Paper_00_UN-Champ (Chemistry = PC+OC+IOC)14-08-2021

SECTION-I : Single Correct Type

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. You will be awarded **3 marks** if only the correct option is chosen and zero mark if none of the option is chosen. **(–1)** marks will be awarded for incorrect answers in this section.

Level : Easy
Topic : Gaseous State
Concept : Ideal gas equation
Subconcept : Ideal gas equation

1. In a sealed rigid container ideal gas is heated, which property must not change

(A) Pressure

(B) Energy of molecules

(C) Average speed of molecules

(D) Density

Ans. (D)

Sol. At constant volume all properties change except density with temperature.

Level : Moderate
Topic : Gaseous State
Concept : Mixed concept
Subconcept : Mixed concept

2. Consider the following statements-

(a) An oleum sample can be labelled as 127%

(b) Mole fraction is temperature dependent

(c) Slope of 'log V' v/s 'log T' graph is constant. (At constant P & n for ideal gas)

(d) 1 gm of $C_6H_{12}O_6$ contains more number of atoms than 1 gm of CH_3COOH

Select the correct code regarding true & false statement -

(A) FFTF (B) TFTF (C) TFTT (D) FFTF

Ans. (A)

Sol. (a) Maximum % labelling can be 122.5 %

(b) mole fraction is mass by mass relationship so it is temperature independent

(c) $\log v = \log \frac{nR}{P} + \log T$

Slope = 1

(d) Since ratio of atoms of C, H, O is same in both molecule.

Level : Easy
Topic : Gaseous State
Concept : Maxwell equation
Subconcept : Maxwell equation

3. In a certain sample of gas at 25° C the number of molecules having speeds between 4 km sec^{-1} and 4.1 km sec^{-1} is N. If the total number of gas molecules at the same temperature are doubled what will happen?

(A) Value of most probable velocity will remain same

(B) Value of most probable velocity will double

(C) Fraction of molecules between 4 km sec^{-1} and 4.1 km sec^{-1} will become 2N

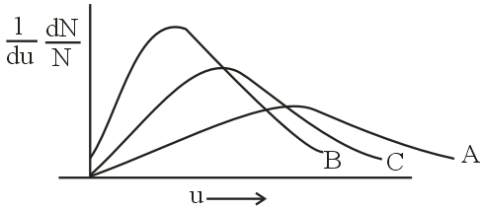
(D) Number of molecules between 4 km sec^{-1} and 4.1 km sec^{-1} will remain same.

Ans. (A)

Sol. Since temperature is contant umps remain same, but number of particles will double.

Level : Moderate
Topic : Gaseous State
Concept : Maxwell equation
Subconcept : Maxwell equation

4. The curve C is for the gas X at 273 K. Choose the **CORRECT** statement.



(A) Curve A may be of a heavier gas but at same temperature

(B) Curve B may be of the same gas but at 373K

(C) Curve A may be of the same gas but at 373K

(D) Curve B may be of the lighter gas but at same temperature

Ans. (C)

Sol. Fact as per Maxwell equation.

Level : Easy

Topic : Periodic Table

Concept : Periodic Table

Subconcept : Periodic Table

5. Whose name is not associated with the development of periodic table?

(A) Prout's (B) Newlands (C) Rutherford (D) Lother Meyer

Ans. (C)

Sol. Rutherford is not associated with the development of periodic table.

Level : Moderate

Topic : Periodic Table

Concept : Periodic Table

Subconcept : Periodic Table

6. Eka-aluminium and Eka-silicon are known as :

(A) Gallium and Germanium (B) Aluminium and Silicon

(C) Iron and sulphur (D) Proton and Silicon

Ans. (A)

Sol. EKa : Aluminium $\Rightarrow$Ga

EKa : Silicon $\Rightarrow$Ge

Level : Moderate

Topic : Periodic Table

Concept : Periodic Table

Subconcept : Periodic Table

7. Among the given elements, select those, which is at the peak of Lother Meyer Curve?

(A) V (B) Se (C) La (D) K

Ans. (D)

Sol. Alkali metals are placed at peak of Lother Meyer curve.

Level : Moderate

Topic : Periodic Table

Concept : Periodic Table

Subconcept : Periodic Table

8. Select the **INCORRECT**match :

(A) Bridge element : K, Mg

(B) Diagonal relationship : (Li $\rightarrow$ Mg), (Be $\rightarrow$ Al), (B $\rightarrow$ Si)

(C) First lanthanoid :Ce

(D) Typical elements : Na, Mg, Al, S

Ans. (A)

Sol. IIIrd group elements are Bridge element Ce is first lanthanoid.

Level : Moderate
Topic : Periodic Table
Concept : Periodic Table
Subconcept : Periodic Table

9. Selectthe **CORRECT**match :

(A) Hg → Transition element (B) Si →Bridging element

(C) Xe→ Representative element (D) Sc→Typical element

Ans. (B)

Sol. Hg → d-block element but not transition element

Xe→ noble gas

Sc→ d-block element are not typical element.

Level : Moderate
Topic : Periodic Table
Concept : Ionisation Energy
Subconcept : Ionisation Energy

10. A neutral atom (Ar) is converted to (Ar^{3+}) by the following process

$$Ar \xrightarrow[-e]{E_1} Ar^{+} \xrightarrow[-e]{E_2} Ar^{2+} \xrightarrow[-e]{E_3} Ar^{3+}$$

The correct order of E_1, E_2 and E_3 energies is :

(A) $E_1 < E_2 < E_3$ (B) $E_1 > E_2 > E_3$ (C) $E_1 = E_2 = E_3$ (D) $E_1 > E_2 < E_3$

Ans. (A)

Sol. $I.E._3 > I.E._2 > I.E._1$

Level : Moderate

Topic : Periodic Table

Concept : Atomic Size

Subconcept : Atomic Size

11. The ionic radii of N^{3-}, O^{2-} and F^{-} are respectively given by :

(A) 1.36, 1.40, 1.71 (B) 1.36, 1.71, 1.40 (C) 1.71, 1.40, 1.36 (D) 1.71, 1.36, 1.40

Ans. (C)

Sol. Order of size = $N^{3-} > O^{2-} > F^{-}$

$$\frac{9}{10} = \frac{7}{10} \quad \frac{8}{10} \quad \frac{9}{10}$$

Level : Moderate
Topic : Periodic Table
Concept : Periodic Table
Subconcept : Periodic Table

12. Which of the following options is **CORRECT**?

(A) Decreasing $I.E._2$: F > N > O

(B) Increasing atomic size : B< Be< Li < Na

(C) Metallic bond strength ; Na < Zn <Ca

(D) Increasing electron affinity : O^{2-}< O^-< O^+< O

Ans. (B)

Sol. (A) I.E. = $\underset{2p^3}{O^+} > \underset{2p^4}{F^+} < \underset{2p^2}{N^+}$

(B) Size = B < Be < Li < Na

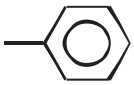
(C) Metallic strength = Na <Ca< Zn

(D) E.A. = O^{2-}< O^-< O < O^+

Level : Easy
Topic : Inductive Effect
Concept : –I Effect
Subconcept : –I Effect

13. Which of the following is incorrect order of –I effect.

(A) $-NO_2 > -F > -CH=CH_2$

(B) $-Cl > -NH_2 >$ 

(C) $-\overset{\oplus}{N}H_3 > -COOH > -CN$

(D) –Br > –I > –OH

Ans. (C)

Sol. Correct order of option "C" is

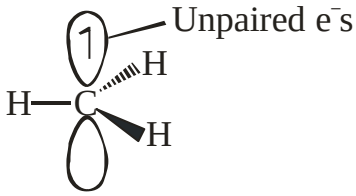
$-\overset{\oplus}{N}H_3 >$ – CN > – COOH

Level : Easy
Topic : Intermidiate
Concept : Free radical
Subconcept : Free radical

14. Intermidiate with one unaired electron is :

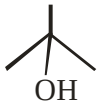
(A) $\overset{\oplus}{C}H_3$ (B) $\overset{\ominus}{C}H_3$ (C) $\overset{\bullet}{C}H_3$ (D) $\overset{\cdot\cdot}{C}H_2$

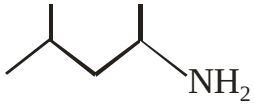
Ans. (A)

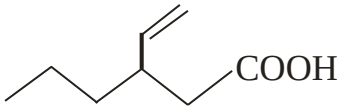
Sol. 

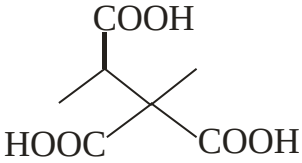
Level : Tough
Topic : Nomenclature
Concept : IUPAC
Subconcept : IUPAC

15. Compound with correct IUPAC name

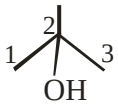
(A)  1, 1 – Dimethyl Ethan-1-ol

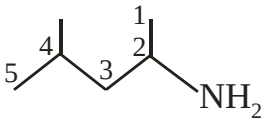
(B)  1, 3 Diethyl Butan-1-amine

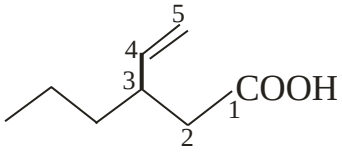
(C)  3-Ethenyl Hexanoic Acid

(D)  Butan- 2,2,3- Tri Carboxylic Acid

Ans. **(D)**

Sol. (A)  2-Methyl Propane-2-ol

(B)  4-Methyl Pentan-2-amine

(C)  3-Propyl Pent-4-enoic acid

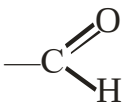
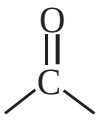
Level : Moderate

Topic : Functional Group

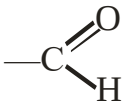
Concept : Preffix

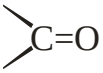
Subconcept : Preffix

16. Oxo is used as a preffix for

(A)  (B)  (C) –O– (D) =O

Ans. (D)

Sol. (A)  Formyl

(B)  keto or Carbonyl

(C) –O– Oxy

(D) =O Oxo

Level : Moderate

Topic : Nomenclature

Concept : IUPAC

Subconcept : IUPAC

17. In IUPAC namiry of organic compounds IUPAC name must have always :

(A) Preffix & suffix (B) Preffix & word root

(C) Word root & suffix (D) Preffix, word root & suffix

Ans. (C)

Sol. Word Root & suffix like meth & ane for methane (CH_4)

Level : Moderate

Topic : General Organic Chemistry

Concept : Resonance

Subconcept : Resonance

18. Which statement is correct :

(A) Inductive effect is distance independent effect

(B) Hetrolytic bond fission takes place in non polar solvent

(C) Resonating structures are hypothetical

(D) Lone pair of N atom in ethanide is localised

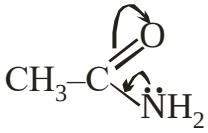
Ans. (C)

Sol. (A) is incorrect because Inductive effect is distance dependent

(B) is incorrect because Hetrolytic bond fission takes place in polar solvent

(C) Correct statement because only resonance hybrid is real

(D) is incorrect because one pair of N atom in ethanamide is delocalised due to resonance phenomenon

Ethanamide 

Level : Moderate

Topic : Nomenclature

Concept : IUPAC

Subconcept : IUPAC

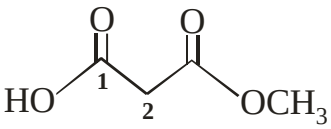
19. Correct IUPAC name of compound 3-methoxy-3-oxo-propanoic acid :

(A) 3-methoxy carbonyl propanoic acid (B) 2-methoxy carbonyl propanoic acid

(C) 2-methoxy carbonyl ethanoic acid (D) methyl-2-carboxy ethanoate

Ans. (C)

Sol. Given compound is



Correct IUPAC name 2 methoxy carbonyl ethanoic acid

Level : Easy

Topic : Nomenclature

Concept : IUPAC

Subconcept : IUPAC

20. Position of $-CH_3$ as per IUPAC in compound methyl butyne is –

(A) 1 (B) 2 (C) 3 (D) 4

Ans. (C)

Sol. Only possible structure $\overset{4}{C}H_3-\overset{3}{C}H(CH_3)-\overset{2}{C}\equiv\overset{1}{C}H$

SECTION-II : Integer Value Correct Type

This section contains **10 questions**. For each question, enter the correct numerical value (in decimal notation, truncated / rounded off to the **second decimal place;** e.g. 6.25, 7.00, –0.33, –0.30, 30.27, –127.30) using the mouse and the on screen virtual numeric keypad in the place designated to enter the answer. You will be awarded **3 marks** if correct numerical value is entered as answer. **No negative marks** will be awarded for incorrect answers in this section.

Level : Moderate
Topic : Gaseous State
Concept : Bimolecular collision
Subconcept : Bimolecular collision

1. Two flask A and B have equal volume at 100K and 200K and have pressure 4 atm and 1 atm respectively. The flask A contains H_2gas and B contains CH_4 gas. The collision diameter of CH_4 is twice that of H_2 Calculate ratio of mean free path of CH_4 to H_2

Ans. (2)

Sol. $$\frac{\lambda_{CH_4}}{\lambda_{H_2}}=\left(\frac{\sqrt{2}\pi\sigma^2 P}{KT}\right)_{H_2}\times\left(\frac{KT}{\sqrt{2}\pi\sigma^2 P}\right)_{CH_4}$$

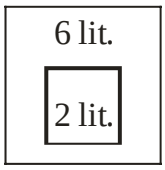
$$=\frac{1^2\times 4}{100}\times\frac{200}{2^2\times 1}=2$$

Level : Easy
Topic : Gaseous State
Concept : Dalton's law
Subconcept : Dalton's law

2. A 2 liter rigid container is present inside a large 6 liter container. 2liter container contain 12 mole of H_2& 10 mole of He. While 6 litre container contains 20 mole of He and 18 mole of CH_4. There is an orifice on one wall of small container which can be operated by a remote control device. Calculate total number of moles present inside small container when orifice is opened for sufficiently long time.

Ans. (20)

Sol.



Moles is small container H_2 = 12
He = 10
Large container H_2 = 20
CH_4 = 18
Total moles = 60
Total volume 6 lite. So 2 lit. volume
Contains 20 mole

Level : Tough
Topic : Gaseous State
Concept : Gratan's law
Subconcept : Gratan's law

3. Gas A taken in a closed rigid container is allowed to decompose partially to the reaction.

$A(g) \longrightarrow 2B(g) + 3C(g)$

The gaseous mixture formed effuses 1.5 times faster then a gas having molecular weight 105 under similar condition. Find the mole fraction of C in the gaseous mixture formed.

Given : Mol. wt. of A = 140
Mol. wt. of B = 64
Mol. wt. of C = 4

Ans. (0.5)

Sol. $\frac{r_{mix}}{r_{gas}} = \frac{3}{2} = \sqrt{\frac{105}{M_{mix}}}$

$\frac{9}{4} = \frac{105}{M_{mix}}$

$M_{mix} = \frac{140}{3}$

$A \rightarrow 2B + 3C$

1-α $2x$ 3α

$\frac{140}{3} = \frac{140}{1+4\alpha}$

$1 + 4\alpha = 3$

$\alpha = \frac{1}{2}$

Md. Fraction of

$$C = \frac{3\alpha}{1+4\alpha} = \frac{\frac{3}{2}}{3} = \frac{1}{2} = 0.5$$

Level : Easy
Topic : Mole concept
Concept : Concentration term
Subconcept : Concentration term

4. In order to remove Pb^{2+} from 10 litre H_2O, Na_2H_2 EDTA (0.4 M, 100 mL) is required.

$PbCl_2(aq.) + Na_2H_2$ EDTA $\rightarrow 2NaCl + PbH_2$ EDTA

Hence millimoles of $PbCl_2$ present in 1 litre of H_2O is.

Ans. (4)

Sol. mmoles of EDTA = 40 numbers
mmoles of EDTA = m moles of Pb^{2+} in 10 lit.
mmoles is 1 lit. = 4

Level : Moderate
Topic : Mole concept
Concept : Concentration term
Subconcept : Concentration term

5. 500 ml of 2M CH_3COOH solution is mixed with 600 ml 12% w/v CH_3COOH solution then calculate the final molarity of solution.

Ans. (2)

12 gm CH_3COOH is present in 100 ml of solution

120 gm CH_3COOH is present in 1000 ml of solution

$M_2 = \frac{120}{60} = 2$, Now we are mixing

500 ml, 2M CH_3COOH + 2M, 600 ml CH_3COOH

$M_1V_1 + M_2V_2 = M_3V_3$

$500 \times 2 + 600 \times 2 = M3 \times 1100$, $M_3 = \frac{2200}{1100} = 2$

Level : Moderate
Topic : Mole concept
Concept : Concentration term
Subconcept : Concentration term

6. Calculate the minimum volume (in Lt) of $\frac{M}{672} H_2O_2$ solution, which can produce at least 1 gm each of I_2 and KOH, as per the following reaction :

$$H_2O_2 + 2\,KI \longrightarrow I_2 + 2KOH$$

Ans. (6)

$$n_{H_2O_2} = \frac{1}{672} \times V = \frac{1}{2} \times n_{KOH}$$

$$\Rightarrow \frac{1}{672} \times V = \frac{1}{2} \times \frac{1}{56}$$

$\Rightarrow V = 6$ Lts.

Level : Moderate
Topic : Periodic Table
Concept : Periodic Table
Subconcept : Periodic Table

7. A has exceptional outer electronic configuration as $4d^{10}$, $5s^0$. Which period does it belongs to?

Ans. (5.00)

Sol. Theexceptional outer electronic configuration suggest that the expected configuration of A $4d^8$, $5s^2$. Thus, it belongs the 5^{th} period.

Level : Moderate
Topic : Periodic Table
Concept : Periodic Table
Subconcept : Periodic Table

8. Find the number of elements having lower EA_2 than EA_1 of Cl.
O, S, P, I, As, Si, Al, Li, K

Ans. (9.00)

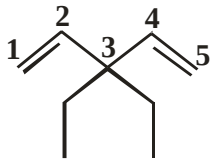
Sol. EA_1 is higher as compared to EA_2 for all the elements in periodic table.

Level : Tough
Topic : Nomenclature
Concept : IUPAC
Subconcept : IUPAC

9. If p_1, p_2 are position of side chains & p_3, p_4 are positions of double bonds as per IUPAC for compound diethylpentadiene then find value of $\left|\frac{p_1+p_2}{p_4-p_1}\right|$ is

Ans. (2)

Sol. The only possible compound is



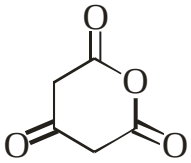
$(p_1, p_2) = (3, 3)$
$(p_4, p_3) = (1, 4)$ or $(4, 1)$
Hence $\left|\frac{3+3}{4-1}\right| = \frac{6}{3} = 2$

Level : Moderate
Topic : Nomenclature
Concept : IUPAC
Subconcept : IUPAC

10. Degree of unsaturation for any compound is total number of π bond & number of rings present in that compound. Degree of unsaturation in 3-oxo pentandioicanhydride is :

Ans. (4)

Sol. 3-oxo pentandioicanhydride is



Hence degree of unsaturation
= total number of π bond + total number of rings
= 3 + 1
= 4