

## Fall Examination Study Questions

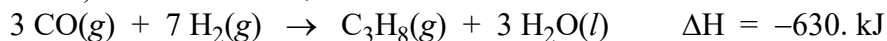
- (Chapter 2) Identify the following properties as physical or chemical properties:
  - Copper is shiny and orange.
  - Potassium reacts explosively with fluorine gas to produce potassium fluoride.
  - Oxygen is a gas at room temperature.
  - Sodium oxide has a very high melting point.
  - Sodium chloride dissolves readily in water.
  - When acid is added to marble chips, bubbles of carbon dioxide are produced.
  - Lithium reacts with oxygen to form lithium oxide.
- (Chapter 4) For each of the following compounds, indicate whether it is ionic or covalent and give the correct formula.
  - diphosphorus pentoxide
  - magnesium nitrate
  - silver(I)oxide
  - potassium hydroxide
- (Chapter 4) Name the following compounds:
  - $\text{PbCl}_2$
  - $\text{Cu}_2\text{SO}_4$
  - $\text{CS}_2$
  - $\text{HF}$
  - $\text{NaClO}_3$
- (Chapter 5) How many significant figures are there in the following numbers or answers?
  - 10.2
  - 0.0030
  - $3.1 \times 10^5$
  - $6.382 + 1.2 = ?$
  - $8.0 \times 10.0 = ?$
- (Chapter 6 & 7) Rust is 52.3% Fe, 44.9% O and 2.8% H.
  - Find the empirical formula for rust.
  - Rust is an ionic compound. What two ions are present in rust?
  - Write a balanced equation for the formation of rust from iron(III)oxide and water.
- (Chapter 6) A sample of aluminum is heated in air and completely converted to aluminum oxide. Use the data below to calculate the simplest formula of aluminum oxide.

Mass of crucible	= 29.00 g
Mass of crucible + aluminum (before heating)	= 30.62 g
Mass of crucible + oxide (after heating)	= 32.06 g
- (Chapter 6) Find the molecular formula of a substance with an empirical formula of  $\text{CH}_2\text{O}$  and a molar mass of 90.0 g/mole.
- (Chapter 8) For each of the reactions below, write a *balanced* chemical equation, and classify the reaction as one of the following types: single replacement, synthesis, decomposition, double displacement, or complete combustion. (Be sure to include physical states.)
  - $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
  - the reaction between aluminum and chlorine to form a compound.
  - the reaction between solutions of ammonium hydroxide and copper(II) nitrate.
  - the addition of solid iron to a nitric acid solution to form iron(III) nitrate and hydrogen gas.
  - the splitting of water into its elements.

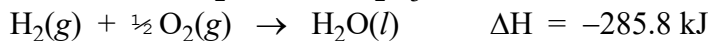
9. (Chapter 8) Decide whether a precipitate will form when the following solutions are mixed. If a precipitate forms, give the name and formula of the precipitate.
- sodium sulfate and barium chloride
  - ammonium sulfide and strontium nitrate
  - lithium carbonate and cobalt(III) chloride
  - potassium phosphate and sodium hydroxide

10. (Chapter 8) For each case where there was a net reaction in **Question 6**, write both a balanced molecular equation and a net ionic equation for the reaction.

11. (Chapter 9 & 10) For the reaction,



- How many moles of  $\text{C}_3\text{H}_8$  are produced from 9.30 moles of  $\text{CO}$ ?
  - How many grams of  $\text{C}_3\text{H}_8$  are produced when 3.66 moles of  $\text{H}_2$  are used up?
  - How many grams of water are produced from 14.4 g of  $\text{H}_2$ ?
  - How many *molecules* of  $\text{C}_3\text{H}_8$  are produced from 8.0 moles of carbon monoxide?
  - How many kJ of heat are produced when 753 *milligrams* of carbon monoxide react?
  - Is this reaction endothermic or exothermic?
12. (Chapter 9) Barium hydroxide precipitates when it is formed in a double replacement reaction.
- Write a balanced molecular equation for the formation of barium hydroxide precipitate from barium nitrate and sodium hydroxide.
  - Calculate the mass of barium nitrate needed to form 3.00 g of barium hydroxide.
  - Calculate the percent yield if only 2.70 g of barium hydroxide are formed in (b).
  - Determine the mass percentage of each element in barium hydroxide.
  - Determine the number of moles of oxygen in 49.7 grams of barium hydroxide.
13. (Chapter 10) A calorimeter containing water is used to measure the heat produced by a chemical reaction. If the water absorbs 58.5 kJ when the temperature is raised from 21.2°C to 77.2°C, how much water was in the calorimeter? (The specific heat of water is 4.18 J/g °C.)
14. (Chapter 10) For the reaction between iron and water to form iron(III) oxide and hydrogen gas,
- write a balanced chemical equation.
  - using the equations below and Hess' Law, calculate  $\Delta H$  for this reaction.



- determine whether this reaction is endothermic or exothermic.

15. (Chapter 11) Give the abbreviated ground state electron configuration for the following atoms:
- Ar
  - Y

16. (Chapter 11) Which element . . . . ?

- has an outer electron configuration of  $3s^2$ ?
- has the lowest ionization energy in Period 3?
- has the smallest atomic radius in Group 14?
- is found in most polyatomic ions?
- is a main group element that forms an ion with a +3 charge?

## Answers to Fall Exam Study Questions

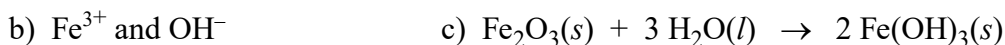
1. a) physical b) chemical c) physical d) physical e) physical f) chemical g) chemical  
 2. a) covalent, P<sub>2</sub>O<sub>5</sub> b) ionic, Mg(NO<sub>3</sub>)<sub>2</sub> c) ionic, Ag<sub>2</sub>O d) ionic, KOH  
 3. a) lead(II) chloride b) copper(I) sulfate c) carbon disulfide d) hydrofluoric acid  
 e) sodium chlorate  
 4. a) 3 b) 2 c) 2 d) 2 (answer is 7.6) e) 2

5. a) In 100 g of the compound:

$$52.3 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.8 \text{ g Fe}} = 0.937 \text{ mol Fe} \quad 0.937/0.937 = 1 \quad \text{FeO}_3\text{H}_3 =$$

$$44.9 \text{ g O} \times \frac{1 \text{ mol O}}{16.0 \text{ g O}} = 2.81 \text{ mol O} \quad 2.81/0.937 = 3 \quad \text{Fe(OH)}_3$$

$$2.8 \text{ g H} \times \frac{1 \text{ mol H}}{1.0 \text{ g H}} = 2.8 \text{ moles H} \quad 2.8/0.937 = 3$$



6. Mass of Al = 30.62 g - 29.00 g = 1.62 g Al  
 Mass of O = 32.06 g - 30.62 g = 1.44 g O

$$1.62 \text{ g Al} \times \frac{1 \text{ mol Al}}{27.0 \text{ g Al}} = 0.0600 \text{ mol Al} \quad 0.0600/0.0600 = 1 \times 2 = 2$$

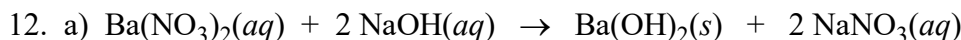
$$1.44 \text{ g O} \times \frac{1 \text{ mol O}}{16.0 \text{ g O}} = 0.0900 \text{ mole O} \quad 0.0900/0.0600 = 1.5 \times 2 = 3 \quad \text{Al}_2\text{O}_3$$

7. molar mass of CH<sub>2</sub>O = 12.0 + 2(1.0) + 16.0 = 30.0; 90.0/30.0 = 3; therefore molecular formula = C<sub>3</sub>H<sub>6</sub>O<sub>3</sub>

8. a) CH<sub>4</sub>(g) + 2 O<sub>2</sub>(g) → CO<sub>2</sub>(g) + 2 H<sub>2</sub>O(l); complete combustion  
 b) 2 Al(s) + 3 Cl<sub>2</sub>(g) → 2 AlCl<sub>3</sub>(s); synthesis (note that Al forms a +3 ion in compounds)  
 c) 2 NH<sub>4</sub>OH(aq) + Cu(NO<sub>3</sub>)<sub>2</sub>(aq) → 2 NH<sub>4</sub>NO<sub>3</sub>(aq) + Cu(OH)<sub>2</sub>(s); double displacement  
 d) 2 Fe(s) + 6 HNO<sub>3</sub>(aq) → 2 Fe(NO<sub>3</sub>)<sub>3</sub>(aq) + 3 H<sub>2</sub>(g); single replacement  
 e) 2 H<sub>2</sub>O(l) → 2 H<sub>2</sub>(g) + O<sub>2</sub>(g); decomposition
9. a) barium sulfate, BaSO<sub>4</sub> b) no reaction, NH<sub>4</sub>NO<sub>3</sub> and SrS are both soluble  
 c) cobalt(III) carbonate, Co<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub> d) no reaction, Na<sub>3</sub>PO<sub>4</sub> and KOH are both soluble

10. a) Na<sub>2</sub>SO<sub>4</sub>(aq) + BaCl<sub>2</sub>(aq) → 2 NaCl(aq) + BaSO<sub>4</sub>(s); Ba<sup>2+</sup>(aq) + SO<sub>4</sub><sup>2-</sup>(aq) → BaSO<sub>4</sub>(s)  
 c) 3 Li<sub>2</sub>CO<sub>3</sub>(aq) + 2 CoCl<sub>3</sub>(aq) → 6 LiCl(aq) + Co<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>(s);  
 2 Co<sup>3+</sup>(aq) + 3 CO<sub>3</sub><sup>2-</sup>(aq) → Co<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>(s)

11. a)  $9.30 \text{ mol CO} \times \frac{1 \text{ mol C}_3\text{H}_8}{3 \text{ mol CO}} = 3.10 \text{ mol C}_3\text{H}_8$
- b)  $3.66 \text{ mol H}_2 \times \frac{1 \text{ mol C}_3\text{H}_8}{7 \text{ mol H}_2} \times \frac{44.0 \text{ g C}_3\text{H}_8}{1 \text{ mol C}_3\text{H}_8} = 23.0 \text{ g C}_3\text{H}_8$
- c)  $14.4 \text{ g H}_2 \times \frac{1 \text{ mol H}_2}{2.016 \text{ g H}_2} \times \frac{3 \text{ mol H}_2\text{O}}{7 \text{ mol H}_2} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 55.1 \text{ g H}_2\text{O}$
- d)  $8.0 \text{ moles CO} \times \frac{1 \text{ mol C}_3\text{H}_8}{3 \text{ mol CO}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol C}_3\text{H}_8} = 16.0 \times 10^{23} = 1.6 \times 10^{24} \text{ molecules}$
- e)  $753 \text{ mg CO} \times \frac{1 \text{ g CO}}{1000 \text{ mg CO}} \times \frac{1 \text{ mol CO}}{28.0 \text{ g CO}} \times \frac{630 \text{ kJ}}{3 \text{ mol CO}} = 5.65 \text{ kJ}$
- f) exothermic ( $-\Delta H$ )



b)  $3.00 \text{ g Ba}(\text{OH})_2 \times \frac{1 \text{ mol Ba}(\text{OH})_2}{171.3 \text{ g Ba}(\text{OH})_2} \times \frac{1 \text{ mol Ba}(\text{NO}_3)_2}{1 \text{ mol Ba}(\text{OH})_2} \times \frac{261.3 \text{ g Ba}(\text{NO}_3)_2}{1 \text{ mol Ba}(\text{NO}_3)_2} = 4.58 \text{ g Ba}(\text{NO}_3)_2$

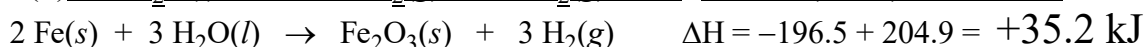
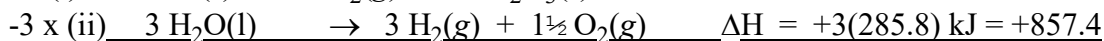
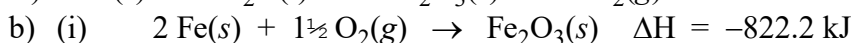
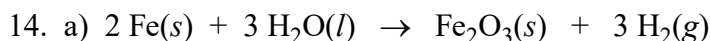
c)  $\% \text{ yield} = \frac{2.70}{3.00} \times 100\% = 90.0\%$

d)  $\text{Ba}(\text{OH})_2 = 1 \text{ mole Ba} = 137.34 \text{ g Ba} \quad 137.34/171.36 = 80.1\% \text{ Ba}$   
 $2 \text{ mole O} = 32.00 \text{ g O} \quad 32.0/171.36 = 18.7\% \text{ O}$   
 $2 \text{ mole H} = 2.016 \text{ g H} \quad 2.016/171.36 = 1.18\% \text{ H}$

e)  $49.7 \text{ g Ba}(\text{OH})_2 \times \frac{1 \text{ mol Ba}(\text{OH})_2}{171.3 \text{ g Ba}(\text{OH})_2} \times \frac{2 \text{ mol O}}{1 \text{ mol Ba}(\text{OH})_2} = 0.580 \text{ moles O}$

13.  $Q = s \times m \times \Delta T$ ;  $Q = 58.5 \text{ kJ} = 58,500 \text{ J}$ ;  $m = ?$ ;  $\Delta T = 77.2 - 21.2 = 56.0^\circ\text{C}$ ;  $s = 4.18 \text{ J/g}^\circ\text{C}$

$$m = \frac{Q}{s \times \Delta T} = \frac{58,500 \text{ J}}{4.18 \text{ J/g}^\circ\text{C} \times 56.0^\circ\text{C}} = 250 \text{ g} = 2.50 \times 10^2 \text{ g (3 sig fig)}$$



c) endothermic

