Sample paper 2

Question 1

Calculate the molarity (M), when 580g of NaClis added to 2L of water.

a) 5 M
b) 3 M
c) 2.5 M
d) 80 M
e) 10 M

Correct Answer: a) 5 M

Explanation:

Molarity (M) = (moles of solute/litres of solution)
Molecular weight of NaCl = 23+35= 58 g/mol
Moles of NaCl = 580/58 = 10 mol
Therefore, Molarity (M) = 10 mol/2 L= 5 M

Question 2

Which of the following gas is the most easily liquefied?

Gas	**O_2**	**N_2**	**NH_3**	**CH_4**
Van der Waals constant (a)	**1.3**	**1.39**	**4.17**	**2.21**

a) O_2
b) N_2
c) NH_3
d) CH_4
e) Can't be predicted using this value

Correct Answer: c) NH_3

Explanation:

A gas with the greater ‘a' value will liquefy easily. Here NH3 has greater ‘a' value than the other gases. Therefore, it will liquefy easily.

Question 3

The coordination number of the Na+ in Rock salt is

a) 4
b) 3
c) 6
d) 8

e) 2

Correct Answer: c) 6

Explanation:

In Rock salt the coordination number of Na+ is six. Because each Na+ is surrounded by six Cl- ions and each Cl- is surrounded by six Na+ ions.

Question 4

Choose the property, which depends only on, the amount of solute in a solution.

a) Osmotic pressure
b) Temperature
c) Heat capacity
d) Melting point
e) None of the above

Correct Answer: a) Osmotic pressure

Explanation:

Properties that depend only on the amount of the solute not on their identity are known as colligative properties. In the above four, osmotic pressure alone depends on the amount of the solute and the rest of properties are independent of amount of solute.

Question 5

Choose the strongest acid from the following.

a) $HClO_4$
b) $HClO_3$
c) $HClO_2$
d) HOCl
e) None of the above

Correct Answer: a) $HClO_4$

Explanation:

HClO4 is the strongest acid than the rest of the acids. The acidity is due to the presence of the more electronegative oxygen. The acid with ore oxygen is the strongest acid and it has the highest electronegativity. It can easily pull the electrons from the central atom and induces the central atom to draw the electrons from the hydrogenated oxygen. This weakens the O-H bond and H+ ion leaves the molecule easily.

Question 6

Which of the following represents a spontaneous reaction if T = +10 k?

a) ΔH = +10, ΔS = -30
b) ΔH = +10, ΔS = +30
c) ΔH = -10, ΔS = +30
d) ΔH = -10, ΔS = -30
e) Both b and d

Correct Answer: e) Both b and d

Explanation:

If the value of enthalpy is negative and the entropy is positive then the reaction is always spontaneous (ΔH = -10, ΔS = +30). If both enthalpy and entropy are negative (ΔH = -10, ΔS = -30), and T < ΔH/ ΔS then the reaction is spontaneous at low temperature.

Question 7

Choose the correct phrase(s) that can apply to first order reactions.
I) The overall rate of the reaction is proportional to the concentration of one of the reactants.
II) If the concentration of the reactant is doubled, the rate is doubled.
III) The unit of rate constant for a first order reaction is sec-1 or time-1.

a) I and III only
b) I and II only
c) I only
d) I, II and III
e) III only

Correct Answer: d) I, II and III

Explanation:

Rate of a first order reaction, depends only on one of the reactant's concentrations. When the concentration of the reactant is increased by 'n' times, the rate of reaction is also increased by 'n' times. The unit of rate constant for the first order reaction is sec-1 or $time^{-1}$.
k_1 = rate/ (a-x) = $mol.lit^{-1}sec^{-1}$/ $mol.lit^{-1}$ = sec^{-1}

Question 8

Predict whether the following half-cell reactions are Oxidation or Reduction.

a) I-Oxidation reaction, II- Reduction reaction
b) I-Reduction reaction, II- Oxidation reaction
c) Both I and II are Oxidation reactions
d) Both I and II are Reduction reactions
e) None of the above

Correct Answer: b) I- Reduction reaction, II- Oxidation reaction

Explanation:

Reduction reaction is one in which, an atom or an ion accepts an electron. Oxidation reaction is one in which, an atom or an ion releases an electron. In the first reaction, Cu2+ ion accepts two electrons. Therefore, it undergoes reduction. In the second reaction, Cu atom releases two electrons. Therefore, it undergoes oxidation.

Question 9

Which of the following element has no neutrons in the nucleus?

a) Helium
b) Deuterium
c) Hydrogen
d) tritium
e) An alpha particle

Correct Answer: c) Hydrogen

Explanation:

Hydrogen has only one proton and one electron and no neutron is present. Deuterium has one proton and one neutron. Tritium has one proton and two neutrons in its nucleus. An alpha particle is also known as helium atom and it has two neutrons.

Question 10

Binding energy of an atom is

a) $\Delta E = mc/\lambda$
b) $\Delta E = \Delta mc^2$
c) $\Delta E = \Delta mc$
d) $\Delta E = m/c^2$
e) $\Delta E = mc/v$

Correct Answer: $\Delta E = \Delta mc^2$

Explanation:

The atomic mass of any atom is less than the sum of the protons, neutrons and electrons present in it. This defect in the mass is measured by the binding energy. Binding energy of an atom can be calculated using the equation $\Delta E = \Delta mc^2$, where ΔE – energy liberated, Δm – loss of mass and c- speed of light in vacuum.

Question 11

Which of the following are nucleophiles?

a) H^+
b) H_3O^+
c) CO_2
d) $AlCl_3$
e) NH_3

Correct Answer: e) NH_3

Explanation:

Generally, electron pair donors are called as nucleophiles. In the case of ammonia, it has a lone of pair of electrons. So, it can donate the electron to the other atoms. But, the rest of the atoms can't donate a pair of electrons instead they can accept a pair of electrons. So, except ammonia all the other molecules above are known as electrophiles.

Question 12

The ratio of relative abundance of two molecular ion peaks of a chlorine atom in mass spectroscopy is

a) $M^+ : (M+2) = 1:3$
b) $M^+ : (M+2) = 3:1$
c) $M^+ : (M+2) = 1:2$
d) $M^+ : (M+2) = 2:1$
e) $M^+ : (M+2) = 1:1$

Correct Answer: b) $M^+ : (M+2) = 3:1$

Explanation:

The ratio of relative abundance of two molecular ion peaks of a chlorine atom in mass spectroscopy is $M^+ : (M+2) = 1:3$, because the natural abundance of chlorine is higher than other elements. The natural abundance of chlorine is Cl^{35}- 75.77% and Cl^{37}t- 24.23%.

Question 13

Compound A reacts by first order kinetics. The rate constant of the reaction is 0.45 sec^{-1}. Calculate the half-life of the compound A in the reaction.

a) 4.62 seconds
b) 3.08 seconds
c) 1.54 seconds
d) 2.25 seconds
e) 0.9 seconds

Correct Answer: c) 1.54 seconds

Explanation:

Half-life period of the first order reaction can be calculated using the following formula, which is derived from the first order rate law.
$t_{1/2} = 0.693/k_1$ seconds.
Therefore, $t_{1/2} = 0.693/ 0.45\ sec^{-1} = 1.54$ seconds.

Question 14

The standard EMF value of a reaction I is $E^o_{cell} = -1.563$ and for a reaction II it is $E^o_{cell} = +0.86$. Predict the feasibility of these reactions.

a) Reaction I is not feasible, reaction II is feasible
b) Reaction I is feasible, reaction II is not feasible
c) Both the reactions are feasible
d) Both the reactions are not feasible
e) Can't be predicted using these values.

Correct Answer: a) Reaction I is not feasible, reaction II is feasible

Explanation:

In general, if E^o_{cell} is positive, the reaction is feasible. If E^o_{cell} is negative, the reaction is not feasible. Here, the E^o_{cell} of the reaction I is negative, therefore the reaction is not feasible and E^o_{cell} of the reaction II is positive, therefore the reaction is feasible.

Question 15

“No pairing occurs until all orbitals of a given sub level are half filled”. The statement is known as

a) Exclusion principle
b) Uncertainty principle
c) Hund's rule
d) Aufbau principle
e) Bohr's theorem

Correct Answer: c) Hund's rule

Explanation:

Exclusion principle states that it is impossible for any two electrons in a given atom to have all the four quantum numbers identical. Hund's rule states, “No pairing occurs until all orbitals of a given sub level are half filled”. Aufbau principle defines that in the ground state of the atoms the orbitals are filled in order of their increasing energies. Uncertainty principle states that the position and momentum of a particle can't be simultaneously measured with high precision.