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முழுப் பதிப்புரிமையுடையது]
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Official Exam Paper

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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

02 E I

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2007 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2007 ஒகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2007

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Important :

- *This paper consists of* **09** *pages (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.*
- *Instructions are given on the back of the answer sheet. Follow those carefully.*
- *In each of the questions* **1** *to* **60**, *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*** (×) *on the number of the correct option in accordance with the instructions given on the back of the answer sheet.*

Universal gas constant, $R = 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$
Avogadro constant, $N_A = 6{\cdot}022 \times 10^{23}\ mol^{-1}$

1. The highest positive oxidation state shown by a 3d transition element is
(1) +2 (2) +3 (3) +5 (4) +6 (5) +7

2. The oxide which is least stable to heat among the following is
(1) CaO (2) Na_2O (3) CuO (4) Ag_2O (5) ZnO

3. Which of the following is **not** a reducing agent?
(1) Cu^+ (2) H^+ (3) Fe^{2+} (4) Cl^- (5) S^{2-}

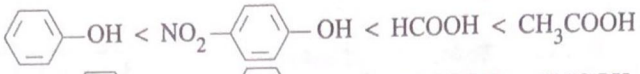
4. The number of electrons and the number of neutrons present in $^{25}_{12}Mg^{2+}$ ion are, respectively,
(1) 12 and 13 (2) 11 and 13 (3) 10 and 13 (4) 10 and 12 (5) 12 and 11

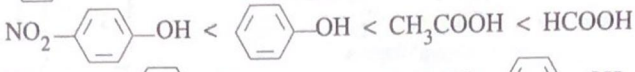
5. The concept of solubility product can be applied to saturated solutions of which of the following?
(1) Highly soluble weak electrolytes (2) Sparingly soluble weak electrolytes
(3) Sparingly soluble strong electrolytes (4) Highly soluble strong electrolytes
(5) Sparingly soluble non-electrolytes

6. Which one of the following statements is **not** true in relation to diluting a 0.1 mol dm^{-3} H_2SO_4 solution two-fold?
(1) The $[H_3O^+]$ decreases. (2) The $[SO_4^{2-}]$ decreases.
(3) The $[HSO_4^-]$ decreases. (4) The $[OH^-]$ decreases.
(5) The density of the solution decreases.

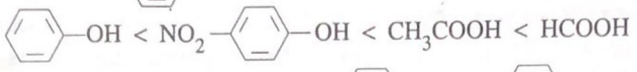
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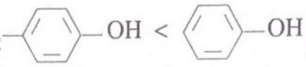
7. Which arrangement of the compounds given below, gives the correct increasing order of **acid strength**?

(1)  $< HCOOH < CH_3COOH$

(2)  $< CH_3COOH < HCOOH$

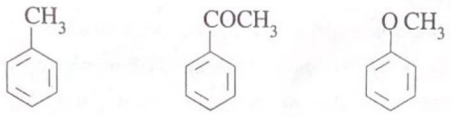
(3) $HCOOH <$ 

(4)  $< CH_3COOH < HCOOH$

(5) $CH_3COOH < HCOOH <$ 

8. A 0.744 g sample of a mixture of $BaCl_2.2H_2O$ (Relative molar mass = 244) and KCl was heated to a constant mass at 150 °C. The mass of the product was 0.708 g. The mass of KCl in the sample is
(H = 1.0, O = 16.0, K = 19.0, Cl = 35.5)

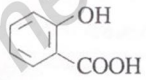
(1) 0.500 g (2) 0.425 g (3) 0.300 g (4) 0.250 g (5) 0.150 g

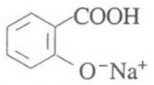
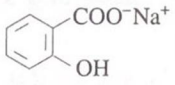
9. 

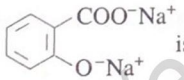
A **B** **C**

The correct order of ease of nitration of the compounds **A**, **B** and **C** is

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

10. Which of the following would take place when  is added to an aqueous solution of Na_2CO_3?

(a)  is formed. (b)  is formed.

(c)  is formed. (d) CO_2 is evolved.

(1) (a) and (b) (2) (b) and (c) (3) (c) and (d)
(4) (a) and (d) (5) (b) and (d)

11. The partition coefficient for the distribution of compound **S** between two immiscible liquids **A** and **B** is 49. **S** is more soluble in **A** than in **B**. 100 cm^3 of **B** containing 1.0×10^{-4} mol of **S** was shaken with 100 cm^3 of pure **A**. The percentage of **S** extracted into **A** from **B** is,

(1) 1% (2) 2% (3) 49% (4) 98% (5) 99%

12. The pH of a 0.01 mol dm^{-3} solution of weak acid HA with $K_a = 1.0\times10^{-5}$ mol dm^{-3} is,

(1) 3.0 (2) 3.5 (3) 4.5 (4) 5.0 (5) 6.5

13. Salt **X** dissolves in conc. HCl forming a yellow-brown solution. When this solution is diluted and reacted with Zn, a light green solution is formed. The cation present in **X** is,

(1) Cu^{2+} (2) Ni^{2+} (3) Fe^{3+} (4) Cr^{3+} (5) Fe^{2+}

14. Which of the following molecules has the lowest dipole moment?

(1) NO_2 (2) O_3 (3) CO_2 (4) SO_2 (5) ClO_2

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15. Which of the following compounds **A**, **B**, **C** and **D** evolve $NH_3(g)$ on heating?

A. $(NH_4)_2Cr_2O_7$ **B.** NH_4Cl **C.** $(NH_4)_2CO_3$ **D.** NH_4NO_3

(1) **A** and **B** (2) **B** and **C** (3) **C** and **D**
(4) **A** and **D** (5) **B** and **D**

16. When H_2S is passed into an aqueous solution of salt **X**, a yellow precipitate is formed. When an aqueous solution of **X** is treated with excess Na_2CO_3, filtered and H_2S passed into the filtrate, a yellow precipitate is formed again.

The cation/anion that is present definitely in the salt **X** is,

(1) Sn^{2+} (2) Sb^{3+} (3) Cd^{2+} (4) CrO_4^{2-} (5) AsO_3^{3-}

17.

A. O_2N–C$_6$H$_4$–NH_2 **B.** C$_6$H$_5$–NH_2

C. $CH_3CH_2NH_2$ **D.** CH_3–C$_6$H$_4$–NH_2

Which of the following correctly represents the increasing order of **base strength** of the compounds **A**, **B**, **C**, and **D** given above?

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

18. Which one of the following **cannot** be used to distinguish between C$_6$H$_5$–NH_2 and C$_6$H$_5$–OH

(1) Br_2 water (2) NaOH solution
(3) HNO_2 solution (4) Neutral $FeCl_3$ solution
(5) Moist blue litmus paper

19. The solubility products of three sparingly soluble salts **AB**, $\mathbf{P_2Q}$ and $\mathbf{R_2S_3}$, at a given temperature, are 9.0×10^{-44} mol^2 dm^{-6}, 1.08×10^{-49} mol^3 dm^{-9} and 1.08×10^{-68} mol^5 dm^{-15}, respectively. The decreasing order of molar solubility of the three salts in water at that temperature is

(1) **AB** > $\mathbf{P_2Q}$ > $\mathbf{R_2S_3}$ (2) **AB** > $\mathbf{R_2S_3}$ > $\mathbf{P_2Q}$
(3) $\mathbf{P_2Q}$ > $\mathbf{R_2S_3}$ > **AB** (4) $\mathbf{P_2Q}$ > **AB** > $\mathbf{R_2S_3}$
(5) $\mathbf{R_2S_3}$ > $\mathbf{P_2Q}$ > **AB**

20.

A. $(CH_3)_2C^+$–C$_6$H$_5$ **B.** $(CH_3)_2C^+$–CH_3 **C.** $CH_2=CH-\overset{+}{C}H-CH=CH_2$

D. $CH_2=CH-\overset{+}{C}H_2$ **E.** $CH_2=CH-\overset{+}{C}H-CH_3$

The correct increasing order of stability of the carbonium ions (carbo-cations) **A**, **B**, **C**, **D** and **E** is,

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

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21. **A**, **B** and **C** are three cations. They react separately

(i) with H_2S, forming precipitates in aqueous solution.

(ii) with NH_4OH, forming precipitates soluble in excess of the reagent.

A, **B**, **C** are

(1) Zn^{2+}, Cu^{2+}, Ba^{2+} (2) Zn^{2+}, Cu^{2+}, Ni^{2+}

(3) Cu^{2+}, Al^{3+}, Ni^{2+} (4) Zn^{2+}, Ni^{2+}, Al^{3+}

(5) Cr^{3+}, Ni^{2+}, Cu^{2+}

22. The arrangement of electron pairs around Sb atom in SbF_5^{2-} is,

(1) octahedral. (2) square pyramidal.

(3) trigonal bipyramidal. (4) square planar.

(5) pentagonal pyramidal.

23. 1 mol of an organic compound **X** required 2 mol of O_2 for complete combustion, and produced 2 mol of CO_2 and 2 mol of H_2O as the only products.

The molecular formula of **X** is

(1) C_2H_4 (2) C_2H_6 (3) C_2H_4O (4) CH_4O (5) $C_2H_4O_2$

24. Which one of the following reactions would produce a product with an asymmetric carbon atom?

(1) $CH_3CHO \xrightarrow{NaBH_4,\ H_2O}$ (2) $CH_3CHO \xrightarrow[\text{Conc. HCl}]{\text{Zn (Hg)}}$

(3) $CH_3CHO \xrightarrow{AgNO_3,\ NH_4OH}$ (4) $CH_3CHO \xrightarrow{HCN}$

(5) $CH_3CHO \xrightarrow[\text{(ii) } H_2O]{\text{(i) } CH_3MgBr}$

25. 25.0 cm^3 of a solution of 0.100 mol dm^{-3} $BaCl_2$ is mixed with 50.0 cm^3 of a solution of 0.050 mol dm^{-3} Na_2CO_3 solution at 25 °C. The Ba^{2+} ion concentration in the resulting solution is (K_{sp} of $BaCO_3$ at 25 °C = 8.1×10^{-9} mol^2 dm^{-6}).

(1) 3.3×10^{-2} mol dm^{-3} (2) 9.0×10^{-3} mol dm^{-3}

(3) 6.0×10^{-4} mol dm^{-3} (4) 9.0×10^{-5} mol dm^{-3}

(5) 5.0×10^{-2} mol dm^{-3}

26. Which one of the following statements is **not** true regarding ideal gases?

(1) There are no attractive or repulsive forces between molecules.

(2) The average value of the kinetic energies of molecules depends only on temperature.

(3) Molecules move randomly in straightlines at the same speed.

(4) Size of gas molecules is negligibly small compared to the distance between them.

(5) Molecular collisions are elastic.

27. **A**, **B**, **C** and **D** are metals.

(i) Only **A** and **C** react with dil. HCl forming H_2.

(ii) **A**, **B** and **D** are displaced when **C** is added to a solution containing ions of **A**, **B** and **D**.

(iii) **B** is displaced when **D** is added to a solution containing ions of **B**.

The correct increasing order of reducing ability of these metals is,

(1) **B < D < A < C** (2) **D < A < B < C**

(3) **B < D < C < A** (4) **A < B < D < C**

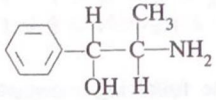
(5) **C < D < A < B**

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28. An iron plate with a mass of 40 g was dipped into 250 cm^3 of a $CuSO_4$ solution. After a certain time the mass of the plate was 42 g. The mass of the deposited Cu is (Fe = 56, Cu = 64),

(1) 42 g (2) 16 g (3) 14 g (4) 8 g (5) 2 g

29. Which one of the following statements about the compound  is **not** true?

(1) It is soluble in dil. HCl.
(2) It has four optical isomers.
(3) It reacts with ethanoyl chloride to form an amide.
(4) It reacts with hot alkaline $KMnO_4$ to form benzoic acid.
(5) It forms a diazonium salt with HNO_2.

30. Which one of the following is **not** used for dehydration reactions?

(1) H_3PO_4 (2) H_2SO_4 (3) Al_2O_3 (4) P_2O_5 (5) alcoholic KOH

31. Which one of the following compounds on heating will produce an oxide of nitrogen as one of the products?

(1) $(NH_4)_2CO_3$ (2) NH_4NO_2 (3) NH_4NO_3
(4) $(NH_4)_2Cr_2O_7$ (5) $(NH_4)_2SO_4$

32. Consider the following:

(a) liquid methane (b) a mixture of water and methanol
(c) an aqueous solution of LiCl (d) a solution of I_2 in methanol.

The correct sequence that gives the increasing strength of intermolecular forces in the above is,

(1) a < d < b < c (2) a < d < c < b (3) a < b < d < c
(4) a < c < b < d (5) a < b < c < d

33. In which of the following do the two molecules have an **unpaired** electron each?

(1) SO_2 and NO (2) NO and CO (3) NO and NO_2
(4) NO_2 and N_2O (5) SO_2 and NO_2

34. The IUPAC name of $K_3[Fe(CN)_5Br]$ is,

(1) Tripotassium pentacyanobromoferrate(III) (2) Potassium pentacyanobromoferrate(III)
(3) Potassium pentacyanobromoferrate II (4) Potassium bromopentacyanoferrate(III)
(5) Potassium bromopentacyanoferrate III

35. Consider the reaction,

$$A(g) + 3B(g) \rightleftharpoons 2C(g)$$

An equimolar mixture of **A**(g) and **B**(g) is placed in a vessel at constant temperature. When 10% of **A**(g) reacts with **B**(g), the decrease in pressure is,

(1) 5% (2) 8% (3) 10% (4) 12% (5) 15%

36. Five energy factors and five processes are given below in pairs. In which pair, the given process **does not** correctly describe the relevant energy factor?

	Energy factor	Process
(1)	Standard enthalpy of combustion of $CH_3OH(l)$ at 298 K	$2CH_3OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(g)$
(2)	Lattice energy of KCl(s)	$K^+(g) + Cl^-(g) \longrightarrow KCl(s)$
(3)	Electron affinity of hydrogen	$H(g) + e \longrightarrow H^-(g)$
(4)	Second ionization enthalpy of Mg	$Mg^+(g) \longrightarrow Mg^{2+}(g) + e$
(5)	Standard enthalpy of formation of $NH_4^+(g)$	$NH_3(g) + H^+(g) \longrightarrow NH_4^+(g)$

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37. The correct increasing order of the first ionization energy of the elements Na, Mg, K, N, P and F is
(1) K < Na < Mg < N < P < F
(2) K < Na < Mg < P < N < F
(3) K < Na < P < Mg < N < F
(4) Na < Mg < K < N < P < F
(5) Mg < K < Na < N < P < F

38. Which one of the following statements is **not** true?
(1) Radius of H^- ion is larger than that of He atom.
(2) He has the highest 1st ionization energy of all elements.
(3) F does not show positive oxidation states.
(4) $O^-(g) + e \longrightarrow O^{2-}(g)$ is an endothermic process.
(5) $Na_2(g)$ shows metallic properties.

The following data/information applies to questions No. 39 and 40.

Four monobasic acid solutions **A**, **B**, **C** and **D** are mixed together as indicated in the table given below to form solution **R**.

Acid Solution	Concentration/mol dm^{-3}	Volume mixed/cm^3
A	0.07	500.0
B	0.06	1000.0
C	0.12	1000.0
D	0.05	500.0

Two of the four acids are strong acids; the other two are weak acids with equal dissociation constants. A few drops of the two indicators, methyl orange and phenolphthalein, were added separately to two 30.0 cm^3 portions of solution **R** which when titrated with Z mol dm^{-3} NaOH solution, gave end points at 10.0 cm^3 and 40.0 cm^3, respectively.

39. The two strong acids are,
(1) **A** and **B** (2) **B** and **C** (3) **C** and **D** (4) **B** and **D** (5) **A** and **D**

40. The value of Z is
(1) 0.02 (2) 0.04 (3) 0.06 (4) 0.08 (5) 0.10

Instructions for questions No. 41 to 50 :

For each of the questions **41** to **50**, four responses (*a*), (*b*), (*c*) and (*d*) are given, out of which one or more of these 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/are correct.

Summary of above Instructions

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

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41. Which of the following will give a precipitate when added to a saturated aqueous solution of CsCl?

(a) $Pb(NO_3)_2$ solution (b) Ethanol

(c) Na_2CO_3 solution (d) KI solution

42. An aqueous solution of $MgSO_4$ has a concentration of 0.001 mol dm^{-3}. Which of the following statements is/are true regarding this solution?

(a) The $MgSO_4$ concentration of this solution is 24.0 ppm.

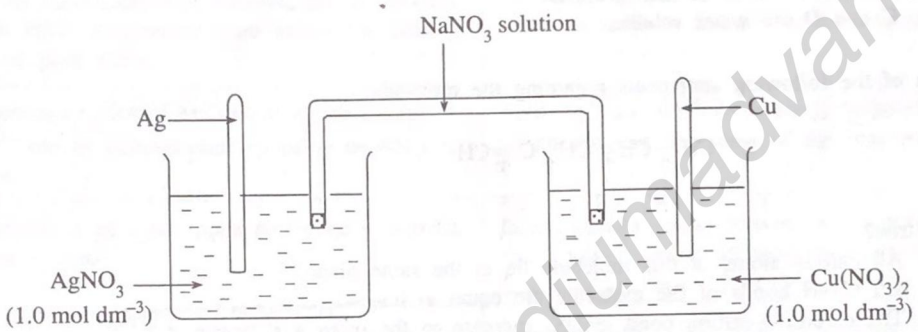
(b) The SO_4^{2-} concentration of this solution is 96.0 ppm.

(c) The $MgSO_4$ concentration of this solution is 120.0 ppm.

(d) The Mg^{2+} concentration of this solution is 2.4 ppm.

(1 ppm = 1 mg dm^{-3}; Mg = 24.0, S = 32.0, O = 16.0)

43.



$Cu^{2+}(aq) + 2e \longrightarrow Cu(s)$ $E^{\ominus} = + 0.34$ V

$Ag^{+}(aq) + e \longrightarrow Ag(s)$ $E^{\ominus} = + 0.80$ V

Consider the above cell at 25 °C. Which of the following statements is/are true when a current is drawn from the cell?

(a) The cell potential remains constant at 0.46 V.

(b) The cell cathode is Cu and the anode is Ag.

(c) Positive ions move to the cathode compartment and negative ions move to the anode compartment.

(d) Electrons move from Cu electrode to the Ag electrode, in the external circuit.

44. A solution **X** has been prepared by mixing 50.0 cm^3 of 0.10 mol dm^{-3} solution of NH_4OH and 50.0 cm^3 of 0.10 mol dm^{-3} solution of NH_4Cl. Which of the following statements is/are true about this solution **X**?

(a) It has a NH_4^+ concentration of 0.10 mol dm^{-3}

(b) It has a OH^- concentration of 0.10 mol dm^{-3}

(c) Its pH is greater than 7.

(d) It has buffer properties.

45. Which of the following can be used to distinguish between AsO_3^{3-} and SO_3^{2-}?

(a) H_2S gas (b) dil H_2SO_4

(c) acidified $KMnO_4$ (d) litmus paper

46. Which of the following statements is/are true?

(a) Positive rays are formed when an electron is removed from an atom or molecule in a cathode ray tube.

(b) Cathode rays originate from the cathode.

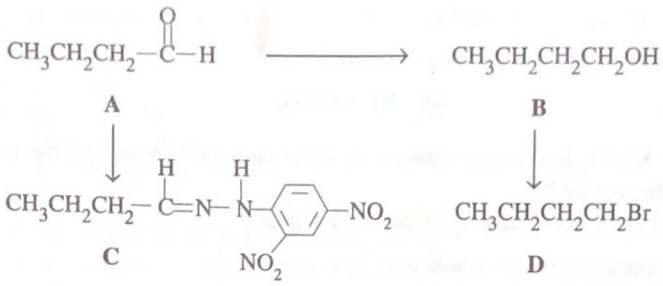
(c) Positive rays originate from the anode.

(d) Cathode rays are a type of electromagnetic radiation.

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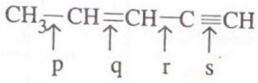
47.



Which of the following statements is/are true about the reaction scheme given above?

(*a*) **A** reacts with 2,4-dinitrophenylhydrazine to give **C**.
(*b*) Both $LiAlH_4$ and $NaBH_4$ can be used to convert **A** to **B**.
(*c*) Reaction of **B** with KBr gives **D**.
(*d*) **C** and **D** are water soluble.

48. Which of the following statements regarding the molecule,

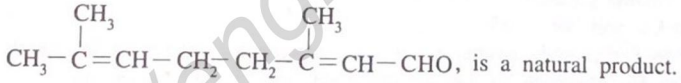


is/are true?

(*a*) All carbon atoms of this molecule lie in the same plane.
(*b*) All C—H bonds of the molecule are equal in length.
(*c*) The carbon — carbon bond lengths increase in the order s < q < p < r
(*d*) Three carbon atoms of this molecule are linearly arranged.

49. Which of the following statements is/are correct regarding the s and p block elements in the periodic table?

(*a*) The acidic character of oxides in a given period increases from left to right.
(*b*) The covalent character of oxides in a given period increases from left to right.
(*c*) The basic character of oxides decreases down a group.
(*d*) The ionic character of oxides decreases down a group.

50. Citral, 

is a natural product.

Which of the following statements about citral is/are true?

(*a*) It shows optical activity.
(*b*) It reacts with ammoniacal silver nitrate to give a silver mirror.
(*c*) It shows geometric isomerism.
(*d*) It is completely miscible with water.

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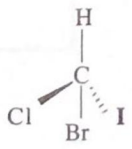
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02/5

● **Instructions for questions No. 51 to 60 :**

In questions No. **51** to **60**, 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 given for each of the questions 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
51.	In steam distillation of an essential oil, the mixture always boils at a temperature below the boiling point of pure water.	The vapour pressure of the essential oil is proportional to its mole fraction in the mixture.
52.	An aqueous solution of Ag^+ and an aqueous solution of Zn^{2+} can be distinguished by using an NH_4OH solution.	Both Ag^+ and Zn^{2+} form precipitates with NH_4OH which dissolve in excess of the reagent.
53.	The solubility of a non-polar substance in a polar solvent is zero.	Intermolecular forces between a non-polar molecule and a polar molecule are weaker compared to dipole-dipole interactions.
54.	The solubility of any sulphide decreases when the medium is acidified.	Sulphide ion concentration in aqueous medium decreases on acidification.
55.	CsCl(s) does not conduct electricity but an aqueous solution of CsCl does.	Cs and Cl atoms in CsCl(s) form Cs^+ and Cl^- ions when dissolved in water.
56.	Alkali metals react with water forming basic solutions.	Alkali metals replace hydrogen from water.
57.	Calcium carbide evolves acetylene when reacted with water.	Calcium carbide contains the acetylide ion, $(C\equiv C)^{2-}$.
58.	A solution containing an α-amino acid cannot function as a buffer solution.	In an α-amino acid a–COOH group and an $—NH_2$ group are attached to the same carbon atom.
59.	Each bond angle in the molecule,  is equal to 109.5°	The carbon atom in this molecule is sp^3 hybridised.
60.	Phenolphthalein is not used as an indicator for weak acid–strong base titrations as the observed end point is lower than the equivalence point.	Any indicator can be used in an acid – base titration as long as there is a rapid change of pH near the equivalence point.

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