

Exam III – Chapters 9, 10, 11, 13

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

$$PV=nRT$$

$$R = 0.0821 \text{ (L atm)/(mol K)}$$

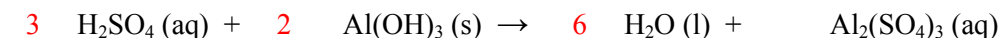
Molar volume = 22.4 L/mol for a gas @ STP

Avogadro's number = 6.02×10^{23} entities/mol

Questions 1-10 are worth 2 points each and there is only one correct answer.

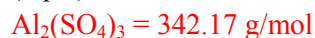
- What is the physical state of ammonia, NH₃, at 43°C? The melting point of NH₃ is -78°C and the boiling point is -33°C.
a. solid b. liquid c. **gas**
- Which of the following is a molecular crystalline solid?
a. Zn b. ZnO c. P₄ d. **IBr**
- Which of the following is considered STP?
a. 1 atm, 25°C b. 760 atm, 25°C c. 760 torr, 25°C d. **760 torr, 0°C**
- What is the strongest type of intermolecular force present between C₂H₅SH (l) molecules?
a. LDF b. **DDF** c. HBF d. ionic
- Which of the following has london dispersion forces (HBF) as the **strongest** force present between molecules?
a. H₂S (l) b. C₆H₁₄ (l) c. H₂O (l) d. CH₃Cl (l)
- Which of the following would have a rather low value for CH₃NH₂ (l) molecules?
a. **vapor pressure** b. boiling point c. viscosity d. surface tension
- Which of the following is an ionic crystalline solid?
a. CO₂ (g) b. C₆H₁₂O₆ (s) c. H₂O (l) d. **Cu₂O**
- Charles' Law states that volume is _____ related to temperature.
a. **directly proportional** b. inversely proportional c. not related
- Which of the following metals will react with nitric acid, HNO₃ (aq)?
a. Cu b. Ag c. Hg d. **Ni**
- Convert 450 torr into atmospheres.
a. **0.59 atm** b. 3.4×10^5 atm c. 1200 atm d. 310 atm

11. (4 pts) Please balance the reaction for sulfuric acid mixed with aluminum hydroxide.

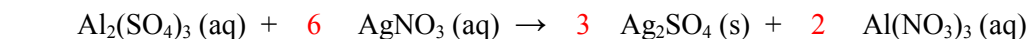


12. (3 pts) What type of reaction occurs in problem number 11? Neutralization

13. (5 pts) What is the molar mass for aluminum sulfate?



14. (4 pts) When 5.00 g of aluminum sulfate reacts with 5.00 g of silver nitrate:



a. (3 pts) What type of reaction is this? Double replacement

b. (2 pts) What is the **precipitate** in the reaction? Ag₂SO₄ (write the formula)

c. (8 pts) What **mass** of precipitate is theoretically produced? 4.59 g Ag₂SO₄
(show all work)

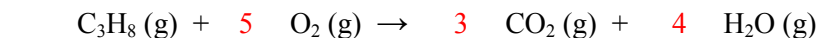
$$5.00 \text{ g Al}_2(\text{SO}_4)_3 \left(\frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{342.17 \text{ g}} \right) \left(\frac{3 \text{ mol Ag}_2\text{SO}_4}{1 \text{ mol Al}_2(\text{SO}_4)_3} \right) (311.81 \text{ g}) = 13.7 \text{ g Ag}_2\text{SO}_4$$

$$5.00 \text{ g Al}_2(\text{SO}_4)_3 \left(\frac{1 \text{ mol AgNO}_3}{169.88 \text{ g}} \right) \left(\frac{3 \text{ mol Ag}_2\text{SO}_4}{2 \text{ mol AgNO}_3} \right) (311.81 \text{ g}) = \mathbf{4.59 \text{ g Ag}_2\text{SO}_4}$$

d. (4 pts) If 3.85 g of precipitate is **actually** produced, what is the percent yield?

$$(3.85 \text{ g} / 4.59 \text{ g}) \times 100\% = 83.9\%$$

15. (4 pts) When 3.50 L of propane gas reacts with excess oxygen gas at STP,



a. (3 pts) What type of reaction occurs? combustion

b. (5 pts) What **mass** of carbon dioxide gas is produced?

$$3.50 \text{ L propane} \left(\frac{1 \text{ mol gas @ STP}}{22.4 \text{ L}} \right) \left(\frac{3 \text{ mol CO}_2}{1 \text{ mol C}_3\text{H}_8} \right) (44.01 \text{ g CO}_2) = 20.6 \text{ g CO}_2$$

16. (4 pts) Calculate the final volume of a gas when 2.90 L at 33°C and 895 torr is changed to STP conditions.

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(895 \text{ torr})(2.90 \text{ L})(273 \text{ K})}{(306 \text{ K})(760 \text{ torr})} = 3.05 \text{ L}$$

17. (6 pts) For each set of liquids, circle the one with

a. the lower viscosity CH₃CH₂OH (l) CH₃CH₂Cl (l)

b. the higher vapor pressure C₆H₁₄ (l) NH₃ (l)

c. the higher boiling point CCl₄ (l) H₂S (l)

18. (4 pts) A steel cylinder with sulfur dioxide, sulfur trioxide, and oxygen gas is at 825°C and 1.00 atm. If the partial pressure of sulfur dioxide is 175 mmHg and sulfur trioxide is 355 mmHg, what is the partial pressure of oxygen in mmHg?

$$1 \text{ atm} = 760 \text{ mmHg} = 175 \text{ mmHg} + 355 \text{ mmHg} + X \text{ mmHg}$$
$$X \text{ mmHg} = 230. \text{ mmHg}$$

19. (8 pts) Circle all of the following that are equal to one mole:

a. 35.45 g Cl₂

b. 18.01 g H₂O This one is ok also even though water is really 18.02 g/mol

c. 100.0 g N₂O₄

d. 184.11 g MgBr₂

20. (4 pts) Write the balanced reaction for the decomposition of solid magnesium oxide into oxygen gas and magnesium metal:



21. (4 pts) How many nitrogen dioxide molecules are there in 2.55 g of NO₂ (g)?

$$2.55 \text{ g NO}_2 \left(\frac{1 \text{ mol NO}_2}{46.01 \text{ g}} \right) \left(\frac{6.02 \times 10^{23} \text{ molecules NO}_2}{1 \text{ mole}} \right) = 3.34 \times 10^{22} \text{ molecules NO}_2$$

22. (5 pts) When 5.00 g of fluorine gas, F₂, is placed in a 4.50 L container at 35.0 °C, what is the pressure of the gas?

$$PV=nRT \quad 5.00\text{g F}_2 \left(\frac{1 \text{ mole}}{38.00 \text{ g}} \right) = 0.132 \text{ mol}$$

$$P = \frac{nRT}{V} = \frac{(0.132 \text{ mol})(0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1})(308 \text{ K})}{(4.50 \text{ L})} = 0.742 \text{ atm}$$

Extra Credit: (4 pts)

Name the following compounds (spelling counts!):

a. CuCrO₄ _____

b. Pb(SO₃)₂ _____

c. Cr(C₂H₃O₂)₃ _____

d. NH₄OH _____