TUTORIAL 1

Name: **ANSWER SCHEME**
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1. Write the numbers presented by the following prefixes:

mega-	kilo-	micro-	nano-	pico-	deci-	centi-	milli-
10^{6}	10^{3}	10^{-6}	10^{-9}	10^{-12}	10^{-1}	10^{-2}	10^{-3}

2. What is the number of significant figures in each of the following measurements?

Measurements	No. of significant figures
5075710.019 s	**10**
2200 g	**2**
4.020 km	**4**
0.0000003 kg	**1**
2.00×10^{19} atoms	**3**

3. Carry out the following conversions using Factor Label Method.

482.2 in^3 to cubic centimeter	**476 cm^2 to square inches**
7901.8 cm^3	**73.78 in^2**

4. To determine the density of ethyl alcohol, a student pipet 5.00 mL sample into an empty flask weight 15.246 g, he finds that the mass of the flask + ethyl alcohol = 19.171 g. Calculate the density of ethyl alcohol.

   0.785 g/mL

5. The density of ethanol, a colorless liquid is 0.798 g/mL. Calculate the mass of 17.4 mL of the liquid?

   13.89 g

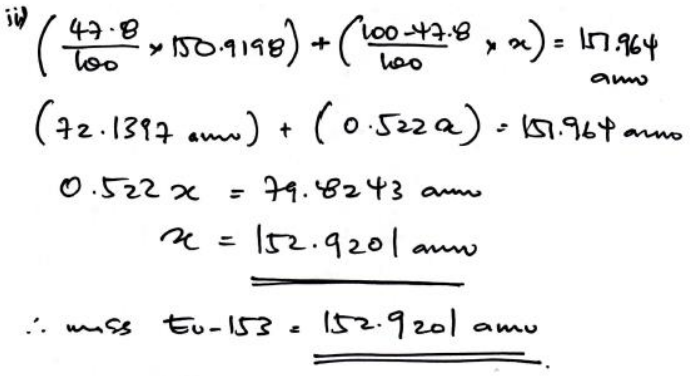
6. The commonly accepted measurement now used by dietary specialist in assessing whether a person is overweight is the body mass index (BMI). BMI is based on a person's weight and height. It is the mass, in kilograms, divided by the square of the height in meters, which is, expressed in kg/m^2. Generally speaking, if the BMI exceeds 25, a person considered overweight. What is the BMI of a person being 69.0 inches tall and weight 158.0 lb.?

   23.33 kg/m^2

7. Give the number of protons, neutrons and electrons in each of the following species

Species	$^{17}_{8}O$	$^{199}_{80}Hg$	$^{200}_{80}Hg$	$^{14}_{7}N^{3-}$	$^{54}_{26}Fe^{2+}$	$^{31}_{15}P^{3-}$	$^{107}_{47}Ag^{+}$
Proton	**8**	**80**	**80**	**7**	**26**	**15**	**47**
Neutron	**9**	**119**	**120**	**7**	**28**	**16**	**60**
Electron	**8**	**80**	**80**	**10**	**24**	**18**	**46**

8. Europium has two naturally occurring isotopes which are Eu-151 and Eu-153. Eu-151 has a mass of 150.9198 amu and a natural abundance of 47.8%. Using the atomic mass of europium, find the mass of Eu-153.



9. Calculate

   a) The mass in gram, of 0.155 mol C_3H_8

      6.82 g

   b) The number of moles of C_4H_{10} in a 165 kg sample

      2844.83 mol

10. Melamine, which is used to make plastic items such as dishes and toys, contains 28.57% carbon, 4.80% hydrogen and 66.64% nitrogen. If the molar mass is 126 g/mol, what is the molecular formula of melamine?

	C	H	N
%	28.57	4.80	66.64
Assume 100 g	28.57 g	4.80 g	66.64 g
mol = mass / m. mass	$\frac{28.57\ g}{12.011\ g/mol}$ = 2.3787 mol	$\frac{4.80\ g}{1.008\ g/mol}$ = 4.7619 mol	$\frac{66.64\ g}{14.007\ g/mol}$ = 4.7576 mol
÷ smallest mol	$\frac{2.3787\ mol}{2.3787\ mol}$ = 1	$\frac{4.7619\ mol}{2.3787\ mol}$ = 2	$\frac{4.7576\ mol}{2.3787\ mol}$ = 2

Empirical formula melamine = CH_2N_2

$(CH_2N_2)_x$ = 126 g/mol.

$(12.011\ g/mol + 2(1.008\ g/mol) + 2(14.007\ g/mol))x = 126\ g/mol$

$(42.041\ g/mol)x = 126\ g/mol$

$x = 2.997$

$\simeq 3$

$\therefore$ molecular formula melamine = $C_3H_6N_6$

11. All alkali metals react with water to produce hydrogen gas and the corresponding alkali metal hydroxide. A typical reaction is that between lithium and water.

$$Li\ (s) + H_2O\ (l) \rightarrow LiOH\ (aq) + H_2\ (g)$$

a) Balance the equation.

$2Li\ (s) + 2H_2O\ (l) \rightarrow 2LiOH\ (aq) + H_2\ (g)$

b) How many moles of H_2 will be formed by the complete reaction of 6.23 moles of Li with water?

2 mol Li ≡ 1 mol H_2
6.23 mol Li = ½ x 6.23 mol H_2
= 3.115 mol H_2

c) How many grams of H_2 will be formed by the complete reaction of 80.57 g of Li with water?

mol Li = 80.57g/6.94 g/mol
= 11.61 mol
2 mol Li ≡ 1 mol H_2
11.61 mol Li = ½ 11.61 mol H_2
= 5.805 mol H_2
mass = mol x molar mass
mass of H_2 = 5.805 mol x 2 g/mol
= 11.61 g

12. Urea, $(NH_2)_2CO$ is prepared by reacting ammonia with carbon dioxide:

$$NH_3 + CO_2 \rightarrow (NH_2)_2CO + H_2O \text{ (not balanced)}$$

In one process 637.2 g of NH_3 are allowed to react with 1142 g of CO_2.

a) Which of the reactants is limiting reagent?

$2NH_3$ + CO_2 → $(NH_2)_2CO$ + H_2O
mol NH_3 = 637.2/17 = 37.48 → 37.48/2 = 18.74 mol
mol CO_2 = 1142/44 = 25.95 → 25.95/1 = 25.95 mol
therefor → NH_3 is a limiting reagent

b) Calculate, the mass of $(NH_2)_2CO$ formed?

2 mol NH_3 ≡ 1 mol urea
37.48 mol NH_3 = 0.5 x 37.48 mol urea
= 18.74 mol urea
m urea = mol x MW urea
= 18.74 mol x (2[14+2]+12+16) g/mol = 1124.4 g

13. Describe how you would prepare 5.00 x 10^2 mL of 1.75 M H_2SO_4 solution starting with an 8.61 M stock solution of H_2SO_4

M_iV_i = M_fV_f
V_i = M_fV_f/M_i

$$= \frac{(1.75\ \text{M})(500\ \text{mL})}{8.61\ \text{M}} \text{ x } \frac{1\ \text{L}}{1000\ \text{mL}}$$

= 0.101 L @ 101 mL

Place 0.101 L @ 101 mL stock solution in volumetric flask 500 mL, add distilled water to give a final volume 500 mL.

14. How many milliliter of a 0.610 M NaOH solution are needed to neutralize 20.0 mL of a 1.75 M H_2SO_4 solution?

$$NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O \text{ (not balanced)}$$

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ (balanced)

$$\frac{MaVa}{a} = \frac{MbVb}{b}$$

$$Vb = \frac{(Ma)(Va)(b)}{(Mb)(a)}$$

$$Vb = \frac{(1.75\ \text{M})(20\ \text{mL})(2)}{(0.610\ \text{M})(1)}$$

$$Vb = 114.75\ \text{mL}$$