

INTRODUCTION TO CHEMICAL THERMODYNAMICS

CHOOSE THE BEST ANSWER FROM THE GIVEN ALTERNATIVES

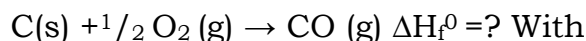
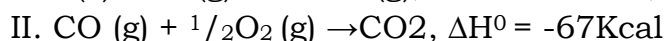
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8. "Entropy of the Universe increases spontaneously & remains constant at equilibrium" this statement is

- A. First Law of thermodynamics
- B. Second Law of thermodynamics**
- C. Faraday's first law of electrolysis
- D. Dalton's Law of partial pressure.

9. What is the heat of formation for the reaction?

Given



- A.** -27Kcal B. 27 Kcal C. 62Kcal D. -62Kcal

10. Thermodynamic systems in which neither energy nor matter exchanged is ____

- A. Open system
- B. Closed system
- C. an isolated system**
- D. adiabatic system

11. Which of the following is not an intensive property?

- A.** Mass B. Temperature C. Color D. Density

12. Which of the following is non-spontaneous process?

- A. The rusting of iron
- B. The dissolution of salt in water
- C. rolling of stone from hill
- D. Cleaning room**

13. Enthalpy is defined as the heat content of the system at constant ____

- A. Heat
- B. moles
- C. Pressure**
- D. Volume

14. From a certain chemical reaction, 9.44kJ of heat energy was liberated and 2.5kJ of work is done by the system. Then what is change in internal energy of the system?

- A. 6.94KJ **B. -11.94KJ** C. 11.94KJ D. -6.94KJ

15. Thermodynamics properties of substances that related to the degree of randomness of molecule (particles) is called ____

- A.** entropy B. enthalpy C. Gibb's free energy D. bond energy

16. Which of the following has lowest entropy?

- A.** CO₂ (s) B. CO₂ (g) C. CO₂ (aq) D. All

17. Which of the following is intensive physical property of substances?

- A. Color
- B. boiling point
- C. melting point
- D. All**

18. In chemical thermodynamics during bond formation;

- A. Energy is absorbed
- B. Energy is neither absorbed nor released out
- C. Energy is released out**
- D. A and C

19. The temperature at which pressure from the surface of liquid is equals to 1 atmosphere is called_____
- A. Boiling point B. Freezing point
C. Melting point D. Critical point
20. For the following thermodynamic quantities, which of the following criteria satisfies the spontaneity of the reaction?
- A. $\Delta G < 0$ B. $\Delta S > 0$ C. $\Delta H < 0$ D. All
21. Which of the following is true of thermodynamics?
- A. Energy lost by the system is gained by surrounding
B. Energy gained is equals to energy lost but opposite in sign
C. The universe is sum of the system & surrounding
D. All are correct
22. Which one of the following thermodynamic quantities is **not** a state function?
- A. Gibbs free energy B. enthalpy
C. internal energy D. work
23. At a constant temperature, an ideal gas is compressed from 6.0 liters to 4.0 liters by a constant external pressure of 5.0 atm. How much work is done on the gas?
- A. $w = +10$ liter atm B. $w = -10$ liter atm
C. $w = +30$ liter atm D. $w = -30$ liter atm
24. A system suffers an increase in internal energy of 80 J and at the same time has 50 J of work done on it. What is the heat change of the system?
- A. +130 J B. +30 J C. -130 J D. -30 J
25. A 5.000 g sample of methanol, CH_3OH , was combusted in the presence of excess oxygen in a bomb calorimeter containing 4000 g of water. The temperature of the water increased from 24.000 °C to 29.765 °C. The heat capacity of the calorimeter was 2657 J/°C. The specific heat of water is 4.184 J/g°C. Calculate ΔE for the reaction in kJ/mol.
- A. -314 kJ/mol B. -789 kJ/mol C. -716 kJ/mol D. -121 kJ/mol
26. The ΔH° for the following reaction at 298 K is -36.4 kJ.
- $$\frac{1}{2} \text{H}_2(\text{g}) + \frac{1}{2} \text{Br}_2(\text{l}) \rightarrow \text{HBr}(\text{g})$$
- Calculate ΔE° at 298 K. The universal gas constant, R, is 8.314 J/mol K.
- A. -35.2 KJ B. +35.2 kJ C. -36.4 kJ D. -37.6 kJ
27. Calculate the amount of work done for the conversion of 1.00 mole of Ni to $\text{Ni}(\text{CO})_4$ in the reaction below, at 75°C. Assume that the gases are ideal. The value of R is 8.31 J/mol. K.
- $$\text{Ni}(\text{s}) + 4 \text{CO}(\text{g}) \rightarrow \text{Ni}(\text{CO})_4(\text{g})$$
- A. 1.80×10^3 J B. 8.68×10^3 J C. -1.80×10^3 J D. -8.68×10^3 J

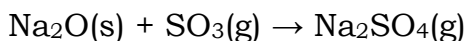
28. All of the following have a standard heat of formation value of zero at 25°C and 1.0 atm **except**:

- A. N₂ (g) B. Fe (s) C. Ne (g) **D. H (g)**

29. For which of the following reactions would the ΔH° for the reaction be labeled ΔH_f° ?

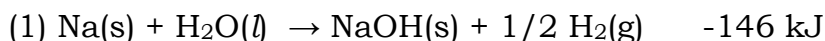
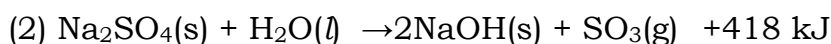
- A.** Al(s) + 3/2 H₂(g) + 3/2 O₂(g) → Al(OH)₃(s)
 B. PCl₃(g) + 1/2 O₂(g) → POCl₃(g)
 C. 1/2 N₂O(g) + 1/4 O₂(g) → NO(g)
 D. CaO(s) + SO₂(g) → CaSO₃(s)

30. Calculate ΔH° for the reaction:



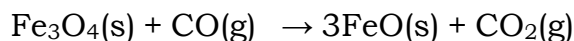
given the following information:

ΔH°



- A. +255 KJ B. -435 kJ **C. -581 kJ** D. +531 kJ

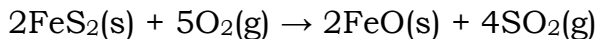
31. Calculate $\Delta H^\circ_{\text{rxn}}$ for the following reaction at 25.0 °C:



ΔH_f° (kJ/mol) -1118 -110.5 -272 -393.5

- A. -263 KJ B. 54 KJ **C. 19 kJ** D. -50 KJ

32. Calculate the standard heat of formation, ΔH_f° , for FeS₂(s), given the following information:



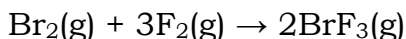
$\Delta H^\circ_{\text{rxn}} = -1370 \text{ kJ}$

ΔH_f° for SO₂(g) = -297 kJ/mol

ΔH_f° for FeO(s) = -268 kJ/mol

- A.** -177 KJ B. -1550 KJ C. -774 kJ D. -686 KJ

33. Estimate the heat of reaction at 298 K for the reaction shown, given the average bond energies below.



Bond Bond Energy

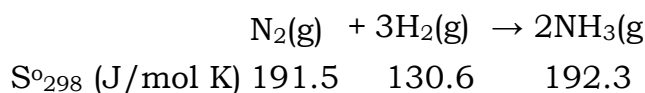
Br-Br =192 kJ

F-F =158 kJ

Br-F = 197 kJ

- A.** -516 KJ B. -410 KJ C. -611 kJ D. -665 KJ

34. What is the standard entropy change of the reaction below at 298 K with each compound at the standard pressure?



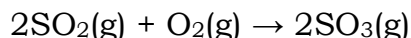
- A. -198.7 J/K B. 76.32 J/K
C. 303.2 J/K D. -129.7 J/K

35. The entropy will usually increase when

- I. a molecule is broken into two or more smaller molecules.
- II. a reaction occurs that results in an increase in the number of moles of gas.
- III. a solid changes to a liquid.
- IV. a liquid changes to a gas.

- A. I, II, III, and IV B. II only
C. III only D. IV only

36. Calculate ΔG° for the reaction given the following information:



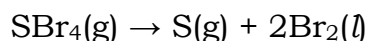
$$\Delta G_f^\circ \text{ for } \text{SO}_2(\text{g}) = -300.4 \text{ kJ/mol}$$

$$\Delta G_f^\circ \text{ for } \text{SO}_3(\text{g}) = -370.4 \text{ kJ/mol}$$

- A. -70.0 KJ B. +70.0 kJ C. -670.8 kJ D. -140.0 kJ

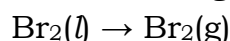
37. For the following reaction at 25°C, $\Delta H^\circ = +115 \text{ kJ}$ and $\Delta S^\circ = +125 \text{ J/K}$.

Calculate ΔG° for the reaction at 25°.



- A. +152 KJ B. -56.7 kJ C. +77.8 kJ D. +37.1 KJ

38. Estimate the boiling point of $\text{Br}_2(\text{l})$ ($\Delta H = 30.9 \text{ kJ}$; $\Delta S = 93.0 \text{ J/K}$).



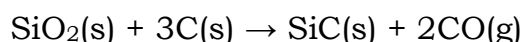
- A. 85°C B. 373°C C. 177°C D. 59°C

39. For the reaction, $\text{A} + \text{B} \rightarrow \text{C}$, $\Delta H^\circ = +30 \text{ kJ}$; $\Delta S^\circ = +50 \text{ J/K}$.

Therefore the reaction is:

- A. Spontaneous at all temperatures.
- B. Nonspontaneous at all temperatures.
- C. Spontaneous at temperatures less than 600 K.
- D. Spontaneous at temperatures greater than 600 K..

40. How much heat is absorbed in the complete reaction of 3.00 grams of SiO_2 with excess carbon in the reaction below? ΔH° for the reaction is +624.7 kJ.



- A. 366 KJ B. $1.13 \times 10^5 \text{ kJ}$ C. 5.06 KJ D. 31.2 kJ

41. The standard heat of combustion of ethanol, $\text{C}_2\text{H}_5\text{OH}$, is 1372 kJ/mol ethanol. How much heat (in kJ) would be liberated by completely burning a 20.0 g sample?
- A. 686 KJ B. 519 kJ
C. 715 kJ D. 597 kJ
42. Which statement is **incorrect**?
- A. At constant pressure, $\Delta H = \Delta E + PV$
B. The thermodynamic symbol for entropy is S.
C. Gibbs free energy is a state function.
D. For an endothermic process, ΔH is negative.
43. Which statement is **false**?
- A. The thermodynamic quantity most easily measured in a "coffee cup" calorimeter is ΔH .
B. No work is done in a reaction occurring in a bomb calorimeter.
C. ΔH is sometimes exactly equal to ΔE .
D. ΔH is equal to ΔE for the reaction: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$
44. The entropy of water is highest at?
- A. 0°C B. 25°C C. 100°C D. all
45. Under which of the ff thermodynamics condition, the reaction is *always non-spontaneous*.
- A. $\Delta H < 0$, $\Delta S > 0$, $\Delta G < 0$ B. $\Delta H > 0$, $\Delta S < 0$, $\Delta G > 0$
C. $\Delta H < 0$, $\Delta S < 0$, $\Delta G < 0$ D. $\Delta H > 0$, $\Delta S > 0$, $\Delta G > 0$
46. The molar heat capacity of $\text{CH}_3\text{CH}_2\text{OH}$ with specific heat capacity of 2.46 J/gK is (C = 12, O = 16, H = 1)
- A. 113.16 J/mol.k B. 71.34 J/mol.k
C. 11.78 J/mol.k D. 18.69 J/mol.k
47. A balloon is inflated to its full extent by heating the air inside it. In the final stages of this process the volume of the balloon changes from $4 \times 10^6 \text{ L}$ to $4.5 \times 10^6 \text{ L}$ by addition of $1.3 \times 10^8 \text{ J}$ of energy as heat. Assuming the balloon expands against a constant pressure of 1 atm, what is the ΔE for the process? (1 L.atm = 101.3J)
- A. $5 \times 10^5 \text{ J}$ B. $5 \times 10^7 \text{ J}$
C. $8 \times 10^7 \text{ J}$ D. $4 \times 10^6 \text{ J}$
48. From a certain chemical reaction, 9.44kJ of heat energy was liberated and 2.5kJ of work is done by the system. Then what is change in internal energy of the system?
- A. 6.94KJ B. -11.94KJ C. 11.94KJ D. -6.94KJ

49. A mode of transference of energy involved when petrol undergoes combustion in an internal combustion engine is:
- A. Heat as well as light
 - B. Heat as well as electricity
 - C. Heat
 - D. Work as well as heat
50. A certain system which can exchange energy but not matter with the surroundings is classified as:
- A. Open system
 - B. Isolated system
 - C. Closed system
 - D. Heterogeneous system
51. In thermodynamic, a quantity whose value simply depends upon the initial and final state of the system is called:
- A. State function
 - B. Thermodynamic quantity
 - C. Adiabatic quantity
 - D. Path function
52. All naturally-occurring processes proceed spontaneously in a direction which leads to:
- A. increase in enthalpy of a system
 - B. decrease in free energy of a system
 - C. decrease in entropy of a system
 - D. increase in free energy of a system

THANK YOU!