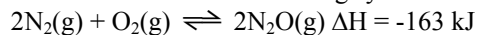


AP Chemistry Exam II

Part I: 39 Questions, 40 minutes, Multiple Choice, No Calculator Allowed

Bubble the correct answer on your scantron for each of the following.

For questions 1-6 consider the following system at equilibrium:



and select from the following choices:

- to the right
- to the left
- neither
- in both directions
- cannot be determined from information provided

- In which direction will the system move in order to reestablish equilibrium if the temperature is raised?
 - In which direction will the system move in order to reestablish equilibrium if the volume is increased?
 - In which direction will the system move in order to reestablish equilibrium if O_2 is added?
 - In which direction will the system move in order to reestablish equilibrium if a catalyst is added?
 - In which direction will the system move in order to reestablish equilibrium if N_2O is removed?
 - In which direction will the system move in order to reestablish equilibrium if a sample of Kr is added?
7. In expanding from 5.00 to 6.00 liters at a constant pressure of 2.00 atmospheres, a gas absorbs 505.64 joules of energy (101.32 J = 1 liter atm). The change in energy ΔE for the gas is:
- 50.66 J
 - 101.32 J
 - 303.00 J
 - 505.64 J
 - 606.00 J
8. A sample of 3.30 grams of an ideal gas at 150.0 °C and 1.25 atmospheres pressure has a volume of 2.00 liters. What is the molar mass of the gas? The gas constant, R, is 0.0821 L atm mol⁻¹ K⁻¹.
- 0.0218 gram/mole
 - 16.2 grams/mole
 - 37.0 grams/mole
 - 45.8 grams/mole
 - 71.6 grams/mole
9. $\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}); \Delta H = -889.1 \text{ kJ}$
 $\Delta H_f^\circ \text{H}_2\text{O}(\text{l}) = -285.8 \text{ kJ / mole}$
 $\Delta H_f^\circ \text{CO}_2(\text{g}) = -393.3 \text{ kJ / mole}$
- What is the standard heat of formation of methane, $\Delta H_f^\circ \text{CH}_4(\text{g})$, as calculated from the data above?
- 107.5 kJ/mole
 - 75.8 kJ/mole
 - 210.0 kJ/mole
 - 75.8 kJ/mole
 - 210.0 kJ/mole
10. 6.0 moles of chlorine gas are placed in a 3.0 L flask at 1250 K. At this temperature, the chlorine molecules begin to dissociate into chlorine atoms. What is the value of K_c , if 50.% of the chlorine molecules dissociate when equilibrium has been achieved?
- 12.0
 - 6.0
 - 4.0
 - 3.0
 - 1.0
11. A sample of 0.1973 mole of nitrogen gas is confined at 37° C and 0.216 atmosphere. What would be the pressure of this sample at 15° C and the same volume?
- 0.0876 atm
 - 0.175 atm
 - 0.201 atm
 - 0.233 atm
 - 0.533 atm
12. $\text{H}_2(\text{g}) + \text{CO}_2(\text{g}) \rightleftharpoons \text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g})$
- Initially, a sealed vessel contained only $\text{H}_2(\text{g})$ with a partial pressure of 6 atm and $\text{CO}_2(\text{g})$ with a partial pressure of 4 atm. The reaction above was allowed to come to equilibrium at a temperature of 700 K. At equilibrium, the partial pressure due to $\text{CO}(\text{g})$ was found to be 2 atm. What is the value of the equilibrium constant K_p , for the reaction?
- $\frac{1}{24}$
 - $\frac{1}{6}$
 - $\frac{1}{4}$
 - $\frac{1}{3}$
 - $\frac{1}{2}$
13. The density of a gas is directly proportional to its
- volume
 - pressure
 - temperature
 - kinetic energy
 - molecular velocity
14. A 3.00-liter flask initially contains 1.50 mol of gas A and 0.450 mol of gas B. Gas A decomposes according to the following reaction: $3\text{A} \rightleftharpoons 2\text{B} + \text{C}$ The equilibrium concentration of gas C is 0.100 mol/L. Determine the equilibrium concentration of gas A.
- 0.500 M
 - 0.100 M
 - 0.200 M
 - 0.300 M
 - none of these

15. At 25 °C, a sample of NH₃ (molar mass 17 grams) effuses at the rate of 0.050 mole per minute. Under the same conditions, which of the following gases effuses at approximately double that rate?

- a. O₂ (molar mass 32 grams) b. He (molar mass 4.0 grams) c. CO₂ (molar mass 44 grams)
 d. Cl₂ (molar mass 71 grams) e. CH₄ (molar mass 16 grams)

16. At constant temperature and pressure, the heats of formation for H₂O(g), CO₂(g) and C₂H₆(g) are as follows:

Species	ΔH (kJ/mole)
H ₂ O(g)	-251
CO ₂ (g)	-393
C ₂ H ₆ (g)	-84

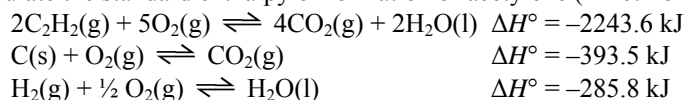
If ΔH values are negative for exothermic reactions, what is the ΔH for 1 mole of C₂H₆ gas to oxidize to carbon dioxide gas and water vapor (temperature and pressure are held constant)?

- a. -8730 kJ/mole b. -2910 kJ/mole c. -1455 kJ/mole
 d. 1455 kJ/mole e. 2910 kJ/mole

17. Which of the following statements correctly describes the signs of q and w for the following exothermic process at P = 1 atm and T = 370 K? H₂O(g) → H₂O(l)

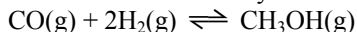
- a. q is negative, w is positive b. q and w are negative c. q and w are both positive
 d. q is positive, w is negative e. q and w are both zero.

18. Calculate the standard enthalpy of formation of acetylene (in kJ.mol⁻¹).



- a. 49.0 b. 98.0 c. 1121.8 d. 1564.3 e. 147.0

19. A sealed isothermal container initially contained 2 moles of CO gas and 3 moles of H₂ gas. The following reversible reaction occurred:



At equilibrium, there was 1 mole of CH₃OH in the container. What was the total number of moles of gas present in the container at equilibrium?

- a. 1 b. 2 c. 3 d. 4 e. 5

20. Which of the following would express the approximate density of carbon dioxide gas at 0°C and 1.00 atm pressure (in grams per liter)?

- a. 2 g/L b. 4 g/L c. 6 g/L d. 8 g/L e. none of the above

21. In which of the following reactions does ΔH_f° = ΔH_{rxn}°?

- a. O(g) + O₂(g) → O₃(g) b. H₂(g) + F₂(s) → 2HF(g) c. H₂(g) + FeO(s) → H₂O(l) + Fe(s)
 d. C(diamond) + O₂ → CO₂(g) e. none of the reactions

22. For which reaction does K_p = K_c?

- a. 2C(s) + O₂(g) ⇌ 2CO(g) b. N₂(g) + 3H₂(g) ⇌ 2NH₃(g)
 c. 2H₂(g) + O₂(g) ⇌ 2H₂O(g) d. H₂(g) + I₂(g) ⇌ 2HI(g)
 e. 2S(s) + 3O₂(g) ⇌ 2SO₃(g)

23. If the absolute temperature of a sample of gas is increased by a factor of 1.5, by what ratio does the average molecular speed of its molecules increase?

- a. 1.2 b. 1.5 c. 2.2 d. 3.0 e. 0.75

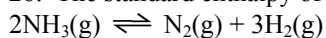
24. The density of an unknown gas is 4.20 grams per liter at 3.00 atmospheres pressure and 127 °C. What is the molecular weight of this gas? (R = 0.0821 liter-atm / mole-K)

- a. 14.6 b. 46.0 c. 88.0 d. 94.1 e. 138

25. A hydrocarbon gas with an empirical formula CH₂ has a density of 1.88 grams per liter at 0 °C and 1.00 atmosphere. A possible formula for the hydrocarbon is

- a. CH₂ b. C₂H₄ c. C₃H₆ d. C₄H₈ e. C₅H₁₀

26. The standard enthalpy of formation for NH₃(g) is -46.1 kJ.mol⁻¹. Calculate ΔH° for the reaction:



- a. -92.2 kJ b. -46.1 kJ c. 46.1 kJ d. 92.2 kJ e. 23.0 kJ

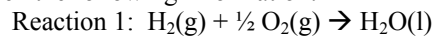
27. Oxygen, which is 16 times as dense as hydrogen, diffuses:
- 1/16 times as fast.
 - 1/4 times as fast.
 - 4 times as fast.
 - 16 times as fast
 - equally as fast as hydrogen.
28. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmosphere. What is the partial pressure of the nitrogen?
- 6.3 atm
 - 0.90 atm
 - 0.63 atm
 - 0.27 atm
 - 0.13 atm
29. A sample of 5.0 grams of an ideal gas at 121 °C and 1.4 atmosphere pressure has a volume of 1.5 liters. Which of the following expressions is correct for the molar mass of the gas? The ideal gas constant, R, is 0.08 (L-atm) / (mole K).
- $[(0.08)(400)] / [(5.0)(1.4)(1.5)]$
 - $[(1.4)(1.5)] / [(5.0)(0.08)(400)]$
 - $[(0.08)(1.4)(1.5)] / [(5.0)(400)]$
 - $[(5.0)(0.08)(400)] / [(1.4)(1.5)]$
 - $[(5.0)(0.08)(1.5)] / (1.4)(400)$
30. A piece of metal weighing 418.6 grams was put into a boiling water bath. After 10 minutes, the metal was immediately placed in 250.0 grams of water at 40.0°C. The maximum temperature that the system reached was 50.0 °C. What is the specific heat of the metal? The specific heat of the water is 4.186 J/g°C.
- 8.00 J/g°C
 - 4.00 J/g°C
 - 2.00 J/g°C
 - 1.00 J/g°C
 - 0.500 J/g°C
31. Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the largest change in temperature?
- The metal with the higher heat capacity
 - The metal with the lower heat capacity.
 - Both undergo the same change in temperature
 - You need to know the initial temperatures of the metals.
 - You need to know which metals you have.
32. For a certain reaction at 298K, the value of K is 1.2×10^{-1} . At 323K the value of K is 3.4×10^{-3} . This means that the reaction is:
- endothermic.
 - exothermic.
 - never favorable.
 - More information is needed.
 - None of these.
33. The equilibrium constant for the reaction: $\text{CO(g)} + \text{H}_2\text{O(g)} \rightleftharpoons \text{CO}_2\text{(g)} + \text{H}_2\text{(g)}$ is 26 at 50°C. What is the K_c for $\text{CO}_2\text{(g)} + \text{H}_2\text{(g)} \rightleftharpoons \text{CO(g)} + \text{H}_2\text{O(g)}$ at the same temperature?
- 0.34
 - 1.8×10^4
 - 0.038
 - 5.7×10^{-5}
 - 2.9
34. What is the heat capacity of a substance if it requires 1973 J to change the temperature of 55.0 g mercury from 15.0°C to 60.0°C?
- 313 J/g °C
 - 6.92×10^{-3} J/g °C
 - 0.797 J/g °C
 - 0.445 J/g °C
 - 1.39 J/g °C
35. Given these two standard enthalpies of formation:
- Reaction 1: $\text{SO}_2 \rightleftharpoons \text{S(s)} + \text{O}_2\text{(g)}$ $\Delta H^\circ = 295$ kJ/mole
- Reaction 2: $\text{S(s)} + \frac{3}{2} \text{O}_2\text{(g)} \rightleftharpoons \text{SO}_3\text{(g)}$ $\Delta H^\circ = -395$ kJ/mole
- What is the heat of reaction for $2\text{SO}_3\text{(g)} \rightleftharpoons 2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)}$ under the same conditions?
- 1380 kJ/mole
 - 200. kJ/mole
 - 100 kJ/mole
 200. kJ/mole
 - 100. kJ/mole
36. 73.0 grams of $\text{O}_2\text{(g)}$ and 73.0 grams of He(g) are in separate containers of equal volume. Both gases are at 197°C. Which of the following statements is true?
- Both gases would have the same pressure.
 - The average kinetic energy of the O_2 molecules is greater than that of the He molecules.
 - The pressure of the He(g) would be greater than that of the $\text{O}_2\text{(g)}$.
 - There are equal numbers of He molecules and O_2 molecules.
 - The average kinetic energy of the He molecules is greater than that of the O_2 molecules.
37. Which one of the following is NOT an assumption of the kinetic theory of gases?
- Gas particles don't attract each other.
 - Gas particles are in constant motion.
 - Gas particles are negligibly small.
 - Gas particles undergo elastic collisions.
 - Gas particles undergo a decrease in kinetic energy when passed from a region of high pressure to a region of low pressure.

38. Sulfur trioxide gas dissociates into sulfur dioxide gas and oxygen gas at 1250°C. In an experiment 3.60 moles of sulfur trioxide were placed into an evacuated 3.0 L flask. The concentration of sulfur dioxide gas measured at equilibrium was found to be 0.20 M.

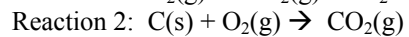
What is the equilibrium constant K_c for the reaction?

- a. 8.0×10^{-3} b. 4.0×10^{-3} c. 2.0×10^{-3} d. 1.0×10^{-3} e. 1.6×10^{-4}

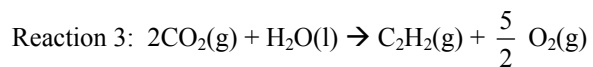
39. Given the following information:



$$\Delta H^\circ = -286 \text{ kJ}$$



$$\Delta H^\circ = -394 \text{ kJ}$$



$$\Delta H^\circ = 1300 \text{ kJ}$$

Find ΔH° for the reaction: $\text{C}_2\text{H}_2(\text{g}) \rightarrow 2\text{C}(\text{s}) + \text{H}_2(\text{g})$

- a. -226 kJ b. -113 kJ c. 113 kJ d. 226 kJ e. 452 kJ

