AGA KHAN UNIVERSITY EXAMINATION BOARD

HIGHER SECONDARY SCHOOL CERTIFICATE

CLASS XI

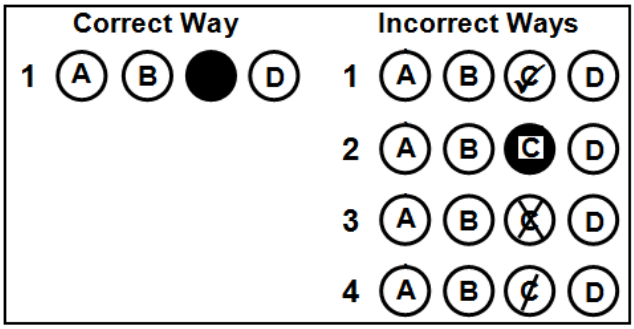
MODEL EXAMINATION PAPER 2023 AND ONWARDS

Chemistry Paper I

Time: 1 hour 30 minutes Marks: 50

INSTRUCTIONS

1. Read each question carefully.
2. Answer the questions on the separate answer sheet provided. DO NOT write your answers on the question paper.
3. There are 100 answer numbers on the answer sheet. Use answer numbers 1 to 50 only.
4. In each question there are four choices A, B, C, D. Choose ONE. On the answer grid black out the circle for your choice with a pencil as shown below.



Candidate's Signature

5. If you want to change your answer, ERASE the first answer completely with a rubber, before blacking out a new circle.
6. DO NOT write anything in the answer grid. The computer only records what is in the circles.
7. You may use a scientific calculator if you wish.

1. The number of moles of $Ca(OH)_2$ that completely reacts with 50 g of NH_4Cl to produce 15.87 g of NH_3 gas in the given reaction is

$$2NH_4Cl_{(s)} + Ca(OH)_{2(s)} \longrightarrow CaCl_{2(s)} + 2NH_{3(g)} + 2H_2O_{(l)}$$

(**Note**: Atomic mass of C = 12 amu, H = 1 amu, N = 14 amu, Cl = 35.5 amu and Ca = 40 amu)

A. 0.467
B. 0.934
C. 1.868
D. 3.736

2. Methane burns exothermically in the presence of free oxygen at standard temperature and pressure (STP) as shown in the given chemical equation.

$$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}$$

If 25 moles of CH_4 combust to give equal moles of CO_2, then the volume of CO_2 formed will be

A. 0.897 dm^3
B. 22.414 dm^3
C. 25.00 dm^3
D. 560.35 dm^3

3. Sodium metal vigorously reacts with water to form sodium hydroxide and hydrogen gas as shown in the given equation.

$$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$$

An experiment under controlled environment in a laboratory produces 80% yield of sodium hydroxide on reacting 2 moles of sodium metal with 2 moles of water. How much actual yield of sodium hydroxide in grams is obtained in the given reaction?

A. 32 g
B. 50 g
C. 64 g
D. 100 g

4. Consider the following reaction.

$$2Al_{(s)} + 6HBr_{(aq)} \rightarrow 2AlBr_{3(s)} + 3H_{2(g)}$$

How many moles of H_2 are produced when 1.61 moles of Al react with 2.48 moles of HBr?

A. 1.24 moles
B. 2.41 moles
C. 3.00 moles
D. 3.22 moles

5. Iron is extracted from its ore, haematite, in a blast furnace which involves all of the following chemical reactions. In which of these reactions is carbon reduced?

A. $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$
B. $CO_{2(g)} + C_{(s)} \rightarrow 2CO_{(g)}$
C. $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$
D. $Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$

6. Which of the following statements BEST defines standard electrode potential?

A. It is the potential set up when an electrode undergoes reduction.
B. It is the potential set up when an electrode undergoes oxidation.
C. It is the potential of an electrode in 1M solution at 25°C and 1atm.
D. It is the potential of an electrode in 1M solution at 100°C and 1atm.

7. The reaction between $Cr_2O_7^{-2}$ and H_2SO_3 gives the following half reactions.

Reduction half reaction: $Cr_2O_7^{-2} \rightarrow Cr^{+3}$
Oxidation half reaction: $H_2SO_3 \rightarrow HSO_4^-$

The equation which represents the balanced reduction half reaction is

A. $Cr_2O_7^{-2} + 14H^+ + 3e^- \rightarrow Cr^{+3} + 7H_2O$
B. $Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow Cr^{+3} + 7H_2O$
C. $Cr_2O_7^{-2} + 14H^+ + 3e^- \rightarrow 2Cr^{+3} + 7H_2O$
D. $Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$

8. Three elements **X**, **Y** and **Z** have standard reduction potential of +1.50, –2.87 and +0.771 volts respectively.

Which element(s) will lose electrons and undergo oxidation?

A. X only
B. Y only
C. X and Z
D. X and Y

9. In the discharge tube, the original glow disappears when the pressure inside the tube is reduced to

A. 0.01 mm Hg
B. 0.5 cm Hg
C. 1 mm Hg
D. 1 cm Hg

10. When rapidly moving electrons collide with heavy metal anode in the discharge tube, it produces

    A. X-rays.
    B. gamma rays.
    C. cathode rays.
    D. positive rays.

11. Visible light is NOT used to determine the position of electrons because the wavelength of visible light is millions of times larger as compared to the

    A. energy of electrons.
    B. velocity of electrons.
    C. diameter of electrons.
    D. momentum of electrons.

12. According to Bohr's atomic model, when an electron falls from a higher to lower orbit, it

    A. absorbs energy.
    B. releases energy.
    C. drops into the nucleus.
    D. changes into a neutron.

13. In which of the following molecules, the highlighted carbon atom contains two unhybridised p-orbitals?

    A. **C**H_4
    B. **C**H≡CH
    C. **C**H_3–CH_3
    D. **C**H_2=CH_2

14. Which of the following bonds between two atoms has the LARGEST bond length?

    A. B–F
    B. B–Cl
    C. Si–H
    D. Si–F

15. Ionic compounds are unable to show isomerism because in ionic compounds the bonds are

    A. rigid and directional.
    B. non-rigid and directional.
    C. rigid and non-directional.
    D. non-rigid and non-directional.

16. When the electron pair is not equally shared between the bonded atoms, it results in the formation of a/ an

    A. ionic bond.
    B. polar covalent bond.
    C. non-polar covalent bond.
    D. coordinate covalent bond.

17. If the electronegativity difference increases between hydrogen and halogen in a hydrogen halide molecule, then what will be the effect on its ionic character and bond strength?

	Ionic Character	Bond Strength
A	Increases	Increases
B	Increases	Decreases
C	Decreases	Increases
D	Decreases	Decreases

18. The density of $CH_{4(g)}$ at 17°C and at 1 atmospheric pressure is

(**Note**: Atomic mass of C = 12 amu, H = 1 amu, and the value of R = 0.0821 dm^3 atm K^{-1} mol^{-1})

A. 0.67 g/dm^3
B. 11.46 g/dm^3
C. 22.32 g/dm^3
D. 380.94 g/dm^3

19. According to Charles's law, if a gas is warmed by 1°C at constant pressure, it will expand

A. twice its original volume at 0°C.
B. twice its original volume at 100°C.
C. 1/273 of its original volume at 0°C.
D. 1/273 of its original volume at 100°C.

20. In a closed system and at a constant temperature, an increase in volume leads to a decrease in the pressure of the gas because the

A. space between the molecules decreases.
B. average kinetic energy of the molecules increases.
C. force of attraction between the molecules increases.
D. collision of molecules with the walls of the container decreases.

21. The boiling point of a substance on a Fahrenheit scale was found to be 160°. This temperature on a centigrade scale can be read as

A. 71.1°
B. 106.7°
C. 230.4°
D. 345.6°

22. What is the volume of one mole of helium gas at a pressure of 55 N/m^2 and temperature 120°C? (**Note**: R = 8.314 J K^{-1} mol^{-1})

A. 0.02 m^3
B. 0.06 m^3
C. 18.13 m^3
D. 59.41 m^3

23. When water is poured into a glass test tube, the surface of the water is concaved. This meniscus forms because of

    A. weak adhesive forces.
    B. strong adhesive forces.
    C. strong cohesive forces.
    D. equal adhesive and cohesive forces.

24. Liquid crystals have wide practical application due to their optical and electrical properties.

    Which of the following statements is INCORRECT about the use of liquid crystals?

    A. They can be used as temperature sensors.
    B. They are used in the dial of analogue watches.
    C. They are used in skin thermography to detect blockage of veins.
    D. They can be used to find the point of potential failure in electrical circuits.

25. Viscosity of a liquid is high if the

    A. size of the molecules is large.
    B. shape of the molecules is spherical.
    C. temperature of the liquid is increased.
    D. intermolecular forces of attraction are weak.

26. Water boils at low temperature when there is low

    A. volume.
    B. polarisation.
    C. vapour pressure.
    D. external pressure.

27. The LEAST volatile organic solvent at room temperature is

    A. ether.
    B. acetone.
    C. acetic acid.
    D. dichloromethane.

28. Graphite exists in the form of layers. It is a conductor parallel to the layers, but an insulator across the layers. This property of graphite is known as

    A. symmetry.
    B. anisotropy.
    C. isomorphism.
    D. polymorphism.

29. In the ionic structure of sodium chloride, each Na^+ is surrounded by

    A. 2 Cl^-
    B. 4 Cl^-
    C. 6 Cl^-
    D. 8 Cl^-

30. In ionic solids, ions are held together by strong electrostatic forces of attraction. However, ionic crystals are highly brittle because they

A. have low density.
B. have loose packing of ions.
C. exist as neutral independent molecules.
D. contain opposite ions in parallel layers.

31. In a unit cell, if all angles are right angles and all edges are of equal length, then the crystal system must be

A. cubic.
B. triclinic.
C. monoclinic.
D. orthorhombic.

32. Calcium carbonate shows the phenomenon of polymorphism. The polymorphs of calcium carbonate

A. show same physical properties.
B. exist in the same crystalline form.
C. show different chemical properties.
D. exist in more than one crystalline form.

33. The equilibrium constant (K_C) for the decomposition of HF at 2000°C is 10^{-13}.

This indicates that its stability and rate of decomposition are respectively

	Stability	**Rate of Decomposition**
A	high	low
B	low	high
C	high	high
D	low	low

34. Which of the following effects would be observed if the concentration of oxygen is increased in the given reaction at equilibrium?

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

	[SO_2]	**[SO_3]**	**Equilibrium shift**
A	Increased	Decreased	Right
B	Decreased	Increased	Right
C	Increased	Decreased	Left
D	Decreased	Increased	Left

35. The ionisation of $KClO_3$ in the given reaction can be suppressed by adding

$$KClO_{3(aq)} \rightleftharpoons K^{+}_{(aq)} + ClO^{-}_{3(aq)}$$

A. KCl
B. HCl
C. NaCl
D. NH_4Cl

36. The mixing of acetic acid with sodium acetate will produce a buffer solution with a pH value

I. < 7.0
II. > 7.0
III. = 7.0

A. I only.
B. II only.
C. III only.
D. II and III.

37. If CH_3COONa is added in excess to CH_3COOH solution, then the

A. pH of the solution will increase.
B. pH of the solution will decrease.
C. dissociation of CH_3COOH will increase.
D. dissociation of CH_3COONa will decrease.

38. The pOH of 0.001 M aqueous hydrochloric acid solution is

A. 3
B. 8
C. 11
D. 14

39. In the given reaction, the reactant H_2O can be classified as a/ an

$$Cr^{3+}_{(aq)} + 6H_2O_{(l)} \rightleftharpoons Cr(H_2O)^{3+}_{6(aq)}$$

A. Lewis acid.
B. Lewis base.
C. neutral species.
D. amphoteric species.

40. When a non-volatile solute is added to a pure solvent, the

A. boiling point of the solution decreases.
B. freezing point of the solution increases.
C. vapour pressure of the solvent increases.
D. rate of evaporation of the solvent decreases.

41. A solution is prepared by mixing three different components, **P**, **Q** and **R**. If the number of moles of each component is $n_P = 4$ moles, $n_Q = 6$ moles and $n_R = 10$ moles, then the mole percent of each component will be

	Mole Percent		
	P	**Q**	**R**
A	20	30	50
B	0.2	0.3	0.5
C	0.4	0.6	0.10
D	40	60	100

42. Amongst the given set of liquids, the completely miscible set is

A. aniline and water.
B. aniline and hexane.
C. cyclohexane and water.
D. benzene and cyclohexane.

43. What is the molality of a solution prepared by dissolving 148 g of butanol ($C_4H_{10}O$) in 0.1 kg of benzene?

(**Note**: Atomic mass of C = 12 amu, O = 16 amu, H = 1 amu)

A. 20 mol/kg
B. 2 mol/kg
C. 0.2 mol/kg
D. 0.05 mol/kg

44. The activated complex is a combination of all the atoms involved in a reaction which

A. is a short lived species.
B. is a highly stable species.
C. slowly decomposes into products.
D. involves atoms having minimum energies.

45. The order of a reaction can be deduced by simply observing the

A. number of reactants involved in a reaction only.
B. time taken to process the chemical reaction only.
C. rate expression which is experimentally obtained.
D. chemical equation showing the slow and fast steps.

46. The rate of a chemical reaction can be retarded by adding a/ an

A. indicator.
B. activator.
C. inhibitor.
D. co-factor.

47. In thermochemistry, a liquid whose boiling point is to be determined is considered as a/ an

A. system.
B. final state.
C. initial state.
D. surrounding.

48. Which of the following is the CORRECT formula for calculating the amount of heat evolved during a neutralisation reaction in a glass calorimeter?

A. Quantity of heat = mass × heat capacity × temperature
B. Quantity of heat = mass × specific heat capacity × temperature
C. Quantity of heat = mass × specific heat capacity × change in temperature
D. Quantity of heat = mass × specific latent heat of fusion × change in temperature

49. If the specific heat capacity of copper is 387 J/kg/°C, then how much energy is needed to raise the temperature of 400 g of copper from 30°C to 55°C?

A. 3.870 kJ
B. 8.514 kJ
C. 3870 kJ
D. 8514 kJ

50. The enthalpy change is a heat change that takes place at constant

A. volume.
B. pressure.
C. temperature.
D. internal energy.

END OF PAPER

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