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## Chemical Calculations Assignment 1

Moles and Mass
1.
(a) Use an analogy to explain the mole concept. "A mole is like..."
/2
(b) State why a mole is a more useful quantity in chemistry than mass.
2. Calculate the molar mass of the following substances, showing full working:
$\begin{array}{lc}\text { (a) } \mathrm{Na}_{2} \mathrm{CO}_{3} & \\ \text { (b) } \mathrm{Mg}\left(\mathrm{NO}_{3}\right)_{2} & \\ \text { (c) } \mathrm{FeSi}_{2} & 12\end{array}$
(c) $\mathrm{FeSi}_{2} \mathrm{O}_{3} \cdot 3 \mathrm{H}_{2} \mathrm{O}$
3. For each species in the equation below, write its formula and molar mass:

$$
2 \mathrm{H}_{2}+\mathrm{O}_{2} \rightarrow 2 \mathrm{H}_{2} \mathrm{O}
$$

4. Calculate the number of moles in the following masses:
(a) 2.50 g of sodium carbonate $\left(105.99 \mathrm{~g} \mathrm{~mol}^{-1}\right) \quad / 2$
(b) 0.62 g of $\mathrm{NH}_{4} \mathrm{Cl} \quad / 3$
(c) 1.0 kg of copper sulfate pentahydrate $\left(249.66 \mathrm{~g} \mathrm{~mol}^{-1}\right) \quad / 3$
5. Calculate the mass of the following:
(a) 1.0 moles of nitric acid $\left(63.01 \mathrm{~g} \mathrm{~mol}^{-1}\right) \quad / 2$
(b) 0.0200 moles of mercury metal /3
6. Consider the balanced chemical equation below:

$$
8 \mathrm{H}^{+}+5 \mathrm{Fe}^{2+}+\mathrm{MnO}_{4}^{-} \rightarrow 5 \mathrm{Fe}^{3+}+\mathrm{Mn}^{2+}+4 \mathrm{H}_{2} \mathrm{O}
$$

(a) Write the mole ratio $\frac{n\left(\mathrm{MnO}_{4}^{-}\right)}{n\left(\mathrm{Fe}^{2+}\right)}$.
(b) Write the mole ratio for one other pair of species.
7. Consider a reaction in which 3.00 moles $\mathrm{CH}_{4}$ is burnt with excess oxygen according to this equation:

$$
\mathrm{CH}_{4}+2 \mathrm{O}_{2} \rightarrow \mathrm{CO}_{2}+2 \mathrm{H}_{2} \mathrm{O}
$$

(a) State what it means for oxygen to be in 'excess'. /1
(b) State the limiting reactant. /1
(c) Suggest one reason why the oxygen is in excess when this reaction is carried out. /1
(d) Explain why 3.00 moles of $\mathrm{CO}_{2}$ will be produced in this reaction. 12
(e) State the mole ratio $\frac{n\left(\mathrm{H}_{2} \mathrm{O}\right)}{n\left(\mathrm{CH}_{4}\right)}$. $\quad 11$
(f) Hence determine the number of moles of water produced in this reaction. /1
(g) Hence calculate the mass of water produced. 12
8. If 7.4 mol of hydrogen gas and 3.6 mol of oxygen gas are ignited, the following reaction occurs:

$$
2 \mathrm{H}_{2}+\mathrm{O}_{2} \rightarrow 2 \mathrm{H}_{2} \mathrm{O}
$$

(a) Determine which reactant is in excess.
(b) Determine the number of moles of water produced.

