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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

02 E I

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2005 අප්‍රේල්
கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர)ப் பரீட்சை, 2005 ஏப்பிரல்
General Certificate of Education (Adv. Level) Examination, April 2005

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

පැ දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Important:

- *This paper consists of 08 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 and then indicate your **Index Number** by shading the appropriate numbers in the grid immediatly below it.*
- *In each of the questions **1** to **60**, pick one of the alternatives. (1), (2), (3), (4), (5) which is **correct or most appropriate** and **shade its number** on the answer sheet in accordance with the instructions given therein.*

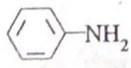
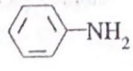
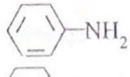
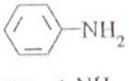
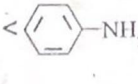
Universal gas constant, R	$= 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$
Avogadro Constant, N_A	$= 6{\cdot}022 \times 10^{23}\ mol^{-1}$

1. The third ionisation enthalpy is highest for,
   (1) Al (2) Si (3) S (4) Mg (5) Ar

2. The oxidation number of the carbonyl carbon in acetaldehyde, $\left(CH_3-\overset{\overset{O}{\|}}{C}-H\right)$ is
   (1) +2 (2) 0 (3) +1 (4) –1 (5) –2

3. Which arrangement of compounds given below, gives the correct increasing order of **acid strength**?
   (1) $H_2O < CH_3OH < CH_3COOH < C_6H_5OH$
   (2) $CH_3OH < H_2O < CH_3COOH < C_6H_5OH$
   (3) $H_2O < CH_3OH < C_6H_5OH < CH_3COOH$
   (4) $CH_3OH < H_2O < C_6H_5OH < CH_3COOH$
   (5) $H_2O < C_6H_5OH < CH_3OH < CH_3COOH$

4. Which of the following **does not occur** when the atomic number of the elements increases in group V of the periodic table?
   (1) Increase in metallic character (2) Oxides becoming more acidic
   (3) Hydrides becoming less basic (4) Hydrides becoming more reducing
   (5) Oxyacids becoming less acidic

5. Which arrangement of compounds given below gives the correct increasing order of **base strength**?
   (1)  $< CH_3CONH_2 < CH_3NH_2 < NH_3$
   (2) $CH_3CONH_2 <$  $< NH_3 < CH_3NH_2$
   (3) $NH_3 < CH_3CONH_2 < CH_3NH_2 <$ 
   (4) $CH_3NH_2 < NH_3 < CH_3CONH_2 <$ 
   (5) $CH_3CONH_2 < CH_3NH_2 <$  $< NH_3$

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6. Which one of the following statements regarding ideal solutions of two volatile liquids is **incorrect**?
   (1) The standard boiling point of an ideal solution of a **given composition** is a constant.
   (2) When an ideal solution is distilled, its boiling point changes with time.
   (3) Ideal solutions can occur only over a limited range of compositions.
   (4) All ideal solutions obey Raoult's law.
   (5) The boiling point of an ideal solution lies between the boiling points of the two pure components.

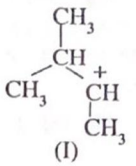
7. With which of the following compounds does H_2O_2 react as a reducing agent?
   (1) H_2S (2) KI (3) $FeSO_4$ (4) SO_2 (5) Ag_2O

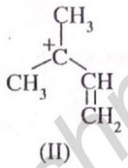
8. Which one of the following compounds has the largest dipole moment?
   (1) *cis* ClCH=CHCl (2) CO_2 (3) $Cl_2C=CCl_2$
   (4) CCl_4 (5) *trans* ClCH=CHCl

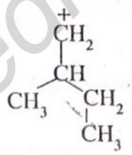
9. The coloured salt that gives a colourless solution in hot water is
   (1) $KMnO_4$ (2) $FeCl_3$ (3) KI (4) PbI_2 (5) $CuSO_4$

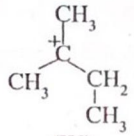
10. One of two identical glass bulbs is filled with **X** moles of an ideal gas and the other with **X** moles of a real gas. Which of the following statements about the two gases is **least likely** to be correct?
   (1) The volumes of the two gases are equal at any temperature where no liquefaction occurs.
   (2) The pressure of the ideal gas is never smaller than that of the real gas at the same temperature.
   (3) The pressures of the two gases may become equal at some temperatures.
   (4) The compressibilities of the two gases may become equal at some temperatures.
   (5) The mean square speeds of the two gases are equal at any temperature.

11. Consider the following carbocations :


(I)


(II)


(III)


(IV)

Which of the following gives the correct increasing order of **stability** of the above carbocations?
   (1) III < I < II < IV (2) III < I < IV < II (3) IV < II < I < III
   (4) I < II < III < IV (5) II < IV < I < III

12. Which one of the following statements is **incorrect**?
   (1) The elements at the top of the electro-chemical series are the most reducing.
   (2) Zn will replace Fe from a solution of $FeSO_4$.
   (3) Cl_2 will liberate I_2 from a solution of KIO_3.
   (4) Elements above H in the electrochemical series will liberate $H_2(g)$ from acids.
   (5) The oxidation state of an element in a compound can be zero.

13. The correct order of the standard enthalpies of formation, ΔH_f^θ of the atoms of oxygen, nitrogen, chlorine and neon is
   (1) Cl < Ne < N < O (2) Cl < N < O < Ne (3) O < Ne < Cl < N
   (4) O < N < Ne < Cl (5) Ne < Cl < O < N

14. Which one of the following statements is **not true** regarding CrO_4^{2-} and $Cr_2O_7^{2-}$ ions?
   (1) Both contain Cr in its highest oxidation state.
   (2) Both oxidise I^- to I_2.
   (3) They are in equilibrium with each other in aqueous solution.
   (4) Both give precipitates with NH_4OH.
   (5) Both are reduced to Cr^{3+} by SO_2.

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15. Which step given below makes the largest contribution to the yield of CH_3Cl in the following reaction?

$$CH_4 \xrightarrow[\text{light}]{Cl_2} CH_3Cl$$

(1) $CH_3^+ + Cl^- \rightarrow CH_3Cl$ (2) $CH_3^\bullet + Cl_2 \rightarrow CH_3Cl + Cl^\bullet$

(3) $CH_3^\bullet + Cl^\bullet \rightarrow CH_3Cl$ (4) $CH_3^+ + Cl_2 \rightarrow CH_3Cl + Cl^+$

(5) $Cl^\bullet + CH_4 \rightarrow CH_3Cl + H^\bullet$

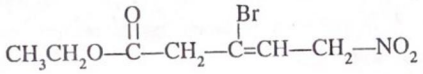
16. Which one of the following statements is **not true** regarding the elements in the periodic table?

(1) All elements with one valence electron are metals.
(2) There are metals as well as non-metals in group IV.
(3) Most elements in group III are metals.
(4) All 3d-transition elements are metals.
(5) Group VII contains elements that exist as gas, liquid or solid at room temperature.

17. **P**, **Q**, **R** and **S** are respectively, pure water, an aqueous solution of sugar, a mixture of ether and water and a mixture of coconut oil and water. The correct order of the boiling points of **P**, **Q**, **R** and **S** is

(1) **P < Q < R < S** (2) **R < S < Q < P** (3) **R < S < P < Q**
(4) **Q < P < R < S** (5) **P < S < Q < R**

18. The IUPAC name of the compound,



is,

(1) 3-Bromo-1-ethoxy-5-nitropent-3-enone. (2) 3-Bromo-5-ethoxy-1-nitropent-2-enone.
(3) 2-Bromo-1-carboethoxy-4-nitrobut-2-ene. (4) Ethyl 3-bromo-5-nitropent-3-enoate.
(5) Ethyl 3-bromo-1-nitropent-2-enoate.

19. In group III of qualitative analysis, the filtrate from group II is,

(1) treated with NH_4Cl and NH_4OH.
(2) boiled with HNO_3 and then treated with NH_4Cl and NH_4OH.
(3) boiled and then treated with NH_4Cl and NH_4OH.
(4) boiled and then heated with HNO_3 and treated with NH_4Cl and NH_4OH.
(5) boiled with HNO_3, NH_4Cl and NH_4OH.

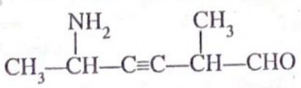
20. The valency and oxidation number of the central atom in $S_2O_3^{2-}$ ion are respectively,

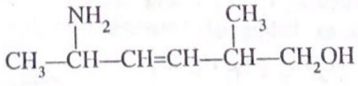
(1) 2 and +4. (2) 4 and +6. (3) 6 and +4. (4) 6 and +2. (5) 4 and +4.

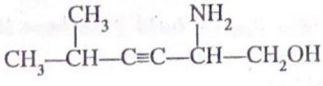
21. The shape of the BrF_5 molecule is

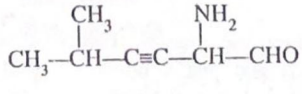
(1) trigonal bipyramidal. (2) octahedral. (3) square pyramidal.
(4) tetrahedral. (5) none of these.

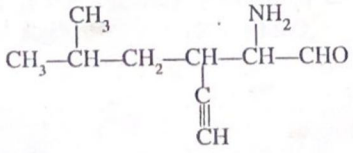
22. Choose the structure which corresponds to the IUPAC name, 2-amino-5-methylhex-3-ynal.

(1) 

(2) 

(3) 

(4) 

(5) 

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23. NaOH reacts with urea as follows.

$$2NaOH + NH_2CONH_2 \rightarrow Na_2CO_3 + 2NH_3\uparrow$$

0·6 g of urea (relative molecular mass of urea = 60·0) reacted completely with 25·0 cm^3 of 1·0 mol dm^{-3} NaOH. All NH_3 was expelled by boiling. The volume of 0·5 mol dm^{-3} HCl necessary to neutralise the resulting solution is

(1) 10·0 cm^3. (2) 12·5 cm^3. (3) 20·0 cm^3. (4) 25·0 cm^3. (5) 50·0 cm^3.

24. For the species NO_2, NO_2^- and NO_2^+ the correct order of the bond angles is,

(1) $NO_2^- > NO_2 > NO_2^+$ (2) $NO_2^+ > NO_2 > NO_2^-$

(3) $NO_2^- > NO_2 = NO_2^+$ (4) $NO_2^- > NO_2^+ > NO_2$

(5) $NO_2^+ > NO_2^- > NO_2$

25. The structural formula of ammonium aquapentafluoroferrate(III) is,

(1) $(NH_4)\left[Fe(H_2O)F_5\right]$. (2) $(NH_4)\left[Fe(H_2O)_5F\right]$.

(3) $(NH_4)_2\left[Fe(H_2O)F_5\right]$. (4) $(NH_4)_2\left[Fe(H_2O)_5F\right]$.

(5) $\left[Fe(NH_3)(H_2O)F_5\right]$.

26. A closed vessel contains water in contact with CO_2 gas at 3 atm pressure. A number of equilibria exist in this system. If CO_2 and H_2O behave ideally in the gas phase, the number of equilibria in the system is

(1) 3. (2) 4. (3) 5. (4) 6. (5) 7.

27. Which of the following will show the largest change in pH when 1.0 cm^3 of 1·0 mol dm^{-3} NaOH solution is added to each of them?

(1) 20·0 cm^3 of 1·0 mol dm^{-3} CH_3COOH
(2) 20·0 cm^3 of 1·0 mol dm^{-3} NaOH
(3) A mixture of 10·0 cm^3 of 1·0 mol dm^{-3} CH_3COOH and 10·0 cm^3 of 1·0 mol dm^{-3} CH_3COONa
(4) 20·0 cm^3 of 1·0 mol dm^{-3} H_2SO_4
(5) 20·0 cm^3 of distilled water

28. Which one of the following cations
(i) gives a precipitate with NaOH, which is insoluble in excess NaOH?
(ii) gives a precipitate with NH_4OH, which is soluble in excess NH_4OH?

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

29. A test tube contains 1-hexyne and another 2-hexyne. Which of the following would you add to each of the two test tubes to distinguish between 1-hexyne and 2-hexyne?

(1) dilute H_2SO_4 and $HgSO_4$ (2) Br_2/CCl_4 (3) alkaline $KMnO_4$
(4) ammoniacal $AgNO_3$ (5) aqueous Na_2CO_3

30. Of those given below, the possible combination of bonds that can be formed between any two atoms is

(1) two σ bonds and one π bond. (2) three σ bonds.
(3) one σ bond and one π bond. (4) three π bonds.
(5) two σ bonds.

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31. Which of the following columns 1-5, contains the correct observations for both tests A and B, performed on aqueous solutions of the respective salts?

	(1) $AgNO_3$	(2) $Ba(NO_3)_2$	(3) $CdSO_4$	(4) $MgSO_4$	(5) $FeCl_3$
(A) Addition of dil HCl	white ppt	no ppt	no ppt	white ppt	no ppt
(B) Passing H_2S through the solution from test A	white ppt	white ppt	black ppt	no ppt	no ppt

32. Consider the solutions given below.
(a) 0·1 mol dm^{-3} aqueous NH_4Cl
(b) 0·1 mol dm^{-3} aqueous NH_4OH
(c) Mixture of 50·0 cm^3 of 0·2 mol dm^{-3} aqueous NH_4Cl and 50·0 cm^3 of 0·2 mol dm^{-3} aqueous NH_4OH
(d) Mixture of 25·0 cm^3 of 0·2 mol dm^{-3} aqueous NH_4OH and 25·0 cm^3 of 0·2 mol dm^{-3} aqueous acetic acid

The pH values of the solutions follow the order,

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

33. 1·0 dm^3 of 0·2 mol dm^{-3} H_2SO_4 and 1·0 dm^3 of 0·2 mol dm^{-3} HCl were mixed to obtain 2·0 dm^3 of solution. The H^+ ion concentration of the resulting solution, if H_2SO_4 is fully dissociated under these conditions, is

(1) 0·1 mol dm^{-3}. (2) 0·15 mol dm^{-3}. (3) 0·2 mol dm^{-3}.
(4) 0·3 mol dm^{-3}. (5) 0·4 mol dm^{-3}.

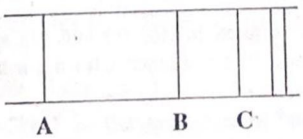
34. Which one of the following is an oxidation-reduction reaction?

(1) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$ (2) $CaCO_3 \rightarrow CaO + CO_2$
(3) $N_2O_4 \rightarrow 2NO_2$ (4) $Ca(COO)_2 \rightarrow CaCO_3 + CO$
(5) $CO_2 + H_2O \rightarrow H_2CO_3$

35. Which one of the following tests can be used to distinguish between acetamide (CH_3CONH_2) and ethylamine ($CH_3CH_2NH_2$)?

(1) addition of Br_2 water
(2) heating with aqueous NaOH
(3) addition of Brady's reagent
(4) heating with dil HCl
(5) treating with acidic $KMnO_4$

36. The emission lines of the Balmer series of the atomic spectrum of hydrogen are shown below.



The colours of the lines **A**, **B** and **C** are respectively

(1) red, green, blue. (2) blue, green, red.
(3) green, red, blue. (4) blue, red, green.
(5) red, blue, green.

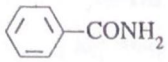
37. Which of the following is **not used** as a bleaching agent?

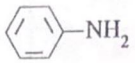
(1) NaOCl (2) $KMnO_4$ (3) moist SO_2 (4) $Ca(OCl)_2$ (5) H_2O_2

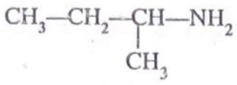
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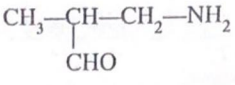
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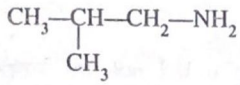
38. An organic compound **X** reacts with nitrous acid to give **Y**. Compound **Y** reacts with acidified $KMnO_4$ to give **Z**. Compound **Z** reacts with acidified, alcoholic, 2,4-dinitrophenylhydrazine to give an orange precipitate. The compound **X** is

(1) 

(2) 

(3) 

(4) 

(5) 

39. Consider the following compounds :

(A) C_6H_5OH (B) HCHO (C) 

(D) $NH_2—(CH_2)_6—NH_2$ (E) $NH_2—CO—NH_2$

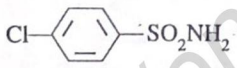
Which pair of these compounds given below will produce a thermoplastic polymer?

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

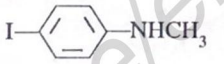
40. An organic compound **X** was fused with sodium. The aqueous extract of the fusion mixture was subjected to the following tests.

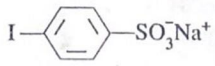
Test	Observation
(i) Boiled with excess dil HNO_3 and added aqueous $AgNO_3$	A precipitate insoluble in excess NH_4OH
(ii) Added a solution of sodium nitroprusside	A purple colouration
(iii) Added aqueous $FeSO_4$	A black precipitate

The compound **X** is,

(1) 

(2) 

(3) 

(4) 

(5) 

● **Instructions for questions No. 41 to 50**

For each of the questions **41** to **50**, four responses (*a*), (*b*), (*c*) and (*d*) are given. 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

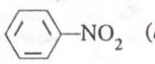
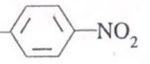
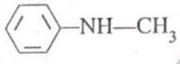
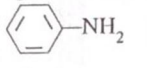
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41. Which of the following statement/s is/are true?
(*a*) Electrons have particle as well as wave properties.
(*b*) A proton is heavier than a neutron.
(*c*) All atoms have electrons, protons and neutrons.
(*d*) All ions have at least one proton.

42. The kinetic molecular theory equation for an ideal gas is $pV = \frac{1}{3}mN\overline{C^2}$. Which of the following statement/s is/are true for an ideal gas?
(*a*) $\overline{C^2}$ is independent of temperature.
(*b*) $\overline{C^2}$ is a constant at constant temperature.
(*c*) pV is a constant at constant temperature.
(*d*) pV is independent of the number of moles.

43. Compound **X** was treated with the reducing agent Sn and conc. HCl. The reaction mixture was basified with aqueous NaOH. The organic product resulting from basification was isolated and treated with nitrous acid, followed by 2-naphthol to give a reddish-orange dye.
Which of the following structures for **X** is / are consistent with the above reaction sequence?
(*a*)  (*b*)  (*c*)  (*d*) 

44. Which of the following can be taken as evidence for the non-ideal nature of real gases?
(*a*) Different real gases have different boiling points.
(*b*) Certain real gases are coloured while others are not.
(*c*) Under identical conditions different real gases have different densities.
(*d*) Certain real gases react chemically with each other.

45. Which of the following solutions **cannot be used** to distinguish between SO_2 and CO_2?
(*a*) $K_2Cr_2O_7/H^+$ (*b*) $KMnO_4$ (*c*) litmus solution (*d*) $FeCl_3/H^+$

46. The rate of a chemical reaction increases when the concentrations of the reactants are increased at constant temperature, because:
(*a*) The number collisions between molecules increases.
(*b*) The fraction of molecules with energy in excess of the activation energy increases.
(*c*) The energy of the collisions increases.
(*d*) The fraction of collisions with the correct geometry increases.

47. The standard electrode potentials of two metal/metal ion electrodes, $P|P^+$ and $Q|Q^{2+}$ are 0·80 and −0·44 V respectively. Which of the following reaction/s is/are consistent with the above potentials?
(*a*) $2P(s) + Q^{2+}(aq) \rightarrow 2P^+(aq) + Q(s)$
(*b*) $Q(s) + 2H^+(aq) \rightarrow H_2(g) + Q^{2+}(aq)$
(*c*) $H_2(g) + P_2O(s) \rightarrow 2P(s) + H_2O(l)$
(*d*) $H_2O(l) + P(s) \rightarrow H_2(g) + POH(aq)$

48. Water from a tube well is clear as it is pumped out, but turns cloudy and brown on exposure to air for some time, due to the formation of $Fe(OH)_3$. Which of the following statements are most likely to be true in this situation?
(*a*) $Fe(OH)_3$ dissolves in water under pressure but is deposited when the pressure is atmospheric.
(*b*) Iron is present mainly as Fe^{2+} in the ground water feeding the well.
(*c*) Conditions underground are reducing.
(*d*) The solubility of $Fe(OH)_3$ is much less than that of $Fe(OH)_2$.

49. Which of the following may be considered as a standard hydrogen electrode / standard hydrogen electrodes at 25°C?
(*a*) $HCl(aq)\ (1{\cdot}0\ mol\ dm^{-3}) \mid^{Pt} H_2(g)\ (1\ atm)$
(*b*) $CH_3COOH(aq)\ (1{\cdot}0\ mol\ dm^{-3}) \mid^{Pt} H_2(g)\ (1\ atm)$
(*c*) $H_2SO_4(aq)\ (1{\cdot}0\ mol\ dm^{-3}) \mid^{Pt} H_2(g)\ (1\ atm)$
(*d*) $HNO_3(aq)\ (1{\cdot}0\ mol\ dm^{-3}) \mid^{Pt} H_2(g)\ (1\ atm)$

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50. **S** is a solution of Na_2CO_3 and $NaHCO_3$ in water. By which method / methods given below can the concentrations of Na_2CO_3 and $NaHCO_3$ in **S** be determined by titrating 25·0 cm^3 of **S** with standard HCl?
   (*a*) Using phenolphthalein as indicator
   (*b*) First using methyl orange as indicator and further titrating the same solution using phenolphthalein as indicator
   (c) First using phenolphthalein as indicator and further titrating the same solution using methyl orange as indicator
   (*d*) Tirate using phenolphthalein as indicator and thereafter titrate a separate 25·0 cm^3 of **S** using methyl orange as indicator

- **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.	Ethylamine does not give a stable diazonium salt with HNO_2.	HNO_2 reacts with aromatic amines only.
52.	Under a given set of conditions, a catalyst increases the amount of product obtained in unit time.	A catalyst alters the enthalpy change of a reaction
53.	CH_4 and CO_2 are green-house gases.	Green-house gases are those that consist of carbon-containing, small molecules.
54.	Two different reactions taking place at the same rate, at the same temperature should have the same activation energy.	The rate of a reaction is directly proportional to the activation energy.
55.	The organic product obtained from the reaction of optically-active 2-butanol with acidic $KMnO_4$ is not optically active.	The organic product is a racemic mixture.
56.	Cl_2 gas dissolved in water can be expelled by boiling.	Dissolution of chlorine in water is exothermic and reversible.
57.	$CuSO_4 \cdot 5H_2O$ becomes colourless on heating.	Cu^{2+} ion is reduced to Cu^+ ion on dehydration.
58.	ICl_4^- ion is tetrahedral.	There are four repulsion units around the iodine atom in ICl_4^-.
59.	The properties of one N-H bond in the NH_4^+ ion are different from those of the other three N-H bonds.	One N-H bond in the NH_4^+ ion can be identified as a co-ordinate bond.
60.	In the fermentation of glucose ($C_6H_{12}O_6$) by yeast, some carbon atoms of the glucose molecule are oxidised while others are reduced.	The chemical products of fermentation of glucose are CO_2 and CH_3CH_2OH.

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