EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE (EAES)
ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)

Chemistry Exam Booklet - Code 692

Hamle 2018 E.C. / July 2026 G.C.

NUMBER OF ITEMS: 80	**SUBJECT CODE: 05**
BOOKLET CODE: 692	**TIME ALLOWED: 2:30 HOURS**

CHEMISTRY (QUESTIONS 1 - 80)

Directions: *Solve each of the problems given in questions 1 - 80 and select the correct answer from the given four alternatives. Then, blacken the letter of your choice on the separate answer sheet provided.*

1. Which of the following is the favorable condition for the formation of an ionic bond?

A. A metal with high ionization energy and a non-metal with low electron affinity.

B. A metal with low ionization energy and non-metal with high electron affinity.

C. A metal with low ionization energy and a non-metal with low electron affinity.

D. A metal with high ionization energy and a non-metal with high electron affinity.

2. Which of the following processes is the reverse of fusion during a phase change of a substance?

A. Condensation

B. Deposition

C. Sublimation

D. Crystallization

3. Consider the following formula of an alcohol:

$CH_3(CH_2)_3$ — OH

What type of alcohol does this formula represent?

A. Quaternary alcohol

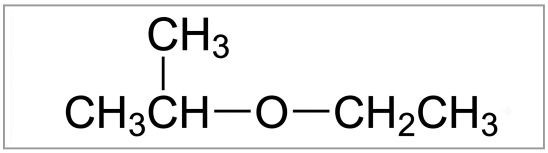
B. Tertiary alcohol

C. Secondary alcohol

D. Primary alcohol

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4. Consider the following structure of an organic compound:



What is the CORRECT name of the given organic compound?

A. 1-isopropoxyethane
B. 2-ethoxypropane
C. Ethylpropyl ether
D. Diethyl ether

5. A sample of O_2 gas effuses through a tiny hole in 40 s. What is the molar mass of a gas that requires 80 s to effuse through this hole under the same condition?

A. 128 g/mol
B. 64 g/mol
C. 32 g/mol
D. 16 g/mol

6. Which of the following laws states that every chemical compound contains constant mass ratio of its composing elements?

A. Law of constant of weight
B. Law of definite proportion
C. Law of multiple proportion
D. Law of conservation of mass

7. According to Mendeleev's periodic law, which of the following determines the properties of elements?

A. Atomic number
B. Mass of neutron
C. Molecular weight
D. Atomic weight

8. Which of the following statements is CORRECT about atoms based on modern atomic theory?

A. Atoms can be created during ordinary chemical reaction.
B. Atoms of different elements can be the same atoms.
C. Isotopes have the same atomic number but different mass number.
D. Atoms of the same element are the same in all their properties.

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9. Which of the following is CORRECT about the general properties of ionic compounds?

A. They have high melting and low boiling point

B. They are insoluble in polar solvents

C. They are hard and breakable

D. They have low density

10. Which of the following represents the group and period, of an element based on the electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^3$ respectively?

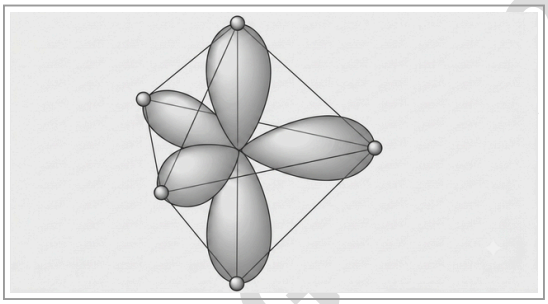
A. IIIB, 5

B. VA, 3

C. VB, 3

D. IIIA, 5

11. Consider the following diagram of the molecule of PCl_5:



From this diagram, what is the hybridization of the central atom, P?

A. d^2sp^3

B. sp^3d^2

C. sp^3d

D. dsp^2

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12. Given the following data for the reaction of lithium metal with fluorine gas:

I. $Li(s) + \frac{1}{2} F_2(g) \rightarrow LiF(s),\ \Delta H_{LiF} = -594.1$ kJ

II. $Li(s) \rightarrow Li(g),\ \Delta H_1 = 155.7$ kJ

III. $F_2(g) \rightarrow 2\ F(g),\ \Delta H_2 = 150.6$ kJ

IV. $Li(g) \rightarrow Li^+(g) + e^-,\ \Delta H_3 = 520$ kJ

V. $F(g) + e^- \rightarrow F^-(g),\ \Delta H_4 = -328$ kJ

What is the lattice energy of lithium fluoride, LiF crystal?

A. -1092.4 kJ B. 1092.4 kJ

C. -1017.0 kJ D. 1017.0 kJ

13. During a laboratory preparation of acetic acid, ethanol and sodium dichromate are allowed to react by heating for half a minute. At the end of the reaction, the distilled product sample is taken and a small amount of solid sodium carbonate is added to it to confirm the formation of acetic acid. What is the importance of adding sodium carbonate to the reaction during this experiment? This is because, sodium carbonate:

A. reacts with sodium dichromate and gets oxidized.

B. stops the reaction by reacting with ethanol.

C. reacts with acetic acid to form CO^2gas.

D. reacts with ethanol to form CO^2gas.

14. According to Bronsted-Lowry definition, which of the following is the proton donor during an acid-base reaction?

A. Oxide B. Salt

C. Base D. Acid

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15. What is acid-base indicators? They are weak:

A. organic acids or bases that maintain their colors in acidic, basic or neutral solutions.

B. organic acids or bases that indicate whether a solution is acidic, basic or neutral.

C. inorganic acids or bases that maintain their colors in acidic, basic or neutral solutions.

D. inorganic acids or bases that indicate whether a solution is acidic, basic or neutral.

16. While performing an experiment to produce a desired product, an unexpected byproduct was co-produced. The desired product weighed 125 g and the byproduct weighed 25 g. What is the atom economy of this reaction?

A. 100 % B. 16.7 %

C. 83.3 % D. 20.0 %

17. Given the following ionization of a certain weak acid (HA):

$HA(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + A^-(aq)$

What is the weak acid dissociation expression of the above equilibrium?

A. $K^a = [HA] / [H^3O^+][A^-]$

B. $K^a = [H^3O^+][A^-] / [HA]$

C. $K^a = [H^3O^+][A^-] / [HA][H^2O]$

D. $K^a = [A^-] / [HA]$

18. Which of the following statements is CORRECT about the redox process that takes place during the corrosion of iron?

A. Iron is reduced at the anode region.

B. Iron is oxidized at the anode region.

C. Oxygen is reduced at the anode region.

D. Oxygen is oxidized at the cathode region.

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19. In cement production several chemical reactions take place in the kiln part of the scheme. It was also explained that the kiln contains three parts:

I. Upper part of the kiln
II. Middle part of the kiln
III. Lower part of the kiln

In which part of the kiln does there is decomposition of limestone?

A. In all parts of the kiln
B. Lower part of the kiln
C. Middle part of the kiln
D. Upper part of the kiln

20. During some polymerization processes, there is a release of a simple molecules as a byproduct. What is the necessary requirement for this kind of polymerization to happen?

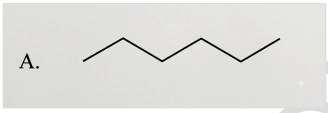
A. The monomers require to undergo a chain reaction to add a monomer.
B. The reaction requires the involvement of unsaturated monomers.
C. The reaction requires a reactive initiator molecule like free radicals.
D. The monomers require to have two functional groups.

21. What is the molecular formula of an alkane that contains eight carbon atoms?

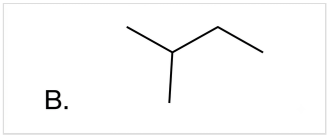
A. C^8H^{18}
B. C^8H^{16}
C. C^8H^{14}
D. C^8H^{12}

22. Which of the following is the CORRECT structural isomer of n-pentane, C_5H_{12}?

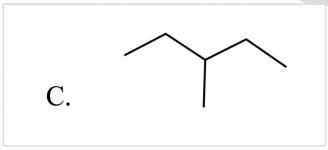
A.



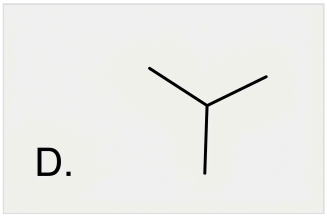
B.



C.



D.



A. Isomer A
B. Isomer B
C. Isomer C
D. Isomer D

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23. A grade 12 student was asked to identify ethene from ethane sample in a laboratory. The teacher gave him/her bromine in CCl_4 solution along with all the necessary apparatus for this experiment. Which of the following statements is CORRECT on how the student identifies ethene sample?

A. Both ethane and ethene does not react and produce color change with Br2in CCl4.

B. Br2in CCl4reacts with ethene with color change but does not react with ethane.

C. Br2in CCl4reacts with ethane with color change but does not react with ethene.

D. Both ethane and ethene react and produce color change with the Br2in CCl4.

24. Which of the following statements differentiate metallic conductivity from electrolytic conductivity? Metallic conductivity is a result of the movement of:

A. neutral particles.

B. electrically charged electrons.

C. both electrons and ions.

D. electrically charged ions.

25. Which of the following statements CORRECTLY differentiate strong bases from weak bases in solution? A solution of strong bases is:

A. strong electrolyte.

B. carry a low electric current.

C. weak electrolytes.

D. non electric conductors.

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26. In which one of the following conditions, does an ion formed from an atom?

A. When the number of neutrons in an atom are equal with number of protons.

B. When the number of electrons in an atom are greater than number of protons.

C. When the number of electrons in an atom are less than number of protons.

D. When the number of electrons in an atom are equal with number of protons.

27. Which of the following is TRUE about masses of subatomic particles?

A. The relative mass of a neutron is greater than that of an electron.

B. The relative mass of a neutron is equal with that of an electron.

C. The mass of an atom is equally distributed throughout its space.

D. The three subatomic particles are equal in their absolute masses.

28. Which of the following statement is CORRECT about periods in the modern periodic table?

A. The first three periods in the periodic table are known as long periods.

B. They start with alkali metals and end with alkaline earth metals.

C. They are vertical columns of elements in the periodic table.

D. There are seven periods in the periodic table of elements.

29. Which of the following statements CORRECTLY defines chemical bonding?

A. It is the process taking place during the evaporation of a compound.

B. It is a kind of chemical reaction taking place in matter.

C. It is a force that holds atoms together in a compound.

D. It is the repulsive force between similar charges.

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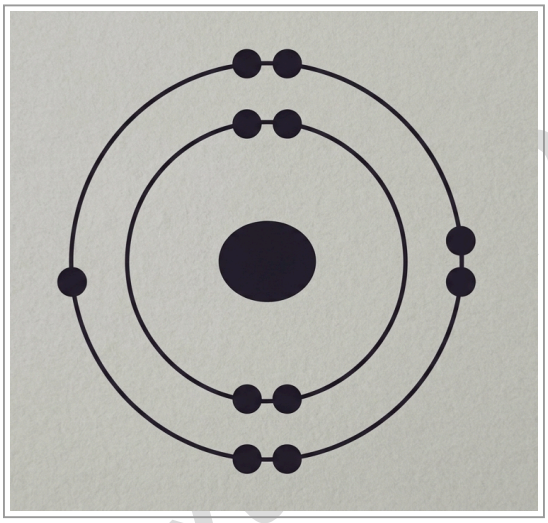
30. Which one of the following is NOT a type of chemical reaction?

A. Double decomposition
B. Single displacement
C. Decomposition
D. Deposition

31. Which of the following reaction schemes represents the formation of coordinate covalent bond?

A. A^{+}+ :M → A^{+}: M
B. :A + :M → A : M
C. :A + :M → :A : M
D. :A + :M → :A : M

32. Consider the following diagram:



Which element in the periodic table is represented by the above electronic configuration diagram?

A. Chlorine
B. Fluorine
C. Sodium
D. Boron

33. Why does atomic radius increase when we go down the group in the periodic table? This is because:

A. effective nuclear charge increases.
B. principal quantum number decreases.
C. number of shell increases.
D. atomic number decreases.

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34. A Table salt and an oil are added to pure water. After stirring for a while, the salt disappears but the oil floats on the surface of the water. Which of the following statements is the CORRECT reason that explains this demonstration?

A. The salt is soluble in polar solvent.

B. The oil is insoluble in non-polar solvent.

C. The oil is soluble in polar solvent.

D. The salt is soluble in non-polar solvent.

35. An aluminum and piece of paper were taken for conductivity experiment. The aluminum conducts electricity and the piece of paper do not. What explanation can be given for the conductivity of the aluminum metal? This is due to the fact that aluminum:

A. contains only protons.

B. does not contain electrons.

C. contains freely moving electrons.

D. contains electric power in its structure.

36. What is the CORRECT explanation for the fact that CCl_4 is a non-polar molecule, while $CHCl_3$ is a polar molecule?

A. The bond polarities in C-Cl bonds of CCl_4 have cancelled each other but not in the case of $CHCl_3$.

B. The bond polarities in C-Cl bonds of $CHCl_3$ have cancelled each other but not in the case of CCl_4.

C. The polarity of C-H bond is greater than the polarity of C-Cl bond.

D. CCl_4 has no polar bonds while $CHCl_3$ has one polar bond.

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37. Grade 11 students were carrying out an experiment to determine the boiling point of ethanol. They started by filling a test tube with a sample of ethanol with boiling chips and fitted a thermometer in rubber stoper and insert it in the test tube. Then they put the test tube in a beaker containing oil and started heating gently the oil using a Bunsen burner. When the temperature is constant for a while their instructor told them to stop the burner and record the temperature on the thermometer. Why did the temperature become constant?

A. This is the temperature at which the alcohol oxidizes.

B. It is the boiling temperature of a pure substance.

C. The heat involved in temperature change rather than state change.

D. That is the maximum heating capacity of the Bunsen burner.

38. Given an equilibrium reaction:

$H_2S(g) + I_2(s) \leftrightarrow 2HI(g) + S(s)$

At equilibrium, the partial pressure of H_2S and HI are 1.6 atm, 2.0×10^{-2} atm at 71 °C respectively. What is the value of the equilibrium constant, K_p of this reaction?

A. 1.3×10^{-4}

B. 2.5×10^{-2}

C. 2.5×10^{-4}

D. 1.3×10^{-2}

39. Which of the following organic compounds is prepared by the elimination of water molecule from two alcohol molecules with a strong dehydrating agent such as concentrated sulfuric acid at a temperature of 140 °C?

A. Carboxylic acids

B. Ethers

C. Ketones

D. Aldehydes

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40. Which of the following statements is CORRECT for the oxidation of aldehydes and ketones?

A. Ketones are readily oxidized to yield ester.

B. Aldehydes are generally inert towards oxidation.

C. Ketones are readily oxidized to yield carboxylic acids.

D. Aldehydes are readily oxidized to yield carboxylic acids.

41. Which of the following is the driving force of the cell reaction in an electrochemical cell?

A. Cell reaction

B. Cathode potential

C. Cell potential

D. Electrode reaction

42. Which branch of chemistry deals about the effect and fate of chemical productions in the surrounding?

A. Physical chemistry

B. Organic chemistry

C. Inorganic chemistry

D. Environmental chemistry

43. Which of the following species is amphiprotic in its reactions with water?

A. HCO^{3-}

B. HNO^{2}

C. NaOH

D. PO^{43-}

44. Which of the following is TRUE about Lithium that has the least standard reduction potential in electromotive series?

A. Lithium ion is the strongest reducing agent.

B. Lithium metal is the strongest reducing agent.

C. Lithium metal is the strongest oxidizing agent.

D. Lithium ion is the strongest oxidizing agent.

45. In which of the following steps of sugar production, carbon dioxide and milk of lime are added to the mixture?

A. Cleansing

B. Juicing

C. Crystallizing

D. Clarifying

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46. Which of the following terms is defined as "how fast a solute goes into solution"?

A. Rate of dissolution
B. Rate of a reaction
C. Rate of precipitation
D. Rate of dissociation

47. Which of the following statements CORRECTLY defines oxides?

A. Oxides are binary compounds of oxygen and any other element.
B. Oxides are organic compounds containing hydrogen, carbon and oxygen.
C. Oxides are inorganic compounds that contain carbon, hydrogen and oxygen.
D. Oxides are ternary compounds of oxygen, hydrogen and other element.

48. Which of the following statements is the CORRECT reason for the conductivity of metals? This is because metals:

A. have free electrons.
B. are hard materials.
C. form bases with oxygen.
D. react with non-metals.

49. In which of the following forms does aluminum occur naturally?

A. Malachite
B. Bauxite
C. Sulfide
D. Hematite

50. Which of the following is the product of the reaction of alkenes with hydrogen molecule in the presence of platinum catalyst?

A. Cycloalkanes
B. Alkynes
C. Alkanes
D. Alkenes

51. What is the pOH of an aqueous solution that is 0.5 M CH_3NH_2 (Methylamine)? (K_b = 4.2×10^{-4}, log 1.45 = 0.16)

A. 2.84
B. 0.16
C. 0.08
D. 11.16

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52. Which of the following ions is preferentially discharged at the anode electrode during the electrolysis of copper sulphate solution by using inert electrodes?

A. SO^{42-}
B. Cu^{2+}
C. OH^{-}
D. H^{+}

53. In the local production of natural compost, what should be done for the decomposition to take place in the absence of oxygen?

A. Dig a hole and bury the plant and animal residues in the hole for longer period of time.
B. Select proper kind of waste which does not need oxygen for their decomposition.
C. Adding other chemicals which absorb oxygen so that it will not interfere with the decomposition.
D. Burning the waste first will remove the oxygen in the form of carbon dioxide.

54. What is the concentration of hydroxide ion, in the weak base methylamine, CH_3NH_2 solution, that has pOH value is 3.00?

A. 2.5×10^{-11}M
B. 1.0×10^{-3}M
C. 1.5×10^{-8}M
D. 2.5×10^{-3}M

55. A 0.15 M solution of hypochlorous acid, HOCl, has a pH value of 4.0. What is the acid ionization constant, K_a, of HOCl?

A. 6.67×10^{-4}
B. 0.15×10^{-4}
C. 6.67×10^{-8}
D. 0.15×10^{-8}

56. Which of the following is CORRECT about reducing agents? Reducing agent is a substance that:

A. undergo oxidation.
B. gains electrons during a reaction.
C. decrease in oxidation number.
D. undergo reduction.

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57. What is the oxidation number of phosphorus in $Ca(H_2PO_4)_2$?

A. -4
B. -3
C. +5
D. +3

58. When 10 g of NaOH crystal was dissolved in 50 g of water, the temperature of the water was increased by 5 °C. What is the amount of heat released during the formation of the solution? (The specific heat of the solution is 4.5 J/g.°C)

A. 5.01 kJ
B. 1.35 kJ
C. 54.21 kJ
D. 22.54 kJ

59. 50 mL solutions of 1 M HCl was added into beaker 1 and 1 M CH_3COOH was added into beaker 2. Finally, electrodes were connected to an AC power in each beaker. Which of the following will be observed from this experiment?

A. Dim light will be observed in Beaker 1.
B. Bright light will be observed in Beaker 2.
C. Dim light will be observed in Beaker 2.
D. Bright light will be observed in both beakers.

60. Which one of the following DOES NOT involve a chemical change?

A. Respiration
B. Vaporization
C. Decomposition
D. Digestion

61. What is the pH of a buffer solution that contains 0.30 M CH_3COOH and 0.30 M CH_3COONa, after the addition of 0.02 mol of HCl to 1.0 L of this buffer solution? ($K_a = 1.8 \times 10^{-5}$, log 2.05 = 0.313)

A. 9.32
B. 4.68
C. 9.26
D. 4.74

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62. Consider a galvanic cell based on the following reduction half reactions:

$Fe^{2+} + 2e^- \rightarrow Fe$, $E° = -0.44$ V

$MnO_4^- + 5e^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$, $E° = 1.51$ V

Under which of the following conditions does the galvanic cell become spontaneous?

A. Reduction takes place at the anode electrode of the electrolytic cell.

B. The half reaction involving permanganate must be at the anode electrode.

C. Oxidation takes place on the electrode containing the permanganate ion.

D. The half reaction involving ferrous ion must be at the anode electrode.

63. Given the following redox reaction:

$MnO_4^- + 2I^- \rightarrow Mn^{2+} + I_2$

What is the coefficient of I_2 when this equation is balanced in acidic medium?

A. 5 B. 2

C. 16 D. 8

64. A rural community has noticed that the nearby river is polluted by the fertilizer they use in their farms and they asked you to recommend them possible solution. Which of the following strategies will you recommend them in order to improve the problem?

A. Advising the farmers to use chemical fertilizers.

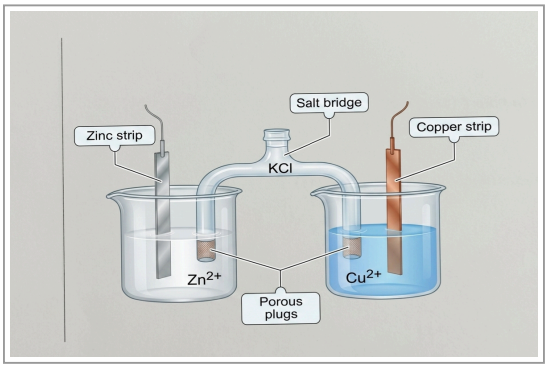
B. Advising the farmers not to use any fertilizers in their farm.

C. Increasing the use of organic fertilizers.

D. Increasing the use of inorganic fertilizers.

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65. Consider the following Zn-Cu voltaic cell:



Which of the following is CORRECT about the above voltaic cell?

A. Oxidation takes place at the copper strip.

B. Zinc strip is used as anode electrode.

C. Redox reactions take place at the salt bridge.

D. Copper strip is the site for electron release.

66. Given the following chemical reaction:

$AgNO_3(aq) + K_2CrO_4(aq) \rightarrow Ag_2CrO_4(s) + KNO_3(aq)$

Which of the following is CORRECT about the given chemical reaction?

A. $Ag^{+}$and $CrO^{42-}$are spectator ions.

B. $Ag^{+}$and $NO^{3-}$are spectator ions.

C. $K^{+}$and $NO^{3-}$are reacting ions.

D. $Ag^{+}$and $CrO^{42-}$are the reacting ions.

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67. Grade 10 students were working an experiment on double displacement reaction. In each group, the students took a solution of Na_3PO_4 in a beaker and added a solution of $Ca(OH)_2$ dropwise and they stirred it continuously for few minutes. What are the expected products of their experiment?

A. $Ca^3(PO^4)^2$+ $Ca(OH)^2$

B. $Ca(OH)^2$+ Na^3PO^4

C. NaOH + Na^3PO^4

D. NaOH + $Ca^3(PO^4)^2$

68. Consider the following cases during the formation of a solution:

Case 1: Solute-solute interparticle interaction force is strong, the solvent-solvent interaction is medium and the solvent-solute interaction is weak.

Case 2: Solute-solute interparticle interaction force is weak, the solvent-solvent interaction is medium and the solvent-solute interaction is weak.

Case 3: Solute-solute interparticle interaction force is weak, the solvent-solvent interaction is medium and the solvent-solute interaction is strong.

Case 4: Solute-solute interparticle interaction force is strong, the solvent-solvent interaction is medium and the solvent-solute interaction is strong.

Which of the above cases produce the most exothermic solution?

A. Case 2

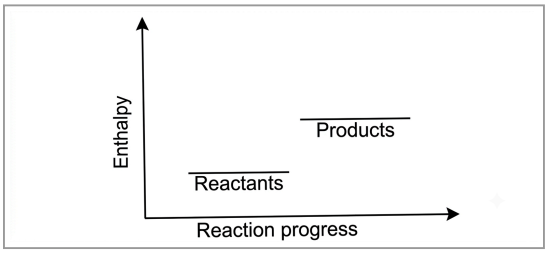
B. Case 1

C. Case 4

D. Case 3

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69. Consider the diagram below:



Which of the following statements is the CORRECT conclusion about the given reaction diagram?

A. Enthalpy of the reaction shows an energy release.

B. Enthalpy of the reaction (ΔH) has positive value.

C. Enthalpy of the reactant and the product are equal.

D. Enthalpy of the reaction (ΔH) has negative value.

70. Acetylene can be prepared in a laboratory by the reaction of calcium carbide with water and finally collected by inverted jar in water. Which of the following statements is CORRECT justification of the collection process?

A. Acetylene is not reactive with water.

B. Acetylene is very soluble in water.

C. Acetylene is converted to liquid product.

D. Acetylene is highly denser than water.

71. If 2 L of Ne gas at 100 °C is cooled at constant pressure until the volume becomes 1.5 L, then what is the final temperature?

A. 9.5 °C B. 6.8 °C

C. 279.8 °C D. 150 °C

72. What is the bond order of He_2 molecule?

A. 1.5 B. 0.5

C. 0 D. 1

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73. The electronic configuration of an atom is, $1s^2 2s^2 2p^6 3s^2 3p^1$. Which type of electronic rearrangement should the atom undergo to form a stable chemical bond?

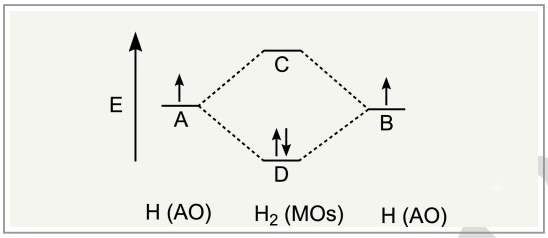
A. The atom has to lose one electron from its 3p orbital.

B. The atom has to gain one electron on its 3p orbital.

C. The atom has to gain five electrons on its 3p orbital.

D. The atom has to lose three electrons from its 3s and 3p orbital.

74. Consider an incomplete molecular orbital energy level diagram for H_2 molecule:



Which of the following representations is CORRECT to complete the given diagram?

A. A = 1s, B = 1s, C = σ^{*1s}, and D = σ^{1s}

B. A = 1s, B = σ^{1s}, C = σ^{1s}, and D = 1s

C. A = σ^{1s}, B = σ^{1s}, C = σ^{*1s}, and D = σ^{*1s}

D. A = σ^{*1s}, B = σ^{*1s}, C = 1s, and D = 1s

75. Which of the following is the CORRECT Lewis structure of the molecule of FCN?

A. :F ≡ C — N: (with lone pairs)

B. :F — C ≡ N: (with lone pairs)

C. :F — C — N: (with lone pairs)

D. :F — C — N: (with different lone pairs)

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76. Four students from grade 10 are asked to prepare solution of sodium sulphate. The students followed the following procedure:

Student A: Heat the saturated solution of the salt to get the unsaturated solution.
Student B: Heat the unsaturated solution of the salt to get the saturated solution.
Student C: Cool the saturated solution of the salt to get the unsaturated solution.
Student D: Cool the unsaturated solution of the salt to get the unsaturated solution.

Which of the students followed the CORRECT procedure in order to prepare an unsaturated solution?

A. Student A
B. Student D
C. Student C
D. Student B

77. Which of the following terms represent particles of light?

A. Cathode rays
B. Electrons
C. Alpha rays
D. Photons

78. Which of the following compounds is a triester of glycerol?

A. Carboxylic acid
B. Carbohydrate
C. Fat
D. Ketone

79. Which of the following is a three dimensional, well-defined and ordered structure of a solid material?

A. Glass
B. Crystal
C. Allotrope
D. Amorphous

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80. Which type of radioactive emission is deflected by a negatively charged plate?

A. Beta rays
B. Alpha rays
C. X-rays
D. Gamma rays

THE END

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ESSLCE CHEMISTRY

Official Answer Key - Booklet Code: 692

Exam Solutions & Answers (1 - 80)

1. B	2. D	3. D	4. B	5. A	6. B	7. D	8. C	9. C	10. B
11. C	12. D	13. C	14. D	15. B	16. C	17. B	18. B	19. D	20. D
21. A	22. A	23. B	24. B	25. A	26. B	27. A	28. D	29. C	30. D
31. A	32. B	33. C	34. A	35. C	36. A	37. B	38. C	39. B	40. D
41. C	42. D	43. A	44. B	45. D	46. A	47. A	48. A	49. B	50. C
51. A	52. C	53. A	54. B	55. C	56. A	57. C	58. B	59. C	60. B
61. D	62. D	63. A	64. C	65. B	66. D	67. D	68. D	69. B	70. A
71. B	72. C	73. D	74. A	75. B	76. A	77. D	78. C	79. B	80. B

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Detailed Explanations: Chemistry (1 - 40)

Q1 (B): Ionic bonding is highly favored when a metal easily loses an electron (low ionization energy) and a non-metal strongly attracts an electron (high electron affinity/electronegativity).

Q2 (D): Fusion is the phase transition from solid to liquid (melting). The reverse process is freezing, also referred to as crystallization or solidification.

Q3 (D): In CH3(CH2)3-OH, the hydroxyl (-OH) group is attached to a terminal carbon atom which is bonded to only one other carbon, classifying it as a primary alcohol.

Q4 (B): The compound CH3CH(CH3)-O-CH2CH3 features an ethoxy group (-O-CH2CH3) attached to the second carbon of a propane chain, giving it the IUPAC name 2-ethoxypropane.

Q5 (A): According to Graham's Law of Effusion, rate1 / rate2 = t2 / t1 = √(M2 / M1). Thus, 80 / 40 = √(M2 / 32) &implies; 2 = √(M2 / 32) &implies; 4 = M2 / 32 &implies; M2 = 128 g/mol.

Q6 (B): The Law of Definite Proportions (Proust's Law) states that a given chemical compound always contains its component elements in a fixed ratio by mass.

Q7 (D): Mendeleev's periodic law states that the physical and chemical properties of elements are periodic functions of their atomic weights.

Q8 (C): Modern atomic theory recognizes that while atoms of the same element have the same atomic number, they can have different masses (isotopes).

Q9 (C): Ionic compounds are characterized by rigid crystal lattices with strong electrostatic attractions, making them hard and brittle (breakable).

Q10 (B): The valence configuration ends in $3s^2 3p^3$. The highest principal quantum number is 3 (Period 3), and the total valence electrons = 2 + 3 = 5 (Group VA).

Q11 (C): Phosphorus in PCl5 has 5 single bonds and 10 valence electrons (expanded octet). This trigonal bipyramidal geometry corresponds to sp3d hybridization.

Q12 (D): By Hess's law, ΔH_LiF = ΔH_subl + (1/2)ΔH_bond + IE + EA - U_lattice. Thus, -594.1 = 155.7 + 75.3 + 520 - 328 - U_lattice &implies; -594.1 = 423 - U_lattice &implies; U_lattice = 1017.1 kJ.

Q13 (C): Acetic acid (carboxylic acid) reacts with carbonates like sodium carbonate to liberate carbon dioxide gas (bubbling), proving its acidic nature.

Q14 (D): According to the Bronsted-Lowry theory, an acid is defined as a proton donor.

Q15 (B): Acid-base indicators are weak organic acids or bases that change color depending on the hydrogen ion concentration, indicating pH levels.

Q16 (C): Atom Economy = [Mass of Desired Product / Total Mass of Products] × 100 = [125 / (125 + 25)] × 100 = (125 / 150) × 100 = 83.3%.

Q17 (B): The equilibrium constant expression for a weak acid (Ka) excludes the pure liquid solvent water: Ka = [H3O+][A-] / [HA].

Q18 (B): During the corrosion of iron, the iron metal undergoes oxidation at the anodic region: Fe → Fe2+ + 2e-.

Q19 (D): In cement manufacture, the decomposition of limestone (calcium carbonate) into calcium oxide and carbon dioxide occurs in the upper, cooler region of the rotary kiln.

Q20 (D): Condensation polymerization releases small molecules as byproducts and requires monomers containing at least two reactive functional groups.

Q21 (A): The general formula for alkanes is CnH2n+2. For n = 8, the molecular formula is C8H18 (octane).

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Q22 (A): n-pentane is a straight-chain alkane containing 5 carbon atoms. Choice A represents the correct unbranched 5-carbon structure.

Q23 (B): Ethene (an alkene) contains a carbon-carbon double bond which readily undergoes addition reactions with bromine water, decolorizing the brown Br2/CCl4 solution. Ethane (an alkane) does not react under these conditions.

Q24 (B): Metallic conductivity occurs due to the free flow of delocalized valence electrons, whereas electrolytic conductivity is driven by the migration of ions in solution.

Q25 (A): Strong bases fully dissociate in aqueous solution, creating a high concentration of free ions and making them strong electrolytes.

Q26 (B): Atoms form negatively charged ions (anions) when they gain electrons, making the number of electrons greater than the number of protons.

Q27 (A): Protons and neutrons are much more massive than electrons (the relative mass of a neutron is approximately 1, while that of an electron is approximately 1/1840).

Q28 (D): The modern periodic table is organized into exactly seven horizontal rows, known as periods.

Q29 (C): A chemical bond is defined as the attractive force that holds atoms or ions together to form stable chemical compounds.

Q30 (D): Deposition is a physical phase change (gas to solid) rather than a chemical reaction.

Q31 (A): A coordinate covalent bond is formed when one atom donates both electrons of the shared pair to an electron-deficient species (such as a proton).

Q32 (B): The atom shown has 2 inner electrons and 7 outer electrons, totaling 9 electrons, which is the atomic number of Fluorine.

Q33 (C): Moving down a group, each consecutive period adds an additional principal electron shell, which increases the distance from the nucleus to the outer shell.

Q34 (A): Water is a highly polar solvent. Table salt (sodium chloride) is ionic and easily dissolves in water, while non-polar oil molecules cannot dissolve and float.

Q35 (C): Metals conduct electricity due to the presence of a mobile, delocalized "sea of electrons" that can flow under an electric potential.

Q36 (A): CCl4 is symmetric (tetrahedral), so its polar C-Cl bond dipoles cancel out completely, resulting in a net dipole moment of zero. CHCl3 is asymmetric, meaning the dipoles do not cancel out.

Q37 (B): During a phase transition (such as boiling), the temperature of a pure substance remains constant because the heat energy is used to break intermolecular forces rather than increase kinetic energy.

Q38 (C): Kp = P_HI^2 / P_H2S = (2.0 × 10^-2)^2 / 1.6 = 4.0 × 10^-4 / 1.6 = 2.5 × 10^-4.

Q39 (B): Ethers are prepared by the intermolecular dehydration of two alcohol molecules in the presence of an acid catalyst at 140 °C.

Q40 (D): Aldehydes are highly reactive and easily oxidized to form carboxylic acids, whereas ketones are generally resistant to oxidation.

Detailed Explanations: Chemistry (41 - 80)

Q41 (C): The cell potential (electromotive force, EMF) is the driving force that pushes electrons through the external circuit.

Q42 (D): Environmental chemistry focuses on the study of chemical species, reactions, and impacts within soil, water, and air.

Q43 (A): HCO3- is amphiprotic because it can act as an acid (donating a proton to form $CO3^{2-}$) or as a base (accepting a proton to form H2CO3).

Q44 (B): A very low standard reduction potential indicates that Lithium is easily oxidized, making Lithium metal a highly powerful reducing agent.

Q45 (D): During the clarification step of sugar processing, milk of lime and carbon dioxide are added to form a calcium carbonate precipitate that carries away impurities.

Q46 (A): The rate of dissolution represents the speed at which a solute dissolves into a solvent to form a uniform solution.

Q47 (A): Oxides are binary chemical compounds formed by the combination of oxygen with another element.

Q48 (A): Metals possess highly mobile, delocalized valence electrons that readily conduct electrical currents.

Q49 (B): Bauxite is the primary natural ore mineral from which aluminum is industrially extracted.

Q50 (C): Alkenes undergo catalytic hydrogenation (addition of H2) in the presence of platinum to form saturated alkanes.

Q51 (A): For weak base, [OH-] = √(Kb × C) = √(4.2 × 10^-4 × 0.05) = √(2.1 × 10^-5) = 1.45 × 10^-3 M. pOH = 3 - log(1.45) = 3 - 0.16 = 2.84.

Q52 (C): In the electrolysis of aqueous copper sulphate, hydroxide ions (OH-) from water are oxidized preferentially at the anode to release oxygen gas because they have a lower standard reduction potential than sulphate ions.

Q53 (A): Anaerobic composting is achieved by burying organic materials in a deep pit, preventing exposure to atmospheric oxygen.

Q54 (B): Since pOH = 3.0, [OH-] = 10^-pOH = 1.0 × 10^-3 M.

Q55 (C): Since pH = 4.0, [H3O+] = 10^-4 M. For weak acid, Ka = [H3O+]^2 / C = (10^-4)^2 / 0.15 = 10^-8 / 0.15 = 6.67 × 10^-8.

Q56 (A): A reducing agent donates electrons to another species, thereby becoming oxidized (undergoing oxidation) in the process.

Q57 (C): Ca(H2PO4)2: Ca is +2, H is +1, O is -2. Thus, +2 + 2[2(+1) + P + 4(-2)] = 0 &implies; 2 + 2[P - 6] = 0 &implies; 2P - 10 = 0 &implies; P = +5.

Q58 (B): Mass of solution = 10 g + 50 g = 60 g. Heat released Q = m c ΔT = 60 g × 4.5 J/g.°C × 5 °C = 1350 J = 1.35 kJ.

Q59 (C): HCl is a strong acid that fully dissociates into ions, carrying a high current (bright light). Acetic acid (CH3COOH) is a weak acid that only partially dissociates, carrying a low current (dim light).

Q60 (B): Vaporization is a physical change of state (liquid to gas) rather than a chemical change.

Q61 (D): Initial moles of CH3COOH = 0.30 mol, CH3COONa = 0.30 mol. Adding 0.02 mol of HCl decreases salt moles to 0.28 mol and increases acid moles to 0.32 mol. pH = pKa + log(salt/acid) = 4.74 + log(0.28 / 0.32) =

4.74 + log(0.875) = 4.74 - 0.06 = 4.68.

Q62 (D): For a spontaneous galvanic cell, the cell potential must be positive. This requires the half-cell with the lower reduction potential (Ferrous/Iron, E° = -0.44 V) to act as the anode (oxidation), while Permanganate acts as the cathode (reduction).

Q63 (A): Balanced redox equation in acidic medium: $2MnO4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I2 + 8H2O$. The coefficient of I2 is 5.

Q64 (C): Organic fertilizers release nutrients slowly and improve soil structure, reducing chemical runoff and eutrophication of nearby water bodies.

Q65 (B): In a Zn-Cu voltaic cell, Zinc has a lower reduction potential than Copper. Therefore, the Zinc electrode undergoes oxidation and acts as the anode.

Q66 (D): The net ionic reaction is: $2Ag^+(aq) + CrO4^{2-}(aq) \rightarrow Ag2CrO4(s)$. Thus, silver and chromate ions are the reacting species.

Q67 (D): The double displacement reaction yields calcium phosphate precipitate and sodium hydroxide solution: $2Na3PO4(aq) + 3Ca(OH)2(aq) \rightarrow Ca3(PO4)2(s) + 6NaOH(aq)$.

Q68 (D): Case 3 describes weak solute-solute and solvent-solvent attractions combined with highly powerful solvent-solute interactions, releasing the most energy (highly exothermic).

Q69 (B): The diagram shows that the products reside at a higher enthalpy than the reactants. Therefore, the reaction absorbs energy, and ΔH is positive.

Q70 (A): Acetylene gas is non-polar and virtually insoluble in water, allowing it to be collected efficiently via the downward displacement of water.

Q71 (B): According to Charles's Law: V1/T1 = V2/T2. Convert temperature to Kelvin: T1 = 100 + 273.15 = 373 K. Thus, 2 / 373 = 1.5 / T2 &implies; T2 = 279.75 K. Converting back to Celsius: 279.75 - 273.15 = 6.6°C.

Q72 (C): Helium-2 has 4 molecular electrons (2 in bonding orbital, 2 in antibonding orbital). Bond order = (2 - 2) / 2 = 0.

Q73 (D): The valence configuration is $3s^2 3p^1$ (Aluminum, 3 valence electrons). To achieve a stable octet, it must lose these three outer electrons.

Q74 (A): The atomic orbitals are 1s. The bonding molecular orbital at the lower energy level is the sigma bonding orbital (σ1s), and the higher energy level orbital is the sigma antibonding orbital (σ*1s).

Q75 (B): Fluorine forms a single bond with Carbon to complete its octet, and Nitrogen forms a triple bond with Carbon. The correct Lewis representation is :F—C≡N:.

Q76 (A): Sodium sulphate exhibits endothermic solubility (solubility increases with temperature). Heating a saturated solution allows more solute to dissolve, making it unsaturated.

Q77 (D): Photons are the fundamental discrete wave-packets or quanta of electromagnetic energy (light).

Q78 (C): Fats and oils (triglycerides) are esters composed of three fatty acid chains bonded to a glycerol backbone.

Q79 (B): Crystalline solids (crystals) possess a highly ordered, three-dimensional geometric arrangement of atoms or molecules.

Q80 (B): Alpha particles carry a positive charge (+2e) and are deflected toward a negatively charged plate in an electric field.