

ANSWER KEY (the answers are bolded)

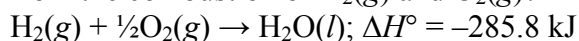
CHEM 111 Fall 2010

Practice Exam 2

- Which of the following ions is most likely to form an insoluble sulfate?
 - K^+
 - Li^+
 - Ca^{2+}**
 - S^{2-}
 - Cl^-
- Identify the spectator ion(s) in the following reaction.
 $Cu(OH)_2(s) + 2H^+(aq) + 2Cl^-(aq) \rightarrow Cu^{2+}(aq) + 2Cl^-(aq) + 2H_2O(l)$
 - Cu^{2+} and Cl^-
 - H^+ and Cl^-
 - $Cu(OH)_2$
 - Cl^-**
 - Cu^{2+}
- A bright yellow precipitate is expected when an aqueous solution of potassium iodide is added to an aqueous solution of
 - sodium sulfate.
 - iron(II) chloride.
 - calcium nitrate.
 - barium hydroxide.
 - lead nitrate.**
- What is the oxidation number of P in $NH_4H_2PO_4$?
 - 3
 - 0
 - +1
 - +3
 - +5**
- Given:
 $4AlCl_3(s) + 3O_2(g) \rightarrow 2Al_2O_3(s) + 6Cl_2(g); \Delta H = -529.0 \text{ kJ}$
determine ΔH for the following thermochemical equation.
 $Cl_2(g) + \frac{1}{3}Al_2O_3(s) \rightarrow \frac{2}{3}AlCl_3(s) + \frac{1}{2}O_2(g)$
 - +529.0 kJ
 - +88.2 kJ**
 - +176.3 kJ
 - +264.5 kJ
 - 176.3 kJ

(Notice that the reaction has been reversed so the sign changes, and the reaction multiplied by a factor 1/6)

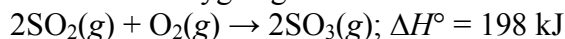
6. What is the quantity of heat evolved at constant pressure when 60.9 g $\text{H}_2\text{O}(l)$ is formed from the combustion of $\text{H}_2(g)$ and $\text{O}_2(g)$?



- a) 285.8 kJ
b) 1.74×10^4 kJ
c) 9.66×10^2 kJ
d) 1.18×10^{-2} kJ
e) 84.5 kJ
7. Given:
 $60\text{C}(s) \rightarrow \text{C}_{60}(s); \Delta H = 2320 \text{ kJ}$
what is ΔH for the following thermochemical equation?
 $\frac{1}{60}\text{C}_{60}(s) \rightarrow \text{C}(s)$
- a) **-38.7 kJ**
b) +38.7 kJ
c) -2320 kJ
d) +2320 kJ
e) -139 MJ
8. Which of the following statements is false concerning the reaction of hydrogen gas and oxygen gas given below?
 $\text{H}_2(g) + \frac{1}{2}\text{O}_2(g) \rightarrow \text{H}_2\text{O}(l); \Delta H = -285.8 \text{ kJ}$
- a) If the equation is multiplied by 2, ΔH becomes -571.6 kJ.
b) If the equation is reversed, ΔH becomes +285.8 kJ.
c) Per mole of O_2 , the change in enthalpy is -571.6 kJ.
d) The value -571.6 kJ pertains to 1 mol of liquid water.
e) For the reaction $\text{H}_2(g) + \frac{1}{2}\text{O}_2(g) \rightarrow \text{H}_2\text{O}(g)$, ΔH is not equal to -285.8 kJ.

(Notice that option (e) is CORRECT given that the water is in gaseous state rather than the given liquid state)

9. What is the change in enthalpy when 3.00 mol of sulfur trioxide decomposes to sulfur dioxide and oxygen gas?



- a) -198 kJ
b) -297 kJ
c) 594 kJ
d) 297 kJ
e) 198 kJ

(Realize that decomposition of Sulfur trioxide will be the reverse of the given rxn, and the mole ratio is 3/2)

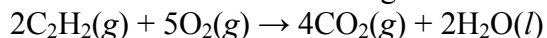
10. What is the change in enthalpy at 25°C and 1 atm for the production of 5.00 mol SnO(s)?
 $\text{Sn}(s) + \text{SnO}_2(s) \rightarrow 2\text{SnO}(s); \Delta H^\circ = 16.2 \text{ kJ}$

- a) 3.24 kJ
- b) -16.2 kJ
- c) -40.5 kJ
- d) 40.5 kJ**
- e) 16.2 kJ

11. How much heat is gained by nickel when 29.2 g of nickel is warmed from 18.3°C to 69.6°C? The specific heat of nickel is 0.443 J/(g · °C).

- a) $2.37 \times 10^2 \text{ J}$
- b) $9.00 \times 10^2 \text{ J}$
- c) 22.7 J
- d) $6.64 \times 10^2 \text{ J}$**
- e) 30.8 J

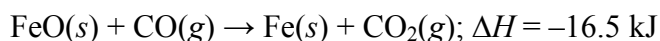
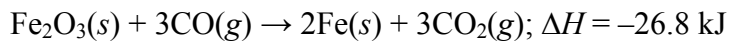
12. What is ΔH° for the following reaction?



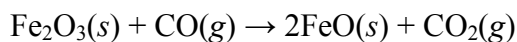
Substance	ΔH_f° (kJ/mol)
$\text{C}_2\text{H}_2(g)$	+226.7
$\text{CO}_2(g)$	-393.5
$\text{H}_2\text{O}(l)$	-285.8

- a) +1692.2 kJ
- b) -2599.0 kJ**
- c) +2599.0 kJ
- d) -1692.2 kJ
- e) -452.6 kJ

13. Given:



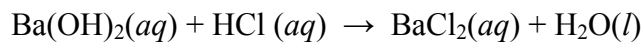
determine ΔH for the following thermochemical equation.



- a) -43.3 kJ
 - b) -10.3 kJ
 - c) **6.2 kJ**
 - d) 10.3 kJ
 - e) 22.7 kJ
14. Which substance has a standard enthalpy of formation equal to zero at 25°C?
- a) C₂H₆(g)
 - b) C₂H₆(l)
 - c) Br₂(s)
 - d) **Br₂(l)**
 - e) Br₂(g)
15. A 63.2-g sample of cobalt ($s = 0.421 \text{ J}/(\text{g} \cdot ^\circ\text{C})$), initially at 187.3°C, is placed in an insulated vessel containing 222.4 g of water ($s = 4.18 \text{ J}/(\text{g} \cdot ^\circ\text{C})$), initially at 11.8°C. Once equilibrium is reached, what is the final temperature of the metal–water mixture? Neglect the heat capacity of the vessel.
- a) **16.7°C**
 - b) 99.6°C
 - c) 6.6°C
 - d) 50.6°C
 - e) 27.9°C

WORK OUT PROBLEMS

16. For the following reaction:



- a. Name each reactant and product from above.

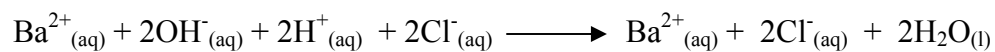
Barium hydroxide

Barium chloride

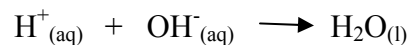
Hydrochloric acid

Water

- b. Write a balanced complete ionic equation.



- c. Write a balanced net ionic equation.



- d. If 125 mL of 0.33 M Ba(OH)₂ is present, what is the minimum amount, in L, of 0.21 M HCl that must be added to neutralize the Ba(OH)₂?

Get the number of mole of Ba(OH)₂ = 0.125 x 0.33 = 0.04125 moles

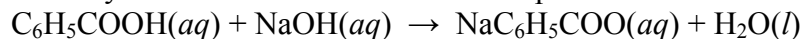
From the balanced rxn # moles of HCl used = 2 x 0.04125 = 0.0825

Therefore Vol of HCl = 0.0825/0.21 = 0.3928L = 392.8 mL of HCl

- e. If phenolphthalein is added to the Ba(OH)₂ solution prepared in Part (d) above and this solution is then titrated with HCl, how will you know when the neutralization is complete (be explicit!)?

Color change from pink to colorless at end point.

17. An impure sample of benzoic acid (C₆H₅COOH, 122.12 g/mol) is titrated with 0.1278 M NaOH. A 0.503798-g sample requires 23.81 mL of titrant to reach the endpoint. What is the percent by mass of benzoic acid in the sample?



Step by step solution

$$\# \text{ Moles of NaOH} = 0.1278M \times 0.02381L = 3.0429 \times 10^{-3}$$

From the balanced equation #moles of NaOH= # moles of Benzoic acid

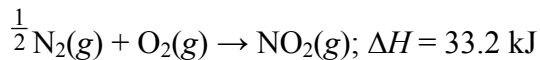
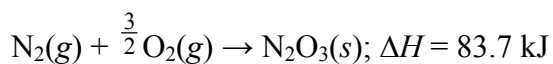
$$\text{Therefore } \# \text{ moles of benzoic acid} = 3.0429 \times 10^{-3}$$

$$\begin{aligned} \text{To convert these moles of benzoic acid to grams} &= 3.0429 \times 10^{-3} \text{ mol} \times 122.12 \text{ g/mol} \\ &= 0.3716\text{g of benzoic acid} \end{aligned}$$

$$\begin{aligned} \text{Therefore the percent by mass of benzoic acid in sample} &= (0.3716\text{g}/0.503798\text{g})100\% \\ &= 73.76\% \end{aligned}$$

(This problem was in your quiz, not well done, so it came around again)

18. Given:



what is ΔH for the following reaction?



NB

Realize that the first equation has been reversed (ΔH sign changes) and the second equation halved (ΔH halved) and then all summed up

