-3}

(d) 5 mol dm^{-3} (e) 0.2 mol dm^{-3}

4 (a) 0.02 (b) 0.015 (c) 0.005 (d) 0.00125 (e) 0.4

Having checked your work you will have either:

1. Completed the task correctly - well done :)

2. Made some mistakes - which you now understand (having seen the correct answer) - that's OK as you have 'learned from your mistakes'

3. Do not understand the answer - if this is the case you **must** seek assistance from your teacher (if you do not then you will ***never*** understand this and this may be a building block for later work!)

When you’re confident with this topic move onto part 7:

Equations