

Sample paper 9

Question 1

The critical temperature of gas in terms of Van der Waals constant

- a) $3b$
- b) $a/27b^2$
- c) $2a/Rb$
- d) $8a/27Rb$
- e) a/bR

Correct Answer: d) $8a/27Rb$

Explanation:

a- Van der Waals constant

R-Universal gas constant

b- Excluded volume

Critical temperature is defined as the temperature above which a gas cannot be liquefied by applying pressure. It's denoted as T_c . It can be expressed in terms of Van der Waals constant $T_c = 8a/27Rb$. It's derived from the Vander Waals equation.

Question 2

The order of randomness of the atoms or ions in solids, liquids and gases.

- a) Solid < Liquid < Gas
- b) Gas < Solid < Liquid
- c) Liquid < Gas < Solid
- d) Liquid = Gas = Solid
- e) None of the above

Correct Answer: a) Solid < Liquid < Gas

Explanation:

Randomness will be very high in gases than in liquids, in which it is higher than in solids. In a solid, inter molecular force of attraction will be very high than that of a liquid and a gas. Therefore, there is close packing of molecules or atoms or ions. This arrangement exists to some extent in the liquid state. In gases, there is no such arrangement of close packing of molecules or atoms due to the absence of inter molecular forces.

Question 3

According to Bronsted-Lowry concept, acid is a/an

- a) Electron donor
- b) Oxide donor
- c) Proton donor
- d) Proton acceptor
- e) Electron acceptor

Correct Answer: c) Proton donor

Explanation:

According to Bronsted-Lowry acid-base theory, an acid is a proton donor and a base is a proton acceptor. Based on Lewis acid – base concept, an acid is an electron acceptor and a base is an electron donor.

Question 4

In a first order reaction, 25% of the reactant decomposed in 40.5 min. Find the rate constant of the reaction.

- a) $7.1 \times 10^{-3} \text{ min}^{-1}$
- b) $0.71 \times 10^{-2} \text{ atm}^{-1} \text{ min}^{-1}$
- c) $5.6 \times 10^{-2} \text{ min}^{-1}$
- d) $0.56 \times 10^{-1} \text{ atm}^{-1} \text{ min}^{-1}$
- e) $1.2 \times 10^{-1} \text{ min}^{-1}$

Correct Answer: a) $7.1 \times 10^{-3} \text{ min}^{-1}$

Explanation:

Since, the reactant is 25% decomposed in 40.5 min, the remaining reactant is 75%.

Rate equation $k_1 = (2.303/t) \log (a/a-x)$

a = initial concentration

a-x = remaining concentration of the reactant

t = time

Therefore, $k_1 = (2.303/40.5 \text{ min}) \log (a/0.75a) = 0.05686 \log 1.33 \text{ min}^{-1}$

$k_1 = 7.1 \times 10^{-3} \text{ min}^{-1}$

Question 5

The angle between the axial chlorine and the equatorial chlorine in PCl_5 is

- a) 180°
- b) 120°
- c) 90°
- d) 109°
- e) 60°

Correct Answer: c) 90°

Explanation:

The geometry of PCl_5 is trigonal bi pyramidal. The angle between the axial chlorine and the equatorial chlorine is 90° and the angle between the two equatorial chlorines is 120° .

Question 6

A spectroscopy technique that allows us to find out the functional group of a molecule is

- a) Microwave spectroscopy
- b) Proton NMR spectroscopy
- c) Mass spectroscopy
- d) IR spectroscopy
- e) UV-Vis spectroscopy

Correct Answer: d) IR spectroscopy

Explanation:

Microwave spectroscopy is used to find out the bond length of a molecule. Proton NMR spectroscopy is used to find out the proton skeleton of a molecule. Mass spectroscopy allows us to find out the molecular mass and molecular formula of a compound. IR spectroscopy allows us to find out the functional group a molecule. UV-Vis spectroscopy is used to determine the electronic transition of a molecule.

Question 7

Which of the following alkyl bromide reacts faster in S_N1 reaction?

- a) Methyl bromide
- b) Ethyl bromide
- c) Propyl bromide
- d) Isopropyl bromide
- e) tert-butyl bromide

Correct Answer: e) tert-butyl bromide

Explanation:

Generally, in S_N1 tertiary carbocation is more stable than the secondary carbocation than the primary carbocation. Therefore, alkyl halides, which can form tertiary carbocation, will react faster than the rest of the alkyl halides. Here, methyl bromide, ethyl bromide and propyl bromide can form primary carbocation and isopropyl bromide can form the secondary carbocation, whereas, the tert-butyl bromide can form the tertiary alkyl halide. Therefore, tert-butyl bromide will react faster than the rest of the molecules.

Question 8

What type of nuclear reaction occurs in the sun?

- a) Nuclear fission
- b) Nuclear fusion
- c) Spallation reaction
- d) Transmutation
- e) None of the above

Correct Answer: a) Nuclear fission

Explanation:

The amount of energy in sun is very high due to the presence of nuclear fission reaction. Nuclear fission reaction occurs between protons, which produces enormous amount of energy in the sun.

Question 9

The geometry of ammonia molecule is

- a) Linear
- b) Trigonal planar
- c) Tetrahedral
- d) Pyramidal
- e) Square pyramidal

Correct Answer: d) Pyramidal

Explanation:

The hybridization of ammonia molecule is sp^3 . But the molecule is in pyramidal structure due to the presence of the lone pair-bond pair repulsion.

Question 10

The oxidation number of oxygen in O_2F_2 is

- a) +2
- b) +1
- c) 0
- d) -1
- e) -2

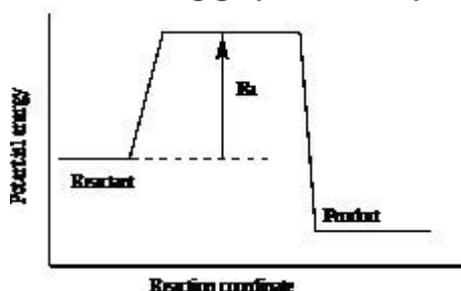
Correct Answer: b) +1

Explanation:

In general oxidation number of oxygen is -2. But in this molecule the oxidation number is +1, because fluorine is more electronegative than oxygen. Therefore, it takes the negative oxidation number -1 and oxygen takes the positive oxidation number.

Question 11

In the following graph E_a corresponds to



- a) Kinetic energy
- b) Potential energy
- c) Threshold energy
- d) Activation energy
- e) Chemical energy

Correct Answer: d) Activation energy

Explanation:

In the potential energy diagram E_a corresponds to the activation energy of the reactant. Activation energy is defined as the minimum amount of energy that a molecule should possess to involve in the chemical reaction.

Question 12

Calculate the amount of heat energy required to raise the temperature of 100 g of water from 25°C to 50°C. Specific heat of water is 4.18 J/g. °C.

- a) 20900 J
- b) 15400 J
- c) 10450 J
- d) 7500 J
- e) Can't be predicted using these values

Correct Answer: c) 10450 J

Explanation:

Heat energy = C.m.ΔT

Where, C- specific heat of the substance

m- mass of substance (g)

ΔT- Temperature change

Therefore heat energy = 4.18 J/ g. °C × 100 × 25°C = 10450 J

Question 13

Which of the following atomic orbitals contains one nodal plane?

- a) 3s
- b) 3p_y
- c) 3d_{z²}
- d) 3d_{xy}
- e) 2s

Correct Answer: b) 3p_y

Explanation:

Each p-orbital has one nodal plane. S-orbital has zero nodal planes. Each d-orbital has two nodal planes.

Question 14

Identify the name of the mechanism for the following reaction.



- a) E₂
- b) E₁
- c) S_N¹
- d) S_N²
- e) Addition

Correct Answer: d) S_N²

Explanation:

The above reaction indicates that it undergoes a Walden inversion. The nucleophile (I^-) of the product is behind the plane to the plane of the leaving group (Br^-). The reaction takes place in single step mechanism with aprotic solvent. So, it is a S_N2 reaction.

Question 15**Osmotic pressure can be used to determine**

- a) Molar mass of solute
- b) Total pressure of solution
- c) Partial pressure of gas
- d) Mole fraction of gas
- e) None of these

Correct Answer: a) Molar mass of solute

Explanation:

Osmotic pressure can be used to determine the molar mass of solute. $M_2 = (W_2RT) / \pi V$; where $\pi = CRT$; where, C-Concentration of the solute, R-Gas constant, T-Temperature; So, $M_2 = W_2/C \cdot V$. Osmotic pressure depends only on the molar concentration of solute. Using Dalton's law total pressure of solution can be calculated. Using Henry's law, partial pressure of gas in vapour state can be calculated.