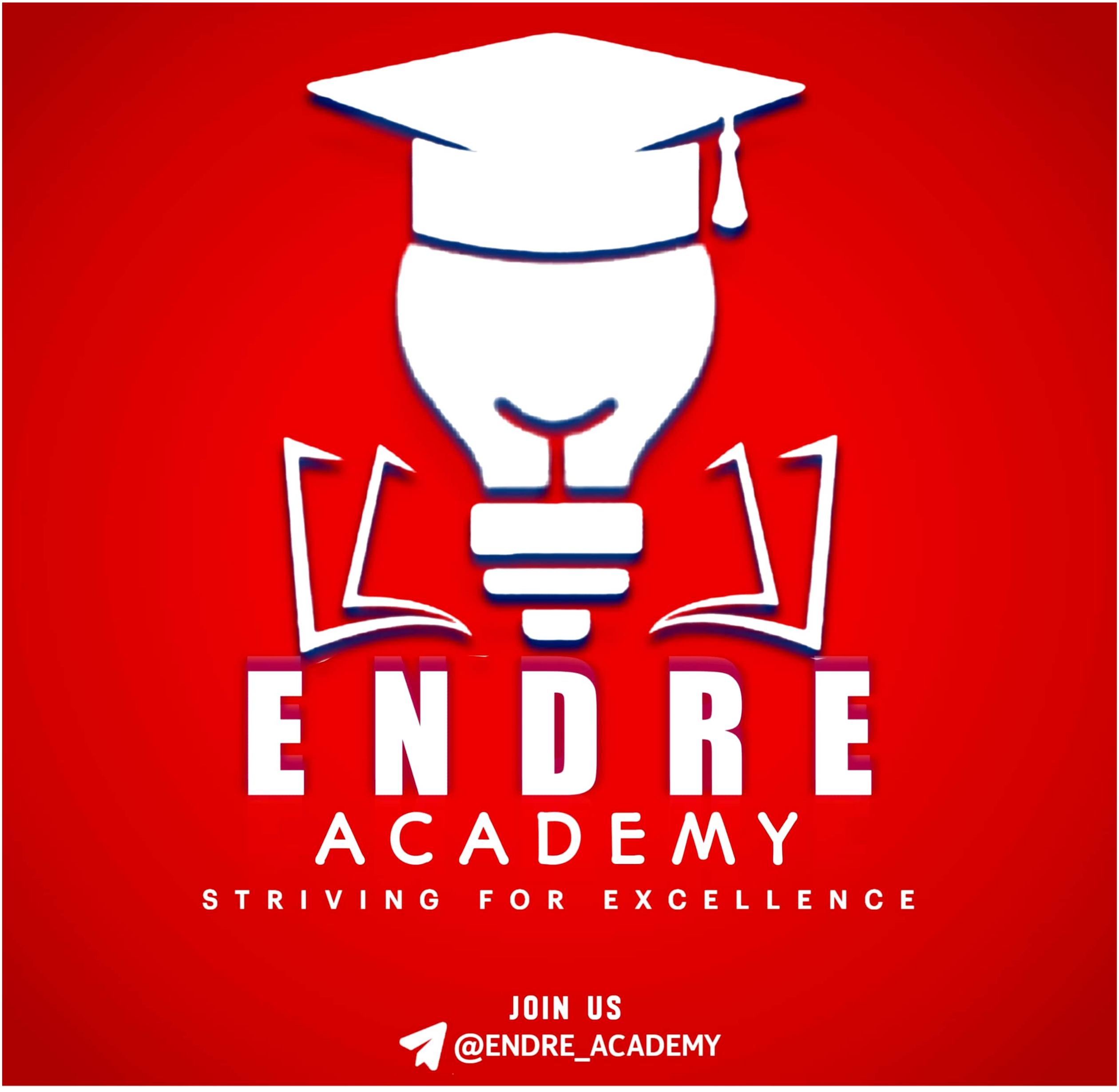

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Constants: c = 3 X 10^8 m/s, h = 6.63X10^{-34} Js, Avogadro No: 6.023X10^{23}, F = 96500 coulo

R = 8.314 J K^{-1} mol^{-1} = 0.08205 L atm K^{-1} mol^{-1}

Use the following data whenever necessary:

Element:	H	He	B	C	N	O	F	Mg	Al	P	Fe	S
At. No:	1	2	5	6	7	8	9	10	11	15	26	16
At. Wt:	1	7	11	12	14	16	19	24	27	30	56	32

Prepared by General Chemistry Instructors

Good Luck

Part I - Multiple choice questions: (Shade the circle for right choice in the answer sheet)

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1. The Principal quantum number is related to the
   (a) Orbital angular momentum (b) Size and shape of the orbital
   (c) Orientation of the orbital (d) Average size of the orbit
2. The quantum number that defines the shape of the orbital occupied by the electron is
   (a) Principal quantum number (b) Azimuthal quantum number
   (c) Magnetic quantum number (d) Spin quantum number
3. The value of azimuthal quantum number for the electrons present in 5s-orbital is
   (a) 0 (b) 1 (c) 2 (d) 5
4. For a multi-electron atom, the energy associated with electrons is s, p, d and f orbitals of a particular principal quantum number is in the order
   (a) s = p = d = f (b) s < p < d < f (c) p < d < f < s (d) d < f < s < p
5. The mass number and atomic number of phosphorus atom are 31 and 15 respectively. The number of neutrons in the nucleus is
   (a) 15 (b) 16 (c) 31 (d) 46
6. The radius of first orbit in hydrogen atom is 0.529 Å. The radius of second orbit is given by
   (a) ½ × 0.529 Å (b) 2 × 0.529 Å (c) 4 × 0.529 Å (d) 8 × 0.529 Å
7. The maximum number of electrons that can be accommodated in a shell is
   (a) 2n (b) n^2 (c) $2n^2$ (d) 2n + 1
8. An atom of silicon with atomic number 14 has the following number of electrons in the outermost shell
   (a) 1 (b) 2 (c) 4 (d) 8

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9. Which one of the following is the most polar

(a) H — F (b) H — Cl (c) H — Br (d) H — I

10. Bond Order of O_2, F_2, N_2 respectively are

(a) 1, 2, 3 (b) 2, 3, 1 (c) 2, 1, 3 (d) 3, 2, 1

11. The hydrogen bromide molecule is formed by

a) The axial p-p overlapping b) The sideways p-p overlapping

c) The axial s- p overlapping d) The sideways s- p overlapping

12. Which of the following complex ion involves d^2sp^3 hybridization for the central atom?

a) $[CoF_6]^{3-}$ b) $[Co(CN)_6]^{3-}$ c) $[FeI_6]^{3-}$ d) $[Cr(H_2O)_6]^{3+}$

13. The greater the electronegativity difference between two atoms bonded together, the greater the bond's percentage of,

a) Metallic character b) Ionic character

c) Covalent character d) electron sharing

14. The Gibb's free energy change for non-spontaneous process is

a) Positive b) Negative

c) Zero d) None of these

15. A gas expands isothermally and reversibly. The work done by the gas is

a) Zero b) Minimum c) Maximum d) Equal to heat change

16. The number of unpaired electrons in chromium atom (Z = 24) is

(a) 12 (b) 24 (c) 8 (d) 6

17. After filling the 4p-orbitals, an electron will enter in

(a) 4d (b) 4f (c) 5s (d) 3d

18. The outermost electronic configuration of manganese (at. no. = 25) is

(a) $3d^5\ 4s^2$ (b) $3d^6\ 4s^1$ (c) $3d^7\ 4s^0$ (d) $3d^6\ 4s^2$

19. The compounds which contain both ionic and covalent bonds are

(a) $CHCl_3$ and CCl_4 (b) KCl and $AlCl_3$ (c) KCN and NaOH (d) H_2 and CH_4

20. The molecule among CCl_4, PCl_3, SF_4 and NH_3 that does not contain lone pairs of electrons around the central atom is

(a) CCl_4 (b) PCl_3 (c) SF_4 (d) NH_3

21. Which of the following does not obey the octet rule?

(a) PCl_5 (b) H_2O (c) NH_3 (d) CCl_4

22. In a bond between two atoms X and Y, the shared electron pair does not lie in the centre. The bond is

(a) Pi bond (b) non-polar covalent bond

(c) polar covalent bond (d) co-ordinate bond

23. For the gaseous system $A + 2B \rightleftharpoons C$, the equilibrium concentration are $[A] = 0.006$ mol litre^{-1}, $[B] = 0.12$ mol litre^{-1}, $[C] = 0.216$ mol litre^{-1}. The equilibrium constant for the reaction is,

a) 250 b) 417 c) 125 d) 4×10^{-3}

24. 4 moles of PCl_5, 2 moles of PCl_3 and 3 moles of Cl_2 are taken in a closed vessel. At equilibrium, if the vessel contains 2 moles of PCl_5, the total number of moles in the container is

a) 8 b) 9 c) 10 d) 11

25. For a spontaneous reaction, total entropy change is always

a) Positive b) Negative c) zero d) Infinite

26. For the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ the production of NO is favoured by

a) Increasing pressure b) Decreasing pressure

c) Decreasing the concentration of N_2 and O_2 d) Removing NO

27. Sodium acetate is added to a solution of acetic acid, then pH of solution,

a) Decreases b) Increases c) Remains unchanged d) None of these

28. More acid is added to solution of pH = 5 in order to reduce the pH =2. The increase in hydrogen ion concentration is,

a) 100 times b) 1000 times c) 3 times d) 5 times

29. Enthalpy of formation of HF and HCl are –161kJ and –92kJ respectively. Which of the following statements is incorrect?

a) The affinity of fluorine for hydrogen is greater than the affinity of chlorine for hydrogen

b) HF is more stable than HCl

c) HCl is more stable than HF

d) HF and HCl are exothermic compounds

30. The solubility product of calcium fluoride is 3.2×10^{-11}. The solubility of calcium fluoride in a saturated solution is,

a) 2.0×10^{-4} mole / litre b) 12.0×10^{-3} mole / litre

c) 0.2×10^{-4} mole / litre d) 2.0×10^{-3} mole / litre

31. Consider the following reaction: $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$,

with reference to the above, which one of the following is the correct statement?

a) Zn is reduced to Zn^{2+} ions b) Zn is oxidized to Zn^{2+} ions

c) Zn^{2+} ions are oxidized to Zn d) Cu^{2+} ions are oxidized to Cu

32. The standard electrode potentials of Zn^{+2}/Zn and Ag^{+}/Ag are -0.763 V and + 0.799 V respectively. The standard potential of the cell is

a) 1.562 V b) 0.036V c) -1.562 d) 0.799 V

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33. Three metals A, B and C are in order of decreasing reduction potential. Indicate the true Statement,

a) Atoms of B can reduce ions of C b) Atoms of B can reduce ions of A

c) Atoms of B can reduce atoms of C d) Atoms of B can reduce atoms of A

34. Electrolysis involves oxidation and reduction respectively at,

a) Anode and cathode b) Cathode and anode c) Both electrodes d) None

35. The order of potential of metals in the electrochemical series is Mg < Al < Zn < Cu<Ag. What will happen if a copper spoon is used to stir solution of silver nitrate?

a) The spoon will get coated with Al b) The alloy of Cu and Al is formed

c) The solution becomes blue d) There is no reaction

36. In a galvanic cell, the electrons flow from,

a) Anode to cathode through the solution b) Cathode to anode through the solution

c) Anode to cathode through the external circuit d) Cathode to anode through the external circuit.

37. 22.5 cm^3 of HCl is required to neutralize 15 cm^3 of 0.15M NaOH. What is the pH of the acid?

a) 7 b) 1 c) 14 d) 10

38. The enthalpy of formation of ammonia is – 46.0kJ mol^{-1}. The enthalpy change for the reaction $2NH_3 \rightarrow N_2 + 3H_2$ is

a) +46.0kJ b) +92.0kJ c) – 23.0kJ d) – 92.0kJ

39. The relation between internal energy change ΔU and enthalpy change ΔH and work W is

a) $\Delta H = \Delta U + W$ b) $\Delta U = \Delta H + W$ c) $\Delta U = W - \Delta H$ d) $\Delta H = \Delta U - W$

40. In a gaseous reaction, the correct relation between K_P and K_C is.

a) $K_C = K_P (RT)^{\Delta n}$ b) $K_P = K_C (RT)^{\Delta n}$ c) $K_C / RT = (KP)^{\Delta n}$ d) $K_P / R_T = (K_C)^{\Delta n}$

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Part II - Answer all questions:

1. Calculate the Empirical and Molecular formula for the following compound; 39.10% carbon, 7.67% hydrogen, 26.11% oxygen, 16.82% phosphorus, and 10.30% fluorine. (The molar mass of the compound would be186 g/mol).

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2. 15 grams of copper (II) chloride react with 20 grams of sodium nitrate produced 11.3 g of sodium chloride, then what is the theoretical yield and percent yield of this reaction?

3. Draw the crystal field splitting diagram for the following complexes.

(i) $[Fe(CN)_6]^{3-}$

(ii) $[Ni(Cl)_4]^{2-}$

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4. Give the nomenclature of following coordination compounds

i. $[Co(en)_3]\,Cl_2$:

ii. $Na[PtCl_5(NH_3)]$:

5. The equilibrium concentrations for the reaction between carbon monoxide and molecular chlorine to form $COCl_2$ (g) at 74 °C are $[CO] = 0.012$ M, $[Cl_2] = 0.054$ M, and $[COCl_2] = 0.14$ M. Calculate the equilibrium constants Kc and Kp.

6. A buffer is made by adding 0.300 mol CH_3COOH and 0.300 mol CH_3COONa to enough water to make 1.00 L of solution. The pK_a of the buffer is 4.74. Calculate the pH of this solution after 0.020 mol of NaOH is added.

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7. In a test of a new reference electrode, a chemist constructs a voltaic cell consisting of a Zn/Zn^{2+} half-cell (-0.76 V) and an H_2/H^+ half-cell under the following conditions: $[Zn^{2+}] = 0.010$ M $[H+] = 2.5$ M $P_{H_2} = 0.30$ atm, calculate the E_{cell} at 298 K.

8. Given the following information:

$2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g)$ $\Delta H^\circ = -173$ kJ

$2\ N_2(g) + 5\ O_2(g) + 2\ H_2O(l) \rightarrow 4\ HNO_3(aq)$ $\Delta H^\circ = -255$ kJ

$N_2(g) + O_2(g) \rightarrow 2\ NO(g)$ $\Delta H^\circ = +181$ kJ

Calculate the ΔH° for the balanced reaction of $NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + NO(g)$.

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9. For F_2 molecule, answer the following questions

a) Draw the molecular orbital energy diagram for F_2 molecule with Labels

b) Calculate the bond order for F_2^+ and F_2^-.

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Answers Astu

Answers

1. a 2. b 3. a 4. b 5. b 6 c

7. c 8. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ outermost shell electrons = 2+2 = 4 answer C

9. a 10. Bond order of O_2, F_2, N_2 ...

⇒ For O_2, total number of e^-_s : 8+8 = 16

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, \begin{cases} \pi 2p_y^2 \\ \pi 2p_z^2 \end{cases}, \begin{cases} \pi^* 2p_y^1 \\ \pi^* 2p_z^1 \end{cases}$

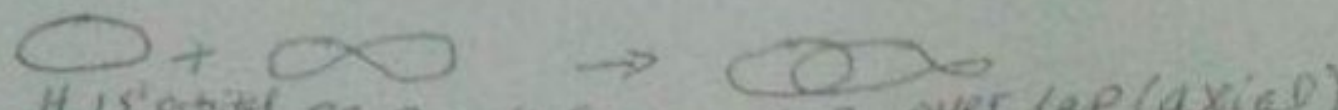
Bond order = $\frac{\text{no of bonding } e^-_s - \text{no of antibonding } e^-_s}{2}$

$= \frac{10-6}{2} = \frac{4}{2} = \underline{\underline{2}}$

⇒ For F_2, Bond order = $\frac{10-8}{2} = 2/2 = \underline{\underline{1}}$

⇒ For N_2, Bond order = $\frac{10-4}{2} = 6/2 = \underline{\underline{3}}$

Bond order = 2, 1, 3 Answer C

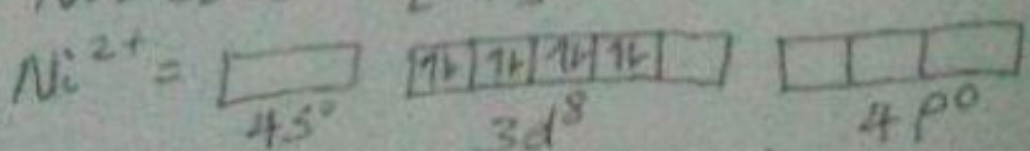
11. 

Answer C

12. To answer this question, we shall consider the electron configuration of the centeral atom (metal). The ligands like F^-, Cl^-, H_2O, NH_3, CN^-, I^- ... have lone pairs of electrons and needs the empty orbitals of the centeral metal atom (ion).

Examples: 1) $[Ni(CN)_5]^{3-}$, the centeral ion is Ni^{2+}

$Ni = 28e^-_s \rightarrow [Ar]\ 4s^2\ 3d^8$; $Ni^{2+} = [Ar]\ 4s^0\ 3d^8\ 4p^0$

$Ni^{2+} =$ 

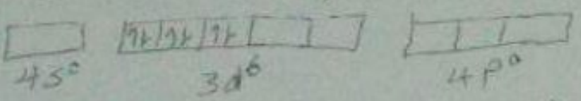
There are 5 ligands (CN^-) needs 5 empty orbitals. So that one s, one d and three p orbitals are used. The hybridization is sp^3d or dsp^3 the geometry is square pyramidal

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Example 2: $[Fe(CN)_6]^{4-}$ & $[Fe(H_2O)_6]^{2+}$

In both cases Fe is +2.

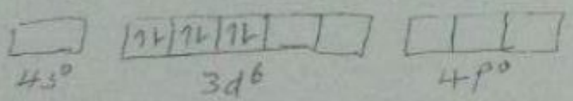
$Fe = 26 = [Ar]\,4s^2\,3d^6$; $Fe^{2+} = 24 = [Ar]\,4s^0\,3d^6$

Fe^{2+} : 

There are 6 ligands (CN^- or H_2O) and requires 6 empty orbitals. One s + two d + three p orbitals are used. So, the hybridization is sp^3d^2 or d^2sp^3 and the geometry is Octahedral.

⇒ Choice a) $[CoF_6]^{3-}$, Co is +3

$Co = 27 = [Ar]\,4s^2\,3d^7$; $Co^{3+} = [Ar]\,4s^0\,3d^6$

Co^{3+} : 

There are 6 ligands (F^-) and requires 6 empty orbitals. The hybridization is sp^3d^2 or d^2sp^3 & Octahedral Geometry.

⇒ Choice b) $[Co(CN)_6]^{3-}$. It is similar to choice a. d^2sp^3

⇒ Try choices c and d. The answer is - - - - - -

24. $PCl_5(g) \rightleftharpoons PCl_3 + Cl_2$

1 mole	1 mole	1 mole	
4 moles	2 moles	3 moles	Initial concentrations
2 moles	2+2 moles	3+2 moles	Equilibrium ??

From the stoichiometry 1 mole of PCl_5 produces 1 mole of PCl_3 and 1 mole of Cl_2. Therefore, 2 moles of PCl_5 will produce additional 2 moles of PCl_3 and 2 moles of Cl_2 at equilibrium.

∴ The total moles at equilibrium is $2+(2+2)+(3+2) = 2+4+5 = 11$ moles Answer d.

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Using the given values $\frac{CuCl_2}{NaNO_3} = \frac{15}{20} = \frac{0.75}{1}$

Comparing the ratios, the limiting reagent is $CuCl_2$ with given mass 15 gm

135 gm of $CuCl_2$ = 118 gm of NaCl

15 gm of $CuCl_2$ = ?

$\frac{15}{135} \times 118 = 13.11$ gm of NaCl is produced and this is theoretical yield.

$\%\ yield = \frac{actual\ mass}{theoretical\ mass} \times 100 = \frac{11.3}{13.1} \times 100 = 86.14\ \%$

4. (i) $[Co(en)_3]Cl_3$ tris(ethylenediamine)cobalt(II) chloride.

(ii) $Na[PtCl_3(NH_3)]$:
sodium monoaminechloroplatinium(II).

5. $CO + Cl_2 \rightleftharpoons COCl_2$, at 74°c = 347K

$K_c = \frac{[COCl_2]}{[CO][Cl_2]} = \frac{0.14}{0.012 \times 0.054} = 216$

$K_p = K_c(RT)^{\Delta n} = 216(8.31\ J/mol\,K \times 347K)^{(1-2)}$

$K_p = (822.86)^{-1}\ 216(2883.6)^{-1} = 7.5 \times 10^{-2}$

6. Given: a buffer solution containing 0.300 mol of CH_3COOH; 0.300 mol of CH_3COONa in 1 Liter of solution. pka = 4.74. Calculate the pH after 0.020 mol of NaOH is added.

First, pH before addition of NaOH.

$pH = pKa + \log \frac{[base]}{[acid]} = 4.74 + \log \frac{0.300}{0.300} = 4.74$

After addition of 0.020 mol of NaOH; the base reacts with the acid (CH_3COOH)

$CH_3COOH_{(aq)} + OH^-_{(aq)} \rightarrow CH_3COO^-_{(aq)} + H_2O_{(l)}$

	1 mol	1 mol		1 mol
				0.300 mol
before:	0.300 mol			0.300 + 0.020
after:	0.300 − 0.020	0.020		0.320
equilibr.	0.28			

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13. b 14. a 15. a
16. d 17. c 18. a
19. b 20. a 21. a
22. a

23. $A + 2B \rightleftarrows C$

$[A] = 0.006M, [B] = 0.12M, [C] = 0.216M$

$K_c = \frac{[C]}{[A][B]^2} = \frac{0.216}{(0.006)(0.12)^2} = \frac{0.216}{864 \times 10^{-5}} = \underline{\underline{2,500}}$

Answer ——

25. b

26. d, because there are equal moles of gaseous reactants and products.

27. Sodium acetate, CH_3COONa is added to the acid CH_3COOH. CH_3COONa reacts with water. $CH_3COO^-_{(aq)} + H_2O_{(l)} \rightleftarrows CH_3COOH + OH^-$
We can see that, a stronger base OH^- is produced. As a result, the pH value increases.
Answer b.

28. $pH = -\log[H^+] \Rightarrow 5 = -\log[H^+]$
$[H^+] = \underline{10^{-5}}$; For $pH = 2$; $pH = 2 = -\log[H^+]$
$[H^+] = \underline{10^{-2}}$ comparing 10^{-5} with 10^{-2}

$\frac{10^{-2}}{10^{-5}} = \underline{10^{3}}$ Answer b.

29. ΔH_f° HF $= -161$ kJ ; $\Delta H_f^\circ HCl = -92$ kJ
For exothermic processes, the larger the ΔH_f° value, the more stable the product formed.
Answer c.

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34. During electrolysis cations (+ve) ions migrate to the cathode. Answer a.

35 E°_{red}: Mg < Al < Zn < Cu < Ag

$Cu \rightarrow Cu^{2+} + 2e^-$

$2Ag^+ + 2e^- \rightarrow Ag$ Answer c.

36. c

37. $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

1 mole 1 mole

$(V_1M_1)_{acid} = (V_2M_2)_{base}$

$M_1 = \frac{V_2M_2}{V_1} = \frac{15 \times 0.15}{22.5} = 0.1M$

$pH = -\log 0.1 = 1$ Answer b

38. a 39. 40. b

PART II: Work-Out

1- Given: C = 39.10%, H = 7.67%, O = 26.11%

P = 16.82%, F = 10.30% & molar mass 186 g/mol

Empirical formula = ?

First Calculate the % to atomic mass ratio:

$C = \frac{39.10}{12} = 3.26$; $H = \frac{7.67}{1} = 7.67$; $O = \frac{26.11}{16} = 1.63$

$P = \frac{16.82}{31} = 0.54$; $F = \frac{10.3}{19} = 0.57$

Next, divide the ratio by the smallest number

$C = \frac{3.26}{0.54} = 6$; $H = \frac{7.67}{0.54} = 14$; $O = \frac{1.63}{1.54} = 3$

$P = \frac{0.54}{0.54} = 1$; $F = \frac{0.57}{0.54} \approx 1$

∴ Empirical formula = $C_6H_{14}O_3PF$

2. $CuCl_2 + 2NaNO_3 \rightarrow 2NaCl + Cu(NO_3)_2$

135 gm 170 gm 118 gm

First calculate the limiting reagent

From the balanced equation, $\frac{CuCl_2}{NaNO_3} = \frac{135}{170} = \frac{0.794}{1}$

14

30. $CaF_2(aq) \rightarrow Ca^{2+}(aq) + 2F^-(aq)$; $K_{sp} = 3.2 \times 10^{-11}$

$x \qquad 2x$

$K_{sp} = (x)(2x) = 3.2 \times 10^{-11} = (x)(2x)^2$

$4x^3 = 3.2 \times 10^{-11} \Rightarrow x^3 = \frac{3.2 \times 10^{-11}}{4} = 8 \times 10^{-12}$

$x = \sqrt[3]{8 \times 10^{-12}} = \underline{2.0 \times 10^{-4}\ mol/l}$; Answer a.

31. $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, Answer b.

32. Zn^{2+}/Zn and Ag^+/Ag

$Zn^{2+}/Zn = -0.763V$; $Ag^+/Ag = +0.799V$

Oxidation: $Zn \rightarrow Zn^{2+} + 2e^-$, $E^\circ_{ox} = -(-0.763) = 0.763V$

Reduction: $2Ag^+ + 2e^- \rightarrow 2Ag$, $E^\circ_{red} = +0.799V$

$E^\circ_{cell} = E^\circ_{red} + E^\circ_{ox} = 0.799V + 0.763V = \underline{1.562V}$

Answer a.

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$pH = pKa + \log \frac{[salt]}{[acid]} = 4.74 + \log\left(\frac{0.320}{0.28}\right) = \underline{\underline{4.80}}$

The result shows that due to the addition of the strong base, there is a slight increase of pH value (from 4.74 to 4.80) and this is the characteristics of buffer solutions

7- Given: Zn/Zn^{2+}, $E^\circ_{red} = -0.76V$; $H_2/H^+ = E^\circ_{red} = 0V$

$[Zn^{2+}] = 0.010 M$; $[H^+] = 2.5 M$; $P_{H_2} = 0.30 atm$

E_{cell} at 298K = ?

$$E_{cell} = E^\circ_{cell} - RT \ln \frac{[C]^c [D]^d}{[A]^a [B]^b} = E^\circ_{cell} - \frac{RT}{nF} \ln Q$$

$$= E^\circ_{cell} - \frac{(8.31)(298)}{n(96,485)} \ln Q$$

$$= E^\circ_{cell} - \frac{(0.0257)(2.303)}{n} \log Q$$

$$= E^\circ_{cell} - \frac{0.0592}{n} \log Q$$; considering cell rxn:

Anode: $Zn \longrightarrow Zn^{2+} + 2e^-$, $E^\circ_{ox} = -(-0.76) = 0.76V$

cathode: $2H^+ + 2e^- \rightarrow H_2$, $E^\circ_{red} = 0.00V$

$E^\circ_{cell} = E^\circ_{red} + E^\circ_{ox} = 0.00V + 0.76V = \underline{0.76V}$

$$E_{cell} = 0.76V - \frac{0.0592}{2} \log \frac{[Zn^{2+}]}{[H^+]^2}$$

$$= 0.76V - \frac{0.0592}{2} \log \frac{0.010}{(2.5)^2}$$

$$= 0.76V - \frac{0.0592}{2} \times (-2.80) = 0.76 + 0.083 = \underline{\underline{0.843V}}$$

8. $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$ $\Delta H^\circ = -173 KJ$ ... ①

$2N_{2(g)} + 5O_{2(g)} + 2H_2O_{(l)} \rightarrow 4HNO_{3(aq)}$ $\Delta H^\circ = -255 KJ$ ... ②

$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$ $\Delta H^\circ = +181 KJ$ ... ③

Calculate ΔH° for $NO_{2(g)} + H_2O_{(l)} \rightarrow HNO_{3(aq)} + NO_{(g)}$

First rearrange equations ①, ② & ③ so that upon addition they will give the final equation.

Reverse equations ① and ③

$pH = pKa + \log \frac{[salt]}{[acid]} = 4.74 + \log\left(\frac{0.320}{0.28}\right) = \underline{\underline{4.80}}$

The result shows that due to the addition of the strong base, there is a slight increase of pH value (from 4.74 to 4.80) and this is the characteristics of buffer solutions

7- Given: Zn/Zn^{2+}, $E^\circ_{red} = -0.76V$; $H_2/H^+ = E^\circ_{red} = 0V$

$[Zn^{2+}] = 0.010 M$; $[H^+] = 2.5 M$; $P_{H_2} = 0.30 atm$

E_{cell} at 298K = ?

$$E_{cell} = E^\circ_{cell} - RT \ln \frac{[C]^c [D]^d}{[A]^a [B]^b} = E^\circ_{cell} - \frac{RT}{nF} \ln Q$$

$$= E^\circ_{cell} - \frac{(8.31)(298)}{n(96,485)} \ln Q$$

$$= E^\circ_{cell} - \frac{(0.0257)(2.303)}{n} \log Q$$

$$= E^\circ_{cell} - \frac{0.0592}{n} \log Q$$; considering cell rxn:

Anode: $Zn \longrightarrow Zn^{2+} + 2e^-$, $E^\circ_{ox} = -(-0.76) = 0.76V$

cathode: $2H^+ + 2e^- \rightarrow H_2$, $E^\circ_{red} = 0.00V$

$E^\circ_{cell} = E^\circ_{red} + E^\circ_{ox} = 0.00V + 0.76V = \underline{0.76V}$

$$E_{cell} = 0.76V - \frac{0.0592}{2} \log \frac{[Zn^{2+}]}{[H^+]^2}$$

$$= 0.76V - \frac{0.0592}{2} \log \frac{0.010}{(2.5)^2}$$

$$= 0.76V - \frac{0.0592}{2} \times (-2.80) = 0.76 + 0.083 = \underline{\underline{0.843V}}$$

8. $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$ $\Delta H^\circ = -173 KJ$ ... ①

$2N_{2(g)} + 5O_{2(g)} + 2H_2O_{(l)} \rightarrow 4HNO_{3(aq)}$ $\Delta H^\circ = -255 KJ$ ... ②

$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$ $\Delta H^\circ = +181 KJ$ ... ③

Calculate ΔH° for $NO_{2(g)} + H_2O_{(l)} \rightarrow HNO_{3(aq)} + NO_{(g)}$

First rearrange equations ①, ② & ③ so that upon addition they will give the final equation.

Reverse equations ① and ③

$2NO_{2(g)} \rightleftharpoons 2NO_{(g)} + O_{2(g)}$ $\Delta H^\circ = +173kJ$ ... ①

$2N_{2(g)} + 5O_{2(g)} + 2H_2O_{(\ell)} \rightarrow 4HNO_3$ $\Delta H^\circ = -255kJ$ ... ②

$2NO_{(g)} \longrightarrow 2N_{2(g)} + O_{2(g)}$ $\Delta H^\circ = -181kJ$ ... ③

Now, multiply equation ①, ② & ③ by numbers so that when we add the equations it will give a balanced net equation. As a result, multiply equation ① by 3, equation ② by 1 and equation ③ by 2.

$3(2NO_2 \rightarrow 2NO + O_2$ ..... $\Delta H^\circ = +173kJ)$

$1(2N_2 + 5O_2 + 2H_2O \rightarrow 4HNO_3$ ..... $\Delta H^\circ = -255kJ)$

$2(2NO \longrightarrow N_2 + O_2$ ..... $\Delta H^\circ = -181kJ)$

$6NO_2 \longrightarrow 6NO + 3O_2$ ..... $\Delta H^\circ = +519kJ$

$2N_2 + 5O_2 + 2H_2O \rightarrow 4HNO_3$ ..... $\Delta H^\circ = -255kJ$

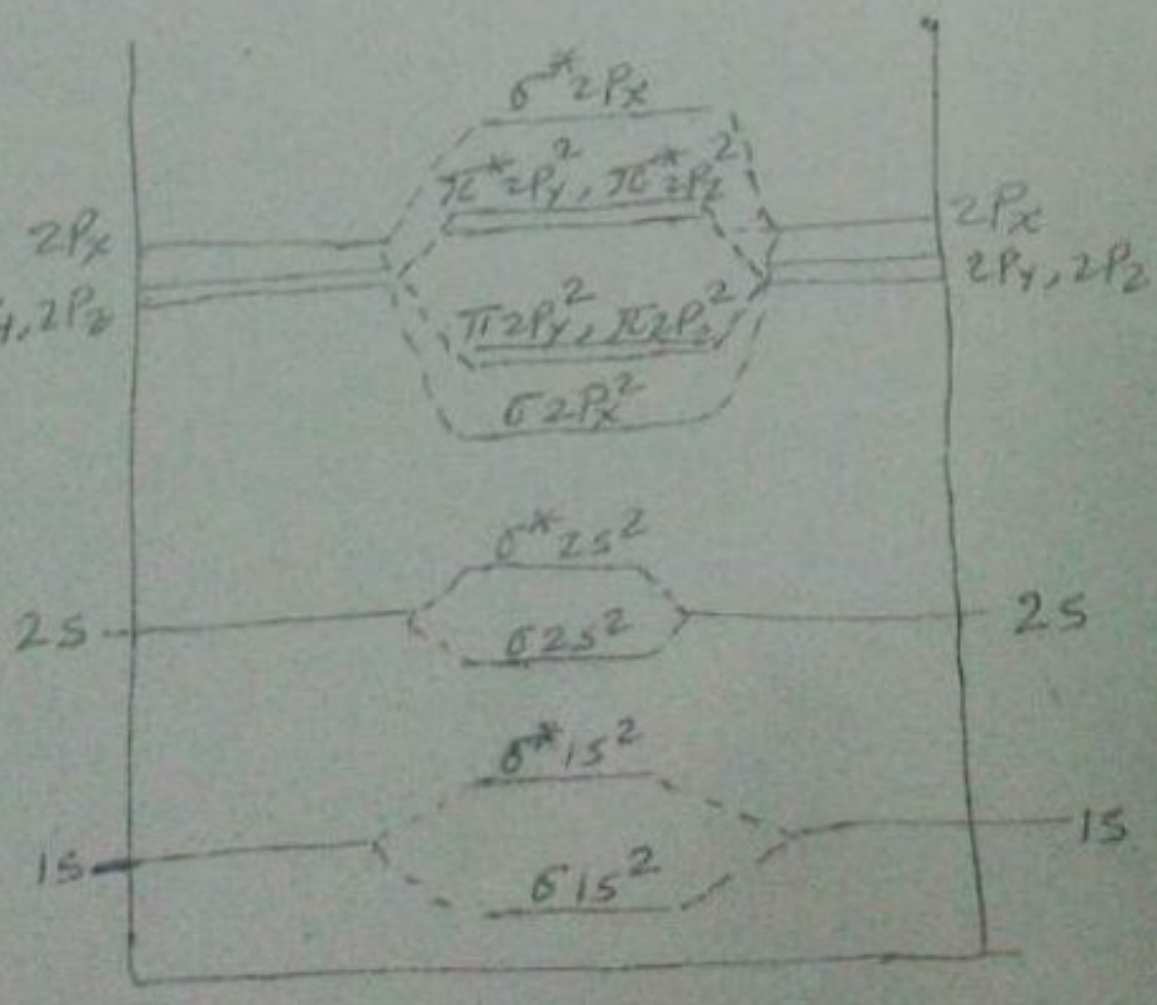
$4NO \longrightarrow 2N_2 + 2O_2$ ..... $\Delta H^\circ = -362kJ$

$6NO_2 + 2H_2O \rightarrow 4HNO_3 + 2NO$ $\Delta H^\circ = -98kJ$

$\therefore \Delta H^\circ$ for the balanced rxn is $-98kJ$

9. For F_2 molecule which is homonuclear diatomic

a) draw MO energy diagram



b) Calculate bond order for F_2^+ and F_2^-

⇒ For F_2^+, total no of e^-s : 9+9−1 : 17

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, \begin{cases} \pi 2p_y^2 \\ \pi 2p_z^2 \end{cases}, \begin{cases} \pi^* 2p_y^2 \\ \pi^* 2p_z^1 \end{cases}$

Bond order = $\frac{1}{2}$ (No. of Bonding e^-s − no of antibonding)

$= \frac{1}{2}(10-7) = \frac{1}{2}(3) = \underline{3/2}$

⇒ For F_2^-, total no of e^-s : 9+9+1 = 19

Bond order = $\frac{1}{2}(10-9) = \frac{1}{2}(1) = \underline{1/2}$

Solved by: AMHA copy center

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Addis Ababa Science and Technology University

Department of Industrial Chemistry

General Chemistry (Chem 1011) Final Exam Time allotted: 2:30 hr Date: August 5, 2022

Name _____ ID. No. _____ Section: _____

General Instruction: The Exam paper contains **44** questions in **4** parts.

Attempt all questions

Mark Distribution:

	Mark allocated (50%)	Mark Scored
Part I	**30**	
Part II	**4**	
Part III	**6**	
Part IV	**10**	
	Total Score	

1																	18
1 H 1.0079	2											13	14	15	16	17	2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305	3	4	5	6	7	8	9	10	11	12	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.409	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.798
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57–71 *	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89–103 #	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Rg (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)			

Physical constants

Planck constant (h) = 6.63×10^{-34} Js Speed of light in vacuum (c) = 3.0×10^{8} m/s

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Part I: Choose the answer from the given alternatives and write the letter of your choice inside the shaded region. (1 pts each)

1. Gaseous state of matter that contains appreciable numbers of electrically charged particles [D]

   A. Gas B. Liquid C. Solid D. Plasma

2. Convert 125 Ethiopian birr to pound sterling assuming 1 pound equals 64.53 birr. [B]

   A. 1.93 B. 1.94 C. 1.937 D. 1.940

3. _____ is a chemical formula that shows the connectivity of atom in a [C] molecule.

   A. Empirical Formula B. Molecular Formula C. Structural Formula D. All

4. Which of the following is **not** polyatomic anion? [A]

   A. O^{2-} B. CO_3^{2-} C. SO_4^{2-} D. SO_3^{2-}

5. Which of the following is binary compound? [B]

   A. Sodium Carbonate B. Magnesium Nitride

   C. Ammonium Chloride D. Calcium Sulfate

6. Which one of the following is the molecular formula of dichlorıne hept(a)oxide? [C]

   A. ClO_7 B. ClO_6 C. Cl_2O_7 D. Cl_2O_6

7. What is the mass number of an atom that has 26 protons, 30 neutrons, and 24 electrons? [B]

   A. 54 B. 56 C. 26 D. 80

8. The majority of the mass of an atom is held by [B]

   A. Proton and Electron B. Electron only

   C. Electron and Neutron D. Proton and Neutron

9. Which of the following is **not** true regarding balanced chemical equations? [C]

   A. They contain the same number of atoms on each side

   B. Electrons are also balanced

   C. An equal number of molecules on both side

   D. Follows the law of conservation of mass

10. Which of the given reactions are counted as balanced reactions? [B]

    A. $H_2 + O_2 \rightarrow 2H_2O$

    B. $4Al + 3O_2 \rightarrow 2Al_2O_3$

    C. $Mg(OH)_2 + 2HNO_3 \rightarrow 2Mg(NO_3)_2 + 2H_2O$

    D. $N_2 + 3H_2 \rightarrow NH_3$

11. Calculate the mass percentage of magnesium in the formation of magnesium oxide. [D]

    A. 30% B. 48% C. 54% D. 60%

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12. Balance the following equation using minimum integral coefficients: D

$$NH_3 + O_2 \rightarrow NO_2 + H_2O$$

The stoichiometric coefficient for oxygen gas O_2 is:

A. 1 B. 4 C. 3 D. 7

13. How many moles of alanine, $C_3H_7NO_2$, are there in 159 g of alanine? B

A. 1.42×10^4 B. 1.78 C. 0.992 D. 0.560

14. Which one of the samples has the largest mass? B

A. 1 mol of CO_2 B. 1 mol of SF_6 C. 1 mol of CH_3COCH_3 D. 1 mol of He

15. Calculate the percent, by weight, of carbon in 154 g of $C_4H_8O_3$? A

A. 46% B. 31% C. 72% D. 55%

16. How many grams of $Ca(OH)_2$ are contained in 1500 mL of 0.0250 M $Ca(OH)_2$ solution? C

A. 3.17 g B. 2.78 g C. 1.85 g D. 2.34 g

17. Which of the following statements is **FALSE** for the chemical equation given below in which nitrogen gas reacts with hydrogen gas to form ammonia gas assuming the reaction goes to completion? D

$$N_2 + 3H_2 \rightarrow 2NH_3$$

A. The reaction of one mole of H_2 will produce 2/3 moles of NH_3.

B. One mole of N_2 will produce two moles of NH_3.

C. The reaction of 14 g of nitrogen produces 17 g of ammonia.

D. The reaction of three moles of hydrogen gas will produce 17 g of ammonia.

18. When 12 g of methanol (CH_3OH) was treated with excess oxidizing agent (MnO_4^-), 14 g of formic acid (HCOOH) was obtained. Using the following chemical equation, calculate the percent yield. (The reaction is much more complex than this; please ignore the fact that the charges do not balance.) C

$$3CH_3OH + 4MnO_4^- \rightarrow 3HCOOH + 4MnO_2$$

A. 100% B. 92% C. 82% D. 70%

19. The limiting reagent in a chemical reaction is one that: C

A. has the largest molar mass B. has the smallest coefficient.

C. is consumed completely D. is in excess

20. How many mL of 17 M NH_3 must be diluted to 500.0 mL to make a 0.75 M solution? B

A. 13 mL B. 22 mL C. 39 mL D. 73 mL

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21. When we light from a Neon sign, we are observing radiation from excited Neon atoms. If this radiation has a wavelength of 600 nm. What is the energy of the photon being emitted? B

A. $3.18x10^{-19}$ J B. $3.31x10^{-19}$ J C. $3.13x10^{-19}$ J D. $4.13x10^{-19}$ J

22. What is the maximum number of electrons that can occupy a shell with n=4 C

A. 50 B. 48 C. 32 D.44

23. Which of the following is **not** true B

A. The energy of atomic orbitals increases as the principal quantum number, n, increases

B. The energy of the orbitals increases within a shell in the order s<p<d<f

C. The increasing n value has more influence on energy than the increasing l value for small atoms

D. For larger atoms, the 4s orbital is higher in energy than the 3d orbital

24. What is the energy (in joules) of the line in the spectrum of hydrogen that represents the movement of an electron from Bohr orbit with n = 4 to the orbit with n = 6? B

A. 8.566×10^{-2} J B. 7.566×10^{-2} J C. 9.566×10^{-2} J D. 8.66×10^{-2} J

25. What is the formal charge of **N** atom in $\mathbf{NCl_3}$? D

A. -2 B.+2 C. +1 D.0

26. From the following alternatives which one has the **lowest** bond energy? C

A. F-Cl B. F-Br C. Si-Si D. Si-P

27. Which of the following is correct order of electron-pair repulsions from greatest to least repulsion B

A. Lone pair-bonding pair > Lone pair-lone pair >bonding pair-bonding pair

B. Lone pair-lone pair>lone pair-bonding pair>bonding pair-bonding pair

C. Lone pair-lone pair> bonding pair-bonding pair > lone pair-bonding pair

D. Bonding pair-bonding pair >lone pair-bonding pair> Lone pair-lone pair

28. From their positions in the periodic table, which of the following series is **correct** in order of increasing electronegativity C

A. C < F< H< O B. C < O <F< H C. H < C< O< F D. C < H <F< O

29. In the following reaction

N_2O_4 (g)⇌$2NO_2$(g), which of the following is the **correct** relationship between K_c and K_p A

A. $K_p = K_c(RT)$ B. $K_p = K_c(RT)^{-1}$ C. $K_c = K_p\,(RT)$ D. $K_p = K_c(RT)^2$

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30. Which of the following is **wrong** when we increase the pressure on a system in which [C] NO, O_2, & NO_2 are at equilibrium in the following reaction?

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$$

A. The formation of additional amounts of NO_2 decreases the total number of molecules

B. The equilibrium shifts to the right

C. The equilibrium shifts to the left

D. The amount of NO and O_2 decreases while that of NO_2 increases

Part II. Match the following and write the letter of your choice inside the shaded region. (4 pts)

	Column A	Column B
1. [E]	Isotope	A. Trigonal pyramid
2. [C]	Oxyacids	B. Trigonal bipyramidal
3. [B]	PF_5 electron pair geometry	C. Compounds that contain Hydrogen, Oxygen
4. [D]	BF_3 electron pair geometry	and at least one other element
		D. Trigonal planar
		E. the same number of protons but different numbers of neutrons
		F. the same number of protons but different numbers of electrons

Part III. Fill in the blank spaces and write your answer in the blank space provided. (6 pts)

1. Extensive property is a property that depends on the amount of matter present.
2. The number 85.6 μm when written in the scientific notation is 8.56×10^{-5} m.
3. Frequency is the number of wave cycles that pass a specified point in space in a specified amount of time.
4. The tendency of main group atoms to form enough bonds to obtain eight valence electrons is known as the octet rule.
5. VSEPR theory enables us to predict the molecular structure, including approximate bond angles around a central atom, of a molecule from an examination of the number of bonds and lone electron pairs in its Lewis structure.
6. An electron in an atom is completely described by four quantum numbers:
   1) principal quantum number (n)
   2) azimuthal quantum number (l)
   3) orientation quantum number (m_l)
   4) spin quantum number (m_s)

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Part IV. Show the necessary steps for the following questions and write your answer in the space provided.

1. Balance the following reaction that took place in acidic media. **(3 pts)**

$\overset{+7}{Mn}\overset{-2}{O_4}^- + \overset{+1}{C}\overset{-2}{H_3}\overset{+1}{O}\overset{-2}{H} \dashrightarrow \overset{+1}{C}\overset{-1}{H_3}\overset{+3}{C}\overset{-2}{O}\overset{-2}{O}\overset{+1}{H} + Mn^{2+}$

Oxidation:

$CH_3OH \longrightarrow CH_3COOH$

$2CH_3OH \longrightarrow CH_3COOH$

$2CH_3OH \longrightarrow CH_3COOH + 4H^+$

$2CH_3OH \longrightarrow CH_3COOH + 4H^+ + 4e^-$

↳ multiply by 5 to get equal e^-

$5(2CH_3OH \longrightarrow CH_3COOH + 4H^+ + 4e^-)$

$10CH_3OH \longrightarrow 5CH_3COOH + 20H^+ + 20e^-$

Reduction

$MnO_4^- \longrightarrow Mn^{2+}$

$MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

$8H^+ + MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

$5e^- + 8H^+ + MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

multiply by 4 to get equal e^-.

$4(5e^- + 8H^+ + MnO_4^- \longrightarrow Mn^{+2} + 4H_2O)$

$20e^- + 32H^+ + 4MnO_4^- \longrightarrow 4Mn^{+2} + 16H_2O$

Oxidation: $10CH_3OH \longrightarrow 5CH_3COOH + 20H^+ + 20e^-$

Reduction: $20e^- + 32H^+ + 4MnO_4^- \longrightarrow 4Mn^{+2} + 16H_2O$

Net: $10CH_3OH + 4MnO_4^- + 12H^+ \longrightarrow 5CH_3COOH + 4Mn^{+2} + 16H_2O$

$12H^+$

$10CH_3OH + 4MnO_4^- + 12H^+ \longrightarrow 5CH_3COOH + 4Mn^{+2} + 16H_2O$

2. One type of anaerobic respiration converts glucose ($C_6H_{12}O_6$) to ethanol (C_2H_5OH) and carbon dioxide (CO_2). If the molecular weight of glucose is 180 grams/mol and the molar mass of ethanol is 46 g/mol, how many grams of carbon dioxide are produced when 0.5 mol of glucose is digested via respiration? **(2 pts)**

$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$

$0.5\ mol\ C_6H_{12}O_6 \times \frac{2\ mol\ CO_2}{1\ mol\ C_6H_{12}O_6} \times \frac{44\ g\ CO_2}{1\ mol\ CO_2} = 44\ g\ CO_2$

↑ mol ratio on the reaction

↑ molar mass of CO_2

2

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3. The equilibrium constant for the decomposition of $PCl_5(g)$ into $PCl_3(g)$ & $Cl_2(g)$ is 0.0211. What are the equilibrium concentrations of PCl_5, PCl_3, and Cl_2 if the initial concentration of PCl_5 was 1.00 M? **(3 pts)**

$$PCl_{5(g)} \longrightarrow PCl_{3(g)} + Cl_{2(g)}$$

$$k_c = \frac{[PCl_3]\,[Cl_2]}{[PCl_5]} = 0.0211$$

$PCl_5(g)$	$\longrightarrow$	$PCl_3(g)$	+	$Cl_2(g)$
1 M		0		0
$-x$		$+x$		$+x$
$1-x$		x		x

$$k_c = \frac{(x)(x)}{(1-x)} = 0.0211$$

$$= \frac{x^2}{1-x} = 0.0211$$

$$x^2 = 0.0211 - 0.0211x$$

$$x^2 + 0.0211x - 0.0211 = 0$$

$$x = \frac{-0.0211 \pm \sqrt{(0.0211)^2 - 4(1)(0.0211)}}{2}$$

← This is equilibrium concentration of $PCl_3(g)$ and $Cl_2(g)$

Equilibrium concentration of PCl_5 $= 1 - x = 1 - \frac{-0.0211 \pm \sqrt{(0.0211)^2 - 4(1)(0.0211)}}{2}$

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but $\sqrt{(0.0211)^2 - 4(0.0211)}$ is undefined, because

$$(0.0211)^2 - 4(0.0211) < 0.$$

x has no defined value.

Therefore, the equilibrium concentrations of $PCl_3(g)$, $Cl_2(g)$ and $PCl_5(g)$ are UNdefined.

4. Air-saturated water has a H_3O^+ concentration of 2.0×10^{-6} M caused by the dissolved CO_2. Calculate the pH of the solution at 25 °C. **(2 pts)**

$$[H^+] = [H_3O^+] = 2.0 \times 10^{-6}\ M$$

$$pH = -\log[H^+] = -\left(\log[2\times10^{-6}]\right) = -\left(\log 2 + \log 10^{-6}\right)$$

$$= -\log 2 - \log 10^{-6}$$

$$= -\log 2 + 6$$

$$= (6 - \log 2)$$

2

Astu

PART I:-Multiple Choice (15 pts)

_____1. An engineer pumps air at 0°C into a newly designed piston-cylinder assembly. The volume measures 6.83 cm^3. At what temperature (in K) will the volume be 9.75 cm^3?

A) 298 K B) 389.9 K C) 180 K D) 396 K E) None

_____2. Which one is false about equilibrium constant (K) and reaction quotient (Q)?

A) If Qc < Kc, more product forms. C) If Qc = Kc, there is no net change

B) If Qc > Kc , more reactant forms. D) If Qc < Kc , more reactant forms. E) None

_____3. All of the following are state function except:

A) Reaction Kinetics B) Work C) Internal energy

D) A & B E) None

____4. A chemical engineer injects limestone ($CaCO_3$) into the hot flue gas of a coal burning power plant to form lime (CaO), which scrubs SO_2 from the gas and forms gypsum ($CaSO_4 \cdot 2H_2O$). What is Kc for the following reaction, if CO_2 pressure is in atmospheres?

$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ $K_p = 2.1 \times 10^{-4}$ (at 1000. K)

A) 1.6×10^{-4} B) 3.6×10^{-5} C) 2.56×10^{-6} D) 2.6×10^{-4} E) None

____5. Fuel engineers use the extent of the change from CO and H_2O to CO_2 and H_2 to regulate the proportions of synthetic fuel mixtures. If 0.250 mol of CO and 0.250 mol of H_2O are placed in a 125-mL flask at 900 K, what is the composition of the equilibrium mixture? At this temperature, Kc is 1.56 for the equation; $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

A) [CO]= 0.15 M , $[H_2O]$ = 1.11M C) [CO]= 1.11 M , $[H_2O]$ = 1.11M

B) [CO]= 2.15 M , $[H_2O]$ = 3.11M D) [CO]= 0.15 M , $[H_2O]$ = 0.15M E) None

____6. Which one of the following increases the molecular disorder?

A) Decomposition of calcium carbonate B) Melting of ice at 25°C

C) A lion chasing an antelope D) All E) None

____7. Which of the following is true for galvanic cell?

A) An electric current is produced by using electrical energy.

B) Anode is positive electrode.

C) Electrons flow towards the anode.

D) Electrons flow through the salt bridge. E. None

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8. What is the heat released when 4.0 L of Cl_2 with density of 2.46 g/mL reacts with an excess of sodium metal to form sodium chloride at 25 °C according to the following reaction?

Na (s) +1/2 Cl_2 → NaCl (s) $\Delta H f°$ NaCl (s) = -411.1 kJ

A) -211.1 kJ B) -311.1 kJ C) -114 kJ D) -411.1 kJ

9. $Pb(s) + 2\ Ag^+(aq) \rightarrow Pb^{2+} + 2\ Ag(s)$

If the equilibrium constant for the reaction above is 2.6×10^{31}, which of the following pair is correctly describes the standard voltage $E°$, and the standard free energy change $G°$, for this reaction?

A) E° and ΔG° are both positive B) E° is negative and ΔG° is positive

C) E° is positive and ΔG° is negative D) E° and ΔG° are both negative

E) E° and ΔG° are both zero

10. In electrolytic cell:

A) System performs work on the surrounding

B) Surrounding performs work on the system

C) The reaction proceeds towards the equilibrium D) A & C E) None

11. Solution is formed in which one of the following option

A, solute/solute interaction > solvent/solvent interaction

B, solvent/solvent interaction> solute/solute interaction

C, solute/solvent interaction >solvent/solvent interaction

D, solute/solvent interaction >solute/solute interaction

E, C &D are answers

12. Activation energy can be described as the

A) Energy of motion. B) Energy of the activated complex.

C) Energy difference between the reactants and the products.

D) Energy difference between the reactants and the activated complex. E) None

13. Reaction rate constant can be affected by:

A) The concentration of reacting species. B) The temperature.

C) The activation energy. D) B & C E) None

14. A gas is cooled and loses 82 J of heat, the gas contracts as it cools and the work done on the system gives 29J in exchange with the surrounding. What are the values of q, w and ΔE?

A) 82 J, 29 J, 53 J B) -82 J, 29 J, -53 J C) 32 J, 19 J, 55 J D) 72 J, 39 J, 53 J E) None

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_____15. The first order of gaseous decomposition of N_2O_4 into NO_2 has a rate constant of 4.5 x 10^3 s^{-1} at 1 °C and activation energy of 58 KJ/mol. At what temperature would the rate constant be $10^2 s^{-1}$?

A) 80 K B) 95 K C) 102 K D) 200 K E) None

Part II: -Short Answer Questions (15 pts)

16. The molar heat of vaporization of ethanol C_2H_5OH is 38.56 KJ/mol at its normal boiling point 78.1 C^0. The change in entropy during the phase transition of 68.3 g of ethanol from liquid to gas at its boiling temperature is _____. (2 pts)
17. What is the effect of the following on the volume of one mole of an ideal gas? (2 pts)
    a) The pressure is reduced by a factor of 4 (at constant T)
    b) The pressure changes from to 760 torr to 202 kPa, and the temperature changes from 37 °C to 155 K.
18) Choose the member with the higher entropy in each of the following pairs (2 pts)
    a) 3 mol of $O_2(g)$ or 2 mol of $O_3(g)$
    b) 1 mol of $CF_4(g)$ or 1 mol of $CCl_4(g)$
19) The molar solubility for MX_2 is 1.52 x 10^{-3} M, then Ksp is_____(2 pts)
20) A concentration cell consists of two Cr/Cr^{3+} half-cells. In half-cell A, electrode A dips into $[Cr^{3+}]$ = 7.0 X 10^{-4} M electrolyte solution and in half-cell B, electrode B dips into $[Cr^{3+}]$ = 2.5 X 10^{-2} M electrolyte solution. Then:
    (a) The cell potential, Ecell at 298.15 K_____.
    (b) The positive electrode is_____ and the negative electrode is_____.
    (c) Draw cell diagram, indicate direction of electron flow in the external circuit & ions flow in salt bridge and check the spontaneity of the cell. (4 pts)

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) A first-order reaction is 38.5% complete in 500 second. (3 pts)

(a) The rate constant in per second is $9.67 \times 10^{-4}\ s^{-1}$

(b) The time required to complete 90% of the reaction is 2382 s

Part III: -Calculations (10 pts)

Show all the steps clearly and neatly.

22. Calculate K_c for the following equilibria: $CO(g) + Cl_2(g) \leftrightharpoons COCl_2(g)$; $K_p = 3.9 \times 10^{-2}$ at 100 K (3 pts)

given

$K_p = 3.9 \times 10^{-2}$ $T = 100\ K$ $R = 0.0821\ L\ atm\ mol^{-1}\ K^{-1}$

req

$K_c = ?$

$K_p = K_c (RT)^{\Delta n}$ $\quad K_p = K_c \cdot RT^{\Delta n g}$

$K_c = K_p \cdot RT$ $\quad K_c = \frac{K_p}{RT^{\Delta n}} = K_p \cdot RT$

$= 3.2019$ ←

$= 3.9 \times 10^{-2}\ Y\ 100\ K \times 0.0821$

$= \boxed{3.2019}\ \frac{L\ atm}{mol}$

23) Given the following reactions, calculate the heat of reaction from heats of formations

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$. (4 pts)

Equation A: $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ $\quad \Delta HA = -45.9$ kJ

Equation B : $N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\quad \Delta HB = 90.3$ KJ

Equation C : $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ $\quad \Delta HC = -241.8$ KJ

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$ $\quad \Delta H = ?$

Ans $\boxed{-636.6\ KJ}$

1st . we balance then

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

$N_2(g) + O_2(g) \rightarrow 2NO(g)$

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

(2, 2) →

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

then

$\Delta HA = 2 \times -45.9\ KJ = -91.8\ KJ + 180.6 + (-725.4)$

$\Delta HB = 2 \times 90.3\ KJ$

$\Delta HC = 3 \times -241.8\ KJ$ $\quad = \boxed{-636.6\ KJ}$

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24) Gaseous X atoms combine to form molecular X in the gas phase

$X(g) + X(g) \rightarrow X_2(g)$, has the high rate constant 7.2×10^{-1} L mol^{-1} s^{-1} at 23 °C. If the initial concentration of X was 0.086 M, calculate the concentration of X after 2.0 min. (3 pts)

$k = 7.2 \times 10^{-1}$ $Lmol^{-1}s^{-1}$ → As it is second order

$[A]_0 = 0.086$

$t = 120s$

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Part-I: Say True if the statement is Correct and False if it is Incorrect. *(1 point each)*

1. Chemical equations depict the kind of reactants and product and their relative amounts in a reaction.
2. Hundu's rule states that "No two electrons in an atom can have the same four quantum numbers".
3. Wavelength & frequency are directly proportional to one another
4. Lattice Energy is the energy that released when positive and negative ions form crystal lattice due to their attraction to each other.
5. The reactant that produces lesser amount of product is called excess reactants.
6. Lambda is number of waves that pass a particular point in one second.
7. The principal quantum number, n, describes the energy level on which the orbital resides.
8. In chemical reaction reactants always consumed equally.
9. In photo electric effect light of the longest wave length is required to emit electron from the surface when compared to that of shortest wave length.
10. The electron-pair geometry of CH_4 and NH_3 are the same, but their molecular structures are different.

Part-II. Choose the correct answer from the given alternatives and write your answer on the provided space *(1.5 each)*

1. Which one of the following compound contains expanded Lewis octet rule central atom?

A. CO_2 B. SF_6 C. NH_3 D. CH_2O E. $BeCl_2$

2. What are the missing coefficients for the skeleton equation below?

$$NH_3(g) + O_2(g) \rightarrow N_2(g) + H_2O(l)$$

A. 4,3,2,6 B. 2,1,2,3 C. 1,3,1,3 D. 2,3,2,3 E. 3,4,6,2

3. How many number of electrons are shared between nitrogen and all oxygen atoms in nitrate ion (NO_3^-)? A. 5 B. 6 C. 8 D. 4 E. 11

4. Which one of the following electromagnetic radiation has the longest wavelength?

A. Y-rays B. Radio wave C. Ultraviolet D. Infrared E. Visible region

5. In a given 3p orbital what are the values of principal quantum number (n) and angular momentum quantum number (l) respectively?

A. 3, 0 B. 1, 3 C. 3, 2 D. 3, 1 E. 2, 3

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6. From the following structures of carbon dioxide which one is most stable?

A. O=C=O B. O≡C—O C. O—C≡O D. B and C E. all are the same

7. Which one of the following statements is not true about chemical equation?

A. It provides the identity of the substances in the reaction

B. it provides the amount of the substances in the reaction

C. It shows the chemical formulas of the species in the reaction

D. It shows the relative number of reactants that combine but not the product that form

E. It shows the physical states of the species in the reaction

8. The quantitative relationship between the reactants and the products in the balanced chemical equation is said to be:

A. Chemical equation B. chemical formula C. stoichiometry

D. chemical reaction E. chemical symbol

9. If you rewrite the following word equation as a balanced chemical equation, what will the Coefficient and symbol for fluorine be? Nitrogen trifluoride → Nitrogen + fluorine

A. 3F B. $6F_2$ C. F_3 D. 6F E. $3F_2$

10. What would be the correct oxidation state of N and O respectively in KNO_3?

A. +1 and -2 B. +3 and -2 C. +5 and -2 D. +5 and -1 E. -3 and -2

11. Which of the following compounds contain a Cl atom with a +7 oxidation state?

A. Cl_2 B. HOCl C. ClO_3 D. KCl E. $KClO_4$

12. Which of the following does not contain ionic bonds?

A. Sulfur dioxide B. Sodium oxide C. Silver oxide D. Strontium oxide

E, potassium chloride

13. Which of the following does not contain covalent bonds?

A. Carbon (graphite) B. Carbon (diamond) C. HCl (g) D. NaCl(s) E. HF

14. Which of the following species contains three bond pairs and one lone pair around the central atom? A. NH_2^- B. BF_3 C. H_2O D. PCl_3 E. CO_2

15. Of the following statements, one is false about a chemical reaction in general:

A. a chemical equation can be balanced by rearranging the subscripts

B. The rearrangement of the atoms to produce substances refers to chemical reaction

C. precipitation reaction involves formation of insoluble products

D. a substance can precipitate out when its concentration is greater than its solubility

E. precipitation reaction involves exchange of ions.

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Use the following information if it is necessary

$^{127}_{53}I$, $^{32}_{16}S$, $^{16}_{8}O$, $^{48}_{22}Ti$, $^{24}_{12}Mg$, $^{35.5}_{17}Cl$, $^{1}_{1}H$, $^{12}_{6}C$, $^{14}_{7}N$, $^{39}_{19}K$, $^{23}_{11}Na$, $^{9}_{4}Be$ $^{31}_{15}P$, $^{131}_{54}Xe$, $^{80}_{35}Br$

Part I: Multiple choice item (40%)

Choose the best answer from the given alternatives for the following questions and write the letter of the correct choice on the answer sheet provided on page 8.

1. The number of iodine atoms present in 1 cm^3 of its 0.1 M solution is

   A. 6.02×10^{23} B. 6.02×10^{22} C. 6.02×10^{19} D. 1.204×10^{20}

2. Identify the false statement from the given alternatives

   A. Dilution is the process whereby the concentration of a solution is lessened by the addition of solvent

   B. Generally solute is a component of a solution that is typically present at a much lower concentration than the solvent

   C. One mole of any element contains the same number of atoms as one mole of any other element

   D. Dilution process change the amount of solute in the solution

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3. Concentrated H_2SO_4 has a density of 1.9 g/mL and is 99% by weight. The molarity of this acid is

   A. 19.19 B. 38.38 C. 9.595 D. None of these

4. A tooth paste has 0.2 g/liters fluoride. It concentration in ppm will be

   A. 2000 B. 200 C. 400 D. 4000

5. The volume of distilled water that should be added to 10.0 mL of 6.00 M HCl(aq) in order to prepare a 0.500 M HCl(aq) solution is approximately

   A. 50.0 mL B. 100 mL C. 110 mL D. 120 mL

6. A compound was analyzed and found to be 12.1% C, 71.7% Cl, and 16.2% O. What is the empirical formula for this compound?

   A. C_2OCl B. CCl_2O C. CO_2Cl_2 D. C_2O_2Cl

7. Which statement is true about the percent composition by mass in $C_6H_{12}O_6$?

   A. Carbon is 6.7% by mass
   B. Carbon is 72% by mass
   C. Oxygen is 53.3% by mass
   D. Hydrogen is 12% by mass

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26. Silicon has an atomic number equal to 14. To what period does silicon belong?

A. Period 2 B. Period 3 C. Period 4 D. Period 5

27. The property of the element with atomic number 37 resembles that of the element with atomic number_____

A. 8 B. 9 C. 18 D. 19

28. Which of the following ions will be the smallest in the isoelectronic series O^{2-}, F^-, Na^+, and Mg^{2+}?

A. O^{2-} B. F^- C. Na^+ D. Mg^{2+}

29. Which one is not the property of ionic compounds?

A. Insoluble in non- polar solvent
B. Exist as discrete, neutral molecules
C. Conduct electricity in molten state
D. Typically solids with high melting points

30. Which substance is not correctly paired with the type of bonding found between the atoms of that substance?

A. CaO — ionic bonds
B. CH_4 — covalent bonds
C. Cl_2 — polar covalent bonds
D. H_3O^+ — coordinate covalent bonds

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31. One of the following molecule obeys octet rule, identify.

A. NO B. NO^+ C. BeH_2 D. $AlCl_3$

32. What is the angle between electron groups in the Trigonal planar electron geometry?

A. 180° B. 120° C. 109.5° D. 90°

33. Which molecule has octahedral electron geometry?

A. ClF_3 B. PF_5 C. SF_4 D. XeF_4

34. What is the formal charge on each atom in dichloromethane, CH_2Cl_2?

A. C = 0, H = 0, Cl = 0
B. C = 0, H = -1, Cl = +1
C. C = 0, H = +1, Cl = -1
D. C = -2, H = +1, Cl = +1

35. What is the predicted molecular geometry of BrF_5 using VSEPR theory?

A. Octahedral
B. Square planar
C. Square pyramidal
D. Triangular bipyramidal

36. In what condition does the electron pair arrangement and geometry of molecules become identical?

A. When the number of bonding electrons is equal to the number of non-bonding electrons
B. When the number of bonding electrons become even
C. When the sum of non-bonding electron become odd
D. When there are no non-bonding electrons on the central atom

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37. Which molecule is a polar molecule?

A. KCl B. H_2O C. CH_4 D. CO_2

38. Of the following molecules, which has the largest dipole moment?

A. CO_2 B. O_2 C. HF D. F_2

39. Which of the following molecules has the shortest bond length?

A. N_2 B. O_2 C. Cl_2 D. Br_2

40. According to the VSEPR model, the progressive decrease in the bond angles in the series of molecules CH_4, NH_3, and H_2O is best accounted for by the_____

A. Increasing strength of the bonds
B. Decreasing size of the central atom
C. Increasing electronegativity of the central atom
D. Increasing number of unshared pairs of electrons

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Part II: TRUE or FALSE questions (10 %)

Directions: Write 'TRUE' if the statement is correct and write 'FALSE' if the statement is incorrect on the answer sheet provided on page 8.

41. The solubility of solids in water generally increases with increasing temperature
42. The oxidation number of Mn in $KMnO_4$ is +5.
43. The electron density at any point is proportional to the wave function of the electron wave at that point.
44. The electronic structure of the SO_2 molecule is best represented as a resonance hybrid of three equivalent structures.
45. For a molecule with an octahedral electronic geometry, the molecular geometry is square planar if there are two lone pairs of electrons on the central atom.
46. Ionic bond is formed from two high electronegative elements
47. Gravimetric analysis describes a set of methods used in analytical chemistry for the quantitative determination of an analyte based on its mass.
48. Despite the trend in increasing first ionization energy values across a period, the first ionization energy for oxygen is slightly less than that for nitrogen.
49. The kinetic energy of the ejected electrons from the surface of metal did not depend on the frequency of the light but increase with increasing intensity of the photon
50. The power of an atom to attract shared pair of electrons is called electron affinity

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14. A chemical equation is balanced according to the law of
    A. multiple proportions
    B. constant compositions
    C. conservation of energy
    D. conservation of mass E. All

15. Which of the following procedures is not taking place while determining the density of liquid in the laboratory ?
    A. mass determination of the container
    B. mass determination of the container with the liquid
    C. calculation of mass to volume ratio of the liquid
    D. density determination of the container E. None

16. The physical property that could be used to test the purity of substances such as gold is
    A. weight B. Volume C. physical state D. density E. None

17. Which of the following subshells has the highest energy according to the Aufabau principle ?
    A. 3d B. 4p C. 5s D. 4d E. 3p

18. Which one of the following orbitals does not exist?
    A. *1s*
    B. *2p*
    C. *3p*
    D. *2d*
    E. *3d*

19. Which of the following sets of quantum numbers is not allowed for an electron in a *4f* orbital?
    A. $n = 4, l = 1, m_l = +1, m_s = +1/2$
    B. $n = 4, l = 3, m_l = +4, m_s = -1/2$
    C. $n = 4, l = 3, m_l = +2, m_s = +1/2$
    D. $n = 4, l = 2, m_l = +1, m_s = -1/2$
    E. None of the above

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20. A given orbital has a magnetic quantum number $m_l = +1$. This could not be
    A. *s* orbital
    B. *p* orbital
    C. *d* orbital
    D. *f* orbital
    E. *g* orbital

21. Bohr's model of the atom included the idea(s) that:
    A. The electron can have only certain energies
    B. Electrons absorb energy by moving to higher energy orbits.
    C. Electrons emit energy in the form of light when they move to lower energy orbits.
    D. All are correct.
    E. None of the above

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22. Which of the following half-reactions is balanced?

A. $SO_4^{-2} + H_2O \rightarrow SO_3^{-2} + 2H^+ + 2e^-$

B. $SO_4^{-2} + H_2O + 2e^- \rightarrow SO_3^{-2} + 2H^+$

C. $SO_4^{-2} + 2H^+ + 2e^- \rightarrow SO_3^{-2} + H_2O$

D. $SO_4^{-2} + 2H^+ \rightarrow SO_3^{-2} + H_2O + 2e^-$

E. None of the above

23. Consider the following reaction: $3I_2 + 3H_2O \rightarrow 6H^+ + 5I^- + IO_3^-$

In this reaction, the I_2 atoms undergo:

A. oxidation only
B. both oxidation and reduction
C. reduction only
D. neither oxidation nor reduction

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24. The toxic pigment called white lead, $Pb_3(OH)_2(CO_3)_2$, has been replaced in white paints by rutile, TiO_2. How much rutile (g) can be prepared from 379 g of an ore that contains 88.3% ilmenite ($FeTiO_3$) by mass? (Molar mass(amu) : $FeTiO_3 = 151.71$, $TiO_2 = 79.866$)

$$2FeTiO_3 + 4HCl + Cl_2 \rightarrow 2FeCl_3 + 2TiO_2 + 2H_2O$$

A. 176.2 g B. 199.5 g C. 46.5 g D. 635.7 g E . None

25. Using complete subshell notation ($1s^22s^22p^6$, and so forth), predict the electron configuration of the Cr^{2+} ion. (Chromium has atomic number of 24)

A. $1s^22s^22p^63s^23p^64s^23d^6$ B. $1s^22s^22p^63s^23p^64s^23d^4$ C. $1s^22s^22p^63s^23p^63d^4$

D. $1s^22s^22p^63s^23p^63d^6$ E. None

26. A sample of 0.53 g of carbon dioxide was obtained by heating 1.31 g of calcium carbonate. What is the percent yield (%) for this reaction? (Molar mass (g/mol) : $CaCO_3 = 100$, $CaO = 56$, $CO_2 = 44$)

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

A. 40.46 B. 91.38 C. 100 D. 89.43 E. 75.76

27. What is the radius, in angstroms, of the orbital of an electron with $n = 5$ in a hydrogen atom??

($a_0 = 0.53Å$)

A. 13.25 B. 2.65 C. 47 D. 21 E. None

28. Which orbital is characterized by the quantum numbers $n = 3$, $l = 0$, $m_l = 0$?

A. 4s B. 4p C. 3s D.3p E. 3d

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15. How much of KOH is needed to completely neutralize 2.0 liters of 0.75 M HNO3?

A. 6.3 g B. 2.81 g C. 3.15 g D. 5.61 g

16. In Bohr model of the hydrogen atom, the energy of the electron in its lowest orbit is

A. Infinite energy B. Maximum energy C. Minimum energy D. Zero energy

17. Which of the following statements is incorrect?

A. Hund's rule states that the electrons fill orbitals so that there is the maximum number of parallel spins

B. The Pauli Exclusion Principle states that no two electrons can have the same four quantum numbers

C. The Aufbau principle states that it impossible for two electrons in the same orbital to have the same spin

D. The uncertainty principle states that it is impossible to know simultaneously the momentum of an electron and its location in space

18. Which one of the following is incorrect about an orbital?

A. An orbital is a wave function

B. An orbital has energies, shapes and orientation in space

C. An orbital is a path the electron follows around the nucleus of an atom

D. An electron in a given orbital is defined by four quantum numbers

19. Which of the following is correct about quantum numbers?

A. Magnetic quantum number describes the orientation of an orbital

B. Principal quantum number describes the size and energy of an orbital

C. Angular momentum quantum number describes the shape of an orbital

D. All of these

20. What is the total number of orbitals for n = 3, where n is the principal quantum number is_____

A. 18 B. 9 C. 4 D. 8

21. Maximum number of electrons in a subshell (s, p, d, f) can be determined by

A. $4l + 2$ B. $4l - 2$ C. $2l + 1$ D. $2n^2$

22. Which one of the following combination of quantum numbers is incorrect?

A. $n=6, l=0, m_l=+1$ B. $n=5, l=4, m_l=0$ C. $n=4, l=1, m_l=-1$ D. $n=3, l=4, m_l=0$

23. The idea of arranging the elements in the periodic table according to their atom number is attributed to

A. Moseley B. Mendeleev C. Bohr D. Ra

24. Which two periods in the periodic table have the same number of elements?

A. 2 and 4 B. 3 and 4 C. 4 and 5 D. 5 and 6

25. Elements in a group in the periodic table can be expected to have similar

A. Atomic masse B. Atomic numbers C. Number of shells D. Number of valence

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Part II. Work out questions (12 pts)

Answer the following questions correctly and write your answers on the answer sheet

1. Using the Bohr model, calculate the lowest possible energy, in joules, for the electron in the Li^{2+} ion (Z of Li = 3) (2pts)

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2. Write the net ionic equation for the following reactions: (4pts)

   A. $K_2CO_3\,(aq) + 2HBr\,(aq) \rightarrow 2KBr\,(aq) + CO_2\,(g) + H_2O\,(l)$

   B. $BaCl_2\,(aq) + K_2SO_4(aq) \rightarrow BaSO_4\,(s) + 2KCl(aq)$

3. *The decomposition of solid barium nitrate leads to the formation of solid barium Oxide, diatomic nitrogen gas, and diatomic oxygen gas. Write the balanced chemical equa for the reaction.(2pts)*

4. *Balance the following chemical equation correctly (2pts)*

   $CuCl_2\,(aq) + Al\,(s) \rightarrow Al\,Cl_3(aq) + Cu(s)$

5. Calculate the mass of oxygen gas, O_2, consumed from the air in the combustion of 22 of octane, C_8H_{18}, one of the principal components of gasoline, according to the ch equation :

   $$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O\ (2\ pts)$$

   (Molar mass (g/mol): $C_8H_{18} = 114.23$, $O_2 = 32$)

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Wolkite Biology

I. **Matching: Match column "A" with column "B". (1 pt. each)**

Column "A"	Column "B"
1. Time interval between initial infection and first appearance of signs and symptoms C	A. Period of decline
2. Characterized by appearance of first mild signs and symptoms B	B. Prodromal period
3. All disease signs and symptoms apparent E	C. Incubation period
4. Body returns to pre diseased state, health is restored F	D. Latent period
5. Signs and symptoms decrease A	E. Period of illness
	F. Period of convalescence

II. **Multiple Choices: Choose the correct answer from the following alternatives. (1 pt. each)**

1. Who is considered as the father of modern taxonomy?
   A. Linnaeus
   B. Aristotle
   C. Lamarck
   D. Theophrastus
2. A change in body function that is felt by a patient as a result of disease is known as _____.
   A. Sign
   B. Symptom
   C. Latent
   D. Syndrome
3. The process of DNA replication that one old strand and one new strand to form double helix are called _____.
   A. Conservative
   B. Dispersive
   C. Semi-descriptive
   D. Semi-conservative
4. In competitive inhibition, inhibitors bears a close structural similarity with the
   A. Co-factor
   B. Co-enzyme
   C. Substrate
   D. Prosthetic group
5. Which one of the following statement is **false** about innate immunity
   A. It has no memory
   B. It is first line of defense
   C. It acquired after infection
   D. It is natural
6. Disease that occurs occasionally in a population is known as _____.
   A. Sporadic disease
   B. Endemic disease
   C. Pandemic disease
   D. Epidemic disease

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7. From the following enzymes, which one is involve in the breakdown of the H-bonds to reveal two single strands and unwind (open) the helix of DNA?

A. Topoisomerase
C. DNA helicase
B. DNA Polymerase
D. DNA ligase

8. Enzyme acts best at a particular temperature called

A. At normal body temperature
C. Minimum temperature
B. Catalytic temperature
D. Optimum temperature

9. A pathogen that causes disease only when body's innate or adaptive defenses are compromised

A. Secondary pathogen
C. Latent pathogen
B. Primary pathogen
D. Opportunistic pathogen

10. The correct sequence from the most to the least comprehensive of the taxonomic levels listed here is_____

A. Domain, Kingdom, Phylum, Order, Class, Family, Genus, and Species.
B. Domain, Family, Phylum, Class, Kingdom, Order, Species, and Genus.
C. Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species.
D. Domain, Phylum, Kingdom, Order, Class, Species, Family, and Genus.

11. A definite charge bearing site of an enzyme on which a chemical substance attaches itself is called

A. Available site
C. Allosteric site
B. Active site
D. Catalytic site

12. The assembling of free DNA nucleotides into new strands alongside each of the template strands is _____.

A. DNA polymerase
C. Topoisomerase
B. DNA helicase
D. DNA ligase

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13. A disease that is easily spread from one host to another host

A. Contagious disease
C. Non-communicable disease
B. Communicable disease
D. Non Contagious disease

14. An enzyme brings about:

A. Reduction in activation energy
C. Increase in activation energy
B. Increase in reaction time
D. Do not bring change on reactant

15. International Code of Zoological Nomenclature (ICZN) is associated with nomenclature of

A. Plants
C. Cultigens
B. Animals
D. Bacteria

16. Aerobic respiration has three stages where reactions occur between free-moving enzymes and substrates. Which line of the table shows the correct location of each stage?

	Glycolysis	link reaction	Krebs cycle
A	Cytoplasm	Cytoplasm	cytoplasm
B	Cytoplasm	mitochondrial matrix	mitochondrial matrix
C	mitochondrial matrix	Cytoplasm	cytoplasm
D	mitochondrial matrix	mitochondrial matrix	mitochondrial matrix

17. How does chemiosmosis lead to ATP synthesis?

A. Hydrogens diffuse from the intermembrane space to the stroma through ATPase.
B. Hydrogens jump from the inner membrane to the outer membrane and out through ATP synthase.
C. Hydrogen ions diffuse from the intermembrane space to the matrix through ATP synthase.
D. Protons are pumped from the matrix to the intermembrane space through ATP synthase.

18. What is the type given to a duplicate specimen of original type?

A. Syntype
C. Neotype
B. Isotype
D. Holotype

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19. From the following, which one does not increase the rate of mutations?

A. Ultraviolet radiation
C. Alcohol
B. Chemical in tobacco smoke
D. X- ray

20. In the final stage of the electron transport chain, what does hydrogen ions and electrons combine with to form water?

A. ATP synthase
C. Carbon
B. Oxygen
D. Carbon dioxide

21. Which one of the following is an example of type II hypersensitivity

A. Allergic asthma
C. Rhesus Incompatibility
B. Atopic dermatitis
D. Anaphylaxis

22. Which stage of respiration generates most ATP?

A. The link reaction
C. Oxidative phosphorylation cycle
B. Glycolysis
D. Krebs

23. Classification of organism deals with

A. Arranging organisms into hierarchy of ranks or categories
B. Identification of organisms or specimen by reference
C. Naming of groups of organisms
D. Arranging organisms in herbaria and museums

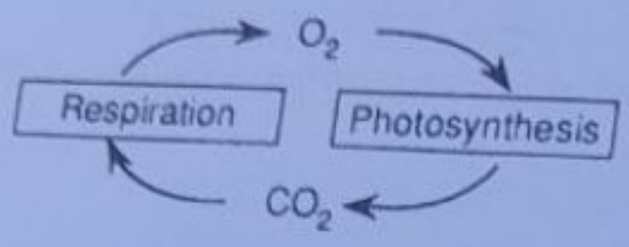
24. From the following Aneuploidy chromosomal mutation, which one causes the Down''s syndrome?

A. 2n+1+1 = double trisomy- 48 chromosomes
B. 2n-1 = monosomics –45 chromosomes
C. 2n-2 – nullisomic – 44 chromosomes
D. 2 n+1 = trisomy/47 chromosomes

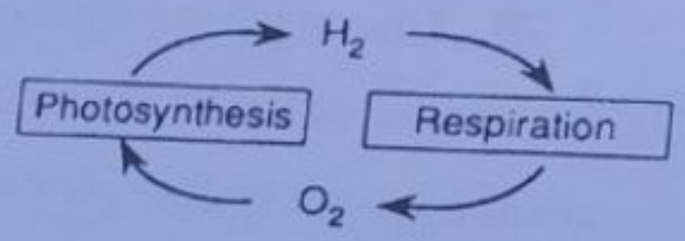
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25. Which of the following diagrams represents the correct cycling of gases?

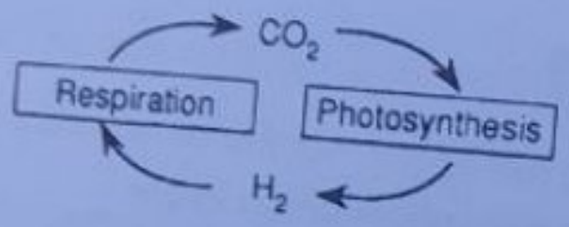
A.



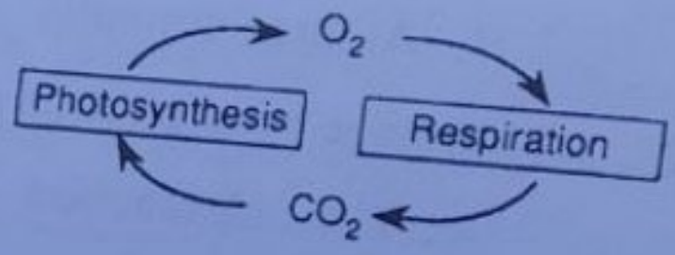
C.



B.



D.



26. Phylogenetic classification system differs from a natural system in its stress on

A. Physiological characters
B. Anatomical facts
C. Origin and evolutionary trends
D. Morphological character

27. Which of the following is the correct way of writing scientific name?

A. *Escherichia Coli*
B. *Escherichia coli*
C. *escherichia Coli*
D. *escherichia coli*

III. Filling the Blank (1 pt. each)

1. The bond that joins substrate and enzyme is called Allostric bond.
2. The modern classification system of diversified organisms is depending up on the combined evidence of morphological, Embryology and Intrinsitive.
3. The sum of all of the chemical reactions occurring in a cell is called Respiration.
4. The fraction of a population that contracts a disease during a specific time is Incidence
5. One particular section of a DNA molecule that tells a cell to perform one specific task is Gene.

13/8
18/17
48

6 morphology
Intrinsitive
DNA, RNA.
Embryology
HOMO SPIENCE

IV. **Short Answer: Ansewr the following questions accordingly.**

1. In the nucleic acid, all nucleotides have three sections with different functions. Mentioned them clearly (**1 Pt.**) phosphate group. Sugar (Pentose) group Nathrogenase base
2. What are the 5 categories of modern taxonomic classification system? (**1 Pt.**)
3. Clearly state the deference between competitive inhibitor and noncompetitive inhibitors of enzyme (**1.5 Pt.**)
4. Describe the main events during the protein synthesis. (**1 Pt.**)
5. Compare and contrast the following couple terms (**1.5 Pt.**)
   A. Cell-mediated immunity vs Antibody-mediated immunity
   B. Immunodeficiency vs Hypersensitivity

V. **Essay.**

1. Briefly discuss about the Origin of Autotrophy with their three consecutive lines of evolution of organisms on earth. (**2 Pt.**)
2. Calculate the net actual energy, reduced NAD and reduced FAD produced from glycogen having 24 carbons in glycolysis, link reaction, Krebs cycle and electron transport chain (8 points). (Show the necessary steps). (**2.5 Pt.**)
3. Briefly discuss how and when Rh incompatibility occurs with its treatment mechanism. (**2.5 Pt.**)

Examclass

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ExamClass

12. C The first concept of immunity was developed by _____
   A. Louis Pasteur
   B. Robert Koch
   C. Edward Jenner
   D. Francisco Redi

13. B Which molecules are responsible for bringing the correct amino acid to the mRNA in the process of translation
   A. Ribosomal RNA
   B. Transfer RNA
   C. Messenger RNA
   D. All of the above

14. A In which of the following models the enzymes change their shape as the substrate approaches?
   A. Lock and key
   B. Induced fit
   C. Both are correct

15. D What is the main role of Genetic engineering?
   A. To produce disease resistant plants
   B. To produce Vaccines
   C. To increase productivity
   D. All of the above

16. D Which of the following risk factors are responsible for metabolic disorder?
   A. Kidney failure
   B. Obesity
   C. Diabetes
   D. All of the above

17. C Which of the following 'Enzyme class' is involved in cleaving a molecule by nonhydrolytic process?
   A. Hydrolases
   B. Ligases
   C. Lyases
   D. All of the above

18. C _____ occurs as result of interaction between pathogenic microbes and the host.
   A. Metabolic disorder
   B. Immune disorder
   C. Infectious disease
   D. Autoimmunity

19. C The first line defender of our body is _____
   A. Adaptive immunity
   B. Specific immunity
   C. Innate immunity
   D. Acquired immunity

20. C A disease that occurs occasionally in a population is_____
   A. Endemic disease
   B. Pandemic disease
   C. Sporadic disease
   D. Acute disease

21. B One of the following is NOT true about DNA?
   A. DNA structure is double helix
   B. DNA structure is single strand
   C. DNA is antiparallel
   D. DNA replicate semi-conservatively

Jimma Biology

By: Examination committee for Freshman students Semester II May 2013 EC

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22. B' Where does electron transport chain and chemiosmosis take place in the cell?

A. In mitochondrial matrix
B. On inner mitochondrial membrane
C. In cytoplasmic fluid
D. On outer mitochondrial membrane

23. D If a woman with blood group 'B' married to a man with blood group 'AB', their offsprings will have _____

A. Blood group A
B. Blood group B
C. blood group AB
D. all of the above

24. C During immune response, the adaptive, the innate immune cells, and the other body cells communicate by _____

A. Complement proteins
B. Immunoglobulin
C. Cytokines
D. Granulocytes

25. C Which of the following cells are NOT a part of the innate immunity?

A. Natural killer cells
B. T and B lymphocytes
C. Macrophages
D. Phagocytes

II. Write 'TRUE' if the statement is correct, if not write 'FALSE' on the space provided

1. TRUE The alteration of the nucleotide sequence of genome of an organism causes mutation.
2. FALSE Mitosis and meiosis are the two major events of cell division in prokaryotes.
3. FALSE Inborn errors of metabolism disorder acquired from alcohol abuses.
4. FALSE Enzyme mediate chemical reactions in the living cells functions only for energy production.
5. FALSE Diabetes insipidus is the metabolic disorder acquired from fatty acids oxidation defect.
6. TRUE Immune system is composed of the same cell types, tissues, and organs.

5

III. Match the expression given under column 'B' to the type of hypersensitivities listed under column 'A'

'A'	'B'
1. C Hypersensitivity Type I	A. Antigen-Antibody/Immune-complex reaction
2. E Hypersensitivity Type II	B. Ag mediated allergic reaction
3. A Hypersensitivity Type III	C. IgE mediated immediate/allergic reaction
4. D Hypersensitivity Type IV	D. Delayed/Cell-Mediated reaction
	E. IgM/IgG mediated cytotoxic reaction

4

Jimma
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IV. Attempt the following questions following the given instruction to each

1. State at least three Mendel's conclusion on his pea plant experiments? (3)

2. Distinguish (3)
   a. Infection and disease
   b. primary and secondary infections

3. List the steps those a pathogen must accomplish to cause infectious disease. (4)

4. State the events that take place during protein synthesis (5 pts.)

Jimma Jfirstyear(ab)

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sheet provided (1pt. each)?? **is correct and "FALSE" if the statement is incorrect**

1. Reduction processes always result in a decrease in the oxidation number of a species.
2. For all atoms of the same element, the 2s orbital is larger than the 1s orbital.
3. Weight by weight percentage expression is temperature independent.
4. The sum of oxidation numbers for all atoms in a neutral compound is zero.
5. An electron in a 3p orbital could have a value of 2 for its angular momentum quantum number.
6. Stoichiometry is the study of the relationship between the number of reactants used and the several products made in a chemical reaction.

Part II: Choose the best answer from the given alternatives and write your answer in the separate answer sheet provided (1.5 pts. each)?

7. What does NOT change when a solution is diluted by the addition of solvent?
   A. Molarity of a solution
   B. Number of moles of solute
   C. Mass of solvent
   D. Volume of solvent
8. Electromagnetic radiation with maximum wavelength is.
   A. Infrared
   B. Radio wave
   C. X-ray
   D.
9. In the reaction

$$SO_2 + 2H_2S \rightarrow 3S + 2H_2O$$

A. Sulfur is reduced and hydrogen is oxidized

B. Sulfur is reduced and there is no oxidation

C. Sulfur is both reduced and oxidized

D. Sulfur is oxidized and hydrogen is reduced

E. Sulfur is oxidized and there is no reduction

10. How many **grams** of the excess reactant is left over unreacted when 4.0 grams of NaOH are required to react with 7.2 grams of $CaSO_4$ to produce Na_2SO_4 and $Ca(OH)_2$ according to the equation given below. (Molar Mass of Na=23,O=16,H=1, Ca=40, and S=32)

$$NaOH + CaSO_4 \rightarrow Ca(OH)_2 + Na_2SO_4 \quad \text{(Unbalanced)}$$

A. 3.2 B. 0.02 C. 0.4 D. 0.2 E. 0.04

11. The lowest whole-number ratio of the elements in a compound is called the ____

A) Molecular formula
C) Empirical formula
B) Ionic compound
D) Representative formula

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12. The electrons, identified by quantum numbers n and *l*.

(i) $n = 4, l = 1$

(ii) $n = 4, l = 0$

(iii) $n = 3, l = 2$

(iv) $n = 3, l = 1$ can be placed in order of increasing energy, from the lowest to highest, as

A. (iii) < (i) < (iv) < (ii) C. (i) < (iii) < (ii) < (iv)

B. (ii) < (iv), (i) < (iii) D. (iv) < (ii) < (iii) < (i)

13. Suppose that 7.0 grams of NH_3 were reacted with 9.6 grams of oxygen to produce N_2 and of O_2 as the equation given below?(Molar mass of N=14, O=16 and H=1)

$NH_3(g) + O_2(g) \longrightarrow N_2(g) + H_2O(l)$ (Unbalanced)

Then, which one of the following is **true** about the reaction?

A) O_2 is the excess reactant and hence determines the amount of product.

B) O_2 is the limiting reactant and hence consumed first.

C) NH_3 is the excess reactant and hence determines the amount of product.

D) NH_3 is the limiting reactant and hence determines the amount of product.

14. The number of moles of sodium ion in 10 L of 0.4 M Na_2SO_4 is

A. 10 moles B. 8 moles C. 4 moles D. 0.4 moles

15. Which of the following terms are unitless?

A. Mass/Volume percent B. Molarity C. Mole fraction D. Molality

16. Bohr's model can explain

A. The solar spectrum

B. The spectrum of an atom or ion containing one electron only

C. The spectrum of the hydrogen molecule

D. The spectrum of hydrogen atom only

17. A beer is approximately 5 % ethanol (C_2H_5OH) by volume. Ethanol has a molar mass of 46 g/mol molar mass and a density of 0.789 g/mL. How many moles of beer are present in a 500 mL bottle of beer? (Molar mass: H = 1 g, C= 12 g, O = 16 g)

A. 0.42 moles B. 0.33 moles C. 0.11 moles D. 0.22moles

18. Balanced equation using redox balancing method

$FeS + MnO_4^- \longrightarrow Fe^{3+} + SO_4^{2-} + Mn^{2+}$ the stoichiometric coefficients of FeS and are in the ratio: MnO_4^-. (In acidic media)

A. 5 : 9 B. 5 : 8 C. 9 : 5 D. 8 : 5

19. Which one of the following represents an impossible arrangement?

A. $n = 5, l = 3, m_l = +3, m_s = +1/2$

B. $n = 4, l = 0, m_l = 0, m_s = +1/2$

C. $n = 3, l = 2, m_l = -3, m_s = +1/2$

D. $n = 3, l = 2, m_l = -2, m_s = +1/2$

20. Among the following, in which of the species is the oxidation number of an element has +6

A. CrO_2Cl_2 B. $Cr(CN)_6^{3-}$ C. NiF_6^{2-} D. MnO_4^-

21. The principal quantum number of an atom is related to the

A. Orbital angular momentum

B. Spin angular momentum

C. Orientation of the orbital in space

D. Size of the orbital

22. In which of the following transition, the wavelength is minimum:

A. $n = 2$ to $n = 1$ B. $n = 4$ to $n = 2$ C. $n = 3$ to $n = 1$ D. $n = 6$ to $n = 4$

23. One of the following ionic compounds are soluble in polar solvent water except

A. $BaSO_4$ B. $NaHCO_3$ C. NH_4NO_3 D. $Ca(NO_3)_2$

24. Consider a hypothetical reaction: $2A + B \rightarrow C$

Suppose 0.300 mol A and 0.200 mol B were allowed to react, but only 0.120 mol C was produced. Calculate the percent yield.

A. 75% B. 25% C. 80% D. 65%

25. A concentrated nitric acid solution sample has a density of 1.41 g/ml and contains 60 % HNO_3 by mass. The molarity in mole per liter of the solution and the mass of HNO_3 in gram per ml of the solution respectively are (Molar mass H= 1, N = 14, O = 16):

A. 43.4 and 84,600 B. 33.4 and 8460 C. 13.4 and 846,000 D. 23.4 and 846

26. In an oxidation-reduction reaction, the total number of electrons gained is

A. Unrelated to the total number of electrons lost

B. Equal to the total number of electrons lost

C. Greater than the total number of electrons lost

D. Less than the total number of electrons lost

27. What is the number of moles of NaOH solution is needed to prepare 4L of 0.5 M from 2M NaOH solution?

A. 3 moles B. 1 moles C. 0.5 moles D. 2 moles

28. The correct set of quantum numbers for the unpaired electron of chlorine atom is n, *l*, and m

A. 3,0 ,0,+1/2 B. 2,1,+1,+1/2 C. 3,1,+1,+1/2 D. 2,1,0,+1/2

29. How many aluminum atoms are there in 3.50 grams of Al_2O_3? (Molar Mass of Al=27 and O=16)

A. 1.68×10^{22} B. 5.0×10^{22} C. 2.07×10^{22} D. 4.13×10^{22}

30. A compound contains, by mass, 40.0% carbon, 6.71% hydrogen, and 53.3% oxygen. A 0.320 mol sample of this compound weighs 28.8 g. The molecular formula of this compound is: (Molar Mass of C=12, H=1, and O=16)

A. CH_2O B. $C_3H_6O_3$ C. C_2H_4O D. $C_2H_4O_2$

31. Compute the percentage by mass of carbon in a compound with the empirical formula C_3H_2O. (Hint: Molar Mass of C=12, H=1 and O=16)

A. 80.00% B. 40.00% C. 57.14% D. 28.57%

32. Which of the following is false about a mole?

A. Two different atoms have different number of atoms per mole.

B. We usually use mole for small particles like ions

C. It takes an Avogadro number of atoms to get 12.01 g of carbon atom

D. 1 mole of mobile phone is equal to Avogadro number of mobile phone

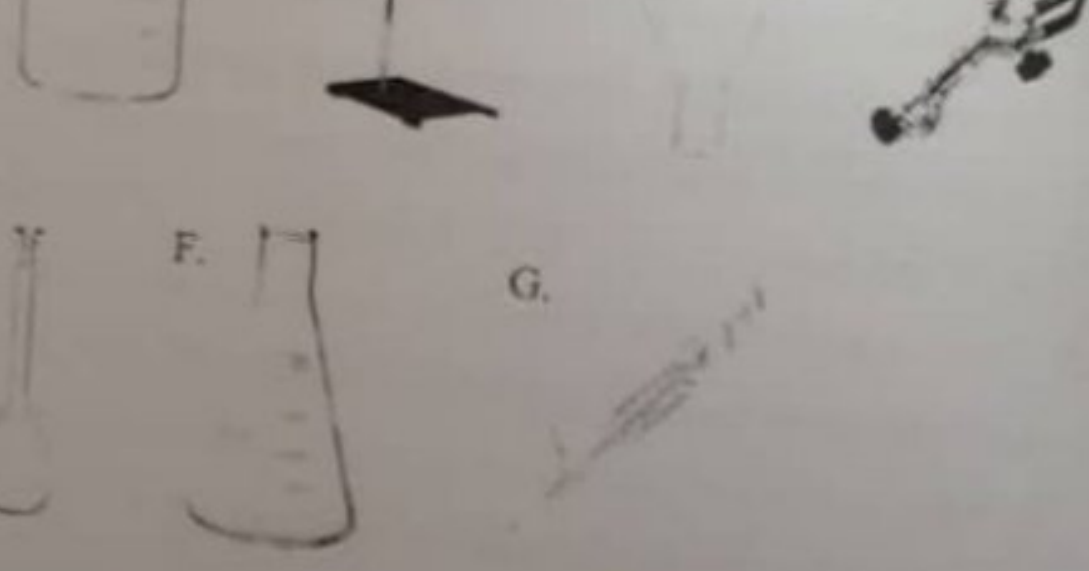
Part III: Match the name in coloumn 'A' with the apparatus in coloumn 'B' (1pt each).

Column "A"

33. Steamless Funnel
34. Condenser
35. Beaker
36. Erlenmeyer Flask
37. Stand and bas

Column "B"

A. B. C. D.



E. F. G.

General chemistry mid-exam for summer I students, August 26, 2021 (30%); time = 60 min

Necessary information:

Avogadro's number $= 6.02 \times 10^{23}$

Atomic mass of: $H = 1\ g$, $C = 12\ g$, $O = 16\ g$, $Na = 23\ g$, $Al = 27\ g$ *and* $Cl = 35.5\ g$

Choose the correct answer among the given alternatives and write the letter of your choice on the space provided at the last page (1.5 pts. each).

1. Which one of the following statement is true about a scientific theory?
   A. A well-tested explanation for the observations
   B. The procedure that is used to test the hypothesis
   C. It is a proposed explanation; based on previous knowledge
   D. It summarizes a vast number of experimental observations
2. Which one of the following is the microscopic domain of chemistry?
   A. Humidity
   B. Solubility of solute
   C. Electrons and protons in an atom
   D. All of them
3. Which state of matter is incompressible, and has fixed volume and definite shape?
   A. Solid B. Gas C. Liquid D. Plasma
4. Which one is a chemical change?
   A. Rusting of iron
   B. Melting of copper
   C. Hardness of alloys
   D. Electrical conductivity of silver
5. All of them are intensive properties of matter **except**:
   A. Color
   B. Volume
   C. Density
   D. Temperature
6. In the following measurements, which one has **four** significant figures?
   A. 0.0540
   B. 1.0301
   C. 5.0010
   D. 7.301
7. One of the following statements is **not** the postulate of Dalton's atomic theory.
   A. Atoms of different elements have different properties
   B. Atoms of an element are identical in mass and other properties
   C. Atoms of one element can be changed in to atoms of another element
   D. Compounds result from the chemical combination of atoms of different elements

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8. Sulfur forms two compounds with Fluorine. In one of them, it is observed that 0.447 g of Sulfur is combined with 1.06 g of Fluorine; in the other, 0.438 g of Sulfur is combined with 1.56 g of Fluorine. This illustrates:
   A. The law of triad
   B. The law of definite proportions
   C. The law of conservation of mass
   D. The law of multiple proportions
9. Analysis of a sample of a covalent compound showed that it contained 14.4% hydrogen and 85.6% carbon by mass. What is the empirical formula for the compound?
   A. CH B. CH_2 C. CH_3 D. C_2H_3
10. In **question number 9**, what would be the molecular formula of the compound if its molecular mass is 52 g/mol?
   A. CH_4 B. C_2H_2 C. C_2H_4 D. C_3H_6
11. A chemical change is accompanied by:
   A. Energy change
   B. Formation of new substances
   C. Change in chemical properties
   D. All of the above
12. What volume of 10.0 M H_2SO_4 is required to prepare 4.0 L of 0.50 M H_2SO_4?
   A. 0.20 L B. 0.40 L C. 0.50 L D. 1.0L
13. How many aluminum atoms are there in 3.50 grams of Al_2O_3?
   A. 4.13×10^{22}
   B. 4.90×10^{22}
   C. 2.07×10^{22}
   D. 1.68×10^{22}
14. The chemical formula of sodium carbonate penta hydrate is:
   A. $NaCO_3.5H_2O$
   B. $Na_2CO_3.5H_2O$
   C. $Na_3CO_3.5H_2O$
   D. $Na_3CO_2.5H_2O$

Examclass

15. A sample of matter has constant composition and properties. In addition, it cannot be separated into other substances by chemical means. This sample is probably a/an:
   A. Element
   B. Compound
   C. Homogeneous mixture
   D. Heterogeneous mixture

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General chemistry mid-exam for summer I students, August 26, 2021 (30%); time = 60 min

16. The two isotopes of copper, ^{63}Cu (69.17%) and ^{65}Cu (30.83%), are 62.929599 amu and 64.927793 amu, respectively. What is the average atomic mass of copper?

A. 63.54 B. 64.56 C.· 62.67 D. 65.0

17. Which of the following is a binary acid?

A. HF B. HNO_3 C. H_2SO_4 D. H_3PO_4

18. What is the molarity of a solution that is formed by dissolving 6.75 g of NaCl in water to make a solution with a total volume of 452 mL?

A. 0.125 M
B. 0.356 M
C. 0.256 M
D. 0.456 M

19. In his oil drop experiment, Robert Millikan:

A. Discovered a neutron
B. Discovered a proton
C. Discovered an electron
D. Calculated the mass of an electron

20. The solution of simple sugar in water is 25% fructose by weight, and has a density of 1.082 g/mL. How many grams of fructose are there in 50 mL of this solution?

A. 11.5 g B. 27 g C. 13.5 g D. 7.5 g

Name: _____ **ID. No:** _____

Answer Key

1. ___	5. ___	9. ___	13. ___	17. ___
2. ___	6. ___	10. ___	14. ___	18. ___
3. ___	7. ___	11. ___	15. ___	19. ___
4. ___	8. ___	12. ___	16. ___	20. ___

Good Luck!!

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23. A biological molecule of the plasma membrane which plays essential role in maintaining fluidity, flexibility and stability of the lipid membrane is

A. cholesterol
B. carbohydrate
C. cytoskeleton
D. Na+-K+ pump

24. If the function of a cellular organelle is sorting, modification, and packaging of synthesized proteins, then this organelle must be a

A. Smooth ER B. Ribosome C. Rough ER D. Golgi body

25. Which of the following organelles have their own DNA?

A. Lysosomes and peroxisomes
B. Smooth end Rough ER
C. Mitochndria and chloroplast
D. Golgi body and ribosomes

26. What are the two main parts of the plasma membrane?

A. Phospholipids and cholesterol
B. Proteins and carbohydrates
C. Carbohydrates and cholesterol
D. Phospholipids and proteins

27. The internal skeleton of a cell is composed of

A. Microfilaments, microtubules, and intermediate filaments
B. Intermediate filaments and cellulose
C. Centrioles, microtubules, and cellulose
D. Microfilaments and centrioles

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45. What are the possible causes of metabolic disorders?

A. Age
B. Family history of genetic metabolic disorder
C. Obesity and lack of exercise
D. All

Short Answer

1. _____ is a process for experimentation which is used to explore observations and give answers to research questions.
2. List three major characteristics of living things
3. Write down three steps used in the scientific method.
4. What are the three types of RNA involved in protein synthesis?
5. Mention the three components of a nucleotide.
6. What do you call fatty acids that have at least one double bond in their hydro-carbon chain?
7. Based on their solubility, vitamins are classified as _____ and _____
8. Write two functions that minerals have in living organisms.
9. Mention two physiological and structural functions of lipids in living cells.
10. Monosaccharides that have the aldehyde functional group are classified as _____
11. _____ is part of the nucleus where ribosomes are synthesized.
12. What are the two unique features of mitochondria?
13. _____ is a kind of enzyme inhibition in which the inhibitor binds on a site other than the active site.
14. What do you call the mechanism of transport of polar molecules or ions according to a concentration gradient (downhill) using carrier molecules but with no expenditure of energy?
15. What is endocytosis?

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28. A form of diffusion in which there is a net movement of water down its concentration gradient through a selectively permeable membrane is called

A. Simple diffusion B. Facilitated diffusion C. Active transport D. Osmosis

29. Which of the following statements is correct?

A. Facilitated diffusion uses proteins to transport molecules across the cell membrane
B. In active transport, substances move from an area that is more concentrated to less concentrated
C. In passive transport, substances move from an area that is less concentrated to more concentrated
D. Passive transport requires energy while active transport does not

30. Which of the following transport processes across the plasma membrane are correctly matched with the mechanisms of transport? Movement of

A. Water along concentration gradient ------- passive diffusion
B. Na+ along concentration gradient ---------- active transport
C. Water along concentration gradient -------- facilitated diffusion
D. Na+ against concentration gradient -------- passive diffusion

31. Which transport mechanism is used to transport charged and polar molecules along a concentration gradient?

A. Passive diffusion C. Bulk transport
B. Active transport D. Facilitated diffusion

32. A cell containing sodium ions at a concentration of 0.05 mM was kept in a 0.005 mM of sodium solution. If more sodium ions happen to enter into the cell, the mechanism used must have been

A. diffusion B. osmosis C. active transport D. exocytosis

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39. What is the name of the glycolytic enzyme that converts dihydroxyacetone phosphate (DHAP) to lyceraldehydes-3-phosphate (GAP)?

A. Hexokinase
B. Trios phosphate isomerase
C. Aldolase
D. Enolase

40. Which of the following occurs in both photosynthesis and cellular respiration?

A. Calvin cycle
B. Chemiosmosis
C. Glycolysis
D. Krebs cycle

41. Where exactly in the cell does the electron transport chain occurs?

A. Cytoplasm
B. Inner membrane of the mitochondria
C. Matrix of the mitochondria
D. Ribosome

42. The synthesis of ATP using the process of chemiosmosis takes place during which phase of respiration?

A. Glycolysis B. TCA cycle C. Electron transport chain D. Biosynthesis

43. NADPH2 and ATP produced by the light-dependent reactions are used to reduce

A. Carbon Monoxide
B. Hydrogen
C. Carbon Dioxide
D. Oxygen

44. What is the fluid-filled space of chloroplasts that contains enzymes for the light-independent reactions of photosynthesis?

A. Thylakoid
B. Grana
C. Matrix
D. Stroma

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33. Which of the following is least likely to cross a cellular membrane by simple diffusion?

A. carbon dioxide B. potassium ion C. oxygen D. steroid hormone

34. Categories of enzymes that have two components which are a protein and a cofactor are called

A. Simple enzymes
B. Conjugate enzymes
C. Isozymes
D. Metallo-enzymes

35. Increasing the substrate concentration increases the reaction rate. But this effect stops at some point and reactions proceed at a constant rate beyond this point. This is due to

A. Reduced efficiency of the enzyme
B. Competition between substrate molecules
C. Saturation of all available enzymes
D. Reduced kinetic energy of substrate molecules

36. Glycolysis occurs in which part of the cell?

A. Inner membrane of the mitochondria
B. Matrix of the mitochondria
C. Cytoplasm
D. Ribosome

37. Organisms that acquire energy through photosynthesis are called

A. Photoautotrophs
B. Chemoautotrophs
C. Heterotrophs
D. Saprotrophs

38. Which of the following occurs during the Krebs cycle?

A. FADH2 accepts two electrons in order to form FAD.
B. NAD^+ is reduced to form NADH.
C. Pyruvate is converted into acetyl-CoA.
D. Acetyl-CoA combines with oxaloacetate to release NADH

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16. Write two factors which affect the rate of diffusion of molecules across the plasma membrane using carrier mediated transport?

17. _____ class of enzymes catalyze reactions involving formation of carbon and other bonds with energy from ATP.

18. _____ is the sum of cellular activities that breakdown large molecules to release energy and synthesize building materials from smaller ones.

19. Enzymes speed up chemical reactions by decreasing the _____ energy of reactions.

20. The light-dependent reactions of photosynthesis are important because they produce _____ and _____ that are used as raw materials for the light-dependent reactions.

_____ END _____

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Addis Ababa University
Department of Chemistry

Fundamentals of Organic Chemistry (Chem.1041) – MidExam

Name: [redacted] **ID. No.** [redacted]

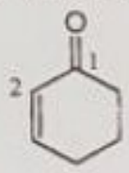
Date: Feb. 03, 2021
Time allowed: 2:00
Total point: 45%

General Instruction:

I. **Answer all questions in the space provided for each question.**
II. **No extra paper is allowed. You can use the back side of the question paper for rough work.**

I. Multiple choices Item (1 point each)
Choose the best answer from the given alternative and write your answer on the space provided

B 1. What is the hybridization of C-1?



a) sp^3 b) sp^2 c) sp d) sp^2d

B 2. Which of the following alkene shows cis –trans isomerism?

a) 1-Butene b) 3-Hexene c) 2-methylpropene d) 2-methyl-2-butene

A 3. Which of the following statements is not correct?

a) a pair of enantiomeric compounds have identical direction optical rotations.
b) a pair of enantiomeric compounds have the same melting point.
c) a pair of enantiomeric compounds have the same solubility.
d) a pair of enantiomeric compounds have the same functional groups.
e) None

D 4. If a given chiral molecule has an absolute configuration of R, which direction does it rotate the plane polarized light?

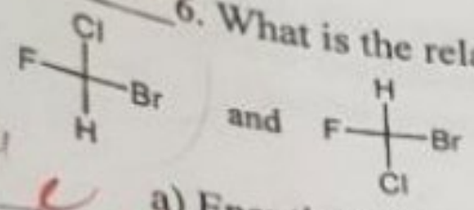
a. Clockwise (dextrorotatory)
b. Counterclockwise(leorotatory)
c. It does't rotate the plane of polarized light
d. Can't be determined from the information given
e. None

C 5. Which of the following molecule would you expect has zero degree of rotation of plane polarized light?

a) 1-chloroethanol b) 2-chlorobutane c) acetic acid d) 2-butanol e) none

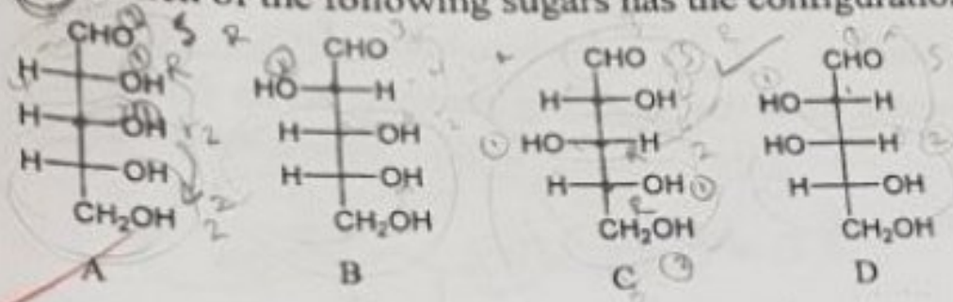
Examclass

6. What is the relationship between the following pairs of compounds?



a) Enantiomers b) diastereomers c) meso d) identical

7. Which of the following sugars has the configuration (2S, 3R, 4R)?

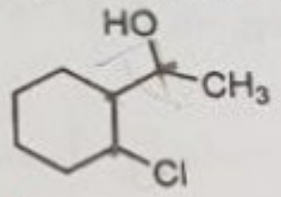


A B C D

8. Which of the following can exist in *Meso* form?

a) 2,3- dimethyl butane c) 2,3-dibromobutane
b) 3-methyl-2-butanol d) a and c e) none

9. What is the maximum number of possible stereoisomersfor the following molecule?

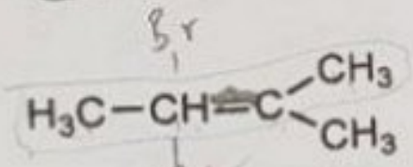


a) 2 b) 4 c) 16 d) 8 e) None

10. Which of the following cycloalkane has no ring strain?

a) Cyclopropane b) Cyclobutane c) Cyclohexane d)Cyclopentane
e) none

11. What is the major product in the following reaction?



a) 2-Bromo-2-methylbutane c) 3-Bromo-2-methylbutane
b) 2-Bromo-3-methylbutane d) 3-Bromo-3-methylbutane

12. Which type of substitution reaction pass through the formation of carbocation?

a) S_N2 b) S_N1 c) both d) none

13. Which of the following alkylhalide favored SN2 reactions?

a) 3° alkyl halide b) 2° alkyl halide c) 1° alkyl halide d) none

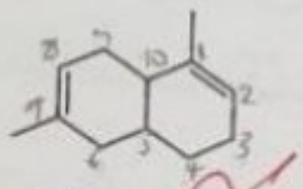
14. Which of the following is true about Markovnikov's rule in the addition of HX to an alkene?

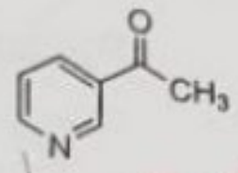
a) the halide adds to the carbon bearing a greater number of H- atoms
b) H- atoms adds to the carbon bearing a greater number of H-atoms
c) H- atoms adds to the carbon bearing a smaller number of H-atoms
d) a and b

Part II. Short answer

Answer the following questions on the space provided

1. Find the molecular formula for the following structures. (2pts)

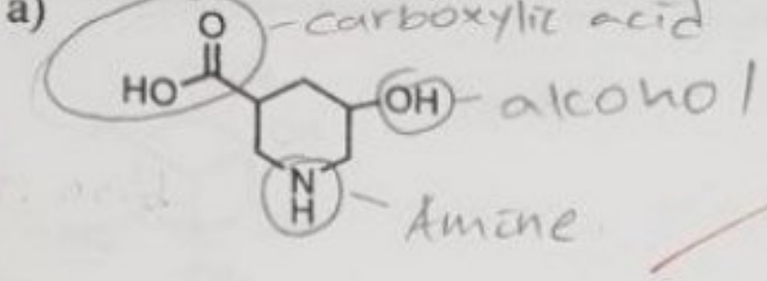
a) 

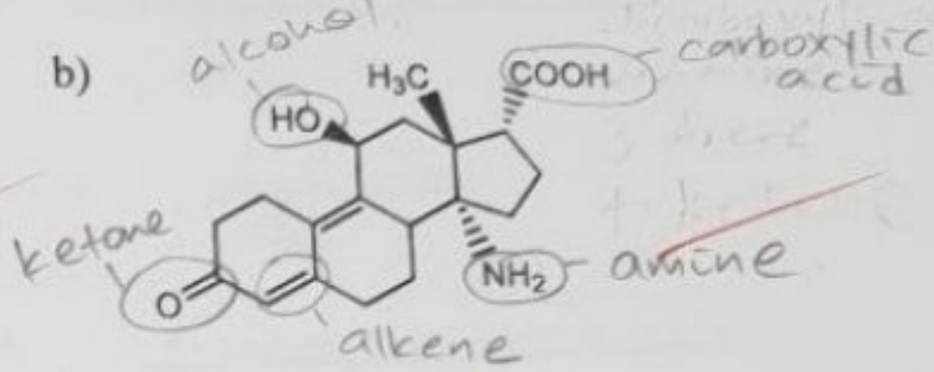
b) 

c) 

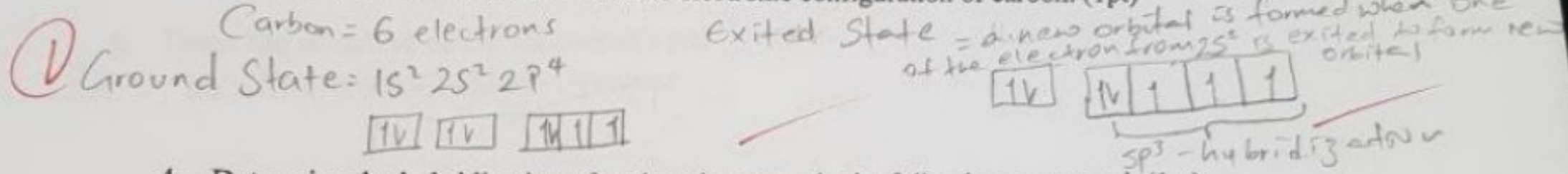
d) 

2. Identify all the functional groups in each of the following compounds (*indicate by Circling each functional group*) (2pts)

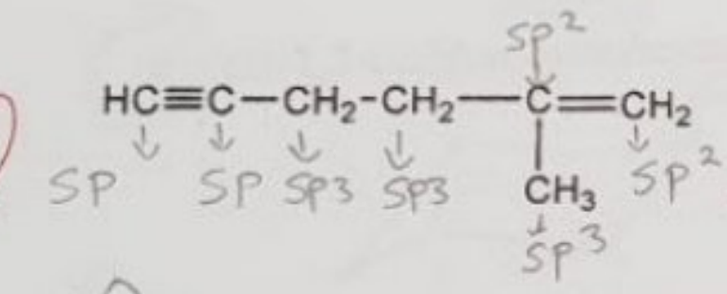
a) 

b) 

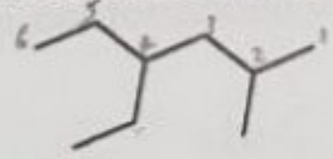
3. Write the ground state and exited state electronic configuration of carbon. (1pt)

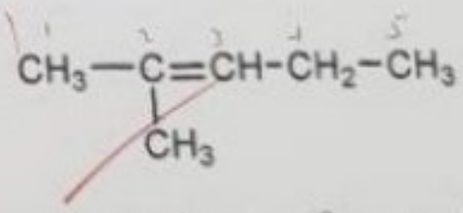


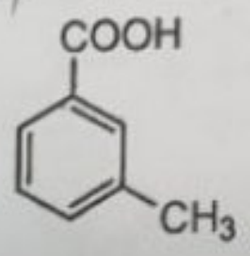
4. Determine the hybridization of each carbon atom in the following compound. (1pt)

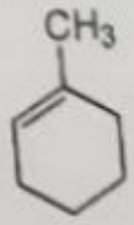


5. Write the **IUPAC** names of the following compounds. (5 pts)

a) 

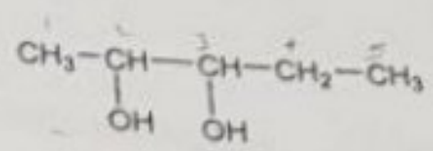
b) 

c) 

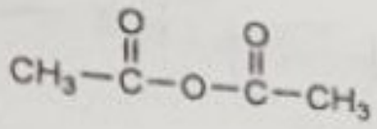
d) 

e) 

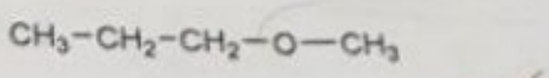
Bicyclic[4.4.0]cyclodecane

f) 

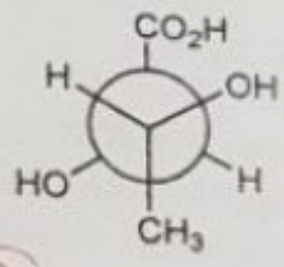
2,3-pentanediol

g) 

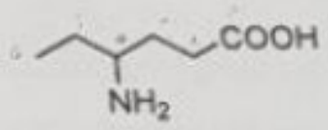
diacethyl ether / diethyl anhydride ether

h) 

Methoxy ethyl ether

i) 

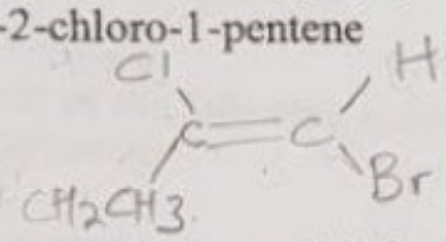
(2S,3R)-2,3-dihydroxybutanoic acid

j) 

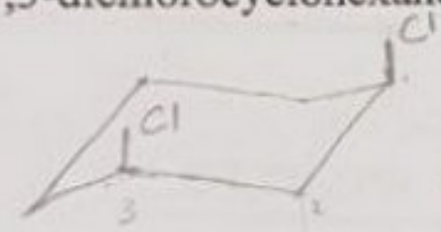
4-amino-hexanoic acid

6. Draw the structure of the following(3 pts)

a) (*E*)-1-bromo-2-chloro-1-pentene



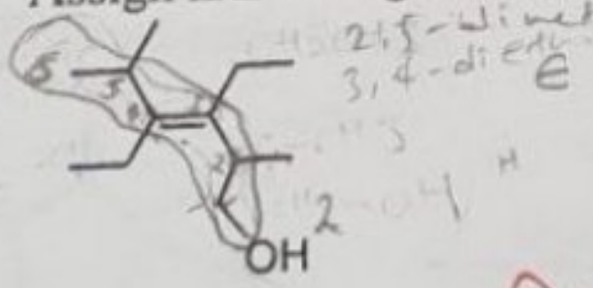
b) *cis*-1,3-dichlorocyclohexane (chair conformation)



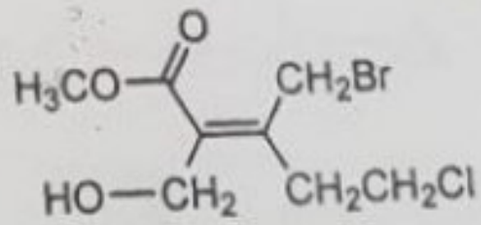
c) anti-conformation of butane.



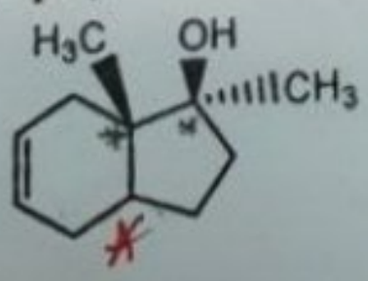
7. Assign E/Z configuration (1 pts)

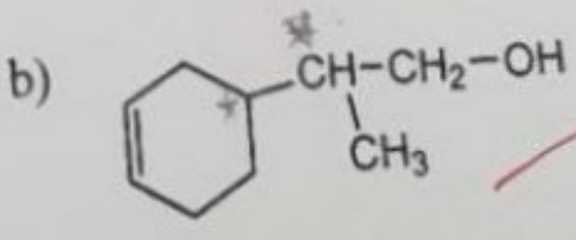
a) 

3,4-diethyl-2,5-dimethyl-3-hexen-1-ol

b) 

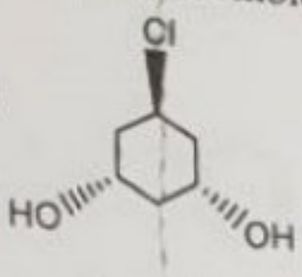
8. How many chiral centers are there in the following compound?Place an asterisk (*) to each chiral center (2 pts)

a) 

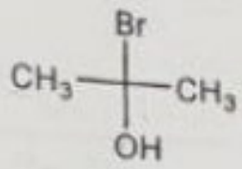
b) 

CamScanner

9. Label each molecule as **Chiral, Achiral or meso**. (2pt)

a) 

Meso

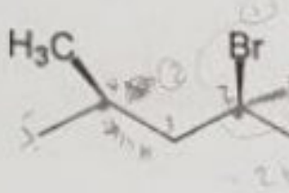
b) 

Achiral

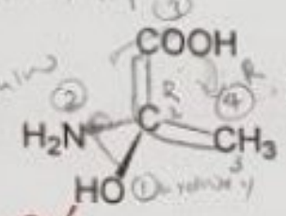
c) 2,4-dimethylheptane — chiral

d) 2-Pentanol — chiral

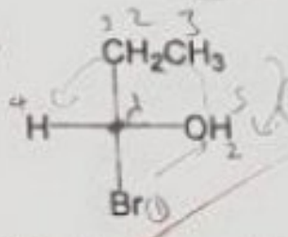
10. Assign **R** or **S** configuration for the following compounds. (2pt)

a) 

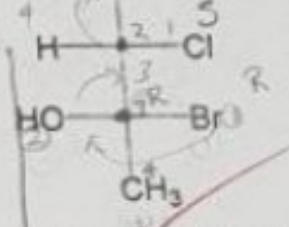
(2S)-2-bromo-4-methyl pentane

b) 

(2S)-2-amino-2-hydroxy propanoic acid

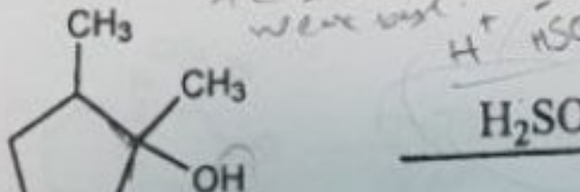
c) 

(R)-1-bromo-1-propanol

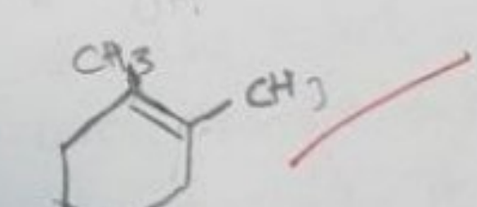
d) 

(2S,3R)-3-bromo-2-chloro-3-hydroxy butanal

11. What is the relationship between each or the following pairs of compounds? (identical, enantiomeric, diasteriomeric, none) (1pt)

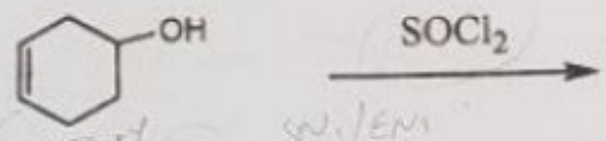
a) 

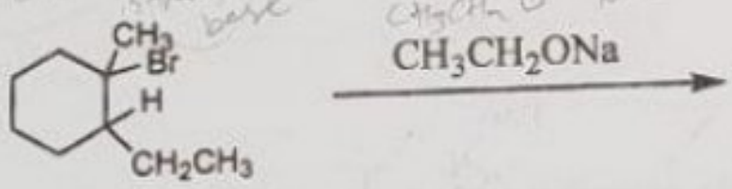
Enantiomeric

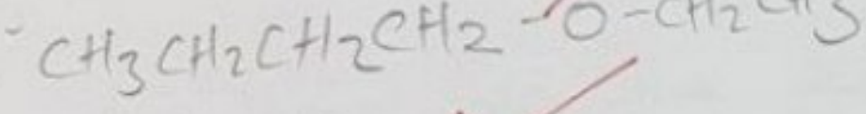
b) 

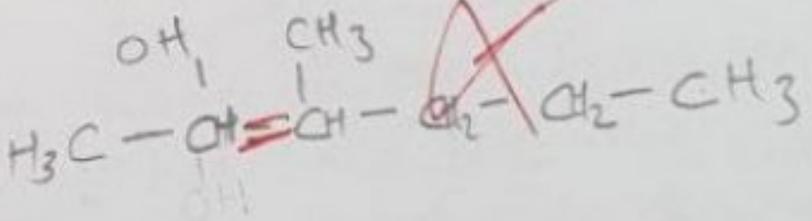
Diasteriomeric

Part III: Find the product of the following reaction. Write only the major product when more than one product possible (0.5pt each)

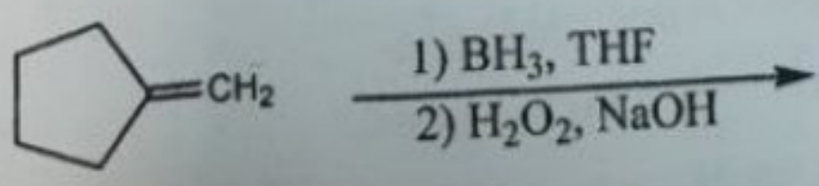
1. 

2. 

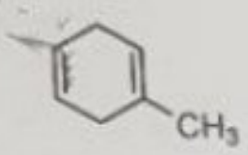
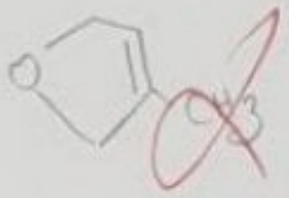
3. $CH_3CH_2CH_2CH_2Cl \xrightarrow{CH_3CH_2ONa}$ 

4. 2-Bromo-3-methylhexane $\xrightarrow{KOH}$ 

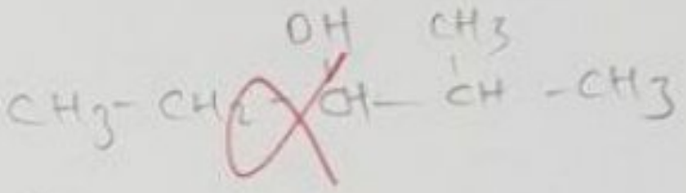
5.

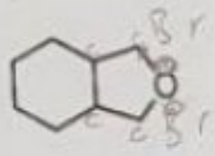
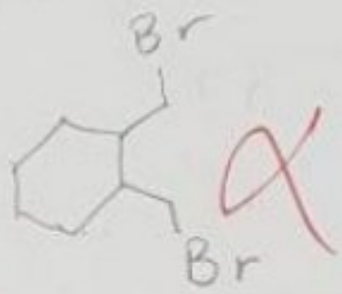
6. 

CamScanner

7.  $\xrightarrow[Zn,\ H^+]{O_3}$ 

8. $CH_3-CH_2-O-CH_3 \xrightarrow{HCl}$ $CH_3-CH_2-Cl + CH_3-OH$

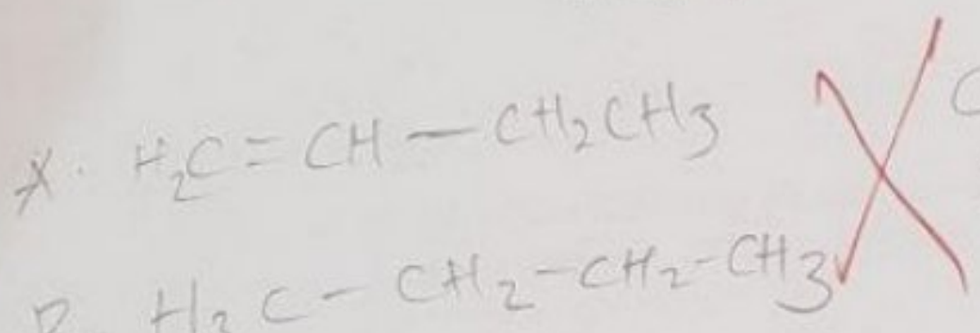
9. 2-Methyl-2-pentene $\xrightarrow[cold,\ H_2O]{KMnO_4,\ OH^-}$ 

10.  $\xrightarrow{HBr}$ 

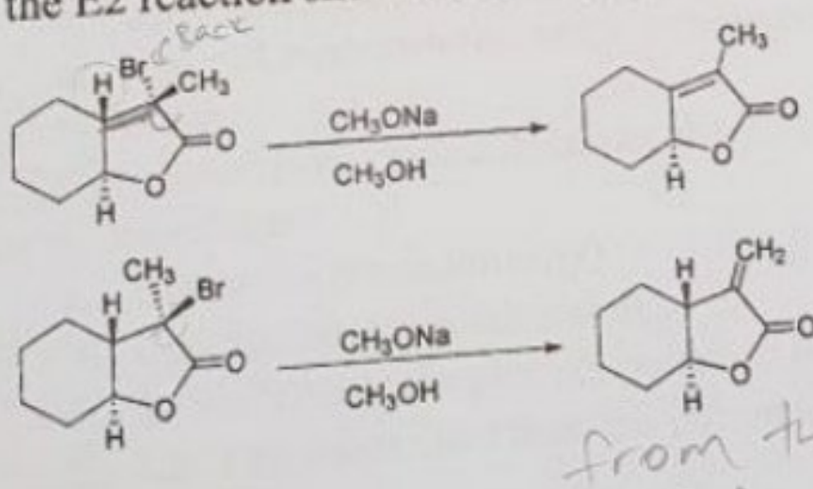
Part IV:

1. Suggest the possible structure of A, B, C and D for the following multistep synthesis.(2 pt)

$HC\equiv C-CH_2CH_3 \xrightarrow[2)\ CH_3CH_2Br]{1)\ NaNH_2,\ NH_3}$ A $\xrightarrow[Lindlar]{H_2}$ B $\xrightarrow{HCl}$ C $\xrightarrow[Ethanol]{CH_3CH_2ONa}$ D



2. Explain why each alkyl halide stereoisomer gives a different alkene as a major product in the E2 reaction shown below. (2 pt)



this is bc the the double bond doesn't form on the methyl substitute bc the bromine is on the back side & when the nucleophile attacks, it attacks from the front side, in this case, the double bond forms on the ring instead of the substituent following Zaitsev's rule. The same rule applies on the second reaction, the nucleophile attacks from the back side which favor the formation of double bond on the substituent.

Department of Chemistry

Fundamentals of Organic Chemistry (Chem.1041) – FinalExam

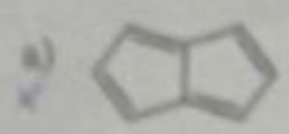
Name: _____ **ID. No.** _____

Date: Feb. 25, 2021
Time allowed: 1:30
Total point: 40%

I. Multiple choices Item (1 point each)
Choose the best answer from the given alternative and write your answer on the space provided

D 1. Which of the following is not characteristic of benzene?
- a) All carbon-carbon bond length are equal
- b) All the H-atoms are equivalent
- c) It has planar structure
- d) It has 2(3) + 2 π electrons

B 2. Which of the following compounds is aromatic?

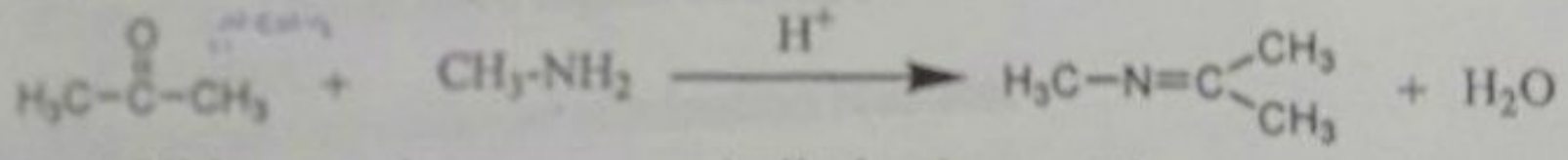
a)  b)  c)  d) 

B 3. Which of the following substituent on a benzene ring is ortho-para directing?

a) -CN b)-OH c)-$COCH_3$ d) -NO_2

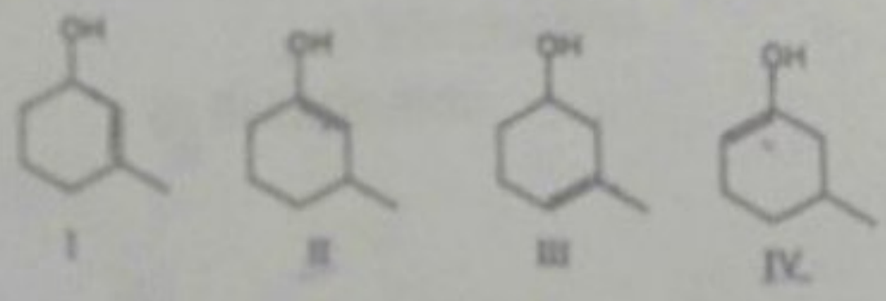
C 4. Which of the following is not reaction of carbonyl?
- a) Addition reaction
- b) Enolization- ketolization
- c) elimination reaction
- d) addition- elimination reaction

D 5. The following reaction is classified under

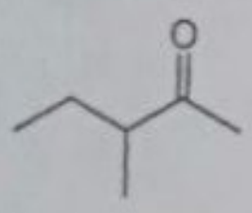
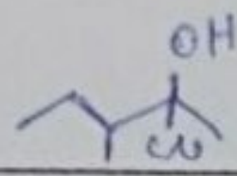


- a) Addition reaction
- b) Enolization- ketolization
- c) elimination reaction
- d) addition- elimination reaction

D 6. Which of the following are enol tautomers of 3-methylcyclohexanone?

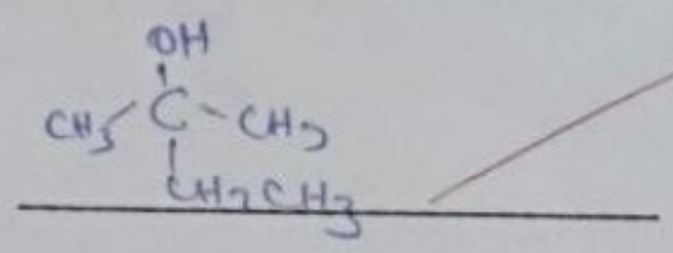


a) I & II b) I & IV c) II & III d) only II

h)  HCN → 

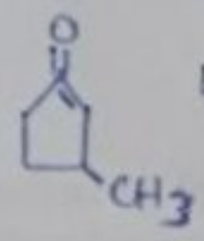
(3)

i) 2-Methyl-2-butanol $\xrightarrow{[O]}$ Can't be oxidized b/c it is a 3° alcoh

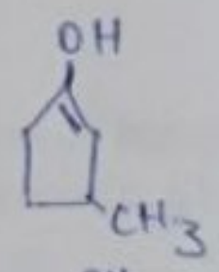
j) Dimethylketone $\xrightarrow[2.\ H^+]{1.\ CH_3CH_2\text{-}Mg\text{-}Br}$ 

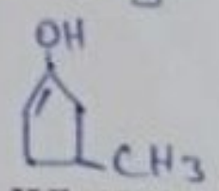
3. Draw the structure of enol tautomers of 3-methylcyclopentanone. (2 pts)

(2)

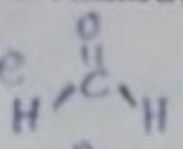


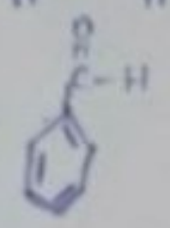
har to possible structures

i- 

ii. 

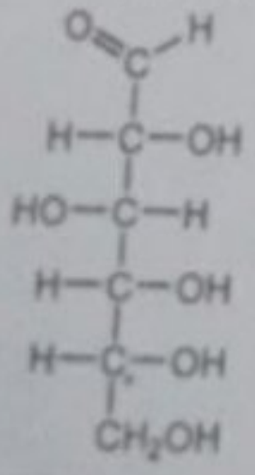
4. Benzaldehyde and formaldehyde don't form enolate anions. Why?(1pt)

Formaldehyde  doesn't have a carbon atom other than the carbonyl carbon for electr to be delocalized and double bond to move around.

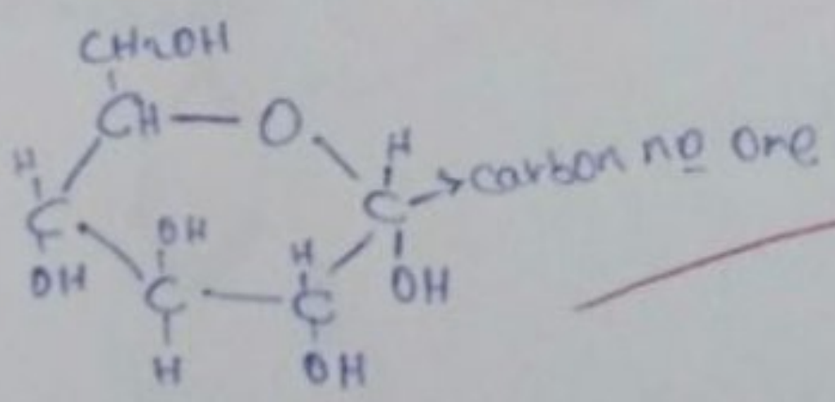
Benzaldehyde  the benzyl carbon already has four bonds. So, it can't form a double bond with the carbonly carbon for the double bond to resonate(move around.)

5. Draw the cyclic hemiacetals structure of glucose resulting from reaction of OH at C-5 with the aldehyde group.(2 pts)

(2)



Glucose



C 7. Which of the following reactions is a good method for preparing an aldehyde?

a) Jones' reagent (CrO_3) and a 1°-alcohol
b) Jones' reagent (CrO_3)and a 2°-alcohol
c) PCC and a 1°-alcohol
d) H_2SO_4, a 1°-alcohol and heat

C 8. Aldol condensation is

a) reaction of aldehyde and alcohol
b) alkylation at α-carbon
c) nucleophilic addition of enolate ion in to another carbonyl.
d) reaction of esters to form diketo esters

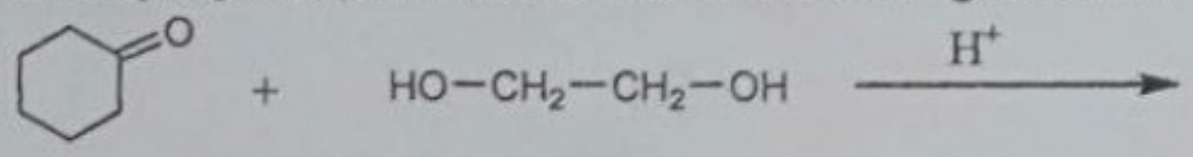
B 9. Which of the following aldehydes, used alone, would undergo an aldol reaction?

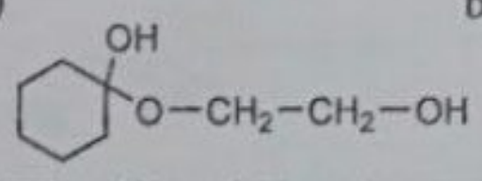
a) formaldehyde, CH_2O
b) butanal, $CH_3(CH_2)_2CHO$
c) benzaldehyde, C_6H_5CHO
d) 2-propenal, $CH_2=CHCHO$

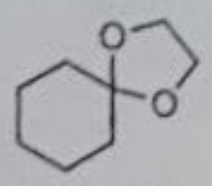
B 10. Which of the following can reduce ester?

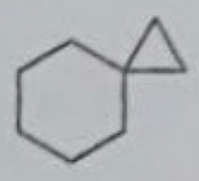
a) $NaBH_4$ b) $LiAlH_4$ c) Li, NH_3 d) PCC

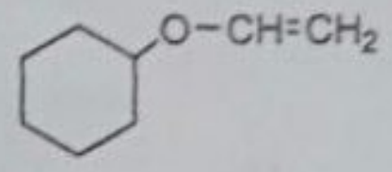
B 11. What is the major product obtained from the following reaction?



a)


b)


c)


d)


B 12. Which of the following reagent would be best for oxidizing a 1° alcohol to an aldehayde?

a) H_3PO_4
b) PCC in CH_2Cl_2
c) Jones' reagent (H_2CrO_4)
d) OsO_4

B 13. The following compounds have similar molecular weights. Which has the highest boiling point?

a) $CH_3CH=O$ b) CH_3CH_2OH c) CH_3OCH_3 d) $CH_3CH_2CH_3$

C 14. Which one of the following statements is true?

a) Aldehydes and ketones are non-polar molecules.
b) Aldehydes and ketones can form hydrogen bonding with each other.
c) Carboxylic acids have higher boiling points than the corresponding aldehydes and ketones.
d) Aldehydes can undergo elimination reaction.

A 15. The reaction below is classified as …

cis-2-pentene ⟶ 2-pentanol

a) Oxidation
b) Reduction
c) Elimination
d) Substitution

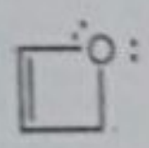
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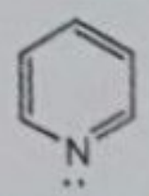
Part II. Short answer

Answer the following questions on the space provided

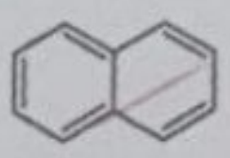
1. Classify the following compounds as aromatic or non-aromatic(2pt)

(2)

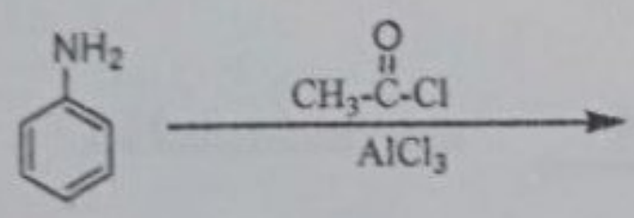
i)  Non-aromatic

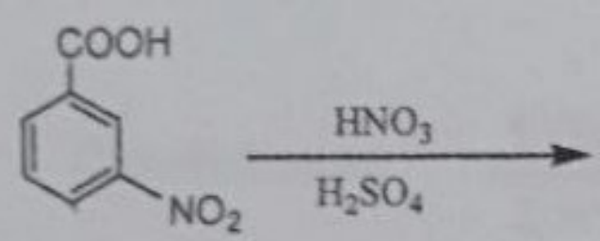
ii)  Aromatic

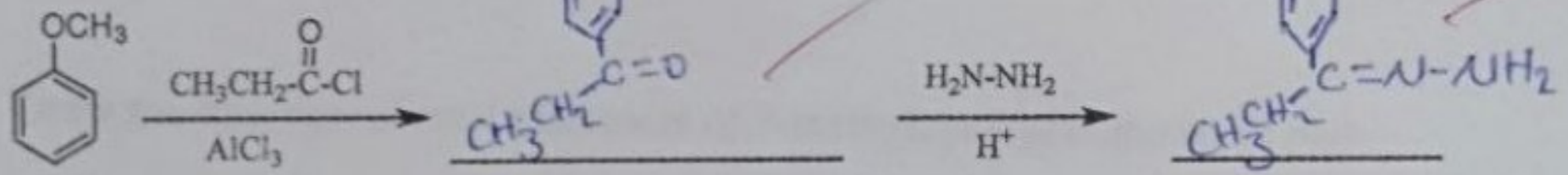
iii)  Nonaromatic

iv)  Aromatic

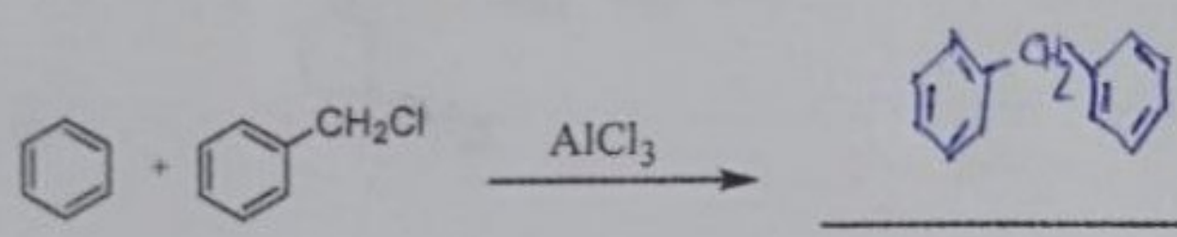
2. Find the product of the following reaction. (11 pts)

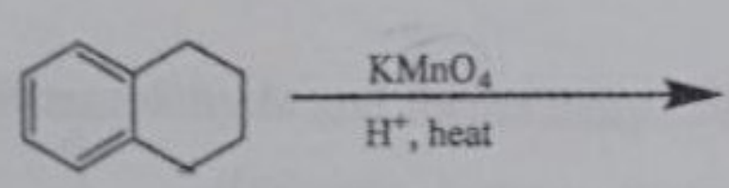
a) 

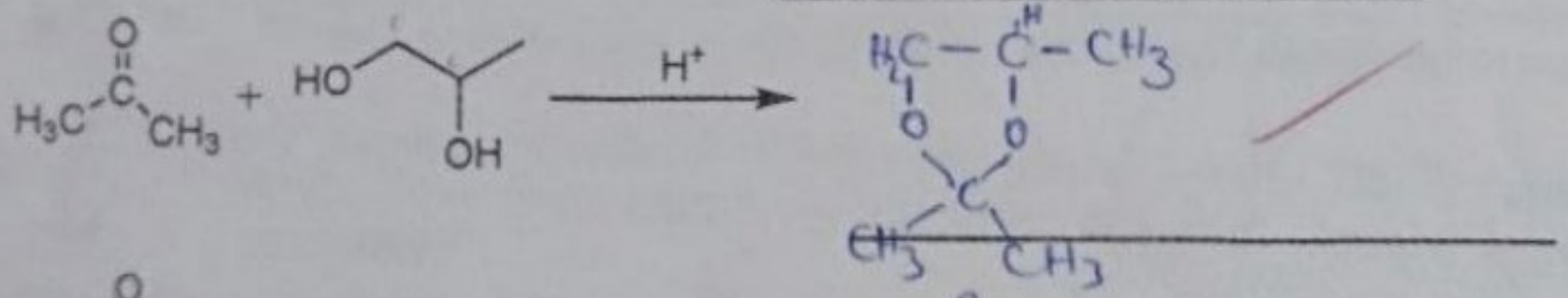
b) 

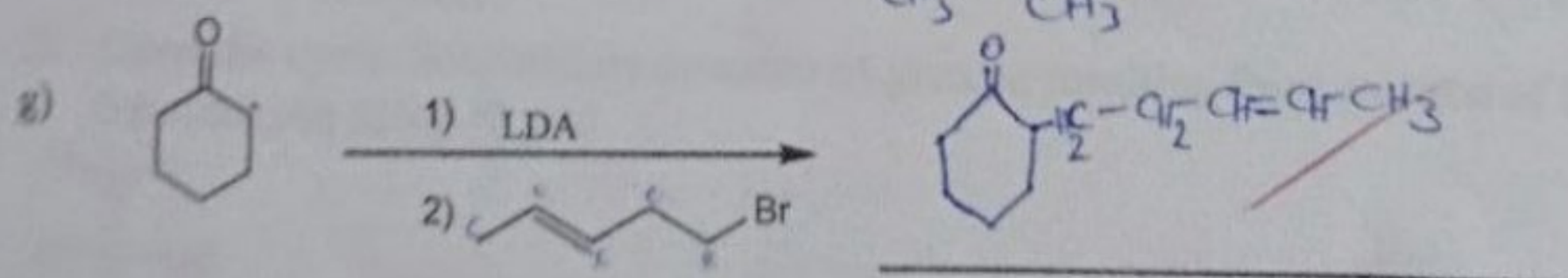
c) 

8

d) 

e) 

f) 

g) 

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A. -518

B. -182

C. -454

D. 3.15

8. The ^{18}O:^{16}O abundance ratio in Hoba meteorite is less than that used to calculate the aver atomic mass of oxygen on earth. The average mass of oxygen atom in Hoba meteorite is....t of terrestrial oxygen atom

A. Less than

B. Greater than

C. Equal to

D. None

9. Beryllium is the lightest member of

A. Alkali metals

B. Noble gases

C. Alkaline earth metals

D. Chalcogens

10. Which of the following solutions could be used to precipitate Ba^{2+} in a water sample

A. NaCl

B. NaOH

C. Na_2SO_4

D. All

11. Which of the following is soluble in aqueous solution

A. $PbCO_3$

B. AgCl

C. $BaSO_4$

D. None

12. Which of the following compounds has the highest oxidation state for S?

A. H_2S

B. SO_2

C. SO_3^{2-}

D. Na_2SO_4

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A. Redox reaction involve transfer of electrons

B. Oxidation is addition of oxygen whereas reduction is addition of hydrogen

C. Redox reactions involve change in oxidation state of one or more reactants

D. All

14. Which of the following reactions is redox reaction?

A. $2H_2O_2(aq) \longrightarrow 2H_2O\,(l) + O_2(g)$

B. $ZnCO_3\,(s) \longrightarrow ZnO\,(s) + CO_2\,(g)$

C. $BaCl_2(aq) + K_2SO_4\,(aq) \longrightarrow 2KCl\,(aq) + BaSO_4\,(s)$

D. B and C

15. The actual yield of a chemical reaction is often less than theoretical yield because

A. Some reactions are inherently inefficient

B. Some reactions can have side reactions

C. Some reactions can be incomplete

D. All

16. ClO_3^- is

A. Perchlorate

B. Hypochlorite

C. Chlorate

D. Chlorite

17. The formula for chloric acid

A. HCl

B. HClO

C. $HClO_3$

D. $HClO_4$

18. Which of the fo

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Part I: Multiple Choice Questions. Write your answers clearly in the answer sheet. *(10 points)*

1. Which of the following is ionic compound
   A. AlF_3
   B. $AlCl_3$
   C. AlI_3
   D. All
2. Which of the following is molecular compound?
   A. KI
   B. BeF_2
   C. KCl
   D. None
3. H_2S (aq) is
   A. Hydrogen sulfide
   B. Dihydrogen monosulfide
   C. Hydrosulfuric acid
   D. Dihydrosulfuric acid
4. NO is
   A. Nitrous oxide
   B. Nitric oxide
   C. Nitric acid
   D. Nitrous acid
5. $1.0x10^4$ in decimal notation will be
   A. 10,000
   B. 10,000.0
   C. 10,000.00
   D. All
6. How many significant figures are contained in $2x10^{20}$
   A. 0
   B. 1
   C. 2

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Part I: Multiple Choice Questions. Write your answers clearly in the answer sheet. (10 points)

1. Which of the following is ionic compound
   A. AlF_3
   B. $AlCl_3$
   C. AlI_3
   D. AlI

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2. Which of the following is molecular compound?
   A. KI
   B. BeF_2
   C. KCl
   D. None
3. H_2S (aq) is
   A. Hydrogen sulfide
   B. Dihydrogen monosulfide
   C. Hydrosulfuric acid
   D. Dihydrosulfuric acid
4. NO is
   A. Nitrous oxide
   B. Nitric oxide
   C. Nitric acid
   D. Nitrous acid
5. $1.0x10^4$ in decimal notation will be
   A. 10,000.
   B. 10,000.0
   C. 10,000.00
   D. All
6. How many significant figures are contained in $2x10^{20}$
   A. 0
   B. 1
   C. 2
   D. 3
7. The temperature of liquid helium (-270°C) in degrees Fahrenheit is

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11. What is the number of moles of sulfur in 1.81 x 1024 atoms of sulfur.

A. 1mole S B. 3.01 moles S C. 2.1 mole S D. 1.5 mole S 12

12. What is the number of moles 0.040kg Na

A. 1.7x103 B.0.92mol C. 92 mol D. 1.7 mol

13. Which one of the following has greater mass?

A.0.2mole O_2 B.0.2 O C.0.02 O_2 D.0.02 O

14. Determine the molar mass for sodium sulfate. (Na_2SO_4)

A. 142.04 amu B. 119.04 amu C. 130 .04amu D. 78 .04amu

15. Calculate the volume of a 0.750 M sulfuric acid (H2SO4) solution containing

11.76g of solute.

A. 0.160 L B. 0.134 L C. 0.320 D. 0.064

1 [redacted] 2 [redacted] 3 [redacted] 4 [redacted] 5 [redacted] 6 [redacted] 7 [redacted] 8 [redacted] 9 [redacted] 10 [redacted]

11. [redacted] 12 [redacted] 13 [redacted] 14 [redacted] 15 [redacted]

Part II: Short answer (write your answer on the space provided)

1. Round off each of the following numbers to three significant figures.

a.61.40 _____ b. 6.171 _____ c. 0.066494_____

2. Write the result of each of the following to the proper number of significant figures:

a. 7.939 + 6.26 _____ B. 8 x 0.80_____

3. Write the name of the following compounds (pt)

a. Cu_2O b.$FeCl_3$.H2O

_____ _____

4. Calculate the empirical formula for caffeine given the following percent composition: 49.5% C, 5.15% H, 28.9% N, and 16.5% O.(2pt)

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1. Which one of the following is an example of Macroscopic domain

A. Proton B. atom C density D. ion

2. Which one of the following is an example of intensive properties?

A. temperature B. mass C. volume D. energy

3. The accepted value is 29.35. Which correctly describes this student's experimental data?

Trial	Measurement
1	29.48
2	28.97
3	29.27

A. accurate but not precise C. precise but not accurate

~~B. both accurate and precise D. neither accurate nor precise~~

4. How many significant figures are contained in 4.20 numbers?

A. 2. B.1 C. 3 D.4

5. How many oxygen atoms are present in 2.50 mol of oxygen molecules?

A. 1.51×10^{24} B. 3.01×10^{24} C. 1.25×10^{24} D. 2.5×10^{24}

6. The freezing temperature of water is $32^{\circ}F$. what is the freezing temperature of water in Celsius units

A. $0^{\circ}c$ B. $32^{\circ}c$ C. $273.15\,c^{\circ}$ D. $303.15^{\circ}c$

7. The chemical formula of ferrous nitrite is

A. $Fe(NO_3)_3$ B. $Fe(NO_3)_2$ C. $Fe(NO_2)_2$ D. $Fe(NO2)_3$

8. Determine the numbers of protons, neutrons, and electrons in S^{2-}

A. 16,16. And 14 B. 14,16,16 C. 16,16,18 D. 16,18,16

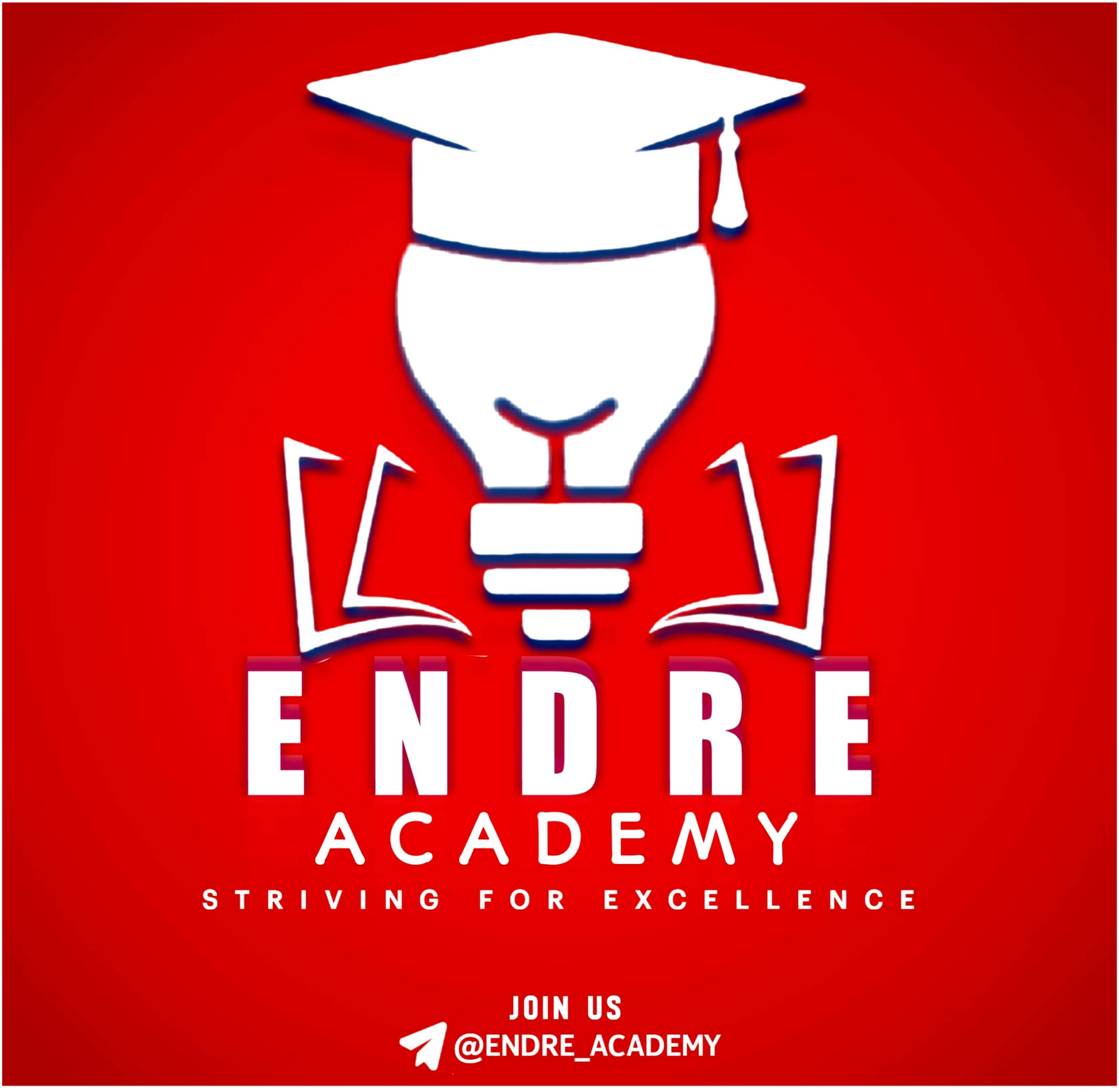
9. Which one of the following is an example of Ionic compound?

A. $SiCl_3$ B. H_2S C. CO_2 D. NO_2

10. The element neon has three naturally occurring isotopes. One of these has a mass of 19.99 amu and a natural abundance of 90.48%. A second isotope has a mass of 20.99 amu and a natural abundance of 0.27%. A third has a mass of 21.99 amu And a natural abundance of 9.25%. what is the atomic mass of neon.

A 20.18amu B 60.97 C 19.67 D 22.1

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