

Please read all the questions VERY carefully before answering. If you do not understand any question, please ask. Use the reverse side of the question paper as scratch. Use the periodic table and constant chart in the last page. No outside paper is allowed. Total points = $56 + (27 \times 3) = 81 = 131$

SHORT ANSWER. Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

- 1) Calculate (with units) how many cubic inches (in^3) are in 15615 cubic decimeter (dm^3) (given $1 \text{ dm} = 0.1 \text{ m}$, $1 \text{ cm} = 0.01 \text{ m}$, and $2.54 \text{ cm} = 1 \text{ in}$)? (8 pts.)

1) 952715.07 in^3

$$1 \text{ dm}^3 = 1000 \text{ cm}^3$$

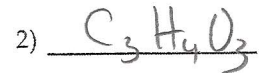
$$15615 \text{ dm}^3 = 15615 \times 10^3 \text{ cm}^3$$

$$1 \text{ in}^3 = 16.39 \text{ cm}^3$$

$$15615 \times 10^3 \text{ cm}^3 = 952715.07 \text{ in}^3$$

$$15615 \text{ dm}^3 \times \frac{(0.1 \text{ m})^3}{(1 \text{ dm})^3} \times \frac{(1 \text{ cm})^3}{(0.01 \text{ m})^3} \times \frac{(1 \text{ in})^3}{(2.54 \text{ cm})^3} = \frac{(15615)(.1)^3}{(.01)^3(2.54)^3} \text{ in}^3 = 952715.07 \text{ in}^3$$

- 2) Show your calculation to determine the empirical formula of a compound that is composed of 40.92% C, 4.58% H, and 54.50% O. (8 pts.)

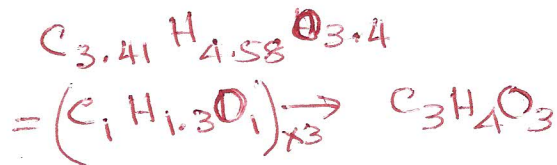


$$\text{C} = \frac{40.92}{12} = 3.41$$

$$\text{H} = \frac{4.58}{1} = 4.58$$

$$\text{O} = \frac{54.5}{16} = 3.4$$

Empirical: $\text{C}_3\text{H}_4\text{O}_3$



- 3) Calculate the mass (in grams) of 1.56×10^{21} atoms of magnesium. (6 pts.)

3) 0.063 g

$$n = \frac{1.56 \times 10^{21}}{(6.022 \times 10^{23})} = 2.6 \times 10^{-3}$$

$$m = 2.6 \times 10^{-3} \times 24.3 = 0.063 \text{ g}$$

$$1.56 \times 10^{21} \text{ atoms} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} \times \frac{24.3 \text{ g Mg}}{1 \text{ mol Mg}} = \frac{(1.56 \times 10^{21})(24.3)}{(6.022 \times 10^{23})} = 0.0630 \text{ g}$$

$$1 \text{ mol} = 6.022 \times 10^{23}$$

1.56

4) Calculate how many grams of HNO₃ is produced when 2.0 moles of NO₂ reacts with water in the following reaction: H₂O (l) + 3 NO₂ → NO (g) + 2 HNO₃ (aq) (6 pts.)

4) 84 g

$$n_{\text{HNO}_3} = \frac{2 \times 2}{3} = \frac{4}{3} \text{ mol}$$

$$2 \text{ mole NO}_2 \times \frac{2 \text{ mol HNO}_3}{3 \text{ mol NO}_2} \times \frac{63 \text{ g HNO}_3}{1 \text{ mol HNO}_3}$$

$$m_{\text{HNO}_3} = n M = \frac{4}{3} \cdot 83 = 84 \text{ g}$$

$$= \frac{2 \times 2 \times 63}{3} \text{ g HNO}_3 = 84 \text{ g HNO}_3$$

5) An inflated balloon has a volume of 6.0 L at 1.0 atm pressure and at 22°C. Calculate its volume when it ascends to an altitude where the pressure is 0.45 atm and the temperature is -21°C. (6 pts.)

5) 11.4 L

$$P_1 = 1 \text{ atm}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_1 = 6 \text{ L}$$

$$T_1 = 295.15 \text{ K}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(1)(6)(252.15)}{(295.15)(0.45)}$$

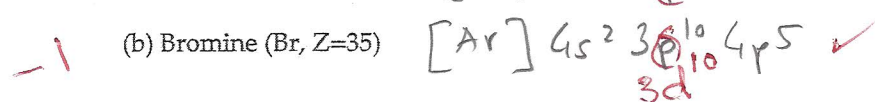
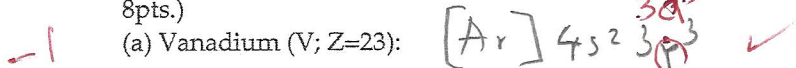
$$P_2 = 0.45 \text{ atm}$$

$$T_2 = 252.15$$

$$V_2 = ?$$

$$V_2 = 11.4 \text{ L} \checkmark$$

6) Use a noble gas core to draw the ground state electron configuration for (4 pts./each; Total = 8 pts.)

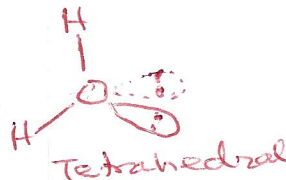
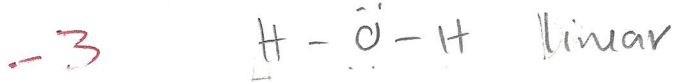


7) (a) Draw the Lewis structure of H₂O (2pts.)

7) _____



(b) Draw and name the electronic geometry of H₂O (4 pts.)



(c) Circle if H₂O molecule is polar or non-polar (2pts.)

