සියලු ම හිමිකම් ඇවිරිණි/முழுப் பதிப்புரிமையுடையது/All Rights Reserved]

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2023 (2024)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2023 (2024)
General Certificate of Education (Adv. Level) Examination, 2023 (2024)

රසායන විද්‍යාව I இரசாயனவியல் I **Chemistry I**	**02 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***Two hours***

Instructions:

* *This paper consists of* **08** *pages.*
* *A Periodic Table is also provided.*
* *Answer* ***all*** *the questions.*
* ***Use of calculators is not allowed.***
* *Write your* ***Index Number*** *in the space provided in the answer sheet.*
* *Follow the instructions given on the back of the answer sheet carefully.*
* *In each of the questions* **1** *to* **50**, *pick one of the alternatives from* (1), (2), (3), (4), (5) *which is* ***correct*** *or* ***most appropriate*** *and* ***mark your response on the answer sheet with a cross*** (×) ***in accordance with the instructions given on the back of the answer sheet.***

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Planck's constant $h = 6.626 \times 10^{-34}\ J\ s$
Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$ Velocity of light $c = 3 \times 10^{8}\ m\ s^{-1}$

1. If the wave length of radiation used in a microwave oven to heat food is 1.1 cm, the energy of one photon of this microwave radiation is,
(**Note** : Use Planck's constant, $h = 6.6 \times 10^{-34}$ J s for the calculation.)
(1) 6.0×10^{-26} J (2) 1.8×10^{-24} J (3) 1.8×10^{-23} J (4) 1.8×10^{-22} J (5) 6.0×10^{-20} J

2. From the list given below, identify the emission lines in the hydrogen spectrum that have the highest frequency and the lowest frequency respectively.
Emission line list (n = Principal quantum number)
$n = 3 \longrightarrow n = 1$, $n = 2 \longrightarrow n = 1$, $n = 3 \longrightarrow n = 2$, $n = 4 \longrightarrow n = 2$, $n = 4 \longrightarrow n = 3$
(1) $n = 3 \longrightarrow n = 1$, $n = 2 \longrightarrow n = 1$ (2) $n = 3 \longrightarrow n = 1$, $n = 4 \longrightarrow n = 3$
(3) $n = 2 \longrightarrow n = 1$, $n = 4 \longrightarrow n = 3$ (4) $n = 3 \longrightarrow n = 1$, $n = 3 \longrightarrow n = 2$
(5) $n = 2 \longrightarrow n = 1$, $n = 3 \longrightarrow n = 2$

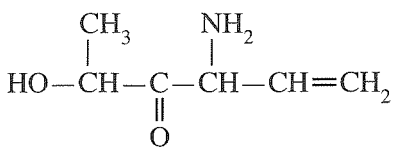
3. When the compounds given below are heated, they decompose according to the reaction,

$$MCO_3(s) \xrightarrow{\Delta} MO(s) + CO_2(g)$$

Identify the compound with the lowest decomposition temperature.
(1) $BeCO_3$ (2) $MgCO_3$ (3) $CaCO_3$ (4) $SrCO_3$ (5) $BaCO_3$

4. The electron pair geometries around the central atoms of $F_2IO_2^+$, $F_2BrO_2^-$ and $IBrCl_3^-$ are respectively,
(1) see-saw, tetrahedral and octahedral.
(2) tetrahedral, see-saw and square pyramidal.
(3) trigonal bipyramidal, square planar and square pyramidal.
(4) tetrahedral, see-saw and octahedral.
(5) tetrahedral, trigonal bipyramidal and octahedral.

5. What is the IUPAC name of the following compound?
(1) 4-amino-3-oxohex-5-en-2-ol
(2) 5-hydroxy-4-oxohex-1-en-3-amine
(3) 3-amino-5-hydroxyhex-1-en-4-one
(4) 4-amino-2-hydroxyhex-5-en-3-one
(5) 3-amino-5-hydroxy-4-oxohex-1-ene



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6. Solubility products of some metal chlorides at a given temperature are listed below.

Metal chloride	Solubility product
A : $PbCl_2$	5.00×10^{-7} $mol^3\ dm^{-9}$
B : CuCl	1.60×10^{-7} $mol^2\ dm^{-6}$
C : AgCl	1.60×10^{-10} $mol^2\ dm^{-6}$
D : Hg_2Cl_2	1.08×10^{-16} $mol^3\ dm^{-9}$

In which sequence are the metal chlorides arranged in the order of **increasing** chloride ion concentration of their saturated aqueous solutions?

(1) A < B < C < D (2) B < A < C < D (3) A < B < D < C
(4) D < C < B < A (5) D < C < A < B

7. Select the **incorrect** statement.

(1) Ionic radii of isoelectronic monoatomic ions decrease when nuclear charge increases.
(2) He (Helium) atom is the smallest among all atoms.
(3) The radius of Na^+ is larger than the atomic radius of Li.
(4) KF shows the greatest ionic character among LiI, KF and KI.
(5) Xe has the highest boiling point among noble gases.

8. The **increasing** order of electronegativity of the underlined carbon atom (C) in $CH_3\underline{C}H_2Br$, $CH_2{=}\underline{C}HF$, $CH_2{=}\underline{C}HCl$ and $HC{\equiv}\underline{C}F$ is

(1) $CH_3\underline{C}H_2Br < CH_2{=}\underline{C}HF < CH_2{=}\underline{C}HCl < HC{\equiv}\underline{C}F$
(2) $HC{\equiv}\underline{C}F < CH_2{=}\underline{C}HCl < CH_2{=}\underline{C}HF < CH_3\underline{C}H_2Br$
(3) $CH_2{=}\underline{C}HF < CH_2{=}\underline{C}HCl < CH_3\underline{C}H_2Br < HC{\equiv}\underline{C}F$
(4) $CH_3\underline{C}H_2Br < CH_2{=}\underline{C}HCl < CH_2{=}\underline{C}HF < HC{\equiv}\underline{C}F$
(5) $CH_3\underline{C}H_2Br < CH_2{=}\underline{C}HF < HC{\equiv}\underline{C}F < CH_2{=}\underline{C}HCl$

9. Which of the following represents a chain propagation step in the free radical chlorination reaction of methane?

(1) $CH_3Cl + \dot{C}l \longrightarrow CH_2Cl_2 + \dot{H}$ (2) $CH_2Cl_2 + \dot{C}l \longrightarrow \dot{C}HCl_2 + HCl$
(3) $\dot{C}H_3 + \dot{C}l \longrightarrow CH_3Cl$ (4) $CHCl_3 + \dot{C}l \longrightarrow CCl_4 + HCl$
(5) $\dot{C}l + \dot{C}l \longrightarrow Cl_2$

10. The experimentally determined rate law of the reaction $A_2 + B_2 \longrightarrow A_2B_2$ is, rate = $k\,[A_2]$. Here k is the rate constant. The following mechanisms are proposed for this reaction.

(I)
$A_2 \longrightarrow 2A$ (slow)
$A + B_2 \longrightarrow AB_2$ (fast)
$AB_2 + A \longrightarrow A_2B_2$ (fast)

(II)
$A_2 \longrightarrow 2A$ (slow)
$2A + B_2 \longrightarrow A_2B_2$ (fast)

(III)
$A_2 \longrightarrow 2A$ (slow)
$A + B_2 \longrightarrow AB + B$ (fast)
$A + AB \longrightarrow A_2B$ (fast)
$A_2B + B \longrightarrow A_2B_2$ (fast)

Which of the following statements is correct regarding the above reaction?

(1) Only the mechanisms I and II are consistent with the rate law.
(2) Only the mechanisms II and III are consistent with the rate law.
(3) Only the mechanisms I and III are consistent with the rate law.
(4) No mechanism is consistent with the rate law.
(5) All the mechanisms are consistent with the rate law.

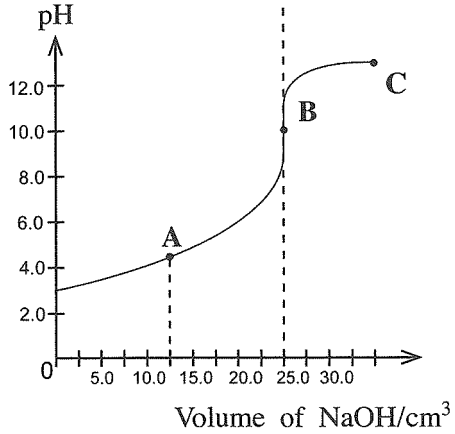
11. Identify the **incorrect** statement with regard to the thermal decomposition of the salts given below.
NH_4Cl, NH_4NO_2, NH_4NO_3, $(NH_4)_2CO_3$ and $(NH_4)_2Cr_2O_7$

(1) Only two of the salts give NH_3 as a product.
(2) Only two of the salts give N_2 as a product.
(3) Only two of the salts give an acidic gas as a product.
(4) Only one of the salts gives a product that exists as a solid at room temperature.
(5) Only two of the salts give H_2O as a product.

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12. The titration curve given was obtained for the titration of a monobasic weak acid with NaOH. Of the statements given below, identify the **incorrect** statement.



(1) At point **A**, the pH of the titration mixture is equal to the pK_a of the weak acid.
(2) At point **A**, the concentrations of the remaining weak acid and its conjugate base in the titration mixture are equal.
(3) At point **B**, the concentrations of H^+ and OH^- in the titration mixture are equal.
(4) Phenolpthalein can be used as an indicator for this titration.
(5) At point **C**, the pH of the titration mixture is lower than the pH of the NaOH solution used.

13. An organic compound **A** gives a coloured precipitate with 2,4-dinitrophenylhydrazine. When compound **A** is reacted with acidified potassium dichromate, compound **B** is formed and the solution becomes green. The compound **B** did not give a coloured precipitate with 2,4-dinitrophenylhydrazine. The structure of **A** could be:

(1) $CH_3\overset{\overset{O}{\|}}{C}CH_2CH_2CH_2\overset{\overset{OH}{|}}{C}HCH_3$ (2) $CH_3\overset{\overset{O}{\|}}{C}CH_2CH_2CH_2CH_2OH$ (3) $HOCH_2CH_2CH_2CH_2CHO$

(4) $HO\overset{\overset{CH_3}{|}}{C}HCH_2CH_2CH_2CHO$ (5) $HO\overset{\overset{CH_3}{|}}{C}HCH_2CH_2CH_2CH_2OH$

14. The volume of 5.0 mol dm^{-3} H_2SO_4 required to react completely with 20.0 cm^3 of 30% NaOH by mass and density 1.4 g cm^{-3} is,
(H = 1, O = 16, Na = 23)
(1) 15.0 cm^3 (2) 21.0 cm^3 (3) 30.0 cm^3 (4) 42.0 cm^3 (5) 84.0 cm^3

15. A closed rigid container at room temperature contains equal masses of He and Ne gases. The total pressure of the container is P. The partial pressure of He is,
(He = 4, Ne = 20)
(1) P (2) $\frac{5P}{6}$ (3) $\frac{6P}{5}$ (4) $\frac{P}{2}$ (5) $\frac{P}{6}$

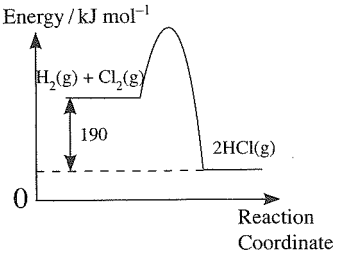
16. $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
The above reaction is at equilibrium in a closed rigid container at constant temperature. Which of the following statements correctly explains the change in the rates of forward and reverse reactions, immediately after the addition of a certain quantity of $I_2(g)$ in to the container?
(1) The rates of forward and reverse reactions decrease.
(2) The rates of forward and reverse reactions increase.
(3) The rates of forward and reverse reactions do not change.
(4) The rate of the forward reaction increases, the rate of the reverse reaction does not change.
(5) The rate of the forward reaction decreases, the rate of the reverse reaction does not change.

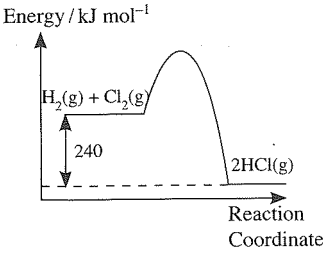
17. A solution was prepared by mixing 100.0 cm^3 of 1.0 mol dm^{-3} $CH_3COOH(aq)$ and 100.0 cm^3 of 1.0 mol dm^{-3} $CH_3COONa(aq)$. The pH of the resulting solution at 25 °C was 4.8. When a few drops of 0.10 mol dm^{-3} HCl(aq) was added to this solution and mixed well, the pH still remained at 4.8. Which of the following reactions would have taken place to prevent the pH from changing?
(1) $H_3O^+(aq) + OH^-(aq) \longrightarrow 2H_2O(l)$
(2) $H_3O^+(aq) + CH_3COO^-(aq) \longrightarrow CH_3COOH(aq) + H_2O(l)$
(3) $H_3O^+(aq) + Cl^-(aq) \longrightarrow HCl(aq) + H_2O(l)$
(4) $H_3O^+(aq) + CH_3COOH(aq) \longrightarrow CH_3COOH_2^+(aq) + H_2O(l)$
(5) $H_3O^+(aq) + OH^-(aq) + CH_3COOH(aq) \longrightarrow CH_3COO^-(aq) + 2H_2O(aq) + H^+(aq)$

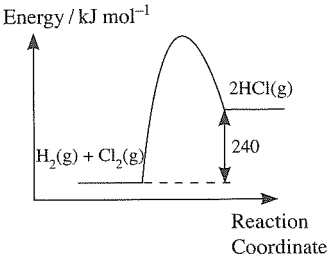
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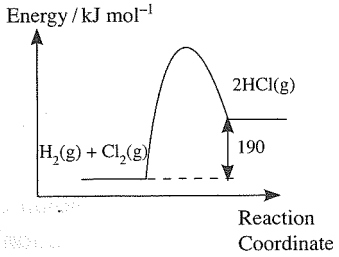
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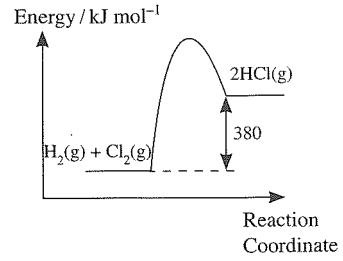
18. Which of the following represents the energy diagram of the reaction $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$? Bond energies of H–H, Cl–Cl and H–Cl are 430, 240 and 430 kJ mol^{-1} respectively.

(1)


(2)


(3)


(4)


(5)


19. Consider the reactions given below. The ΔG values at temperature T are given.

$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$ $\quad \Delta G = -1010$ kJ mol^{-1}

$2NO_2(g) \longrightarrow 2NO(g) + O_2(g)$ $\quad \Delta G = 70$ kJ mol^{-1}

$4NO_2(g) + O_2(g) + 2H_2O(l) \longrightarrow 4HNO_3(aq)$ $\quad \Delta G = -170$ kJ mol^{-1}

ΔG (kJ mol^{-1}) for the reaction $NH_3(g) + 2O_2(g) \longrightarrow HNO_3(aq) + H_2O(l)$ at temperature T is,

(1) –1320 (2) –1250 (3) –1110 (4) –580 (5) –330

20. Which of the given compounds will undergo all three of the reactions (I, II and III) given below?

I Reacts with PCl_5 to give a chloro compound.
II Undergoes self-condensation in the presence of aqueous NaOH.
III Undergoes a reduction reaction with $LiAlH_4$.

(1) $CH_3-\underset{\displaystyle OH}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-NH_2$

(2) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CHO$

(3) $H-\overset{\displaystyle O}{\overset{\|}{C}}-\langle\bigcirc\rangle-\overset{\displaystyle CH_3}{\overset{|}{C}}-OH$ (with CH_3 below the C)

(4) $CH_3-\underset{\displaystyle NH_2}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3$

(5) $CH_3O-\overset{\displaystyle O}{\overset{\|}{C}}-\langle\bigcirc\rangle-CH_2OH$

21. Consider the following reversible reaction.

$FeF_2(s) + 2H^+(aq) \rightleftharpoons Fe^{2+}(aq) + 2HF(aq)$

(K is the equilibrium constant of the above reaction.)

This equilibrium is reached through the following mechanism.

$FeF_2(s) \rightleftharpoons Fe^{2+}(aq) + 2F^-(aq)$ $\quad K_1 = 2.0 \times 10^{-6}$ mol^3 dm^{-9}

$F^-(aq) + H^+(aq) \rightleftharpoons HF(aq)$ $\quad K_2 = 1.0 \times 10^3$ mol^{-1} dm^3

Which of the following statements is correct regarding the overall equilibrium?

(1) The position of equilibrium lies close to products because $K_2 > 1$.
(2) The position of equilibrium lies close to reactants because $K_1 < 1$.
(3) The position of equilibrium lies close to products because $K > 1$.
(4) The position of equilibrium lies close to reactants because $K < 1$.
(5) Cannot determine the position of equilibrium from the given information.

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22. Which of the following statements regarding carboxylic acids is **incorrect**?

(1) Carboxylic acids cannot be reduced to alcohols with $NaBH_4$.
(2) The boiling points of carboxylic acids are higher than the boiling points of alcohols with comparable relative molecular masses.
(3) Carboxylic acids react with aqueous NaOH, with the evolution of $CO_2(g)$.
(4) Carboxylic acids can form dimeric structures due to hydrogen bonding.
(5) The water solubility of carboxylic acids decreases with increasing relative molecular mass.

23. $CH_3OH(g) \longrightarrow CO(g) + 2H_2(g) \quad \Delta H^\circ = 91 \text{ kJ mol}^{-1}$

The above reaction occurs to completion in a thermally insulated closed rigid container. Which of the following is correct regarding

(i) the temperature of the contents in the container,
(ii) the sign of ΔS° of the reaction?

	Temperature	**Sign of ΔS°**
(1)	Increases	+
(2)	Decreases	+
(3)	Decreases	−
(4)	Increases	−
(5)	Does not change	+

24. A closed container equipped with a piston contains an ideal gas at temperature T and pressure P_1. The volume occupied by the gas is 2.0 dm^3. When the volume is increased to 5.0 dm^3 at the same temperature, the pressure is changed to P_2. Which of the following statements is correct regarding this system?

(1) The average kinetic energy of the gas remains the same and $P_2 = 0.4\ P_1$
(2) The average kinetic energy of the gas increases and $P_2 = 2.5\ P_1$
(3) The average kinetic energy of the gas increases and $P_2 = 0.4\ P_1$
(4) The average kinetic energy of the gas remains the same and $P_2 = 2.5\ P_1$
(5) The average kinetic energy of the gas decreases and $P_2 = 2.5\ P_1$

25. Consider the reaction below occuring at a given temperature.

$N_2O(g) + CO(g) \rightarrow N_2(g) + CO_2(g)$

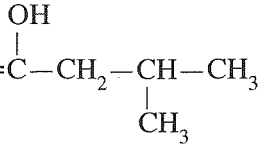
The rate of the reaction is increased when this reaction is carried out in the presence of a small amount of Pd powder. Which of the following best explains this observation?

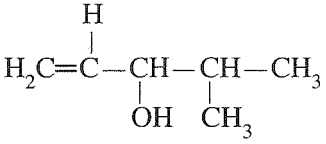
(1) Pd powder decreases the activation energy of the reaction.
(2) Pd powder supplies energy to the reaction.
(3) Pd powder helps to decrease the concentration of products.
(4) One of the products bonds to Pd and increases the rate of the reaction by decreasing the concentration of products.
(5) At least one of the reactants bonds to Pd and the reaction occurs through an alternative path having low activation energy.

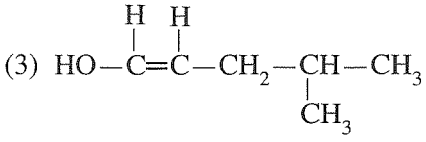
26. The number of moles of electrons given out when one mole of C_2H_5OH is oxidized to CO_2 under suitable conditions is,

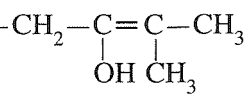
(1) 4 (2) 5 (3) 7 (4) 10 (5) 12

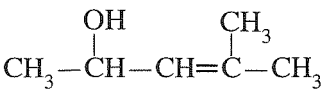
27. Consider the reaction of an alkyne with dil. H_2SO_4 / $HgSO_4$ giving a ketone. A structure that could be formed during this reaction is,

(1) 

(2) 

(3) 

(4) 

(5) 

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28. Consider the following half reactions at 298 K.

$Mg^{2+}(aq) + 2e \rightarrow Mg(s)$ $\quad E^\circ = -2.37$ V

$Cr^{3+}(aq) + 3e \rightarrow Cr(s)$ $\quad E^\circ = -0.74$ V

Which of the following gives the overall cell reaction and the electromotive force (E°_{cell}) of an electrochemical cell formed by the above electrodes?

		E°_{cell} (V)
(1)	$2Cr^{3+}(aq) + 3Mg(s) \rightarrow 2Cr(s) + 3Mg^{2+}(aq)$	5.63
(2)	$3Mg^{2+}(aq) + 2Cr^{3+}(aq) \rightarrow 3Mg(s) + 2Cr(s)$	1.63
(3)	$3Mg^{2+}(aq) + 2Cr(s) \rightarrow 3Mg(s) + 2Cr^{3+}(aq)$	1.63
(4)	$3Mg^{2+}(aq) + 2Cr(s) \rightarrow 3Mg(s) + 2Cr^{3+}(aq)$	5.63
(5)	$2Cr^{3+}(aq) + 3Mg(s) \rightarrow 2Cr(s) + 3Mg^{2+}(aq)$	1.63

29. $TiCl_4$ is an important industrial chemical. This can be prepared by reacting $TiO_2(s)$, $Cl_2(g)$ and C(s). The **unbalanced** chemical equation for the reaction is given below.

$TiO_2(s) + Cl_2(g) + C(s) \rightarrow TiCl_4(s) + CO_2(g)$

When 160 g of $TiO_2(s)$, 213 g of $Cl_2(g)$ and 60 g of C(s) are made to react, the maximum quantity of $TiCl_4$ that can be formed is,

(C = 12, O = 16, Cl = 35.5, Ti = 48)

(1) 190 g (2) 285 g (3) 380 g (4) 570 g (5) 950 g

30. Consider the reaction below at constant temperature.

$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ $\quad K_C = 6.5\ mol^{-1}\ dm^3$

1.5 mol of $PCl_3(g)$, 1.0 mol of $Cl_2(g)$ and 2.5 mol of $PCl_5(g)$ were introduced in to a previously evacuated closed rigid container having a volume 1.0 dm^3. Which of the following best explains the way the measured pressure of the container changes as the reaction approaches equilibrium?

(Q_C = reaction quotient, K_C = equilibrium constant)

(1) The pressure increases because $Q_C < K_C$
(2) The pressure increases because $Q_C > K_C$
(3) The pressure decreases because $Q_C < K_C$
(4) The pressure decreases because $Q_C > K_C$
(5) The pressure does not change because $Q_C = K_C$

● For each of the questions **31** to **40**, one or more responses out of the four responses (*a*), (*b*), (*c*) and (*d*) given is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

(1) if only (*a*) and (*b*) are correct.
(2) if only (*b*) and (*c*) are correct.
(3) if only (*c*) and (*d*) are correct.
(4) if only (*d*) and (*a*) are correct.
(5) if **any other** number or combination of responses is correct.

Summary of above Instructions

(1)	(2)	(3)	(4)	(5)
Only (*a*) and (*b*) are correct	Only (*b*) and (*c*) are correct	Only (*c*) and (*d*) are correct	Only (*d*) and (*a*) are correct	**Any other** number or combination of responses is correct

31. Which of the following statements correctly explain/explains why an increase in temperature increases the rate of a chemical reaction?

(*a*) At high temperature, the activation energy of the reaction is decreased.
(*b*) At high temperature, the activation energy of the reaction is increased.
(*c*) At high temperature, products are formed from every collision of reactant molecules.
(*d*) At high temperature, the fraction of collisions having energy greater than the activation energy of the reaction is increased.

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32. Of the following, which alkyne/alkynes can give 3-ethylhexane on catalytic hydrogenation?

(*a*) $CH_3-CH_2-\underset{\displaystyle CH_2-CH_3}{\underset{|}{CH}}-CH_2-C\equiv CH$

(*b*) $HC\equiv C-CH_2-CH_2-\underset{\displaystyle CH_2-CH_3}{\underset{|}{CH}}-CH_3$

(*c*) $HC\equiv C-\underset{\displaystyle CH_2-CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_3$

(*d*) $CH_3-CH_2-\underset{\displaystyle CH_2-CH_3}{\underset{|}{CH}}-C\equiv C-CH_3$

33. Which of the following statements is/are correct?

(*a*) Boiling point of a liquid decreases when the pressure is increased.
(*b*) Boiling point of a liquid increases when the pressure is increased.
(*c*) On the top of Mount Everest, water can be boiled at a temperature less than 100 °C.
(*d*) Water cannot be evaporated in a closed rigid container.

34. Which of the following statements is/are true with regard to *p*-block elements and their compounds?

(*a*) The reaction of PCl_5 and SCl_2 with water gives $H_3PO_4(aq)$ and S(s) as one of the products respectively.
(*b*) Reaction of $Cl_2(g)$ with water and decomposition of $H_2O_2(aq)$ are examples of disproportionation reactions.
(*c*) A product obtained in the reaction of $Cl_2(g)$ with excess $NH_3(g)$ can be used to disinfect water.
(*d*) $SO_2(g)$ cannot act as a reducing agent.

35. Which of the following statements is/are correct regarding the reactions of alcohols?

(*a*) The leaving group of the reaction between alcohols and HBr giving bromoalkanes is OH^-.
(*b*) Some alkenes can be prepared by heating alcohols with conc. H_2SO_4.
(*c*) Alcohols react with HI to give alkyliodides only when Lewis acids are present.
(*d*) Primary alcohols do not produce turbidity when subjected to the Lucas test, because primary alcohols are soluble in water.

36. Which of the following statements is/are correct with regard to colours observed for precipitates / solutions when (i) excess NaOH(aq) and (ii) excess $NH_4OH(aq)$ are added separately to aqueous solutions of each of the following cations Co^{2+}, Ni^{2+}, Cu^{2+} and Zn^{2+}?

(*a*) Co^{2+} gives (i) a brown precipitate and (ii) a red solution respectively.
(*b*) Ni^{2+} gives (i) a blue precipitate and (ii) a green solution respectively.
(*c*) Cu^{2+} gives (i) a blue precipitate and (ii) a dark blue solution respectively.
(*d*) Zn^{2+} gives (i) a colourless solution and (ii) a colourless solution respectively.

37. Which of the following statements is/are correct?

(*a*) Addition of phosphate fertilizers to soil contributes to increase in N_2O level in the atmosphere.
(*b*) Respiration of farm animals such as cattle and goats contributes to the increase in CO_2 level in the atmosphere.
(*c*) Fossil fuel burning contributes to the increase in CH_4 level in the atmosphere.
(*d*) Burning of bio-fuel does not contribute to the increase in CO_2 level in the atmosphere.

38. Which of the following statements is/are correct regarding the reaction given below?

$$Cu(OH)_2(s) \rightleftharpoons Cu^{2+}(aq) + 2OH^-(aq)$$

(*a*) Increasing the pH of the solution decreases the solubility of $Cu(OH)_2(s)$.
(*b*) Addition of NaOH(s) into the solution does not change the solubility of $Cu(OH)_2(s)$.
(*c*) Solubility of $Cu(OH)_2(s)$ is independent of temperature.
(*d*) Addition of more $Cu(OH)_2(s)$ to the solution does not change the solubility of $Cu(OH)_2(s)$.

39. Which of the following statements is/are correct regarding the transesterification reaction of biodiesel production?

(*a*) Glycerol is a by-product.
(*b*) Bases cannot be used as catalysts.
(*c*) Presence of free fatty acids is favourable for the reaction.
(*d*) Activity of the catalyst is decreased due to the formation of soap.

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40. Which of the following statements is/are correct regarding the gases present in a liquid fossil fuel burning vehicle exhaust?

(*a*) The exhaust contains gases that contribute to photochemical smog.
(*b*) The exhaust contains gases that contribute to global warming.
(*c*) The exhaust contains gases that contribute to acid rain.
(*d*) The exhaust contains gases that contribute to ozone layer depletion.

● In question Nos. **41** to **50**, two statements are given in respect of each question. From the Table given below, select the response, out of the responses (1), (2), (3), (4) and (5), that **best** fits the two statements and mark appropriately on your answer sheet.

Response	First Statement	Second Statement
(1)	True	True, and correctly explains the first statement
(2)	True	True, but does **not** explain the first statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

	First Statement	Second statement
41.	$H_2S(g)$ can act as a reducing agent as well as an oxidizing agent under suitable conditions.	Sulphur is a non metal with oxidation numbers in the range –2 to +6.
42.	Boiling point of propanone is less than the boiling point of butane.	Propanone contains a pi (π) bond whereas butane does not contain a π bond.
43.	Under certain conditions, the pressure of a real gas sample could be lower than that predicted by the ideal gas equation.	Inter molecular attractive forces are present among real gas molecules.
44.	The electronegativity of Mn is lower than the electronegativity of Cr and Fe.	The electronic configuration of Mn is more stable than the electronic configurations of Cr and Fe.
45.	Aromatic diazonium salts when warmed with water, form phenols.	Aromatic diazonium ions are electrophiles.
46.	In an electrochemical cell, the electrode having the lower reduction potential acts as the anode.	In an electrochemical cell electrons are easily released from the electrode with comparatively low reduction potential.
47.	In the production of nitric acid using Ostwald method NO(g) is reacted with $O_2(g)$ at a temperature higher than the temperature at which $NH_3(g)$ is reacted with $O_2(g)$.	High temperatures are not favourable for reactions with negative entropy changes.
48.	The partition coefficient of a solute is temperature dependent.	The solubility of a solute in different solvents changes by the same amount with temperature.
49.	During the production of sulphuric acid, $SO_2(g)$ is converted to $SO_3(g)$ in several steps.	Complete conversion of $SO_2(g)$ to $SO_3(g)$ in a single step is not spontaneous under the conditions used in sulphuric acid production.
50.	HFC (hydrofluorocarbon) gas does not contribute to ozone layer depletion in the upper atmosphere.	HFC is quickly destroyed in the upper atmosphere by breaking the C–F bond.

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