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Empirical formula test Year 11 Chemistry

Name _________________________

1) Three unidentified compounds are found to have the empirical formula CH_2O. What is needed to identify the compound?

   a) The mass of the compound.
   b) The volume one mol of the substance occupies in cm^3.
   c) The percentage composition by mass of the compound.
   d) The molar mass of the compound.

2) Styrene has the empirical formula CH and a molar mass of 104g/mol. What is the molecular formula of styrene?

   a) C_2H_2
   b) CH
   c) C_8H_8
   d) C_5H_5

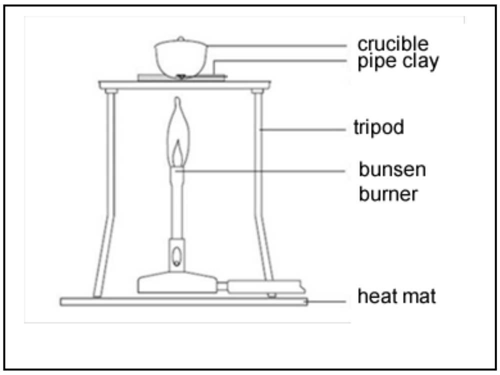
3) What is the empirical formula of a compound containing 60.0% sulphur, 40.0% oxygen by mass?

   a) SO_3
   b) SO_4
   c) S_2O_3
   d) S_3O_4

4) A compound is found to have the **molecular formula** CH_5N. Its percentage mass composition is most likely:

   a) 16.2% carbon, 38.8% hydrogen and 45.1% nitrogen
   b) 38.8% carbon, 16.2% hydrogen and 45.1% nitrogen
   c) 39.0% carbon, 12.0% hydrogen and 49.0% nitrogen
   d) 49.0% carbon, 12.0% hydrogen and 39.0% nitrogen

5) Hydrated copper sulphate has the formula $CuSO_4.xH_2O$. A student used the setup shown below to evaluate x in the formula. A student placed 10.0 grams of hydrated copper sulphate into the crucible and strongly heated the sample. For most accurate results the student should:



   a) heat the sample until it visibly looks free of all water.
   b) use 20.0 grams of hydrated copper sulphate.
   c) not heat the sample with a strong flame.
   d) allow the sample to cool overnight and then weigh it.

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6) A sample of the solvent used in an expensive brand of perfume contained 0.60 g of carbon, 0.15 g of hydrogen and 0.40 g of oxygen. Which comment is true about the molecular formula of the compound?

a) Each molecule of the compound has three time as many carbon atoms as oxygen atoms.
b) Each molecule of the compound has three times as many oxygen atoms as carbon atoms.
c) Each molecule of the compound has three time as many hydrogen atoms as oxygen atoms.
d) Each molecule of the compound has twice as many carbon atoms as oxygen atoms.

7) A 1.34 gram sample of an organic compound contained 0.36 grams of carbon. Which comment is true?

a) The sample contained 0.36 mol of carbon atoms
b) The sample contained 1.9 X 10^{22} carbon atoms
c) The sample contained 36.0 % by mass carbon.
d) The sample contained 64.0 % by mass carbon

8) A 100.0 g sample of pure $CuSO_4.5H_2O$ (**molar mass 250 g/mol)** contains:

a) 36.0 grams of water
b) 90.0 grams of water
c) 64.0 grams of copper
d) both options a) and b).

9) A 25.0 grams sample of $MgSO_4$ contains:

a) 20.2% Mg, 53.2% O and 26.6% S by mass.
b) 2.34 X 10^{23} atoms of Mg
c) 13.2 grams of Mg
d) 2.42 X 10^{24} atoms of oxygen.

10) An unknown molecular compound was analysed. 36.4 grams of this pure compound contained 1.2 X 10^{23} molecules. Which of the following can be evaluated from this information?

i. The empirical formula
ii. The molar mass of the compound.
iii. The molecular formula of the compound.

a) i. and ii. only
b) ii. and iii. only
c) i. ii. and iii.
d) ii. only

1) You can find the empirical formula of a compound using **percentage composition** data. Below are six steps, not all are required to find the empirical formula of a compound.

1. Assume you have 100 g of the compound
2. Convert the grams to moles for each element.
3. Consider the percentage composition you are given as being in units of grams.
4. Find the smallest whole number ratio of moles for each element.
5. Use step 3. to find the total mass of the compound.
6. Find the percentage composition of the compound.

a) Place the necessary steps, shown above, in the right order to determine the empirical formula of a compound.

1 mark

b) Which step is not necessary for the calculation of the empirical formula of the compound?

1 mark

c) Which step must be experimentally determined?

1 mark

d) Which step provides the greatest opportunity for error.

1 mark

2) A compound is found to contain 23.3% magnesium, 30.7% sulfur and 46.0% oxygen. What is the empirical formula of this compound? Show all working in the space provided below.

4 marks

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3) A 1.50 g sample of hydrocarbon undergoes complete combustion to produce 4.50 g of CO_2 and 2.46 g of H_2O.

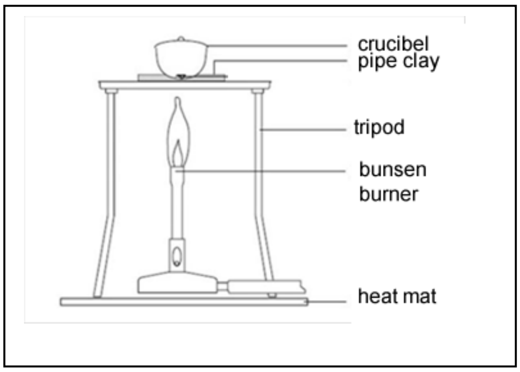
a) Find its empirical formula. Show all working in the space provided below.

5 marks

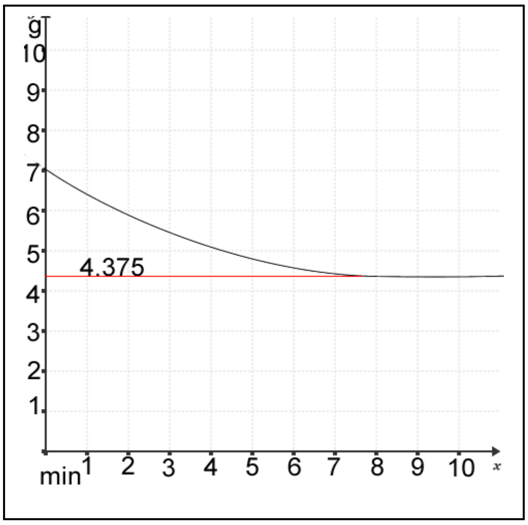
b) What is the molecular formula of the compound if its molar mass is 44.0 g/mol? Show all working in the space provided below.

2 marks

4) When exposed to the atmosphere, $MgSO_4$ bonds with water molecules in the air. This behaviour can be shown as $MgSO_4 \cdot \boldsymbol{x}H_2O$ where ***x*** is some integer quantity of water molecules. A student used the setup below to find the value of ***x***.



The student strongly heated a 7.00 g sample of $MgSO_4.xH_2O$ and recorded the mass of the sample every two minutes to constant mass. The results were plotted on the set of axes shown on the right.



a) Calculate the mol of dried $MgSO_4$ (molar mass of $MgSO_4$ = 120.4 g/mol). Show all working.

2 marks

b) Calculate the mol of water present (molar mass of H_2O = 18.0 g/mol).

2 marks

c) Calculate the value of *x*.

2 marks

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The Periodic Table Of The Elements

I *1*	*II* *2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*III* *13*	*IV* *14*	*V* *15*	*VI* *16*	*VII* *17*	*VIII* *18*
1 **H** 1.0																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 96.0	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La*** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac**** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (267)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)	112 **Cn** (285)						

* Lanthanides	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.1	71 **Lu** 175.0
** Actinides	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)