Code : N

CAREER LAUNCHER Inspiring leadership 8-12

Chemistry

81. The equivalent conductances of two strong electrolytes at infinite dilution in H_2O (where ions move freely through a solution) at 25°C are given below

$\Lambda^\circ_{CH_3COONa} = 91.0\,S\,cm^2/equiv$

$\Lambda^\circ_{HCl} = 426.2\,S\,cm^2/equiv$

What additional information/quantity one needs to calculate Λ° of an aqueous solution of acetic acid?

(1) Λ° of chloroacetic acid ($ClCH_2COOH$)

(2) Λ° of NaCl

(3) Λ° of CH_3COOK

(4) The limiting equivalent conductance of H^+ $\left(\lambda^\circ_{H^+}\right)$

Sol. (2)

According to Kohlrausch' law

$$\Lambda_{m_{CH_3COOH}} = \Lambda^\infty_{m_{CH_3COO^-Na^+}} + \Lambda^\infty_{m_{HCl}} - \Lambda^\infty_{m_{NaCl}}$$

$\therefore \Lambda^\infty_m$ of NaCl is required.

82. Which one of the following is the strongest base in aqueous solution?

(1) Methylamine (2) Trimethylamine

(3) Aniline (4) Diemethylamine

Sol. (3)

Dimethylamine is the strongest base in aqueous solution

Order of basic character in aqueous solution is

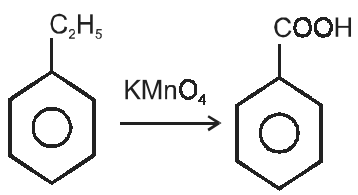
2° amine > 1° amine > 3° amine

83. The compound formed as a result of oxidation of ethyl benzene by $KMnO_4$ is

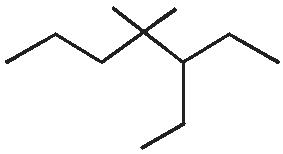
(1) benzyl alcohol (2) benzophenone

(3) acetophenone (4) benzoic acid

Sol. (4)

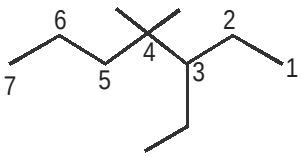


On oxidation with $KMnO_4$ the side chain attached to ring gets oxidised to —COOH group.

84. The IUPAC name of  is

(1) 3-ethyl-4, 4-dimethylheptane
(2) 1,1-diethyl-2, 2-dimethylpentane
(3) 4,4-dimethyl-5, 5-diethylpentane
(4) 5,5-diethyl-4, 4-dimethylpentane

Sol. (1)



The IUPAC name of the compound is 3-ethyl-4, 4-dimethylheptane.

85. Which of the following species exhibits the diamagnetic behaviour?

(1) NO (2) O_2^{2-} (3) O_2^{+} (4) O_2

Sol. (2)

Species	Molecular orbital configuration.
NO	$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p^2x = \pi 2p^2y, \sigma 2p^2_z, \pi^*2px = \pi^*2py$
O_2^{2-}	$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z{}^2 \pi 2p^2x = \pi 2p^2y, \pi^*2p^2x = \pi^*2p^2y, \sigma * 2p^2_z$
O_2^{+}	$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p^2_z, \pi 2p^2x = \pi 2p^2y, \pi * 2p^1x = \pi^*2py$
O_2	$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p^2_z, \pi 2p^2x = \pi 2p^2y, \pi^*2p^1x = \pi^*2p^1x$

$\therefore$ Only O_2^{2-} does not contain any unpaired electron and is diamagnetic.

86. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence

(1) $PbX_2 \ll SnX_2 \ll GeX_2 \ll SiX_2$
(2) $GeX_2 \ll SiX_2 \ll SnX_2 \ll PbX_2$
(3) $SiX_2 \ll GeX_2 \ll PbX_2 \ll SnX_2$
(4) $SiX_2 \ll GeX_2 \ll SnX_2 \ll PbX_2$

Sol. (4)

Stability of +2 oxidation state in group 14 increases down the group

$\therefore$ correct order is $SiX_2 \ll GeX_2 \ll Sn\ X_2 \ll PbX_2$

87. Identify the incorrect statement among the following:
(1) Br_2 reacts with hot and strong NaOH solution to give NaBr, $NaBrO_4$ and H_2O
(2) Ozone reacts with SO_2 to give SO_3
(3) Silicon reacts with $NaOH_{(aq)}$ in the presence of air to give Na_2SiO_3 and H_2O
(4) Cl_2 reacts with excess of NH_3 to give N_2 and HCl

Sol. (3)

Si dissolves in hot aqueous alkali to liberate hydrogen

$$Si + 4OH^- \rightarrow SiO_4^{4-} + 2H_2$$

88. The charge/size ratio of a cation determines its polarizing power. Which <u>one</u> of the following sequences represents the <u>increasing order</u> of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Be^{2+}?
(1) $Ca^{2+} < Mg^{2+} < Be^{2+} < K^+$ (2) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
(3) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$ (4) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

Sol. (4)

Polarising power of cation $\alpha \frac{\text{charge}}{\text{size}}$, for $Be^{2+}, Mg^{2+}, Ca^{2+}$ since charge is same and size is in the order $Ca^{2+} > Mg^{2+} > Be^{2+}$, the order of polarising power is $Be^{2+} > Mg^{2+} > Ca^{2+}$ charge of K^+ is lowest and size is larger than Ca^2+
$\therefore$ its polarising power is lowest.

Hence the correct order is $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

89. The density (in g mL^{-1}) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (Molar mass = 98 g mol^{-1}) by mass will be
(1) 1.45 (2) 1.64 (3) 1.88 (4) 1.22

Sol. (4)

Let the mass of solution be 100 g then mass of H_2SO_4 =29 g

$$\text{moles of } H_2SO_4 = \frac{29}{98} = 29 \cdot 59 \times 10^{-2}$$

$$\text{Molarity} = \frac{\text{no of moles}}{\text{Volume of solution (L)}}$$

$$V(L) = \frac{\text{no of moles}}{\text{molarity}}$$

$$= \frac{29 \cdot 59 \times 10^{-2}}{3.6}$$

$= 8.22 \times 10^{-2}$ L

= 82.2 mL

$\therefore$ density of solution = $\frac{\text{mass of solution}}{\text{volume of solution}}$

$= \frac{100}{82.2} = 1.22$ g/ml

90. The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. The overall dissociation constant of the acid will be

(1) 0.2×10^{5} (2) 5.0×10^{-5} (3) 5.0×10^{15} (4) 5.0×10^{-15}

Sol. (4)

$K_1 = 1.0 \times 10^{-5}$

$K_2 = 5.0 \times 10^{-10}$

$K_{Total} = K_1 \times K_2 = 5 \times 10^{-15}$

91. A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be

(1) 360 (2) 350 (3) 300 (4) 700

Sol. (2)

Let ethanol be component A and propanol be component B.

$P_T = P_A^\circ x_A + P_B^\circ x_B$

$290 = P_A^\circ \times 0.6 + 200 \times 0.4$

$290 = 0.6 + P_A^\circ + 80$

$0.6 \times P_A^\circ = 210$

$P_A^\circ = \frac{210}{0.6} = 350$ mm of Hg

92. In conversion of lime-stone to lime, $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

the values of ΔH° and ΔS° are +179.1 kJ mol^{-1} and 160.2 J/K respectively at 298 K and 1 bar. Assuming that ΔH° and ΔS° do not change with temperature, temperature above which conversion of limestone to lime will be spontaneous is

(1) 1118 K (2) 1008 K (3) 1200 K (4) 845 K

Sol. (1)

$\Delta H^\circ = +179.1\,kJ/mol$

$\Delta S^\circ = +160.2\ J/K$

$T = 298\ K,\ P = 1\,bar$

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

at equilibrium $\Delta G^\circ = 0\ \ \Delta H^\circ = T\Delta S^\circ$

$$T = \frac{\Delta H^\circ}{\Delta S^\circ} = \frac{179.1\times 10^3}{160.2} = 1117.98\ K$$

Therefore conversion of limestone to line will be spontaneous above 1118 K

93. The energies of activation for forward and reverse reactions for $A_2 + B_2 \rightleftharpoons 2AB$ are 180 kJ mol^{-1} and 200 kJ mol^{-1} respectively. The presence of a catalyst lowers the activation energy of both (forward and reverse) reactions by 100 kJ mol^{-1}. The enthalpy change of the reaction $(A_2 + B_2 \rightarrow 2AB)$ in the presence of catalyst will be (in kJ mol^{-1})

(1) 20 (2) 300
(3) 120 (4) 280

Sol. (1)

In the presence of catalyst
E_a (forward) = 80 kJ/mol
E_a (backward) = 100 kJ/mol

$\Delta H = E_a(\text{forward}) - E_a(\text{backward})$

= 80 – 100
= – 20 kJ/mol. (Considering options (1) is correct.)

94. The cell, $Zn\,|\,Zn^{2+}\ (1M)\,||\,Cu^{2+}\ (1M)\,|\,Cu\left(E^0_{cell} = 1.10\ V\right)$, was allowed to be completely discharged at 298 K. The relative concentration of Zn^{2+} to Cu^{2+}, $\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ is

(1) 9.65×10^4 (2) antilog (24.08)
(3) 37.3 (4) $10^{37.3}$

Sol. (4)

$Zn\left|Zn^{2+}(IM)\right|\left|Cu^{2+}\ (IM)\right|Cu$

E° cell = 1.10 V

$\Delta G^\circ = -nFE^\circ_{cell}$

$= -2 \times 96500 \times 1.1\,J$

$\Delta G^\circ = -2.12 \times 10^5$

$\Delta G^\circ = -RT \ln K$

$= -2.303\,RT \log \frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]}$

$\therefore \log \frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]} = \frac{2.12 \times 10^5}{-2.303 \times 8.314 \times 298}$

$\log \frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]} = 37.15$

or $\frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]} = 10^{37.15}$

95. The pK_a of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA in which 50% of the acid is ionized is

(1) 7.0 (2) 4.5 (3) 2.5 (4) 9.5

Sol. (4)

$pH = pK_a + \log \frac{[Salt]}{Acid}$

$pH = 4.5 + \log \frac{1}{1}$

pH = 4.5

pOH = 14 – 4.5 = 9.5

96. Consider the reaction,

$2A + B \rightarrow Products$

When concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is

(1) s^{-1} (2) L mol^{-1} s^{-1} (3) no unit (4) mol L^{-1} s^{-1}

Sol. (1)

(1) It is example of first order reaction.

(2) The unit of rate constant for this reaction is sec^{-1} .

97. Identify the incorrect statement among the following

(1) 4*f* and 5*f* orbitals are equally shielded

(2) d-block elements show irregular and erratic chemical properties among themselves

(3) La and Lu have partially filled d orbitals and no other partially filled orbitals

(4) The chemistry of various lanthanoids is very similar.

Sol. (1)

4f and 5f orbitals are equally shielded is incorrect statement.

98. Which one of the following has a square planar geometry?

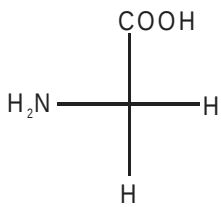
(1) $[PtCl_4]^{2-}$ (2) $[CoCl_4]^{2-}$ (3) $[FeCl_4]^{2-}$ (4) $[NiCl_4]^{2-}$

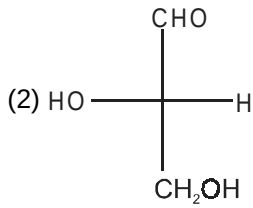
(At. nos. Co = 27, Ni = 28, Fe = 26, Pt = 78)

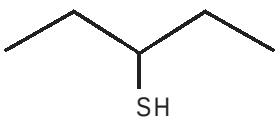
Sol. (1)

$[PtCl_4]^{2-}$ has a square planar geometry.

99. Which of the following molecules is expected to rotate the plane of plane-polarised light ?

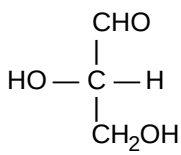
(1) 

(2) 

(3) 

(4) 

Sol. (2)

Only  is chiral.

100. The secondary structure of protein refers to:
(1) fixed configuration of the polypeptide backbone
(2) α – helical backbone
(3) hydrophobic interactions
(4) sequence of α – amino acids

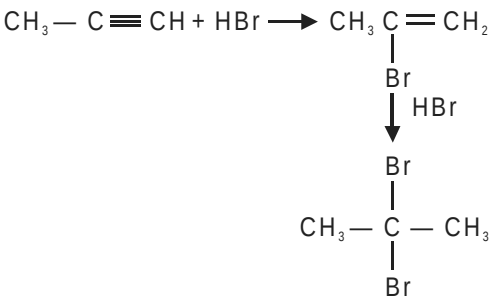
Sol. (2)

101. Which of the following reactions will yield 2, 2- dibromopropane ?

(1) $CH_3 - CH = CH_2 = HBr \rightarrow$ (2) $CH_3 - C \equiv CH = 2HBr \rightarrow$

(3) $CH_3CH = CHBr + HBr \rightarrow$ (4) $CH \equiv CH + 2HBr \rightarrow$

Sol. (2)



102. In the chemical reaction,

$CH_3CH_2NH_2 = CHCl_3 + 3KOH \rightarrow$

(A) + (B) + $3H_2O$, the compounds (A) and (B) are respectively:

(1) C_2H_5NC and 3KCl (2) C_2H_5CN and 3KCl

(3) $CH_3CH_2CONH_2$ and 3KCl (4) C_2H_5NC and K_2CO_3

Sol. (1)

It is carbylamine reaction

$$CH_2CH_2NH_2 + CHCl_3 + 3KOH \longrightarrow \underset{(A)}{C_2H_5NC} + 3KCl + \underset{(B)}{3H_2O}$$

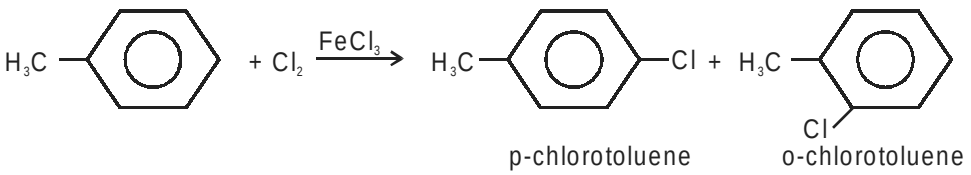
103. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives predominantly:

(1) m - chlorotoluene (2) benzoyl chloride

(3) benzyl chloride (4) o - and p - chlorotoluene

Sol. (4)

—CH_3 group is o-and p- directing, and in the presence of $FeCl_3$, electrophilic aromatic substitution takes place.



104. Presence of a nitro group in a benzene ring
(1) deactivates the ring towards electrophilic substitution
(2) activates the ring towards electrophilic substitution
(3) renders the ring basic.
(4) deactivates the ring towards nucleophilic substitution

Sol. (1)

—NO_2 reduce the electron density on benzene ring. So, it deactivates the ring towards electrophilic substitution reaction.

105. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed ?

(1) $N_2 \rightarrow N_2^+$ (2) $C_2 \rightarrow C_2^+$

(3) $NO \rightarrow NO^+$ (4) $O_2 \rightarrow O_2^+$

Sol. (4)

O_2^+ loses one electron from antibonding molecular orbital, so the bond order increases and magnetic behaviour change due to change in number of unpaired electrons.

106. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because
(1) the 5*f* orbitals extend farther from the nucleus than 4*f* orbitals
(2) the 5*f* orbitals are more buried than the 4*f* orbitals
(3) there is similarity between 4*f* and 5*f* orbitals in their angular part of the wave function.
(4) the actinoids are more reactive than the lanthanoids

Sol. (1)

107. Equal masses of methane and oxygen are mixed in an empty container at 25 °C. The fraction of the total pressure exerted by oxygen is

(1) $\frac{1}{2}$ (2) $\frac{2}{3}$ (3) $\frac{1}{3} \times \frac{273}{298}$ (4) $\frac{1}{3}$

Sol. (4)

Let masses of methane and oxygen be m and total pressure be P.

$$\text{Partial pressure of } O_2 = \frac{\frac{m}{32}}{\frac{m}{32}+\frac{m}{16}} \times P = \frac{1}{3} \times P$$

108. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 g mol $^{-1}$) in the same solvent. If the densities of both the solution are assumed to be equal to 1.0 gm^{-3}, molar mass of the substance will be

(1) 210.0 g mol^{-1} (2) 90.0 g mol^{-1}

(1) 115.0 g mol^{-1} (1) 105.0 g mol^{-1}

Sol. (1)

$\pi_1 = \pi_2$

$$\frac{w_1}{M_1V_1}R = T = \frac{w_2}{M_2V_2}RT$$

$V_1 = V_2$ because densities are same

$$\frac{5.26}{M_1} = \frac{1.5}{60}$$

$$\text{or } M_1 = \frac{5.25 \times 60}{1.5} = 210 \text{ gmol}^{-1}$$

109. Assuming that water vapour is an ideal gas, the internal energy change (ΔU) when 1 mol of water is vapourised at 1 bar pressure and 100 °C, Given Molar enthalpy of vapourisation of water at 1 bar and 373 K = 41 kJ mol^{-1} and R = 8.3 J mol^{-1} K^{-1}) will be:

(1) 41.00 kj mol^{-1} (2) 4.100 kj mol^{-1}

(3) 3.7904 kj mol^{-1} (4) 37.904 kj mol^{-1}

Sol. (4)

$\Delta H - \Delta U = P\Delta V = nRT$

$\Delta U = \Delta H - nRT$

$= 41000 - 1 \times 8.3 \times 373$

$= 37904.1$ J mol^{-1}

$= 37.904$ kJ mol^{-1}

110. In a saturated solution of the sparingly soluble strong electrolyte $AgIO_3$ (Molecular mass = 283) the equilibrium which sets in is

$$AgIO_{3(s)} \rightleftharpoons Ag^{+}_{(aq)} + IO^{-}_{3(aq)}$$

If the solubility product constant K_{sp} of $AgIO_3$ at a given temperature is 1.0×10^{-8}, what is the mass of $AgIO_3$ contained in 100 ml of its saturated solution ?

(1) 1.0×10^{-4} g (2) 28.3×10^{-2} g

(3) 2.83×10^{-3} g (4) 1.0×10^{-7} g

Sol. (3)

Concentration $AgIO_3 = 10^{-4}$

Moles of $AgIO_3 = \frac{100}{1000}\times10^{-4} = 10^{-5}$

Mass of $AgIO_3 = 10^{-5}\times283 = 2.83\times10^{-3}$ g

111. A radioactive element gets spilled over the floor of a room. Its half-life period is 30 days. If the initial activity is ten times the permissible value, after how many days will it be safe to enter the room ?

(1) 100 days (2) 1000 days

(3) 300 days (4) 10 days

Sol. (1)

$$t = 30\times\frac{2.303}{0.693}\log\frac{10}{1}$$

t = 100 days.

112. Which one of the following conformations of cyclohexane is chiral ?

(1) Boat (2) Twist boat

(3) Rigid (4) Chair

Sol. (2)

Twist boat form

113. Which of the following is the correct order of decreasing SN^2 reactivity ?

(1) $R_2CHX > R_3CX > RCH_2X$ (2) $RCH_2X > R_3CX > R_2CHX$

(3) $RCH_2X > R_2CHX > R_3CX$ (4) $R_3CX > R_3CHX > RCH_2X$

(X = a halogen)

Sol. (3)

$RCH_2X > R_2CHX > R_3CX$

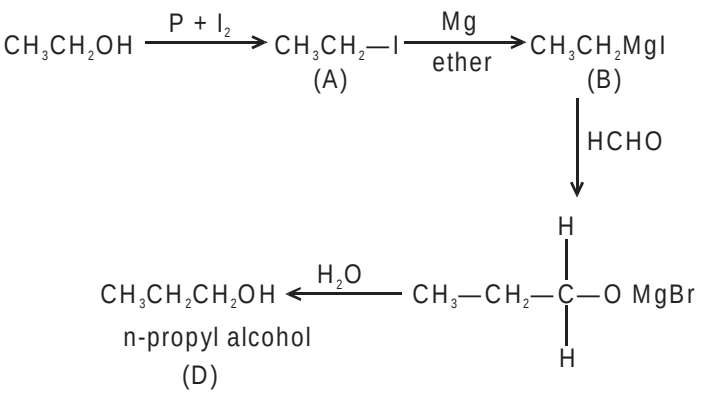
114. In the following sequence of reactions,

$CH_3CH_2OH \xrightarrow{P+I_2} A \xrightarrow{Mg} B \xrightarrow{HCHO} C \xrightarrow{H_2O} D$ the compound 'D' is"

(1) propanal (2) butanal

(3) n-butyl alcohol (4) n-propyl alcohol

Sol. (4)



115. Which of the following sets of quantum numbers represents the highest energy of an atom?

(1) n = 3, l = 0, m = 0, s = + 1/2 (2) n = 3, l = 1, m = 1, s = + 1/2

(3) n = 3, l = 2, m = 1, s = + 1/2 (4) n = 4, l = 0, m = 0, s = + 1/2

Sol. (1)

The order of energy is

3d > 4s > 3p > 3s

$\therefore$ n = 3, l = 2, m = 1, s = + $\frac{1}{2}$

116. Which of the following hydrogen bonds is the strongest ?

(1) O – H .....F (2) O – H .... N

(3) F – H .....F (4) O – H .... O

Sol. (3)

F – H .... F has strongest hydrogen bond.

117. In the reaction, $2Al_{(s)} + 6HCl_{(aq)} \rightarrow 2Al^{3+}_{(aq)} + 6Cl^{-}_{(aq)} + 3H_{2(g)}$,

(1) 11.2 L H_2(g) at STP is produced for every mole $HCl_{(aq)}$ consumed

(2) 6 L $HCl_{(aq)}$ is consumed for every 3L H_2(g) produced

(3) 33.6 L H_2(g) produced regardless of temperature and pressure for every mole Al that reacts

(4) 67.2 L H_2(g) at STP is produced for every mole Al that reacts

Sol. (1)

6 mol of HCl (aq) produced 3 mol of H_2

$\therefore 1$ mol of HCl(aq) = $\frac{3}{6} = .5$ mol

Volume of H_2 gas = $.5 \times 22.7 = 11.35$ L

118. Regular use of which of the following fertilizers increases the acidity of soil ?

(1) Ammonium sulphate (2) Potassium nitrate

(3) Urea (4) Superphosphate of lime

Sol. (1)

Ammonium sulphate increases acidity of soil.

119. Identify the correct statement regarding a spontaneous process:

(1) Lowering of energy in the reaction process is the only criterion for spontaneity

(2) For a spontaneous process in an isolated system, the change in entropy is positive

(3) Endothermic processes are never spontaneous

(4) Exothermic processes are always spontaneous

Sol. (2)

For spontaneous reaction free energy change must be negative, for isolated system it happens when entropy changes is positive. (At constant pressure)

120. Which of the following nuclear reactions will generate an isotope ?

(1) β – particle emission (2) neutron particle emission

(3) positron emission (4) α -particle emission

Sol. (2)

Neutron particle emission.