

Name: \_\_\_\_\_

date: \_\_\_\_\_ period: \_\_\_\_\_

ch. 2, 5, 11 conversion factor, light, mole

test

70 points

honors chemistry

In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) proper number of significant figures in your answer.

1. Solve [15 points]

a.  $275 \text{ cm}^2 = \underline{\quad} \text{ m}^2$

$$\begin{aligned} 3 \text{ pt} \quad & 275 \text{ cm}^2 \left( \frac{1 \text{ m}}{10^2 \text{ cm}} \right)^2 \\ & = 275 \cdot 10^{-4} \text{ m}^2 \end{aligned}$$

b.  $\frac{5.0 \text{ km}}{25 \text{ minutes}} = \frac{? \text{ meters}}{\text{second}}$

$$\begin{aligned} \frac{5.0 \text{ km}}{25 \text{ min}} & \frac{1 \text{ min}}{60 \text{ sec}} \frac{10^3 \text{ m}}{1 \text{ km}} \\ & = 3.3 \frac{\text{m}}{\text{sec}} \end{aligned}$$

c.  $88 \text{ m}^3 = \underline{\quad} \text{ L}$

$$\begin{aligned} 88 \text{ m}^3 & \left( \frac{10^2 \text{ cm}}{1 \text{ m}} \right)^3 \frac{1 \text{ mL}}{1 \text{ cm}^3} \frac{1 \text{ L}}{10^3 \text{ mL}} \\ & = 88 \cdot 10^3 \text{ L} \end{aligned}$$

2. A 5.0 inch cube has a density of 8.0 g/mL; what is its mass? [10 points]

$$\text{i) } V = s^3 = \left( 5 \text{ inch} \cdot \frac{2.54 \text{ cm}}{1 \text{ inch}} \right)^3 = 2048 \text{ cm}^3$$

$$\text{ii) } 2048 \text{ cm}^3 \frac{8.0 \text{ g}}{1 \text{ mL}} \frac{1 \text{ mL}}{1 \text{ cm}^3} = 16387 \rightarrow 1.6 \cdot 10^4 \text{ g}$$

347 pt

3. Solve problems involving light. [10 points]

a. If wavelength = 125 micrometers, then what is its frequency?

$$\lambda f = c \rightarrow f = \frac{c}{\lambda} = \frac{3.0 \cdot 10^8 \text{ m/s}}{125 \mu\text{m}} \cdot \frac{10^6 \mu\text{m}}{\text{m}} = 2.40 \cdot 10^{12} \text{ Hz}$$

3 + 7 pt

b. If wavelength = 125 nanometers, then what is its energy?

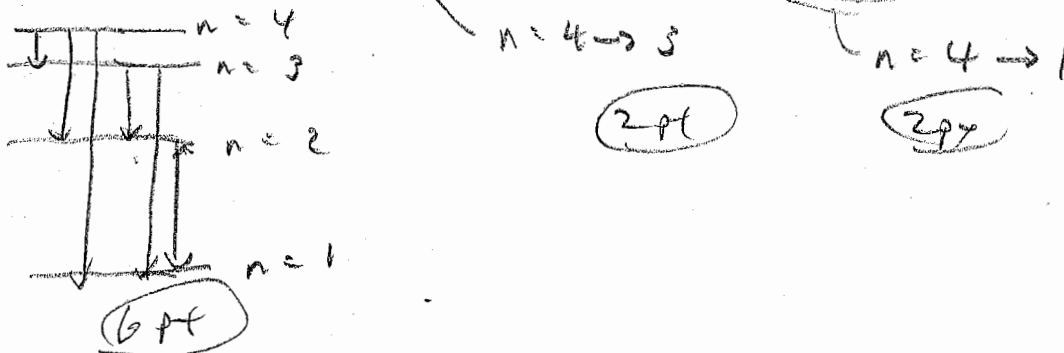
i)  $\lambda f = c \rightarrow f = \frac{c}{\lambda} = \frac{3.0 \cdot 10^8 \text{ m/s}}{125 \text{ nm}} \cdot \frac{10^9 \text{ nm}}{\text{m}} = 2.4 \cdot 10^{15} \text{ Hz}$

2 + 1 pt

ii)  $E = hf = 6.63 \cdot 10^{-34} \text{ J}\cdot\text{s} (2.4 \cdot 10^{15} \text{ Hz}) = 1.59 \cdot 10^{-18} \text{ J}$

2 + 1 pt

4. A hypothetical hydrogen-like atom has four electron energy levels, where  $n = 1, 2, 3,$  or  $4$ . Identify all possible signals in the emission spectrum with respect to the electron energy levels. Also, identify the signal with the least amount of energy, as well as, the most amount of energy. [10 points]



5. Solve [10 points]

a. 825 milligrams  $\text{Mg}_3(\text{PO}_4)_2 =$  \_\_\_ moles  $\text{Mg}_3(\text{PO}_4)_2$

$$825 \text{ mg} \cdot \frac{1 \text{ g}}{10^3 \text{ mg}} \cdot \frac{1 \text{ mol}}{263 \text{ g}} = 0.00314 \text{ mol}$$

4 + 1 pt

b. 364 millimoles  $\text{Mg}_3(\text{PO}_4)_2 =$  \_\_\_ grams  $\text{Mg}_3(\text{PO}_4)_2$

$$364 \text{ mmol} \cdot \frac{1 \text{ mol}}{10^3 \text{ mmol}} \cdot 263 \frac{\text{g}}{\text{mol}} = 95.7 \text{ g}$$

6. Based on:  $2.0 \text{ g C}_x\text{H}_y\text{O}_z + \text{excess O}_2 \rightarrow 4.0 \text{ g CO}_2 + 1.636 \text{ g H}_2\text{O}$  [15 points]

a. What is its empirical formula?

$$i) \% \text{C} = \frac{12}{44} = \frac{\# \text{g C}}{4 \text{g}}$$

$$\# \text{g C} = 1.091 \text{g}$$

$$ii) \% \text{H} = \frac{2}{18} = \frac{\# \text{g H}}{1.636}$$

$$\# \text{g H} = 0.1818 \text{g}$$

$$iii) \# \text{g O} = \# \text{g C} + \# \text{g H} + \# \text{g O}$$

$$2 = 1.091 + 0.1818 + \# \text{g O}$$

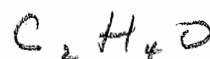
$$\# \text{g O} = 0.727 \text{g}$$

$$iv) 0.727 \text{g O} \frac{\text{mol}}{16 \text{g O}} = 0.0454 \text{ mol O}$$

$$0.1818 \text{g H} \frac{\text{mol}}{1 \text{g H}} = 0.1818 \text{ mol H}$$

$$1.091 \text{g C} \frac{\text{mol}}{12 \text{g}} = 0.0909 \text{ mol C}$$

$$v) \begin{array}{ccc} \text{C} & \text{H} & \text{O} \\ 0.0909 & 0.1818 & 0.0454 \\ 2 & 4 & 1 \end{array}$$



b. If its molar mass is 88 g, what is its chemical formula?

$$i) \text{CF} = (\text{EF})_n$$

$$n = \frac{\text{molar mass CF}}{\text{molar mass EF}} = \frac{88}{44} = 2$$

$$ii) \text{CF} = (\text{C}_2\text{H}_4\text{O})_2 = \text{C}_4\text{H}_8\text{O}_2$$