Level 1-2

1. **State** the formulas for molarity, molality and molar fracon.

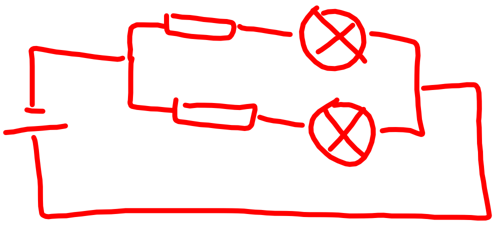
$M = \frac{mol}{L}$ $m = \frac{mol}{kg}$ $x_i = \frac{\text{mol of solute}}{\text{mol total}}$

2. **Calculate** which is the fastest of these speeds: 100 km/h; 40 m/s; 0.02 km/s

$100 \frac{km}{h} \cdot \frac{1000\ m}{1\ km} \cdot \frac{1\ h}{3600\ s} = 27.8\ m/s$ // $0.02 \frac{km}{s} \cdot \frac{1000\ m}{1\ km} = 20\ m/s$

$40\ m/s > 27.8\ m/s > 20\ m/s$

3. **Draw** a simple parallel circuit that contains a baery, 2 resistors and 2 bulbs. (They do not need to be in a parcular order)



(Or any variation)

Level 3-4

4. **Formulate** these compounds: ammonium chloride, gold(I) oxide, nitrous acid, stronum hypobromite, methane, $Ni(OH)_3$, $HClO$, B_2H_6, Sc_2S_3, $K_2Cr_2O_7$.

NH_4Cl $Sr(BrO)_2$ Hypochlorous acid Potassium dichromate
Au_2O CH_4 Diborane (borane)
HNO_2 Nickel (III) hydroxide Scandium sulfide

5. Methane reacts with oxygen gas to form carbon dioxide and water. **Write** a balanced equaon and **calculate** how many mole of water are produced if we use 2 moles of methane and 4 moles of oxygen.

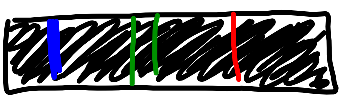
$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

2 mol ÷ 1 = 2; 4 mol ÷ 2 = 2; x

Neither is limiting

x = 4 mol

6. **Explain** how Bohr´s model of the atom explains atomic emission spectra like the one below.



Bohr's model stated that electrons are found in specific energy levels. So when an electron absorbs energy it can jump up to a higher level. When it drops down again, it releases a specific amount of energy causing a line of a specific colour.

Level 5-6

7. A body moves from rest with a constant acceleraon of 8 m/s [2]. **Calculate** the velocity aer 5 s and the distance travelled in the first 5 s.

Data

$S_0 = 0$
$S_f = ?$
$V_0 = 0$
$V_f = ?$
$t = 5$
$a = 8$

Formula

$S_f = S_0 + (V_0 \cdot t) + \frac{1}{2} a t^2$

$V_f = V_0 + (a \cdot t)$

Calculation

$V_f = 0 + 8 \cdot 5 = 40\ m/s$

$S_f = 0 + (0 \cdot t) + \frac{1}{2} \cdot 8 \cdot 5^2 = 100\ m$

8. A sample of He(*g*) occupies 15.0 L with a pressure of 856 mmHg when the temperature is 52 ºC. How many grams of He(*g*) does the sample contain?

Data: atomic mass He=4 g/mol; 1 atm = 760 mmHg; R = 0.082 atm·L/K·mol

Data

$V = 15.0\ L$
$P = \frac{856\ mmHg}{760\ mmHg} = 1.13\ atm$
$T = 325\ K$
$mm = 4\ g/mol$
$m = ?$

Formula

$PV = nRT$

$n = \frac{m}{mm}$

Calculations

$\rightarrow n = \frac{PV}{RT} = 0{,}636\ mol$

$\rightarrow m = n \cdot mm = 0{,}636 \cdot 4 = 2{,}54\ g$

9. Calculate the volume of a 10000 tonne ship that is submerged if the density of seawater is 1030 kg/m³.

Data

$V = ?$
$m = 10000\ tonne$
$= 10000000\ kg$
$d_{sea} = 1030\ kg/m^3$

Formula

$F_{upthrust} = V \cdot d \cdot g$

$F_{weight} = m \cdot a$

Calculations

$F_{weight} = m \cdot 9{,}8 = 98000000\ N$

$F_{weight} = F_{upthrust}$

$98000000 = V \cdot 1030 \cdot 9{,}8$

$V = 9710\ m^3$

Level 7-8

1. How many grams of acec acid should we dissolve in 250 mL of water in order to change its boiling point up to 101.3 °C?

Data: molecular mass acec acid = 60 g/mol; density of water = 1g/ml. Water k $_b$=0.512

Data
$\Delta BP = 1.3$
$K_b = 0{,}512$
mass H_2O = 250g = 0.250 kg
mm = 60

Formula
$\Delta BP = k_b \cdot m$
$m = \frac{mol}{kg}$
$mol = \frac{mass}{mm}$

Calculation
$1{,}3 = 0{,}512 \cdot m$ // $m = 2{,}54$ mol/kg
$2{,}54 = \frac{mol}{0.250}$ // mol = 0,635 mol
$0{,}635 = \frac{mass}{60}$ // mass = 38,1 g

2. An electrolyc cell was set up with an unknown manganese ion soluon. It was run for 10 minutes at a current of 4 A and produced a mass of 0.684 g of manganese metal. **Calculate** the oxidaon state of the manganese in soluon.

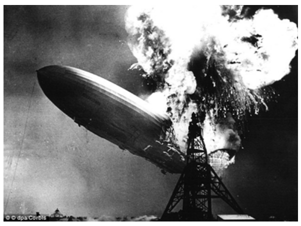
Data: Atomic mass=55; F=96500 C/mol, Common oxidaon states of manganese = +2,+6,+7

Data
t = 10 min = 600 s
I = 4 A
Mass = 0,684 g
F = 96500
mm = 55
n = ?

Formula
$mass = \frac{mm}{n \cdot F} \cdot I \cdot t$

Calculation
$n = \frac{mm}{mass \cdot F} \cdot I \cdot t = \frac{55}{0{,}684 \cdot 96500} \cdot 4 \cdot 600$
$n = 1.997 \approx 2$
Oxidation state is +2

3. The Hindenburg was a large hydrogen(very flammable) filled balloon that caught fire when it came close to the metal landing tower that it was supposed to be aached to. One theory is that stac electricity caused the fire. **Explain** how.



- Perhaps static charge built up on the balloon as it travelled.
- When it came close to the metal landing tower, electrons jumped from one object to the other to balance the charge.
- This "spark" (of electrons) caused the hydrogen to set on fire.