Sample paper 4

Question 1

How many significant figures are there in the following figures?
i. $6*10^4$
ii. 0.008320
iii. $4.05*10^{-2}$
iv. 100.0

a) 1, 7, 5, 4
b) 5, 6, 5, 3
c) 1, 4, 3, 4
d) 1, 7, 5, 3
e) 1, 4, 3, 1

Correct Answer: c) 1, 4, 3, 4.

Explanation:

$6*10^4$ = 6000 has only one significant figure. Leading zeros are not significant, for 0.008320 it is 4. Zeros appearing anywhere between two non-zero digits are significant figures, for $4.05*10^{-2}$ = 0.00405, it is 3. Trailing zeros in a number containing a decimal point are significant, for 100.0 it is 4.

Question 2

One mole of any gas at STP occupies

a) 0.224 L
b) 0.022L
c) 2.24 L
d) 22.4 L
e) 23 L

Correct Answer: d) 22.4 L

Explanation:

By applying Ideal gas equation, V = nRT/P
At STP, P=1 atm, n=1mol, R=0.082 L atm K^{-1} mol^{-1}, T=273K
V = (1*0.082*273)/273 = 22.38 L = 22.4 L

Question 3

The conversion of liquid to solid is known as

a) Melting
b) Freezing
c) Sublimation
d) Condensation
e) Deposition

Correct Answer : b) Freezing

Explanation:

Freezing – liquid to solid, melting – solid to liquid, sublimation – solid to vapour, condensation – gas to liquid, deposition – gas to solid.

Question 4

Identify the unit of concentration of the solution (N_A)/(Kg of solvent).

a) Molarity
b) Molality
c) Normality
d) Mole fraction
e) ppm

Correct Answer: b) Molality

Explanation:

Molarity (M_A) = n_A/ volume in litres.
Normality = Gram equivalent of A/Volume in litres of solution.
Mole fraction (χ_i) = n_i/ (n_1+n_2+n_3....).
Parts per million (ppm) = (Mass of A/Total mass) x 10^6

Question 5

In a polyatomic species, the sum of oxidation numbers of the element in the ion _________ the charge on that species.

a) Is greater than
b) Is lesser than
c) Equals
d) Is either greater or lesser than
e) Is zero to

Correct Answer: c) Equals

Explanation:

The sum of oxidation numbers in polyatomic ion or species is equal to the charge of the ion. For example, the sum of the oxidation number for SO_4^{2-} is -2.

Question 6

In which of the following processes, is the process always non-feasible?

a) $\Delta H>0$, $\Delta S>0$
b) $\Delta H<0$, $\Delta S>0$
c) $\Delta H>0$, $\Delta S<0$
d) $\Delta H<0$, $\Delta S<0$
e) $\Delta H=0$, $\Delta S=0$

Correct Answer: c) $\Delta H>0$, $\Delta S<0$

Explanation:

For a non-spontaneous or non-feasible process, ΔH>0 and ΔS<0. For a spontaneous or irreversible reaction, ΔH<0 and ΔS>0. For an equilibrium or reversible process, ΔH=0 and ΔS=0.

Question 7

The hybridisation in NH_4^+ is

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

Correct Answer: c) sp^3

Explanation:

Number of valence electrons in N is 5 and in H it is 4.
So total number of valence electrons = 5 + 4 = 9; Charge = +1.
Therefore, total electrons in NH_4^+ = 9 - 1 = 8
When the total number of electrons is less than 8, divide by 2. If it lies between 9 and 56, divide it by 8.
8/2 = 4; X=4
Therefore, hybridisation in NH_4^+ is sp^3.

Question 8

Slater's rule is used to calculate the value of

a) Screening constant
b) Electron affinity
c) Ionisation energy
d) Effective nuclear charge
e) Both a and d

Correct Answer: e) Both a and d

Explanation:

The value of screening constant (S) and effective nuclear charge (Z^*) can be calculated using Slater's rule. Effective charge (Z^*) = Z – S (where Z- atomic number and S-screening constant).

Question 9

Which of the following solvents is suitable for S^{N2} reactions?

a) Ethanol
b) Water
c) Acetonitrile
d) Acetic acid
e) t-butanol

Correct Answer: c) Acetone

Explanation:

Aprotic solvents do not solvate the anions effectively and it is used for S_N2 reactions. Acetonitrile is the only aprotic solvent whereas others are polar protic solvents.

Question 10

Identify the glass equipment with ground-glass joints

a) Graduated pipette
b) Erlenmeyer flask
c) Buckner funnel
d) Separating funnel
e) Funnel

Correct Answer: d) Separating funnel

Explanation:

Glass equipments are divided into two; with ground-glass joints and without ground-glass joints. Separating funnel is the only glass equipment with ground-glass joints.

Question 11

The base peak in a mass spectrum is

a) The peak set to 100 % relative intensity
b) The peak set to 0 % relative intensity
c) The peak corresponding to the parent ion
d) The highest mass peak
e) The lowest mass peak

Correct Answer: a) The peak set to 100 % relative intensity

Explanation:

The most intense peak is called as base peak. It usually corresponds to the molecular ion only, if the spectra are recorded at low ionization energy.

Question 12

Which of the following is the weakest base?

a) CH_3
b) H-F
c) H-Cl
d) H-Br
e) H-I

Correct Answer: e) H-I

Explanation:

The electronegativity and atomic size of iodine is larger so there is a weaker bond between hydrogen and iodine that makes the electron cloud much lesser than H-F bond. So, H-I is the weakest base; in other words it is the strongest acid.

Question 13

Which of the following shows the increasing order of solubility?

a) KCl<pbs<agcl< li="" style="margin: 0px; padding: 0px;"></pbs<agcl<>
b) KCl<agcl<pbs< li="" style="margin: 0px; padding: 0px;"></agcl<pbs<>
c) PbS<agcl<kcl< li="" style="margin: 0px; padding: 0px;"></agcl<kcl<>
d) AgCl<pbs<kcl< li="" style="margin: 0px; padding: 0px;"></pbs<kcl<>
e) AgCl<kcl<pbs< li="" style="margin: 0px; padding: 0px;"></kcl<pbs<>

Correct Answer: b) KCl<agcl<pbs< p="" style="margin: 0px; padding: 0px;"></agcl<pbs<>

Explanation:

KCl is highly soluble because its solubility is greater than 0.1M. AgCl is sparingly soluble because its solubility is less than 0.01 M. PbS is least sparingly soluble becauseits solubility is very much less than 0.01 M.

Question 14

Calculate the cell potential at 25^{0}C for the following cell reaction using Nernst equation.E^o_{ox} = -3.402 V, E^0_{red}=0.7996 V
$Cu|Cu^{2+}$(0.024 M)||Ag^+(0.0048 M)|Ag

1. 0.25 V
2. 0.30 V
3. 0.370 V
4. 0.5 V
5. 0.1V

Correct Answer: c) 0.370 V

Explanation:

Oxidation: $Cu \rightarrow Cu^{2+} + 2 e^-$ E^o_{ox} = -(0.340 V) Reduction: $Ag^+ + e^- \rightarrow Ag$ E^o_{red} = 0.799 V Overall cell reaction is Cu(s) + 2 Ag^+(aq)$\rightarrow$ Cu^{2+} (aq) + 2 Ag(s) $E^0_{cell} = E^0_{red} + E^0_{ox}$ = 0.799 V + (-0.340 V) = 0.459 V Nernst equation, $E_{cell} = E^0_{cell}$ – (0.0256/n) ($\ln_{ox}/\ln_{red}$) = 0.459 –(0.0256/2) * ln [0.024 / $(0.0048)^2$] = 0.459 – 0.0128 * ln (1043) = 0.459 – 0.0128 * 6.95 E_{cell} = 0.370 V

Question 15

An ideal gas can be defined thermodynamically, when,
I. PV = constant
II. $(\partial U/\partial V)_p = 0$
III. $(\partial U/\partial V)_T = 0$

0 I only
1 I & II
2 I & III
3 II & III
4 II

Correct Answer: c) I & III

Explanation:

For an ideal gas, PV = constant, at constant temperature. The internal energy of a given quantity of an ideal gas at a constant temperature is independent of its volume, thus $(\partial U/\partial V)T = 0$.