ANANDALAYA
PERIODIC TEST -3
Class: XI

Subject: Chemistry (043)	MM : 40
Date : 10-01-2024	Time: 1 Hr. 30 min.

General Instructions:
(1) There are 20 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
(3) Section A consists of twelve MCQs of 1 mark each, Section B consists of two questions of 2 marks each, Section C consists of two questions of 3 marks each, Section D consists of two long questions of 5 marks each and Section E consists two case study-based questions of 4 marks each.
(4) There is no overall choice. However, an internal choice has been provided in section D and E. You have to attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.

SECTION A

1. The state of a gas can be described by quoting the relationship between ___, ____ and _____. (1)
   (A) pressure, volume, temperature   (B) temperature, amount, pressure
   (C) amount, volume, temperature   (D) pressure, volume, temperature, amount

2. The volume of gas is reduced to half from its original volume. The specific heat will ____. (1)
   (A) reduce to half   (B) be doubled   (C) remain constant   (D) increase four times

3. Which of the following is not correct? (1)
   (A) ΔG is zero for a reversible reaction
   (B) ΔG is positive for a spontaneous reaction
   (C) ΔG is negative for a spontaneous reaction
   (D) ΔG is positive for a non-spontaneous reaction

4. The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are, –890.3 kJ mol^{-1} –393.5 kJ mol $^{-1}$, and –285.8 kJ mol^{-1} respectively. Enthalpy of formation of CH4 (g) will be: (1)
   (A) – 74.8 kJ mol^{-1} (B) – 52.27 kJ mol^{-1} (C) +74.8 kJ mol^{-1} (D) +52.26 kJ mol^{-1}

5. A reaction, $A + B \rightarrow C + D + q$ is found to have a positive entropy change. The reaction will be _____. (1)
   (A) possible at high temperature   (B) possible only at low temperature
   (C) not possible at any temperature   (D) possible at any temperature

6. What is the effect of adding helium gas (at constant volume) to an equilibrium mixture of this reaction: $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$? (1)
   (A) The reaction shifts toward the products.   (B) The reaction shifts toward the reactants.
   (C) The reaction does not shift in either direction.   (D) The reaction slows down

7. Consider the reaction between NO and Cl_2 to form NOCl. (1)
   $$2 NO(g) + Cl_2(g) \rightleftharpoons 2 NOCl(g)$$
   A reaction mixture at a certain temperature initially contains only [NO] = 0.50 M and [Cl_2] = 0.50 M. After the reaction comes to equilibrium, the concentration of NOCl is 0.30 M. Find the value of the equilibrium constant (Kc) at this temperature.
   (A) 11   (B) 4.3   (C) 6.4   (D) 0.22

8. What is the OH^- concentration in an aqueous solution at 25°C in which (1)
$[H_3O^+] = 1.9$ x 10^{-9} M?
(A) 1.9 x 10^{-9} M?   (B) 5.3 x 10^{-6} M?   (C) 5.3 x 10^{+6} M?   (D) 1.9 x 10^{-23} M?

9. Consider the given acid ionization constants and identify the strongest conjugate base. (1)

Acid	K_a
HNO_2(aq)	4.6×10^{-4}
$HCHO_2$(aq)	1.8×10^{-4}
$HClO$(aq)	2.9×10^{-4}
HCN(aq)	4.9×10^{-4}

.
(A) NO_2^- (aq)   (B) CHO_2^-(aq)   (C) ClO^-(aq)   (D) CN^-(aq)

10. Which pair is a Brønsted–Lowry conjugate acid–base pair? (1)

(A) NH_3 ; NH_4^+ (B) H_3O^+ ; OH^- (C) HCl ; HBr   (D) ClO_4^- ; ClO_3^-

For question numbers 11 and 12, two statements are given-one labelled Assertion and the other labelled Reason. Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.
(C) Assertion is true but Reason is false
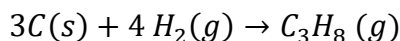(D) Assertion is false but Reason is true.

11. **Assertion (A):** Spontaneous process is an irreversible process and may be reversed by some (1)
external agency.
Reason (R): Decrease in enthalpy is a contributory factor for spontaneity.

12. **Assertion (A):** A catalyst does not influence the values of the equilibrium constant. (1)
Reason (R): Catalysts influence the rate of both forward and backward reactions equally.
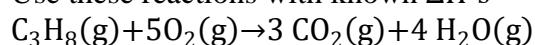
SECTION B
13. Calculate the number of kJ of heat necessary to raise the temperature of 60.0 g of aluminium (2)
from 35°C to 55°C. Molar heat capacity of Al is 24 J mol^{-1} K^{-1} .

14. Consider this reaction at equilibrium: 2 $KClO_3$(s) $\rightleftharpoons$ 2 KCl(s) + 3 O_2(g) Predict whether the (2)
reaction will shift left, shift right, or remain unchanged after each disturbance.
 (a) O_2 is removed from the reaction mixture. (b) KCl is added to the reaction mixture.
 (c) $KClO_3$ is added to the reaction mixture. (d) O_2 is added to the reaction mixture.
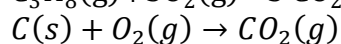
SECTION C
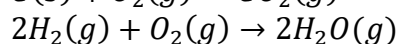15. Find ΔH_{rxn} for the reaction: (3)
$$3C(s) + 4 H_2(g) \rightarrow C_3H_8 (g)$$
Use these reactions with known ΔH's
$C_3H_8(g)+5O_2(g) \rightarrow 3 CO_2(g)+4 H_2O(g)$ $\Delta H = $ -2043 kJ
$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5 \ kJ$
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ $\Delta H = -483.6 \ kJ$

16. Equal volumes of 0.002 M solutions of sodium ($NaIO_3$) and cupric chlorate $Cu(ClO_3)_2$ are (3)
mixed together. Will it lead to precipitation of copper iodate? (For cupric iodate
$Ksp = 7.4 \times 10^{-8}$).

SECTION D

17. Extensive properties depend on the quantity of matter but intensive properties do not. Explain (5) whether the following properties are extensive or intensive. Mass, internal energy, pressure, heat capacity, molar heat capacity, density, mole fraction, specific heat, temperature and molarity.

OR

Consider the combustion of propane gas: $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$
$\Delta H_{rxn} = -2044$ kJ
(a) Calculate the entropy change in the surroundings associated with this reaction occurring at 25 °C.
(b) Determine the sign of the entropy change for the system.
(c) Determine the sign of the entropy change for the universe. Is the reaction spontaneous?

18. (a) Does the value of the equilibrium constant depend on the initial concentrations of the (5) reactants and products? Do the equilibrium concentrations of the reactants and products depend on their initial concentrations? Explain
(b) What is the definition of the reaction quotient (Qc) for a reaction? What does Qc measure?
(c) What is the value of Qc when each reactant and product is in its standard state?
(d) In what direction does a reaction proceed for each condition:
(a) Qc < Kc;   (b) Qc > Kc

SECTION E

Questions 19 and 20 are Case Study Based questions and are compulsory. Each question carries 4 marks.

19. Read the passage given below and answer the following questions.
The Haber process for the synthesis ammonia from molecular hydrogen and nitrogen is represented by the following thermochemical equations. $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$: $\Delta H^o = -92.6$ kJ/mol the reaction is carried out in the presence of a heterogeneous catalyst containing iron the value of Kc for the reaction is 1.2 at 375 °C.
(i) Write the equilibrium constant expression for the reaction taking place during Haber (1) process.
(ii) How does the value of Kc for this reaction change with increase in temperature? (1)
(iii) (a) Write the expression which represents the relationship between Kp and Kc for this (2) reaction.
(b) Starting with two mol each (N_2, H_2, NH_3) predict the direction of reaction?
OR
(iii) State Le Chatelier's principle and explain why optimum pressure and temperature are preferred for Haber process?

20. We can measure energy changes associated with chemical or physical processes by an experimental technique called calorimetry. In calorimetry, the process is carried out in a vessel called calorimeter, which is immersed in a known volume of a liquid. Knowing the heat capacity of the liquid in which calorimeter is immersed and the heat capacity of calorimeter, it is possible to determine the heat evolved in the process by measuring temperature changes. Measurements are made under two different conditions
(i) at constant volume, q_v (ii) at constant pressure, q_p

(i) Suppose you are cold-weather camping and decide to heat some objects to bring into (1) your sleeping bag for added warmth. You place a large water jug and a rock of equal mass near the fire. Over time, both the rock and the water jug warm to about 38 °C (100 °F). You can bring only one into your sleeping bag. Which one should you choose to keep you warmer? Why?

(ii) Substances A and B, initially at different temperatures, come in contact with each other and reach thermal equilibrium. The mass of substance A is twice the mass of substance B. The specific heat capacity of substance B is twice the specific heat capacity of substance A. Which statement is true about the final temperature of the two substances once thermal equilibrium is reached? (1)
  (a) The final temperature is closer to the initial temperature of substance A than substance B.
  (b) The final temperature is closer to the initial temperature of substance B than substance A.
  (c) The final temperature is exactly midway between the initial temperatures of substance A and B.

(iii) Lighters are usually fuelled by butane (C_4H_{10}). When 1 mole of butane burns at constant pressure, it produces 2658 kJ of heat and does 3 kJ of work. What are the values of ΔH and ΔE for the combustion of one mole of butane? (2)

OR

(iii) If an endothermic reaction absorbs heat, why does it feel cold to the touch?