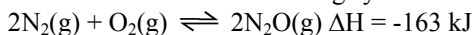


AP Chemistry Exam II**Part I: 38 Questions, 40 minutes, Multiple Choice, No Calculator Allowed****Bubble the correct answer on your scantron for each of the following.**

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

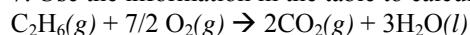


and select from the following choices:

- 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. Use the information in the table to calculate the enthalpy of this reaction.



Reaction	ΔH_f° , $\text{kJ}\cdot\text{mol}^{-1}$
$2\text{C}(\text{s}) + 3\text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$	-84.7
$\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$	-393.5
$\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$	-285.8

- (A) -764 kJ (B) -1560 kJ (C) -1664 kJ (D) -3120 kJ (E) -595 kJ

8. Under which conditions will a gas behave most ideally?

- (A) low P and high T (B) low P and low T (C) high P and low T
(D) high P and high T (E) a gas will behave ideally at all conditions

9. Which statement is true for a reaction at equilibrium?

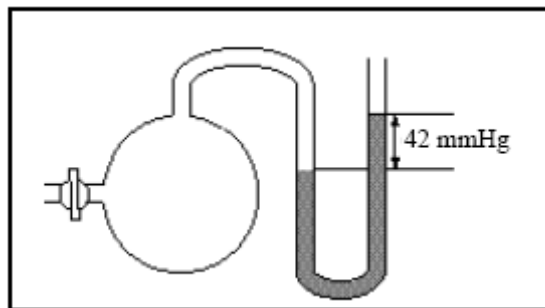
- (A) All reaction ceases.
(B) The reaction has gone to completion.
(C) The rates of the forward and reverse reactions are equal.
(D) The amount of product equals the amount of reactant.
(E) The forward reaction ends and the reverse reaction begins.

10. A sample of neon gas has a volume of 248 mL at $30.^\circ\text{C}$ and a certain pressure. What volume would it occupy if it were heated to $60.^\circ\text{C}$ at the same pressure?

- (A) 226 mL (B) 273 mL (C) 278 mL
(D) 496 mL (E) 124 mL

11. A gas is collected in the flask shown here. What is the pressure exerted by the gas if the atmospheric pressure is 735 mmHg?

- (A) 42 mmHg (B) 693 mmHg
(C) 735 mmHg (D) 777 mmHg
(E) 84 mmHg



12. For the reaction: $2\text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g)$ $\Delta H^\circ < 0$

Which change(s) will increase the fraction of $\text{SO}_3(g)$ in the equilibrium mixture?

1. Increasing the pressure
2. Increasing the temperature
3. Adding a catalyst

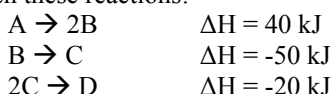
(A) 1 only (B) 2 only (C) 3 only (C) 1 and 3 only (D) 1, 2 and 3

13. A sample of oxygen gas and a sample of an unknown gas are weighed separately in the same evacuated flask. Use the data given to find the molar mass of the unknown gas (assume experiments are carried out at the same pressure and temperature).

Mass of evacuated flask	124.46 g
Mass of flask + oxygen	125.10 g
Mass of flask + unknown gas	125.34 g

(A) 22 g/mol (B) 38 g/mol (C) 44 g/mol (D) 84 g/mol (E) 66 g/mol

14. Given these reactions:



Calculate ΔH for the reaction; $\text{D} + \text{A} \rightarrow 4\text{C}$.

(A) -100 kJ (B) -60 kJ (C) -40 kJ (D) 100 kJ (E) -30 kJ

15. $\text{C}_2\text{H}_6(g) + 7/2\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(g)$ $\Delta H^\circ = -1427.7 \text{ kJ}$

If the enthalpy of vaporization for $\text{H}_2\text{O}(l)$ is 44.0 kJ/mol, what is ΔH° for this reaction if $\text{H}_2\text{O}(l)$ is formed instead of $\text{H}_2\text{O}(g)$?

(A) -1295.7 kJ (B) -1383.7 kJ (C) -1471.7 kJ (D) -1559.7 kJ (E) -1515.7 kJ

16. A gas mixture at 27°C and 760 mm Hg contains 1.0 g each of He, H_2 , N_2 and CO_2 . How do their average molecular speeds compare?

(A) $\text{He} = \text{H}_2 = \text{N}_2 = \text{CO}_2$ (B) $\text{CO}_2 < \text{H}_2 = \text{N}_2 < \text{He}$ (C) $\text{He} < \text{H}_2 < \text{N}_2 < \text{CO}_2$
(D) $\text{CO}_2 < \text{N}_2 < \text{He} < \text{H}_2$ (E) $\text{H}_2 < \text{He} < \text{N}_2 < \text{CO}_2$

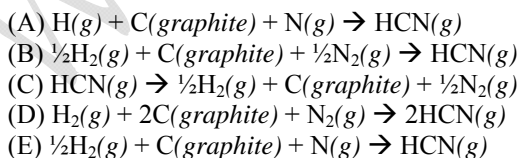
17. For which of these is ΔH_f° not equal to zero?

(A) $\text{Br}_2(l)$ (B) $\text{Fe}(s)$ (C) $\text{I}_2(s)$ (D) $\text{O}_3(g)$ (E) $\text{Xe}(g)$

18. Helium is often found with methane, CH_4 . How do the diffusion rates of helium and methane compare at the same temperature? Helium diffuses

(A) sixteen times as fast as methane. (B) four times as fast as methane.
(C) twice as fast as methane. (D) at the same rate as methane.
(E) half as fast as methane.

19. The enthalpy change for which reaction represents the standard enthalpy of formation for hydrogen cyanide, HCN?



20. What is the molar mass of a gas if 10.0 grams of it occupy 4.48 liters at 273 K and 101.3 kPa (1.00 atm)?

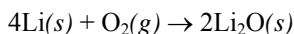
(A) 2.00 g/mol (B) 25.0 g/mol (C) 50.0 g/mol (D) 100. g/mol (E) 75.0 g/mol

21. The specific heats of several metals are given in the table. If the same number of Joules were applied to the same mass of each metal, which metal would show the greatest temperature change?

Substance	Specific Heat, $\text{J}\cdot\text{g}^{-1}\cdot^{\circ}\text{C}^{-1}$
Al	0.900
Au	0.129
Cu	0.385
Hg	0.139

- (A) Al (B) Au (C) Cu (D) Hg (E) all would be equal

22.



At 25°C , ΔH° for this reaction is -598.8 kilojoules per mole of $\text{Li}_2\text{O}(s)$ formed. What mass of Li should be reacted with excess $\text{O}_2(g)$ in order to release $150.$ kJ?

- (A) 0.874 g (B) 1.74 g (C) 3.48 g (D) 6.98 g (E) 7.52 g

23. A 2.00 liter evacuated container has a mass of 1050.0 g. When the container is filled with an unknown gas at 800. mm Hg pressure and 25.0°C the mass is 1052.4 g. What is the molar mass of the gas (in $\text{g}\cdot\text{mol}^{-1}$)?

- (A) 28 (B) 31 (C) 54 (D) 56 (E) 62

24. Consider this reaction. $2\text{N}_2\text{H}_4(l) + \text{N}_2\text{O}_4(l) \rightarrow 3\text{N}_2(g) + 4\text{H}_2\text{O}(g)$ $\Delta H = -1078$ kJ

How much energy is released by this reaction during the formation of 140. g of $\text{N}_2(g)$?

- (A) 1078 kJ (B) 1797 kJ (C) 3234 kJ (D) 5390 kJ (E) 16170 kJ

25. Calculate the amount of energy released when 0.100 mol of diborane, B_2H_6 , reacts with oxygen to produce solid B_2O_3 and steam.

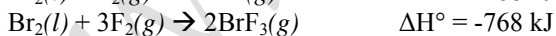
Substance	ΔH_f° , ($\text{kJ}\cdot\text{mol}^{-1}$)
$\text{B}_2\text{H}_6(g)$	35
$\text{B}_2\text{O}_3(s)$	-1272
$\text{H}_2\text{O}(l)$	-285
$\text{H}_2\text{O}(g)$	-241

- (A) 203 kJ (B) 216 kJ (C) 330 kJ (D) 343 kJ (E) 124 kJ

26. How much heat is required to raise the temperature of 100. g of Fe_2O_3 from 5.0°C to 25.0°C ? (Specific heat Fe_2O_3 , $0.634 \text{ J}\cdot\text{g}^{-1}\cdot^{\circ}\text{C}^{-1}$)

- (A) 1.58 kJ (B) 1.27 kJ (C) 0.845 kJ (D) 0.0634 kJ (E) 1.902 kJ

27. Given the thermochemical equations:



Determine ΔH° for the reaction: $\text{BrF}(g) + \text{F}_2(g) \rightarrow \text{BrF}_3(g)$ $\Delta H^{\circ} = ?$

- (A) -956 kJ (B) -580 kJ (C) -478 kJ (D) -290 kJ (E) 580 kJ

28. When a bomb calorimeter is used to determine the heat of reaction, which property of the system under investigation is most likely to remain constant?

- (A) number of molecules (B) pressure (C) temperature (D) volume (E) number of moles

29. A 0.239 g sample of a gas in a 100-mL flask exerts a pressure of 600 mmHg at 14°C . What is the gas?

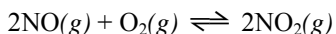
- (A) chlorine (B) nitrogen (C) krypton (D) xenon (E) oxygen

30. Hydrogen gas is collected over water at 24°C . The total pressure of the sample is 755 millimeters of mercury.

At 24°C , the vapor pressure of water is 22 millimeters of mercury. What is the partial pressure of the hydrogen gas?

- (A) 22 mm Hg (B) 733 mm Hg (C) 755 mm Hg (D) 760 mm Hg (E) 777 mm Hg

Questions 31 and 32 should both be answered with reference to this reaction, for which ΔH° is negative.



31. Which would increase the partial pressure of $\text{NO}_2(g)$ at equilibrium?

- (A) decreasing the volume of the system (B) adding a noble gas to increase the pressure of the system
(C) removing some $\text{NO}(g)$ from the system (D) adding an appropriate catalyst
(E) none of the above

32. At a certain temperature the equilibrium concentrations for this system are: $[\text{NO}] = 0.52\text{M}$; $[\text{O}_2] = 0.24\text{M}$; $[\text{NO}_2] = 0.18\text{M}$.

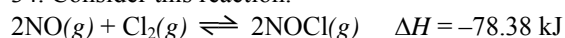
What is the value of K_C at this temperature?

- (A) 0.063 (B) 0.50 (C) 1.4 (D) 2.0 (E) 1.0

33. Three balloons are filled with the same number of atoms of He, Ar, and Xe, respectively. Which statement is true under the same conditions of temperature and pressure?

- (A) The balloons contain the same mass of gas.
(B) All balloons have the same volume.
(C) The densities of the three gases are the same.
(D) The average speed of the different types of atoms is the same.
(E) All gases have the same root mean square velocity.

34. Consider this reaction.



What conditions of temperature and pressure will produce the highest yield of NOCl at equilibrium?

	<i>T</i>	<i>P</i>
(A)	high	high
(B)	high	low
(C)	low	high
(D)	low	low
(E)	medium	medium

35.

Substance	Specific Heat Capacity ($\text{J} \cdot \text{g}^{-1} \cdot ^\circ\text{C}^{-1}$)
Au	0.129
H_2O	4.18

A gold ring that weighs 3.81 g is heated to 84.0°C and placed in 50.0 g of H_2O at 22.1°C . What is the final temperature?

- (A) 22.2°C (B) 24.0°C (C) 26.5°C (D) 53.1°C (E) 30.5°C

36. When the actual gas volume is greater than the volume predicted by the ideal gas law, the explanation lies in the fact that the ideal gas law does NOT include a factor for molecular.

- (A) volume (B) mass (C) velocity (D) attractions (E) shape

37. In which of the following systems would the number of moles of the substances present at equilibrium NOT be shifted by a change in the volume of the system at constant temperature?

- (A) $\text{CO}(g) + \text{NO}(g) \rightleftharpoons \text{CO}_2(g) + \frac{1}{2} \text{N}_2(g)$ (B) $\text{N}_2(g) + 3 \text{H}_2(g) \rightleftharpoons 2 \text{NH}_3(g)$
(C) $\text{N}_2(g) + 2 \text{O}_2(g) \rightleftharpoons 2 \text{NO}_2(g)$ (D) $\text{N}_2\text{O}_4(g) \rightleftharpoons 2 \text{NO}_2(g)$
(E) $\text{NO}(g) + \text{O}_3(g) \rightleftharpoons \text{NO}_2(g) + \text{O}_2(g)$

38. Which of the following is the correct equilibrium expression for the hydrolysis of CO_3^{2-} ?

- (A) $K = [\text{HCO}_3^-] / ([\text{CO}_3^{2-}][\text{H}_3\text{O}^+])$ (B) $K = ([\text{HCO}_3^-][\text{OH}^-]) / [\text{CO}_3^{2-}]$
(C) $K = ([\text{CO}_3^{2-}][\text{OH}^-]) / [\text{HCO}_3^-]$ (D) $K = [\text{CO}_3^{2-}] / ([\text{CO}_2][\text{OH}^-]^2)$
(E) $K = ([\text{CO}_3^{2-}][\text{H}_3\text{O}^+]) / [\text{HCO}_3^-]$