AGA KHAN UNIVERSITY EXAMINATION BOARD

HIGHER SECONDARY SCHOOL CERTIFICATE

CLASS XI

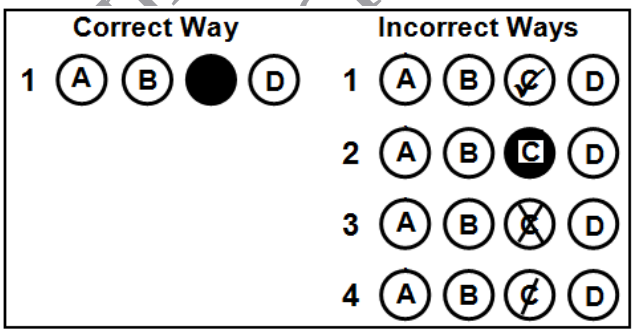
ANNUAL EXAMINATIONS (THEORY) 2023

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 given chemical equation shows a reaction of chlorine with cold, dilute solution of sodium hydroxide.

$$Cl_{2(g)} + 2NaOH_{(aq)} \rightarrow NaCl_{(aq)} + NaClO_{(aq)} + H_2O_{(l)}$$

How many grams of sodium hydroxide will be used to synthesise 6 moles of sodium chlorate(I)?

(**Note**: Molar mass of Na = 23 g mol^{-1}, Cl = 35.5 g mol^{-1}, H = 1 g mol^{-1} and O = 16 g mol^{-1})

A. 13.33 g
B. 80 g
C. 240 g
D. 480 g

2. The number of moles in 4.8×10^{24} atoms of helium is

(**Note**: $^{4}_{2}He$)

A. 0.13 mol.
B. 7.97 mol.
C. 2.4×10^{24} mol.
D. 4.8×10^{24} mol.

3. The percentage by mass of carbon in $(CH_3)_2CO$ is

(**Note**: Molar mass of C = 12 g mol^{-1}, H = 1 g mol^{-1} and O = 16 g mol^{-1})

A. 20.7%.
B. 33.3%.
C. 52.2%.
D. 62.1%.

4. A compound has molecular mass 110.15 g mol^{-1} and empirical formula C_3H_3O. Its molecular formula will be

(**Note**: Molar mass of C = 12 g mol^{-1}, O = 16 g mol^{-1} and H = 1 g mol^{-1})

A. C_6H_6O
B. $C_6H_6O_2$
C. $C_{12}H_{12}O$
D. $C_{12}H_{12}O_2$

5. The oxidation number of nitrogen in $[Cu(NH_3)_4]^{2+}$ is

A. – 3
B. – 7
C. – 12
D. – 24

6. The reaction between HCl and $KMnO_4$ in an acidic medium gives the following half reactions.

Oxidation half reaction: $2Cl^-_{(aq)} \rightarrow Cl_{2(g)}$

Reduction half reaction: $MnO^-_{4(aq)} \rightarrow Mn^{2+}_{(aq)}$

What should be added on the left hand side (L.H.S.) and the right hand side (R.H.S.) of the equation to balance the reduction half reaction?

	L.H.S.	**R.H.S.**
A	$16H^+$	$8H_2O + 5e^-$
B	$16H^+$	$8H_2O + 2e^-$
C	$8H^+ + 5e^-$	$4H_2O$
D	$8H^+ + 2e^-$	$4H_2O$

7. Which of the following daily life chemical reactions does NOT exemplify a redox reaction?

A. Photosynthesis in plants
B. Combustion of fossil fuels
C. Neutralisation of acid in stomach
D. Decomposition of dead organic matter

8. The standard cell potential of a voltaic cell that uses the Ag/Ag^+ and Sn/Sn^{2+} half-cell reactions is

(**Note**: E°_{Ag} = + 0.80 V and E°_{Sn} = − 0.14 V)

A. 0.94 V.
B. 0.66 V.
C. – 0.66 V.
D. – 0.94 V.

9. Which of the following conditions were applied in the discharge tube to study the production of cathode rays?

	Pressure	**Voltage**
A	Low	High
B	High	High
C	Low	Low
D	High	Low

10. The amount of energy associated with a quantum of radiation is

    A. inversely proportional to the velocity of photons.
    B. directly proportional to the frequency of radiations.
    C. directly proportional to the wavelength of radiations.
    D. inversely proportional to the wavenumber of photons.

11. In the discharge tube experiment, X-rays are produced when rapidly moving electrons strike with the

    A. walls of the tube.
    B. anode of large atomic mass.
    C. cathode of large atomic mass.
    D. gas molecules inside the tube.

12. The quantum number representing the energy level in which the electron revolves around the nucleus is called

    A. spin quantum number.
    B. principal quantum number.
    C. magnetic quantum number.
    D. azimuthal quantum number.

13. The bond energy values of HF > HCl > HBr > HI.

    This decreasing trend is observed because when moving from HF to HI the

    A. bond length between bonded atoms decreases.
    B. bond stability between bonded atoms increases.
    C. ionic character between bonded atoms decreases.
    D. electronegativity difference between bonded atoms increases.

14. The CORRECT order for the decrease in repulsion between electron pairs is

    A. lone pair-lone pair > lone pair-bond pair > bond pair-bond pair
    B. lone pair-lone pair > bond pair-bond pair > lone pair-bond pair
    C. bond pair-bond pair > lone pair-bond pair > lone pair-lone pair
    D. lone pair-bond pair > lone pair-lone pair > bond pair-bond pair

15. Compared to the valence bond theory, the molecular orbital theory

    A. does not explain the non-existence of helium molecule.
    B. gives an idea about the bond order of diatomic molecules.
    C. does not explain the paramagnetic behaviour of oxygen molecule.
    D. discusses involvement of only valence electrons in the bond formation.

16. A molecule of chlorine is formed by the overlapping of

    A. s-s orbitals.
    B. s-p orbitals.
    C. head-on p-p orbitals.
    D. sideways p-p orbitals.

17. The option that CORRECTLY relates bond order to the types of bonds in a nitrogen molecule is

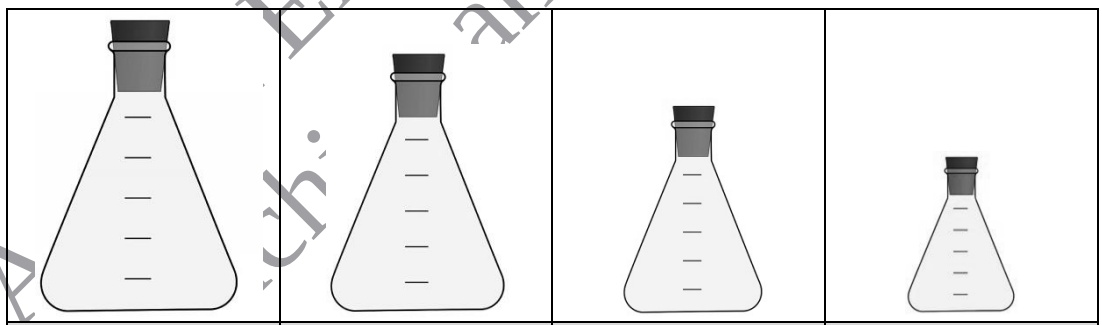
(**Note**: $^{14}_{7}N$)

	Bond Order	**σ Bond**	**л bond**
A	2	1	1
B	3	1	2
C	2	2	2
D	3	2	1

18. According to Charles's Law, what will happen if a blown balloon is left inside a car at noon on a hot summer day?

	Balloon's Volume	**Balloon's Pressure**
A	Decreases	Decreases
B	Increases	Decreases
C	Remains constant	Increases
D	Increases	Remains constant

19. If four flasks contain same number of molecules of a gas at room temperature, then which flask will have the HIGHEST pressure?



A	B	C	D

20. On a Kelvin scale, the temperature of 23°F is equal to

A. 250.15 K.
B. 268.15 K.
C. 285.92 K.
D. 296.15 K.

21. The density of a substance is directly proportional to its molar mass. If the density, temperature and pressure are known, then the molar mass of the substance can be calculated.

    This information is TRUE if the substance at standard temperature and pressure is a

    A. plasma.
    B. liquid.
    C. solid.
    D. gas.

22. Gases are non-ideal at low temperature because the molecules of gases have

    A. negligible volume.
    B. high kinetic energy.
    C. few frequent collisions.
    D. strong intermolecular forces.

23. The momentary force of attraction created between instantaneous dipole and induced dipole is called

    A. dipole moment.
    B. hydrogen bonding.
    C. dipole-dipole force.
    D. London dispersion force.

24. Long chains of amino acids can form helix by

    A. ion-dipole forces.
    B. hydrogen bonding.
    C. dipole-dipole forces.
    D. London dispersion forces.

25. The vapour pressure of ethyl ether at 20°C is 442.2 torr while that of water is 43.9 torr. The vapour pressure of water is less because water has

    A. lower boiling point.
    B. lower molecular mass.
    C. stronger hydrogen bonding.
    D. stronger London dispersion forces.

26. Liquid crystal is a state of matter which is in between

    A. pure liquid and crystalline solid.
    B. pure liquid and amorphous solid.
    C. impure liquid and crystalline solid.
    D. impure liquid and amorphous solid.

27. The statement that BEST describes the relationship between energy and intermolecular forces is that

A. liquids with high boiling points exhibit strong intermolecular forces of attraction.
B. solids with stronger intermolecular forces of attractions melt at low temperatures.
C. conversion from solid into liquid phase increases the intermolecular forces of attraction.
D. conversion from liquid into gaseous phase increases the intermolecular forces of attraction.

28. A student studied electrical conductivity in four different substances. He found one of these substances to be anisotropic as it showed greater electrical conductivity in one direction than in another.

Based on his study, the anisotropic substance must be

A. sodium chloride.
B. graphite.
C. sulphur.
D. sugar.

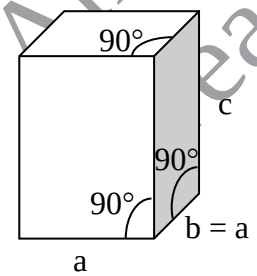
29. K_2SO_4 and K_2CrO_4 are isomorphs with orthorhombic crystalline forms because they both have the same

A. cation of group IA.
B. number of oxygen atoms.
C. physical and chemical properties.
D. tetrahedral shape of SO_4^{2-} and CrO_4^{2-} ions.

30. The two different crystalline forms of $CaCO_3$ are

A. trigonal and cubic.
B. rhombohedral and cubic.
C. trigonal and orthorhombic.
D. cubic and orthorhombic.

31. The given crystal system can be identified as



NOT TO SCALE

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

32. NaCl and CsF have the same geometry because the

A. formula mass of both units is the same.
B. radius ratio of cations and anions is the same.
C. cations belong to group IA of the periodic table.
D. anions belong to group VIIA of the periodic table.

33. What will be the effect on the equilibrium constant when the concentration of the reactants is doubled in a reversible reaction?

A. It will also be doubled.
B. It will remain the same.
C. It will be reduced to half.
D. It will be reduced to a quarter.

34. In 1 dm^3 container, 3 moles of $N_2O_{4(g)}$ and 1.5 moles of $NO_{2(g)}$ are placed to give the following reaction.

$N_2O_{4(g)} \leftrightharpoons 2NO_{2(g)}$ $K_C = 0.36$ at 25°C

Which of the following conditions is CORRECT for the reaction to achieve equilibrium?

	Reaction Quotient Q_C	**Direction of Net Reaction**
A	$Q_C < K_C$	Forward
B	$Q_C > K_C$	Forward
C	$Q_C < K_C$	Backward
D	$Q_C > K_C$	Backward

35. Consider the given equilibrium system.

$CO_{2(g)} + H_{2(g)} \rightleftharpoons H_2O_{(g)} + CO_{(g)}$

If the equilibrium is to be shifted in the reverse direction, then the two stresses that must be applied on this system are

	Reactant Side	**Product Side**
A	increase $[H_2]$	increase [CO]
B	decrease $[H_2]$	increase $[H_2O]$
C	increase $[CO_2]$	decrease [CO]
D	decrease $[CO_2]$	decrease $[H_2O]$

36. Which of the following relationships is INCORRECT?

A. $K_a + K_b = K_w$
B. $pH + pOH = 14$
C. $pK_a + pK_b = pK_w$
D. $pH = pK_a + \log [salt]/[acid]$

37. In a reaction between hydrogen sulphide gas (H_2S) and water (H_2O), H_2S acts as a

A. weak base.
B. Lewis acid.
C. strong acid.
D. Brønsted-Lowry base.

38. A 100 cm^3 of aqueous solution of $Fe_2(SO_4)_3$ is prepared by dissolving 2 g of it in water.

The concentration of SO_4^{2-} ions in this solution is

(**Note**: The molecular mass of $Fe_2(SO_4)_3$ is 400 g mol^{-1}.)

A. 1.5×10^{-1} mol dm^{-3}.
B. 5.0×10^{-2} mol dm^{-3}.
C. 1.5×10^{-3} mol dm^{-3}.
D. 5.0×10^{-3} mol dm^{-3}.

39. Consider the given solubility equilibrium.

$$NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH_{4(aq)}^{+} + OH_{(aq)}^{-}$$

The K_b expression for this reaction would be

$K_b = \frac{[NH_3]}{[NH_4^+][OH^-]}$	$K_b = \frac{[NH_3][H_2O]}{[NH_4^+][OH^-]}$	$K_b = \frac{[NH_4^+][OH^-]}{[NH_3][H_2O]}$	$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$
A	B	C	D

40. Blood and paints are classified as sol because the dispersed phase and dispersion medium in these colloidal systems are

	Dispersed Phase	**Dispersion Medium**
A	solid	liquid
B	solid	gas
C	liquid	solid
D	liquid	gas

41. In cryoscopy, the formula for finding molar (molecular) mass of a solute is

A. $M_2 = \frac{\Delta T_f}{W_2}\frac{1000K_f}{W_1}$

B. $M_2 = \frac{\Delta T_f}{K_f}\frac{1000W_1}{W_2}$

C. $M_2 = \frac{K_f}{\Delta T_f}\frac{1000W_2}{W_1}$

D. $M_2 = \frac{K_f}{W_2}\frac{1000W_1}{\Delta T_f}$

Note:

M_2 = Molar mass of solute

ΔT_f = Depression in freezing point

K_f = Molal freezing point constant

W_1 = Mass of solvent in kg

W_2 = Mass of solute

42. The Raoult equation that shows the quantitative relationship between relative lowering of vapour pressure and mole fraction of solute is

A. $p = p^\circ x_1$

B. $\frac{p}{p^\circ} = x_1$

C. $\frac{p^\circ}{\Delta p} = x_2$

D. $\frac{\Delta p}{p^\circ} = x_2$

43. The depression in freezing point (ΔT_f) is directly proportional to

A. mass of solvent in kg.
B. molarity of the solution.
C. molality of the solution.
D. molar mass of the solute.

44. The given reaction is an example of

$$N_{2(g)} + 3H_{2(g)} \overset{Fe_2O_{3(s)}}{\rightleftharpoons} 2NH_{3(g)}$$

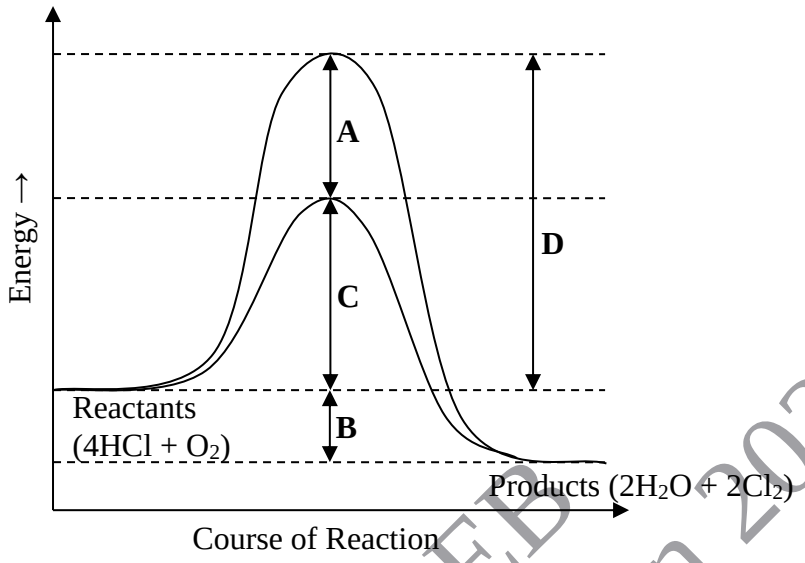
A. autocatalysis.
B. negative catalysis.
C. homogeneous catalysis.
D. heterogeneous catalysis.

45. Given that $2A + B \rightarrow 2C$ has the order with respect to A = 2 and the order overall = 3.

What will be the rate law expression for this reaction?

A. Rate = $k[A]^2$
B. Rate = $k[A]^3$
C. Rate = $k[A]^2[B]$
D. Rate = $k[A][B]^2$

46. In the given energy diagram, the activation energy of the reaction in the presence of catalyst ($CuCl_2$) is represented by



47. The sum of kinetic energies and potential energies of the molecules constituting the system as a whole (and not of individual molecule) is termed as

A. enthalpy.
B. state function.
C. internal energy.
D. thermodynamics.

48. Lattice energy of an ionic compound increases and becomes more negative when

	Ionic Radius	**Ionic Charge**
A	increases	increases
B	increases	decreases
C	decreases	decreases
D	decreases	increases

49. Consider the given reaction with a negative enthalpy.

$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)} \qquad \Delta H = -184\ kJ\ mol^{-1}$

In this reaction, the negative sign indicates that

A. an ionic bond is formed in hydrogen chloride.
B. more number of bonds are formed than are broken.
C. the speed of reaction increases with rising temperature.
D. the total energy of products is lesser than that of reactants.

50. The amount of heat required to raise the temperature of one gram of a substance by one Kelvin is called

A. molar heat capacity.
B. specific heat capacity.
C. enthalpy of formation.
D. enthalpy of neutralisation.

END OF PAPER

Please use this page for rough work

Please use this page for rough work

Please use this page for rough work

Please use this page for rough work