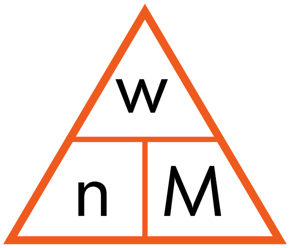
Tailored Tutors

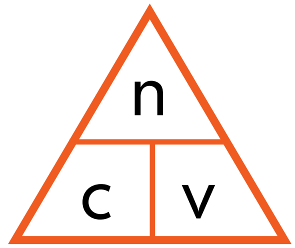
YEAR 1 CHEMISTRY EQUATIONS (OCR)

MOLE CALCULATIONS

number of moles = mass / molar mass (g) ($g.mol^{-1}$)

number of moles = concentration x volume ($mol.dm^{-3}$) (dm^3)

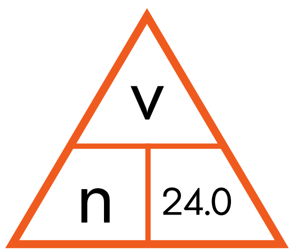




Avogadro's Constant = 6.02 x 10^{23} atoms or molecules = **1 mole**

MOLAR GAS CONSTANT

1 mole of ANY gas occupies 24.0 dm^3 at room temperature & pressure



IDEAL GAS EQUATION

P = Pressure (pa) **V** = volume (m^3) **n** = no. of moles

R = Gas Constant (8.314 $J.K^{-1}.mol^{-1}$) **T** = Temperature (K)

$$PV = nRT$$

$$P = \frac{nRT}{V} \qquad V = \frac{nRT}{P} \qquad n = \frac{PV}{RT} \qquad T = \frac{PV}{nR}$$

For changes in conditions:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

MASS SPECTROSCOPY

$$\text{Relative Atomic Mass (Ar)} = \frac{(\text{mass isotope 1} \times \text{abundance}) + (\text{mass isotope 2} \times \text{abundance}) + \ldots}{\sum \text{abundance}}$$

OTHER EQUATIONS

$$\%\ \text{by mass} = \frac{\text{mass of element in 1 mole}}{Mr}$$

$$\text{Empirical formula} = \frac{M1}{Mr1} : \frac{M2}{Mr2} : \frac{M3}{Mr2}$$

Where M1, M2 etc is the mass or % composition of element 1, 2 etc

then divide each by the smallest number to give empirical formula

$$\%\ \text{Atom Economy} = \frac{\text{mass of desired product}}{\text{total mass of all products}} \times 100$$

You can use mass or number of moles here!

$$\%\ \text{Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

You can replace masses with Mr values here too!

ENTHALPY

Q = energy transferred (J)
m = mass of **solution** (g)
c = specific heat capacity ($J.K^{-1}.mol^{-1}$)
$\triangle$T = **change** in temperature (°C **or** K)

$$\mathbf{Q = m.c.\triangle T}$$

$$\mathbf{\triangle H = \frac{Q}{n}}$$

($J.mol^{-1}$)

Don't forget to add a sign for $\triangle$H!

Divide by 1000 for $kJ.mol^{-1}$

$$\mathbf{\triangle H\ reaction = \sum reactant\ mean\ bond\ enthalpies - \sum product\ mean\ bond\ enthalpies}$$

($kJ.mol^{-1}$) ($kJ.mol^{-1}$) ($kJ.mol^{-1}$)

EQUILIBRIA

$$aA + bB \rightleftharpoons cC + dD$$

$$Kc = \frac{[C]^c\ [D]^d}{[A]^a\ [B]^b}$$

Where:
[A] = concentration ($mol.dm^{-3}$)
a = no. of moles from equation

COMMON IONS

POSITIVE

GROUP 1 = +

GROUP 2 = 2+

H^+

Ag^+

Zn^{2+}

Pb^{2+}

Al^{3+}

(Transition metals are variable)

e.g. Fe^{2+}, Fe^{3+}

NEGATIVE

GROUP 7 = -

GROUP 6 = 2-

GROUP 5 = 3-

MOLECULAR IONS

NH_4^+ ammonium

H_3O^+ hydronium

OH^- hydroxide

CO_3^{2-} carbonate

NO_3^- nitrate

SO_4^{2-} sulfate

CN^- cyanide

PO_4^{3-} phosphate

ACIDS & BASES

ACIDS

HCl	hydrochloric acid
HNO_3	nitric acid
H_2SO_4	sulphuric acid
H_3PO_4	phosphoric acid
CH_3COOH	ethanoic acid

BASES

NaOH	sodium hydroxide
KOH	potassium hydroxide
$Ca(OH)_2$	calcium hydroxide
CuO	copper (II) oxide

COMMON OXIDATION STATES

POSITIVE

GROUP 1 = +I
GROUP 2 = +II
H = +I
Ag = +I
Zn = +II
Pb = +II or +IV
Al = + III
(Transition metals are variable)
Fe = +II or +III
Cu = +II (sometimes +I)
C = +II or +IV

NEGATIVE

F = -I
O = -II
Cl = -I
Br = -I
I = -I
N = -III
S = -II
P = -III

(Cl, Br, I, N, S, P:) Most common oxidation states, but may be positive when covalently bonded to more highly electronegative elements. i.e. F or O

GROUP 1 SALTS: ALL SOLUBLE

NITRATE SALTS = ALL SOLUBLE

GROUP 2 SALTS:
HYDROXIDES INCREASE IN SOLUBILITY DOWN THE GROUP
SULFATES DECREASE IN SOLUBILITY DOWN THE GROUP
CARBONATES ARE NOT SOLUBLE

Ag SALTS: ALL INSOLUBLE EXCEPT $AgNO_3$

Pb SALTS ALL INSOLUBLE EXCEPT $Pb(NO_3)_2$

GROUP 7 SALTS: ALL SOLUBLE EXCEPT AgX and PbX_2

CO_3 SALTS: ALL INSOLUBLE EXEPT GROUP 1

YEAR 1 CHEMISTRY PRACTICALS (OCR)

No.	Practical	Detail	Done?
1	Moles Determination	Use apparatus to record the mass and volume of a gas	
2	Perform a simple acid-base titration	Use titration to: - Determine the concentration of an acid - Determine the molar mass of an acid - Identify and unknown carbonate	
3	Measure Enthalpy Change	Use a calorimeter to experimentally determine the energy released by: - A neutralisation reaction - A combustion reaction	
4	Identify Unknown Inorganic Ions in Solution	Use chemical tests to identify Group 2, Group 7, OH^-, CO_3^{2-} and SO_4^{2-} ions in solution	
5	Synthesis of an Organic Liquid	Synthesis of a haloalkane (Reflux & Distillation)	
7	Testing for organic functional groups	Use chemical tests to identify a carboxylic acid, an alcohol and an aldehyde.	
9	Rates of Reaction	Using the “continuous rate monitoring” method	

THERMODYNAMICS

$$\Delta H^{\ominus}_{solution} = \Delta H^{\ominus}_{latt\ diss} + \sum \Delta H^{\ominus}_{hydration}$$

(ENDOTHERMIC) (EXOTHERMIC)

$$\Delta S_{system} = \sum \Delta S_{products} - \sum \Delta S_{reactants}$$

$(J.K^{-1}.mol^{-1})$

$$\Delta G = \Delta H - T\Delta S$$

$(kJ.mol^{-1})$

$$T = \frac{\Delta H}{\Delta S}$$

$$\Delta G = -\Delta S\,T + \Delta H$$

Always divide ΔS by 1000 to match your units!

When calculating the temperature at which a reaction becomes / ceases being feasible

For the ΔG Vs T Graph! Equivalent to: y = mx + c

RATE EQUATIONS & ARRHENIUS

$$Rate = k\,[A]^{order}\,[B]^{order}$$

$(mol.dm^{-3}.s^{-1})$

$$K = \frac{Rate}{[A]^{order}\,[B]^{order}}$$

$$K = A\,e^{\left(\frac{-Ea}{RT}\right)} \quad \text{OR} \quad \ln K = \left(\frac{-Ea}{RT}\right) + \ln A \quad \text{OR} \quad \ln K = \frac{-Ea}{R} \times \frac{1}{T} + \ln A$$

Standard Arrhenius (given in data booklet)

Natural Log of Arrhenius (given in data booklet)

For the lnK Vs 1/T Graph!

Equivalent to: y = mx + c

ELECTROCHEMISTRY

$$EMF_{(V)} = \text{Most Positive } E^{\circ} - \text{Most Negative } E^{\circ}$$

OR

$$EMF = E^{\circ} \text{ Cell being Reduced} - E^{\circ} \text{ Cell being Oxidised}$$

ACIDS & BASES

$$pH = -\log [H^+] \quad \text{and} \quad [H^+] = 10^{-pH}$$

$$Ka = \frac{[H^+][X^-]}{[HX]}$$

$$Kw = [H^+][OH^-]$$

Kw = 1.00×10^{-14} $mol^2.dm^{-6}$
at 298K
(given in data booklet)

ACID BUFFERS

Ka of Weak Acid

Weak Acid Concentration

$$[H^+] = \frac{Ka \times [HX]}{[X^-]}$$

Salt Concentration

$$\text{Then } pH = -\log [H^+]$$

COMMON OXIDATION STATES

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
+III	+IV	+II, +III +IV, +V	+II, +III +VI	+II, +III +IV, +VI +VII	+II, +III	+II, +III	+II	+I, +II	+II

COMMON COMPLEX COLOURS

	$+H_2O$	+ limited $OH^-_{(aq)}$ or $NH_{3(aq)}$	+ Excess $OH^-_{(aq)}$	+ Excess $NH_{3(aq)}$	+ conc. $HCl_{(aq)}$
Iron II	$[Fe(H_2O)_6]^{2+}_{(aq)}$	$[Fe(H_2O)_4(OH)_2]_{(s)}$	NVR	NVR	NVR
	GREEN SOLUTION	GREEN PRECIPITATE (may oxidise to brown)			
Iron III	$[Fe(H_2O)_6]^{3+}_{(aq)}$	$[Fe(H_2O)_3(OH)_3]_{(s)}$	NVR	NVR	$FeCl_4^-$
	YELLOW SOLUTION	BROWN PRECIPITATE			YELLOW SOLUTION
Chromium	$[Cr(H_2O)_6]^{3+}_{(aq)}$	$[Cr(H_2O)_3(OH)_3]_{(s)}$	$[Cr(OH)_6]^{3-}_{(aq)}$	$[Cr(NH_3)_6]^{3+}_{(aq)}$	NVR
	*VIOLET SOLUTION	GREY/GREEN PRECIPITATE	GREEN SOLUTION	PURPLE SOLUTION	
Copper	$[Cu(H_2O)_6]^{2+}_{(aq)}$	$[Cu(H_2O)_4(OH)_2]_{(s)}$	NVR	$[Cu(H_2O)_2(NH_3)_4]^{2+}_{(aq)}$	$CuCl_4^{2-}$
	LIGHT BLUE SOLUTION	BLUE PRECIPITATE		ROYAL BLUE SOLUTION	YELLOW / GREEN SOLUTION
Manganese	$[Mn(H_2O)_6]^{2+}_{(aq)}$	$[Mn(H_2O)_4(OH)_2]_{(s)}$	NVR	NVR	NVR
	PALE PINK SOLUTION	LIGHT BROWN PRECIPITATE			

*** Officially violet in colour, but is green when produced from the oxidation of alcohols using acidified potassium dichromate**

No.	Practical	Detail	Done?
6	Preparation and purification of an organic solid	Using reflux, reduced pressure filtration, distillation & thin layer chromatography	
8	Set up an electrochemical cell	Set up an electrochemical cell and measure EMF	
10	Rates: Initial Rates Method	Use of the initial rates method to determine the rate of reaction	
11	pH Curve	Investigate how pH changes when a weak acid reacts with a strong base	
12	Research Skills	Apply investigative approaches and methods to practical work and use secondary sources of information	