JEE MAIN JAN'19

QUESTION WITH SOLUTION

DATE : 10-01-2019 _ MORNING

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[CHEMISTRY]

1. A process has $\Delta H = 200\ \text{Jmol}^{-1}$ and $\Delta S = 40\ \text{JK}^{-1}\text{mol}^{-1}$. Out of the values given below, choose the minimum temperature above which the process will be spontaneous:

(A) 12 K (B) 20K (C) 4 K (D) 5 K

Sol. **D**

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

$T = \dfrac{\Delta H}{\Delta S} = \dfrac{200}{40} = 5K$

2. Consider the following reduction processes:

$Zn^{2+} + 2e \rightarrow Zn(s); E^0 = 0.76V$

$Ca^{2+} + 2e \rightarrow Ca(s); E^0 = 2.87V$

$Mg^{2+} + 2e \rightarrow Mg(s); E^0 = -2.36V$

$Ni^{2+} + 2e \rightarrow Ni(s); E^0 = 0.25V$

The reducing power of the metals increases in the order :

(A) Ca <Mg<Zn<Ni (B) Ni <Zn<Mg<Ca (C) Ca <Zn<Mg<Ni (D) Zn <Mg<Ni<Ca

Sol. **B**

Higher the oxidation potential better will be reducing power.

3. Two pi and half sigma bonds are present in :

(A) O_2^+ (B) N_2 (C) N_2^+ (D) O_2

Sol. **C**

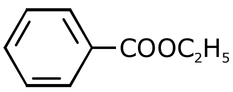
$N_2^{\oplus} \Rightarrow BO = 2.5 \Rightarrow [\pi - \text{Bond} = 2\ \&\ \sigma\text{–bond} = \frac{1}{2}]$

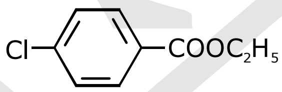
$N_2 \Rightarrow B.O. = 3.0 \Rightarrow [\pi\text{-Bond} = 2\ \&\ \sigma\text{-Bond} = 1]$

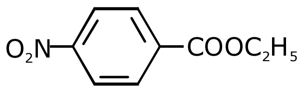
$O_2^{\oplus} = B.O. \Rightarrow 2.5 \Rightarrow [\pi\text{-Bond} \Rightarrow 1.5\ \&\ \sigma\text{-Bond} = 1]$

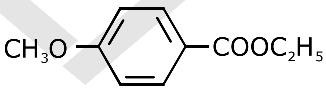
$O_2 \Rightarrow B.O. \Rightarrow 2 \Rightarrow [\pi\text{-Bond} \Rightarrow 1\ \&\ \sigma\text{-bond} = 1]$

4. The decreasing order of ease of alkaline hydrolysis for the following esters is

I. 

II. 

III. 

IV. 

(A) IV>II>III>I (B) III>II>I>IV (C) III>II>IV>I (D) II>III>I>IV

Sol. **B**

More is the electrophilic character of carbonyl group of ester faster is the alkaline hydrolysis

5. The values of K_p/K_c for the following reactions at 300 K are, respectively: (At 300K, RT = 24.62 dm_3 atm mol^{-1})

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$N_2O_4(g) \rightleftharpoons 2NO_2$

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(A) 1, 24.62 dm^3 atm mol^{-1}, $1.62 \times 10^{-3}\ dm^{-2}$ atm^{-2} mol^2

(B) $1, 4.1 \times 10^{-2}\ dm^{-3} atm^{-1} mol, 606\ dm^6 atm^2 mol^{-2}$

(C) $1, 24.62 dm^3 atm\ mol^{-1}, 606.0\ dm^6 atm^2 mol^{-2}$

(D) $24.62 dm^3 atm\ mol^{-1}, 606.0 dm^6 atm^2 mol^{-2}, 1.65 \times 10^{-3}\ dm^{-6} atm^{-2} mol^2$

Sol. **A**

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$\frac{k_p}{k_c} = (RT)^{\Delta ng} = (RT)^0 = 1$

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$\frac{k_p}{k_c} = (RT)^1 = 24.62$

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

$\frac{k_p}{k_c} = (RT)^{-2} = \frac{1}{(RT)^2} = 1.65 \times 10^{-3}$

6. Hall-Haroult's process is given by:

(A) $ZnO + C \xrightarrow{\text{Coke},1673K} Zn + CO$

(B) $Cu^{2+}(aq) + H_2(g) \rightarrow Cu(s) + 2H^+(aq)$

(C) $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$

(D) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$

Sol. **C**

In Hall-Heroult's process is given by

$2Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2$

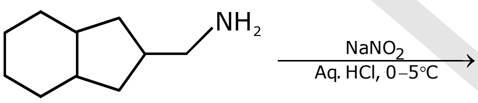
$2Al_2O_3(\ell) \rightleftharpoons 4Al^{3+}(\ell) + 6O^{2(-)}(\ell)$

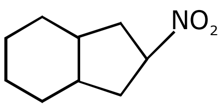
At cathode : $4Al^{3+}_{(\ell)} + 12e^{(-)} \rightarrow 4Al(\ell)$

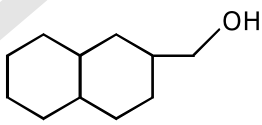
At Anode : $6O^{2(-)}_{(\ell)} \rightarrow 3O_2(g) + 12e^{(-)}$

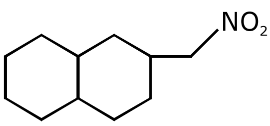
$3C + 3O_2 \rightarrow 3CO_2(\uparrow)$

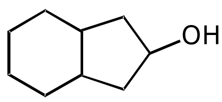
7. The major product formed in the reaction given below will be:



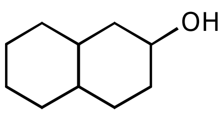
(A) 

(B) 

(C) 

(D) 

Sol. **Bonus**

Answer should be 

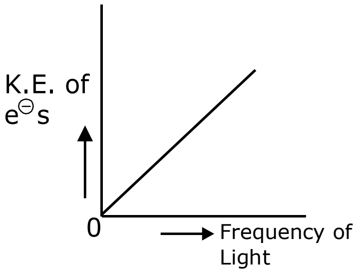
8. The metal used for making X-ray tube window is:

(A)Mg (B)Na (C) Ca (D)Be

Sol. **D**

"Be" Metal is used in x-ray window is due to transparent to x-rays.

9. Which of the graphs shown below does not represent the relationship between incident light and the electron ejected from metal surface?

(A)


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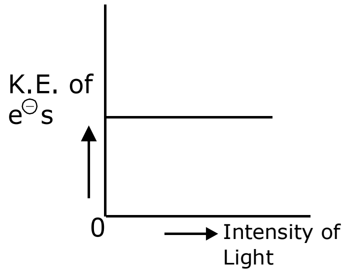
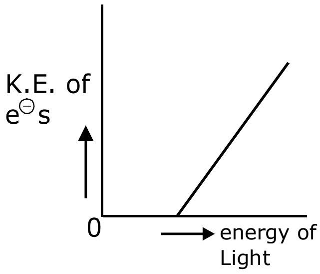
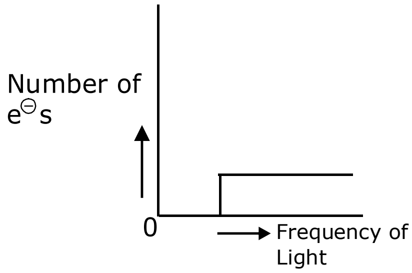


(C)


(D)


Sol. **A**

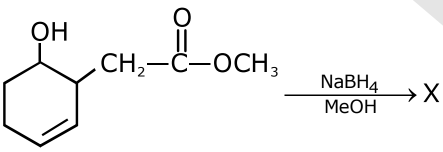
$E = W + \frac{1}{2} mv^2$

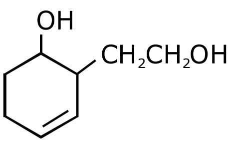
K.E. = $h\nu - 4\nu_0$

K.E. = $h\nu + (-h\nu_0)$

$y = mx + C$

10. The major product 'X' fromed in the following reaction is:



(A)


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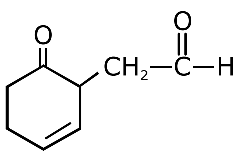

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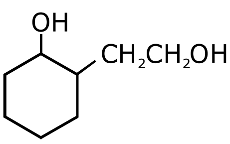

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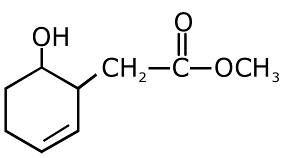


Sol. **D**

$NaBH_4$ Reduced Ketone to 2° alcohol. Inert to Enter & C = C

11. Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapor pressures of pure A and pure B are 7×10^{3} Pa and 12×10^{3} Pa, respectively. The composition of the vapor in equilibrium with a solution containing 40 mole percent of A at this temperature is:

(A) $x_A = 0.28; x_B = 0.72$ (B) $x_A = 0.76; x_B = 0.24$ (C) $x_A = 0.37; x_B = 0.63$ (D) $x_A = 0.4; x_B = 0.6$

Sol. **A**

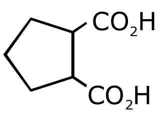
$$y_A = \frac{P_A}{P_{Total}} = \frac{P_A^o X_A}{P_A^o X_A \times p_B^o x_B}$$

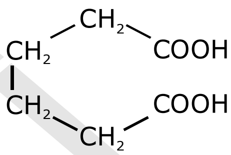
$$= \frac{7\times10^3\times0.4}{7\times10^3\times0.4+12\times10^3\times0.6}$$

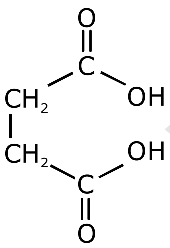
$$= \frac{2.8}{10} = 0.28$$

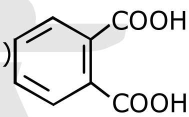
$y_B = 0.72$

12. Which dicarboxylic acid in presence of a dehydrating agent is least reactive to give an anhydride?

(A) 

(B) 

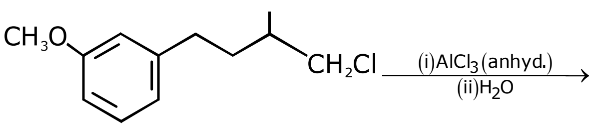
(C) 

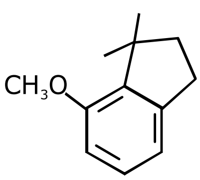
(D) 

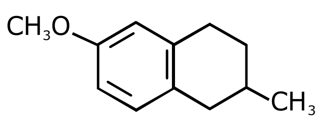
Sol. **B**

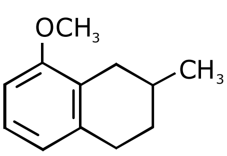
Adipic acid $CO_2H-(CH_2)_4-CO_2H \xrightarrow[\text{agent}]{\text{dehydrating}}$ 7 membered cyclic anhydride (Very unstable)

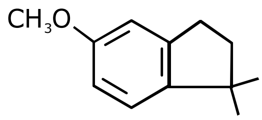
13. The major product of the following reaction is:



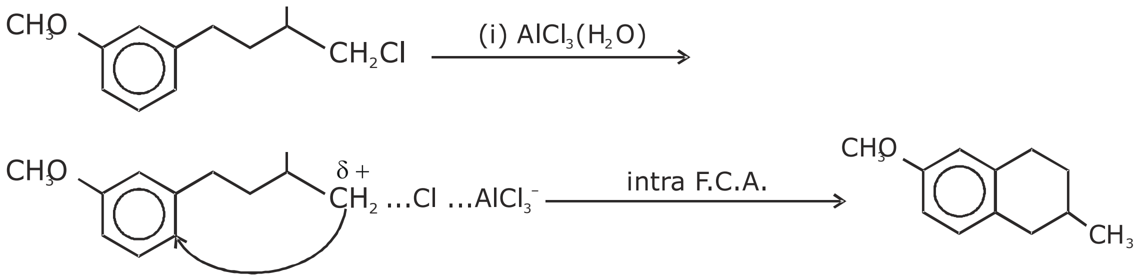
(A) 

(B) 

(C) 

(D) 

Sol. **B**

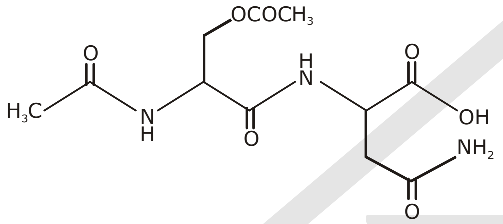


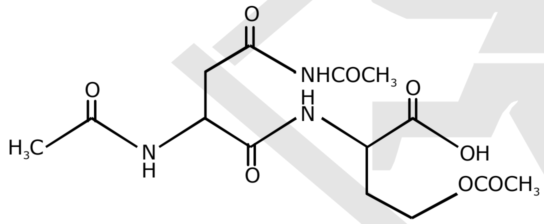
14. If dichloromethane (DCM) and water (H_2O) are used for differential extraction, which one of the following statements is correct ?
(A) DCM and H_2O will be miscible clearly
(B) DCM and H_2O will make turbid/ colloidal mixture
(C) DCM and H_2O would stay as lower and upper layer respectively in the S.F.
(D) DCM and H_2O would stay as upper and lower layer respectively in the separating funnel (S.F.)

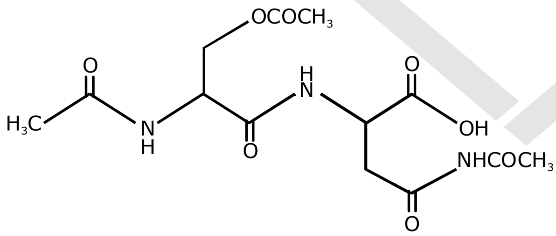
Sol. **C**

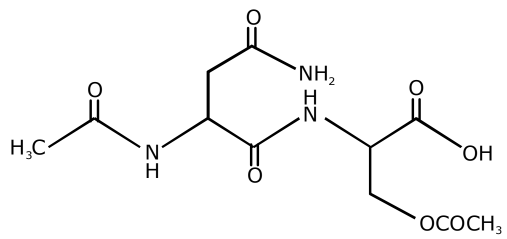
15. The correct structure of product 'P' in the following reaction is :

Asn —Ser + $\underset{\text{(excess)}}{(CH_3CO)_2O} \xrightarrow{NEt_3} P$

(A) 

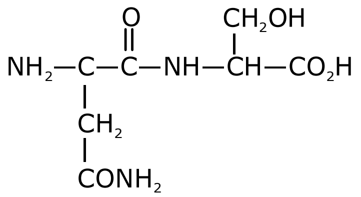
(B) 

(C) 

(D) 

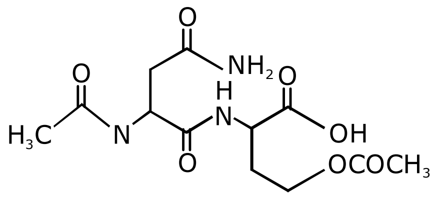
Sol. **D**

Asn–Ser is dipeptide having following structure



$$\text{Asn – Ser} + \underset{\text{(excess)}}{(CH_3CO)_2O} \xrightarrow{NEt_3} P$$

P is



16. Water filled in two glasses A and B have BOD values of 10 and 20, respectively. The correct statement regarding them, is :

(A) A is suitable for drinking, whereas B is not.
(B) A is more polluted than B.
(C) B is more polluted than A.
(D) Both A and B are suitable for drinking.

Sol. **C**

Two glasses "A" and "B" have BOD values 10 and "20", respectively. Hence glasses "B" is more polluted than glasses "A".

17. Which hydrogen in compound (E) is easily replaceable during bromination reaction in presence of light ?

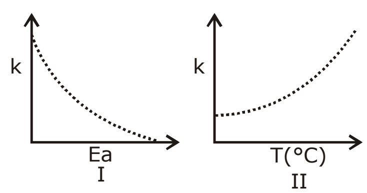
$$\underset{\delta}{CH_3}-\underset{\gamma}{CH_2}-\underset{\beta}{CH}=\underset{\alpha}{CH_2}$$
(E)

(A) δ-hydrogen (B) β–hydrogen
(C) γ – hydrogen (D) α – hydrogen

Sol. **C**

Intermediate formed free radical $CH_3-\dot{C}H-CH=CH_2$ stable due to Resonance & hyperconjugation

18. Consider the given plots for a reaction obeying Arrhenius equation (0°C < T < 300°C) : (k and E_a are rate constant and activation energy, respectively)

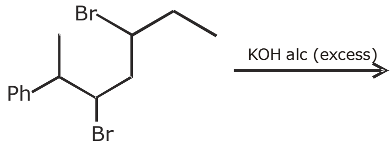


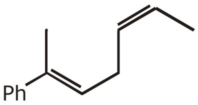
Choose the correct option :
(A) I is right but II is wrong (B) Both I and II are correct
(C) Both I and II are wrong (D) I is wrong but II is right

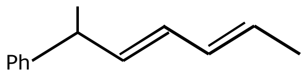
Sol. **B**

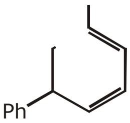
On increasing E_a, K decreases

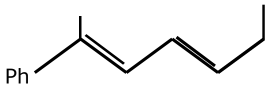
19. The major product of the following reaction is :



(A) 

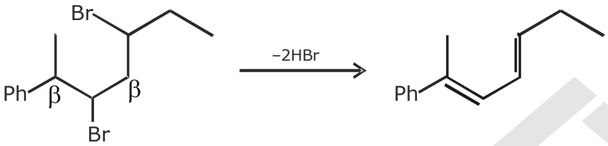
(B) 

(C) 

(D) 

Sol. **D**

Dehydrohalogenation at β – Position



20. The electronegativity of aluminium is similar to :

(A) Boron
(B) Lithium
(C) Beryllium
(D) Carbon

Sol. **C**

E.N. of Al = (1.5) $\cong$ Be (1.5)

21. The chemical nature of hydrogen peroxide is :

(A) Oxidising and reducing agent in acidic medium, but not in basic medium.
(B) Oxidising and reducing agent in both acidic and basic medium.
(C) Reducing agent in basic medium, but not in acidic medium
(D) Oxidising agent in acidic medium, but not in basic medium

Sol. **B**

H_2O_2 act as oxidising agent and reducing agent in acidic medium as well as basic medium.

H_2O_2 Act as oxidant :-

$H_2O_2 + 2H^{\oplus} + 2e^{(-)} \rightarrow 2H_2O$ (In acidic medium)

$H_2O + 2e^{(-)} \rightarrow 2OH^{\oplus}$ (In basic medium)

H_2O_2 Act as reductant : –

$H_2O_2 \rightarrow 2H^{+} + O_2 + 2e^{(-)}$ (In acidic medium)

$H_2O_2 + 2OH^{(-)} \rightarrow 2H_2O + O_2 + 2e^{(-)}$ (In basic medium)

22. The effect of lanthanoid contraction in the lanthanoid series of elements by and large means :

(A) increase in atomic radii and decrease in ionic radii
(B) increase in both atomic and ionic radii
(C) decrease in both atomic and ionic radii
(D) decrease in atomic radii and increase in ionic radii

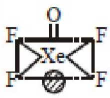
Sol. **C**

Due to Lanthanoid contraction both atomic radii and ionic radii decreases gradually in the lanthanoid series.

23. The type of hybridisation and number of lone pair(s) of electrons of Xe in $XeOF_4$, respectively, are :

(A) sp^3d and 1
(B) sp^3d and 2
(C) sp^3d^2 and 2
(D) sp^3d^2 and 1

Sol. **D**



$sp^3d^2 \Rightarrow$ [5s-bond +1 l.p.]

24. A mixture of 100 m mol of $Ca(OH)_2$ and 2 g of sodium sulphate was dissolved in water and the volume was made up to 100 mL The mass of calcium sulphate formed and the concentration of OH^- in resulting solution, respectively are (Molar mass of $Ca(OH)_2$, Na_2SO_4 and $CaSO_4$ are 74, 143 and 136 g mol^{-1}, respectively ; K_{sp} of $Ca(OH)_2$ is 5.5×10^{-6})

(A) 1.9 g, 0.14 mol L^{-1} (B) 13.6 g, 0.28 mol L^{-1}
(C) 1.9 g, 0.28 mol L^{-1} (D) 13.6 g, 0.14 mol L^{-1}

Sol. **C**

$$Ca(OH)_2 + Na_2SO_4 \longrightarrow CaSO_4 + 2NaOH$$

$$\begin{array}{cccc} 100\text{ m mol} & 14\text{ m mol} & - & - \\ - & - & 14\text{ m mol} & 28\text{ m mol} \end{array}$$

$$W_{CaSO_4} = 14 \times 10^{-3} \times 13.6 = 1.9\text{ gm}$$

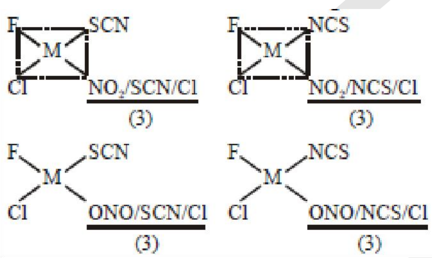
$$[OH^-] = \frac{28}{100} = 0.28\text{ M}$$

25. The total number of isomers for a square planar complex $[M(F)(Cl)(SCN)(NO_2)]$ is :

(A) 16 (B) 4
(C) 8 (D) 12

Sol. **D**

The total number of isomers for a square planar complex $[M(F)(Cl)(SCN)(NO_2)]$ is 12.



26. Wilkinson catalyst is :

(A) $[(Ph_3P)_3RhCl]$ (Et = C_2H_5)
(B) $[(Ph_3P)_3IrCl]$
(C) $[(Et_3P)_3RhCl]$
(D) $[(Et_3P)_3IrCl]$

Sol. **A**

Wilkinsion catalyst is $[(ph_3P)_3RhCl]$

27. Which of the following is not an example of heterogeneous catalytic reaction ?

(A) Combustion of coal (B) Hydrogenation of vegetable oils
(C) Ostwald's process (D) Haber's process

Sol. **A**

Then is no catalyst is required for combustion of coal.

28. Which premitive unit cell has unequal edge lengths $(a \neq b \neq c)$ and all axial angles different from 90° ?

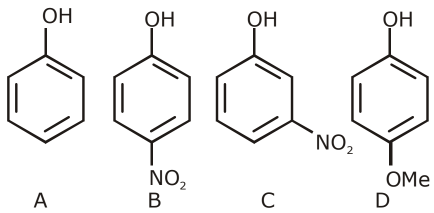
(A) Triclinic (B) Hexagonal
(C) Tetragonal (D) Monoclinic

Sol. **A**

In Triclinic unit cell

$a \neq b \neq c$ & $\alpha \neq \beta \neq g \neq 90°$

29. The increasing order of the pKa values of the following compounds is :

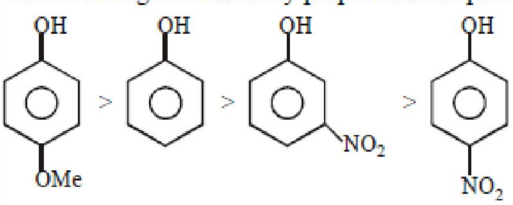


(A) B < C < D < A (B) D < A < C < B

(C) B < C < A < D (D) C < B < A < D

Sol. **C**

Acidic strength is inversely proportional to pka.



30. The total number of isotopes of hydrogen and number of radioactive isotopes among them, respectively, are :

(A) 3 and 2 (B) 3 and 1

(C) 2 and 1 (D) 2 and 0

Sol. **B**

Total number of isotopes of hydrogen is 3

$\Rightarrow {}^1_1H\left({}^2_1H \text{ or } {}^2_1D\right)\left({}^3_1H \text{ or } {}^3_1T\right)$

and only ${}^3_1H$ or ${}^3_1T$ is an Radioactive element.