MOLES, MOLAR MASS, MOLARITY, ETC. EXTRA TEST REVIEW

ANSWERS ARE IN ONENOTE

1. Calculate the **molar mass** for: $Ir_2(SO_4)_3 \cdot 9\ H_2O$
   (Hint: the "dot" means that you have a hydrate)

Answers:

$$2\left(192.2\frac{g}{mol}\right) + 3\left(32.06\frac{g}{mol}\right) + 12\left(16.00\frac{g}{mol}\right) + 9\left[2\left(1.008\frac{g}{mol}\right) + \left(16.00\frac{g}{mol}\right)\right] = 834.724\frac{g}{mol}$$

2. Calculate **molar mass** for $Sr_3(PO_4)_2$.

Answers:

$$3\left(87.62\frac{g}{mol}\right) + 2\left(30.97\frac{g}{mol}\right) + 8\left(16.00\frac{g}{mol}\right) = 452.8\frac{g}{mol}$$

3. Calculate the number of **moles** for 184 kilograms of $Co_2(CO_3)_3$.

Answers:

Recall the steps:

$$mg \leftrightarrow g \leftrightarrow moles \leftrightarrow molecules \leftrightarrow atoms$$

$$\frac{184\ kg\ Co_2(CO_3)_3}{} \times \frac{1000\ g}{1\ kg} \times \frac{1\ mol\ Co_2(CO_3)_3}{297.89\ g} = 618\ mol\ Co_2(CO_3)_3$$

4. Calculate the number of **moles** for 186 grams of $Mg(C_2H_3O_2)_2$.

Answers:

Recall the steps:

$$kg \leftrightarrow g \leftrightarrow moles \leftrightarrow molecules \leftrightarrow atoms$$

$$\frac{186\ g\ Mg(C_2H_3O_2)_2}{} \times \frac{1\ mol\ Mg(C_2H_3O_2)_2}{142.388\ g} = 1.31\ mol\ Mg(C_2H_3O_2)_2$$

5. Calculate the number of **molecules** for 73.9 milligrams of $Ba(NO_3)_2$.

Answers:

Recall the steps:

$$kg \leftrightarrow g \leftrightarrow moles \leftrightarrow molecules \leftrightarrow atoms$$

$$\frac{73.9\ mg}{} \times \frac{1\ g}{1000\ mg} \times \frac{1\ mol\ Ba(NO_3)_2}{261.35\ g} \times \frac{6.02\times10^{23}\ molecules}{1\ mol\ Ba(NO_3)_2} = 1.70\times10^{20}\ molecules\ Ba(NO_3)_2$$

6. Calculate the number of **molecules** for 18.4 moles of $Ni_2(AsO_4)_3$.

Answers:

A question like this is perfect for LEARNING HOW to read a question – Notice, you DO NOT need to calculate the grams for the molecule to answer the question since it asked only for MOLECULES and you know the number of MOLES !!!

Recall the steps:

$$kg \leftrightarrow g \leftrightarrow moles \leftrightarrow molecules \leftrightarrow atoms$$

$$\frac{18.4\ mol\ Ni_2\left(AsO_4\right)_3}{} \times \frac{6.02\times10^{23}\ molecules}{1\ mol\ Ni_2\left(AsO_4\right)_3} = 1.11\times10^{25}\ molecules\ Ni_2\left(AsO_4\right)_3$$

7. Calculate the number of **atoms** for 2.87×10^6 milligrams of $Cr(SO_4)_3$.

Answers:

This will be the LONGEST problem (the one with the most steps)

$$kg \leftrightarrow g \leftrightarrow moles \leftrightarrow molecules \leftrightarrow atoms$$

$$\frac{2.87\times10^{6}\ mg}{} \times \frac{1\ g}{1000\ mg} \times \frac{1\ mol\ Cr\left(SO_4\right)_3}{340.18\ g} \times \frac{6.02\times10^{23}\ molecules}{1\ mol\ Cr\left(SO_4\right)_3} \times \frac{16\ atoms}{1\ molecule\ Cr\left(SO_4\right)_3} = 8.13\times10^{25}\ atoms$$

8. Calculate the number of **moles** of $Ti_3(PO_4)_4$ that are dissolved in three liters of a 8.33 *M* solution?

Answers:

If you KNOW both the volume and molarity of a substance, ALWAYS start with the VOLUME !!!

$$\frac{3\ L}{} \times \frac{8.33\ mol}{1\ L} = 25.0\ mol$$

A question like this is perfect for LEARNING HOW to read a question – Notice, you DO NOT need to write the formula for titanium(III) chlorate to answer the question since it asked only for MOLES !!!

9. Calculate the number of **grams** needed to make 7.00 liters of a 0.258 *M* $Au_2(CrO_4)_3$ solution?

Answers:

If you KNOW both the volume and molarity of a substance, ALWAYS start with the VOLUME !!!

$$\frac{7.00\ L}{} \times \frac{0.258\ mol\ Au_2\left(CrO_4\right)_3}{1\ L} \times \frac{741.94\ g}{1\ mol\ Au_2\left(CrO_4\right)_3} = 1340\ g\ Au_2\left(CrO_4\right)_3$$

10. Calculate the **molarity** of a solution where 3.88 kilograms of $Pb(C_2H_3O_2)_4$ are dissolved in enough water so that the final volume is five liters?

Answers:

$$M = \frac{moles}{liters}$$

$$Pb(C_2H_3O_2)_4: \frac{3.88\ kg}{} \times \frac{1000\ g}{1\ kg} \times \frac{1\ mol\ Pb(C_2H_3O_2)_4}{443.376\ g} = 8.75\ mol\ Pb(C_2H_3O_2)_4$$

$$M = \frac{8.75\ mol}{5\ liters} = 1.75\ M$$

OR

$$M = Pb(C_2H_3O_2)_4: \frac{3.88\ kg}{5\ L} \times \frac{1000\ g}{1\ kg} \times \frac{1\ mol\ Pb(C_2H_3O_2)_4}{443.376\ g} = 1.75\ M\ Pb(C_2H_3O_2)_4$$

11. A certain compound contains the elements carbon, hydrogen, and oxygen (**in that order**). When a 12.6290 gram sample was analyzed, 3.7879 grams of carbon, and 1.2717 grams of hydrogen were detected. What is the **molecular formula for this compound** if the molecular mass is 320.336 grams / mole?

Answers:

$$mass\ of\ O: \ 12.6290\ g\ C_xH_yO_z - \left[(3.7879\ g\ C) + (1.2717\ g\ H)\right] = 7.5694\ g$$

$$C: \frac{3.7879\ g}{} \times \frac{1\ mol\ C}{12.01\ g} = 0.3154\ mol \quad ; \quad \frac{0.3154\ mol}{0.3154\ mol} = 1 \quad ; \quad 1\ x\ 2 = 2$$

$$H: \frac{1.2717\ g}{} \times \frac{1\ mol\ H}{1.008\ g} = 1.2616\ mol \quad ; \quad \frac{1.2616\ mol}{0.3154\ mol} = 4 \quad ; \quad 4\ x\ 2 = 8$$

$$O: \frac{7.5694\ g}{} \times \frac{1\ mol\ O}{16.00\ g} = 0.4731\ mol \quad ; \quad \frac{0.4731\ mol}{0.3154\ mol} = 1.5 \quad ; \quad 1.50 = 1\frac{1}{2}\ x\ 2 = 3$$

Empirical Formula = $C_2H_8O_3$

$$Empirical\ formula\ mass\ of\ C_2H_8O_3 = 2(12.01\ g) + 8(1.008\ g) + 3(16.0\ g) = 80.084\ g$$

$(C_2H_8O_3)_n$

$$n = \frac{molecular\ formula\ mass}{empirical\ formula\ mass} = \frac{320.336\ g}{80.084\ g} = 4$$

$(C_2H_8O_3)_4 = C_8H_{32}O_{12}$

12. What is the **formula for the hydrate** that is 92.952% $Os_3(PO_4)_4$ and 7.048% H_2O?

Answers:

$$Os_3(PO_4)_4: \frac{92.952\ g}{} \times \frac{1\ mol\ Os_3(PO_4)_4}{950.48\ g} = 0.09779\ mol \quad ; \quad \frac{0.09779\ mol}{0.09779\ mol} = 1$$

$$H_2O: \frac{7.048\ g}{} \times \frac{1\ mol\ H_2O}{18.016\ g} = 0.3912\ mol \quad ; \quad \frac{0.3912\ mol}{0.09779\ mol} = 4$$

$$\boldsymbol{Os_3(PO_4)_4 \cdot 4\ H_2O}$$