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PAPER-1 (B.E./B. TECH.)

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 02 September, 2020 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT : CHEMISTRY

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PART : CHEMISTRY

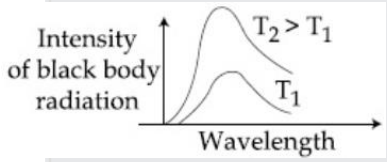
SECTION – 1 : (Maximum Marks : 80)

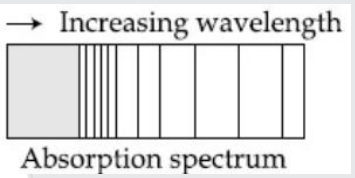
Straight Objective Type (सीधे वस्तुनिष्ठ प्रकार)

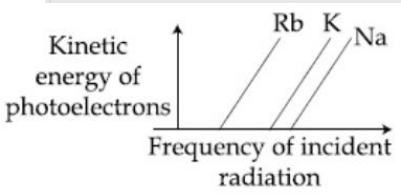
This section contains **20 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

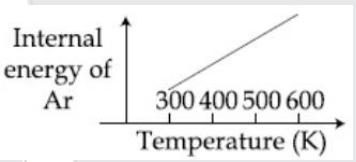
इस खण्ड में **20 बहु–विकल्पी प्रश्न** हैं। प्रत्येक प्रश्न के 4 विकल्प (1), (2), (3) तथा (4) हैं, जिनमें से **सिर्फ एक सही** है।

1. The figure that is not a direct manifestation of the quantum nature of atom is :

(1) 

(2) 

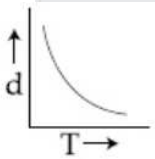
(3) 

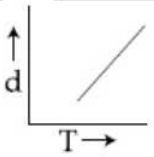
(4) 

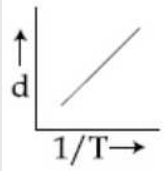
Ans. (4)

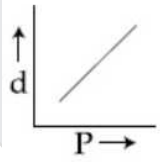
Sol. 1, 2 and 3 are according to quantum theory but (4) is statement of kinetic theory of gases.

2. Which one of the following graphs is not correct for ideal gas ?

(1) 

(2) 

(3) 

(4) 

d = Density, P = Pressure, T = Temperature

Ans. **(4)**

Sol^{n}. For ideal gas

$PM = dRT$

$$d = \left[\frac{PM}{R}\right]\frac{1}{T}$$

So graph between d Vs T is not straight line.

3. For the following Assertion and Reason, the correct option is

Assertion (A) : When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid.

Reason (R) : The equilibrium constant of Cu^{2+} (aq) + S^{2-} (aq) $\rightleftharpoons$ CuS(s) is high because the solubility product is low.

(1) (A) is false and (R) is true.

(2) Both (A) and (R) are false.

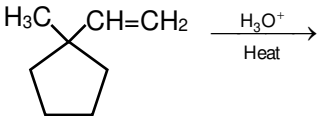
(3) Both (A) and (R) are true but (R) is not the explanation for (A).

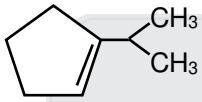
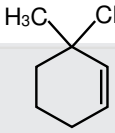
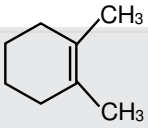
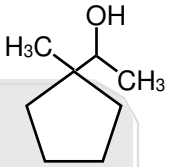
(4) Both (A) and (R) are true and (R) is the explanation for (A).

Ans. (3)

Sol. Rate of chemical reaction has nothing to do with value of equilibrium constant.

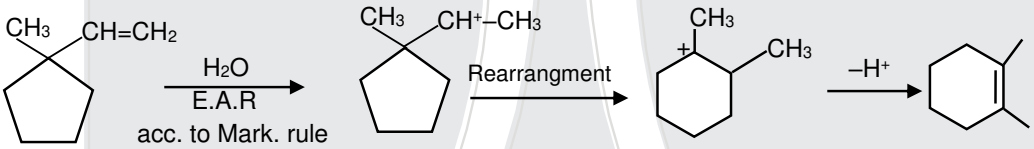
4. The major product in the following reaction is :



(1) 
(2) 
(3) 
(4) 

Ans. **(3)**

Sol.



5. While titration dilute HCl solution with aqueous NaOH, which of the following will not be required ?

(1) Clamp and phenolphthalein (2) Burette and porcelain tile
(3) Bunsen burner and measuring cyclinder (4) Pipette and distilled water

Ans. (3)

Sol. In this acid base Titrating there is no use of Bunsen burner and measuring cylinder other laboratory equipments will be required for getting the end point of titration.

6. On heating compound (A) gives a gas (B) which is a constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should not be :

(1) $(NH_4)_2Cr_2O_7$ (2) NH_4NO_2 (3) $Pb(NO_3)_2$ (4) NaN_3

Ans. **(3)**

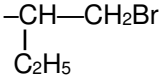
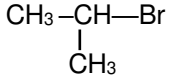
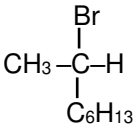
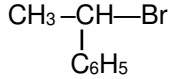
Sol. (1) $Pb(NO_3)_2 \xrightarrow{\Delta} PbO + 2NO_2$

(2) $NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

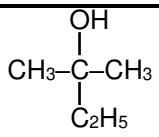
(3) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + H_2O$

(4) $NaN_3 \xrightarrow{300°C} 3N_2 + 2Na$

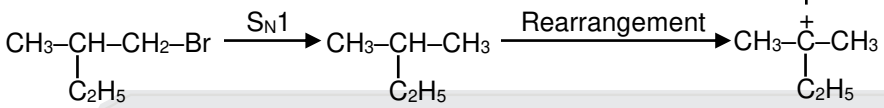
7. Which of the following compounds will show retention in configuration on nucleophile substitution by OH^- ion ?

(1)  (2)  (3)  (4) 

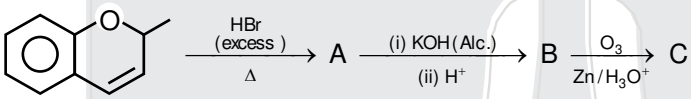
Ans. **(1)**

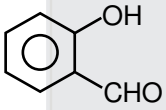


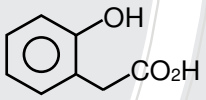
Sol.

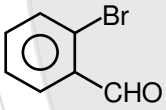


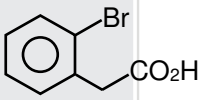
8. The major aromatic product C in the following reaction sequence will be :



(1) 

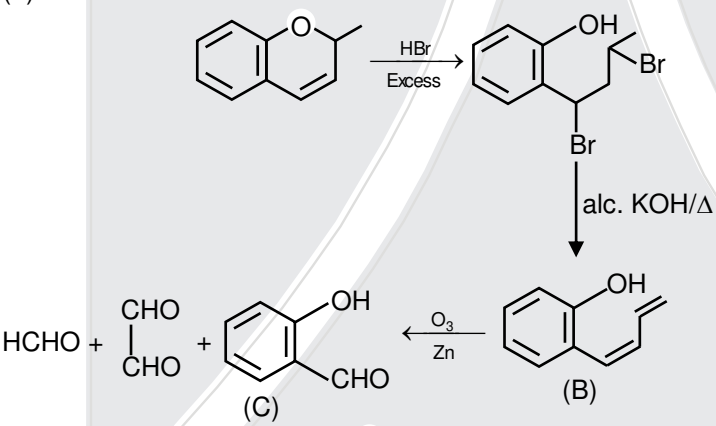
(2) 

(3) 

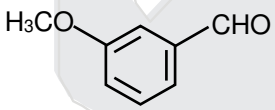
(4) 

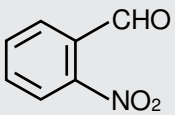
Ans. (1)

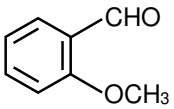
Sol.

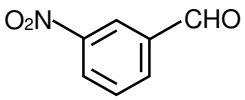


9. The increasing order of the following compounds towards HCN addition is :

(i) 

(ii) 

(iii) 

(iv) 

(1) (iii) < (i) < (iv) < (ii) (2) (i) < (iii) < (iv) < (ii) (3) (iii) < (iv) < (ii) < (i) (4) (iii) < (iv) < (i) < (ii)

Ans. **(1)**

Sol. –I, – M effect of NO_2 increase reactivity towards nucleophilic addition reaction with HCN.

10. In general, the property (magnitudes only) that shows an opposite trend in comparison to other properties across a period is :

(1) Electronegativity (2) Electron gain enthalpy

(3) Ionization enthalpy (4) Atomic radius

Ans. **(4)**

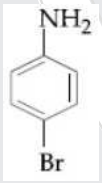
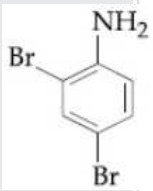
Sol. On moving Left to Right along a period.
Atomic Radius ⇒ decreases.
Electronegativity ⇒ Increases.
Electron gainenthalpy ⇒ Increases.
Ionisation Enthalpy ⇒ Increases.

11. For octahedral Mn(II) and tetrahedral Ni(II) complexes, consider the following statements :
(I) both the complexes can be high spin.
(II) Ni(II) complex can very rarely be of low spin.
(III) with strong field ligands, Mn(II) complexes can be low spin.
(IV) aqueous solution of Mn(II) ions is yellow in color.
The correct statements are :
(1) (I) and (II) only
(2) (I), (II) and (III) only
(3) (I), (III) and (IV) only
(4) (II), (III) and (IV) only

Ans. **(2)**

Sol. With weak field ligands Mn(II) will be of high spin and with strong field ligands it will be of low spin. Ni(II) tetrahedral complexes will be genrally of high spin due to sp3 hybridisation. Mn(II) is of light pink color in aqueous solution.

12. In Carius method of estimation of halogen, 0.172 g of an organic compound showed presence of 0.08 g of bromine. Which of these is the correct structure of the compound ?

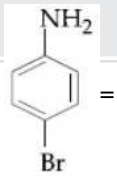
(1) $H_3C–Br$
(2) $H_3C–CH_2–Br$
(3) 
(4) 

Ans. **(3)**

Sol. Mole of Bromine = $\frac{0.08}{80} = 10^{-3}\text{mole}$

Molar mass of compound = $\frac{0.172}{M} = 10^{-3}$

$$M = \frac{0.172}{10^{-3}} = 172\text{gm}$$

Molar mass of  = 80 + 72 + 6 + 14 = 172 gm

13. An open beaker of water in quilibrium with water vapour is in a sealed container. When a few grams of glucose are added to the beaker of water, the rate at which water molecules :
(1) leaves the vapour decreases
(2) leaves the solution decreases
(3) leaves the vapour increases
(4) leaves the solution increases

Ans. **(3)**

Sol. The vapour pressure of solution will be less than vapour pressure of pure solvent, so some vapour molecules will get condensed to maintain new equilibrium.

14. The statement that is not true about ozone is :
(1) in the stratosphere, CFCs release chlorine free radicals (Cl) which reacts with O_3 to give chlorine dioxide radicals.
(2) in the stratosphere, it forms a protective shield against UV radiation.
(3) it is a toxic gas and its reaction with NO gives NO_2
(4) in the atmosphere, it is depleted by CFCs.

Ans. **(1)**

Sol. In presence of sunlight CFC's molecule divides & release chlorine free radical, which react with ozone give chlorine monoxide radical ($ClO^{\bullet}$) and oxygen.

$$CF_2Cl_2(g) \xrightarrow{UV} \dot{C}l(g) + \dot{C}F_2Cl(g)$$

$$Cl^{\bullet}(g) + O_3(g) \longrightarrow ClO^{\bullet}(g) + O_2(g)$$

$$ClO^{\bullet}(g) + O(g) \longrightarrow Cl^{\bullet}(g) + O_2(g)$$

15. The metal mainly used in devising photoelectric cells is :
(1) Li (2) Rb (3) Cs (4) Na

Ans. **(3)**

Sol^{n} Cesium has lowest ionisation enthalpy and hence it can show photoelectric effect to the maximum extent hence it is used in photo electric cell.

16. Which of the following is used for the preparation of colloids ?
(1) Ostwald process (2) Van Arkel Method
(3) Mond Process (4) Bredig's Arc Method

Ans. **(4)**

Sol. Bredig's Arc Method is used for preparation of colloidal sol's of less reactive metal like Au, Ag, Pt.

17. Consider that d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is :
(1) tetrahedral and $-1.6\Delta_t + 1P$ (2) octahedral and $-2.4\Delta_0 + 2P$
(3) tetrahedral and $-0.6\Delta_t$ (4) octahedral and $-1.6\Delta_0$

Ans. **(3)**

Sol. Since spin only magnetic moment is 4.90 BM so number of unpaired electrons must be 4. so If the complex is octahedral, then it has to be high spin complex with configuration $t_{2g}^{2,1,1}e_g^{1,1}$, in that case CFSE = 4 X $(-0.4\Delta_0)$ + 2 X 0.6 Δ_0 = -0.4 Δ_0
If the complex is tetrahedral then its electronic configuration will be = $e_g^{2,1}t_{2g}^{1,1,1}$ and CFSE will be = 3 X $(-0.6\ \Delta_t)$ + 3 X $(0.4\ \Delta_t)$ = $-0.6\Delta_t$

18. If AB_4 molecule is a polar molecule, a possible geometry of AB_4 is :
(1) Square pyramidal (2) Rectangular planar
(3) Square planar (4) Tetrahedral

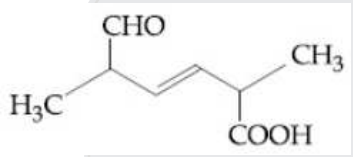
Ans. **(1)**

Sol^{n}. For AB_4 compound possible geometry are

S. No.	Bond pair	Lone pair	Total	Hybridisation	Geometry	Polarity
1	4	0	4	SP^3	Tetrahedral	non polar
2	4	1	5	SP^3d	Sea-saw	Polar
3	4	2	6	sp^3d^2	Square Planar	non polar

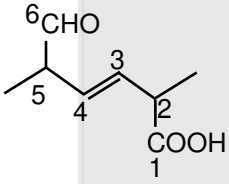
Square pyramidal can be polar due to lone pair moment as the bond pair moments will get cancelled out.

19. The IUPAC name for the following compound is :



(1) 2, 5-dimethyl-6-carboxy-hex-3-enal (2) 2, 5-dimethyl-5-carboxy-hex-3-enal
(3) 6-formyl-2-methyl-hex-3-enoic (4) 2, 5-dimethyl-6-oxo-hex-3-enoic acid

Ans. **(4)**

Sol. 

(2, 5-dimethyl-6-oxo-hex-3-enoic acid

20. Consider the following reactions :

(i) Glucose + ROH $\xrightarrow{\text{dry HCl}}$ Acetal $\xrightarrow[(CH_3CO)_2O]{\text{x eq. of}}$ acetyl derivative

(ii) Glucose $\xrightarrow{Ni/H_2}$ A $\xrightarrow[(CH_3CO)_2O]{\text{y eq. of}}$ acetyl derivative

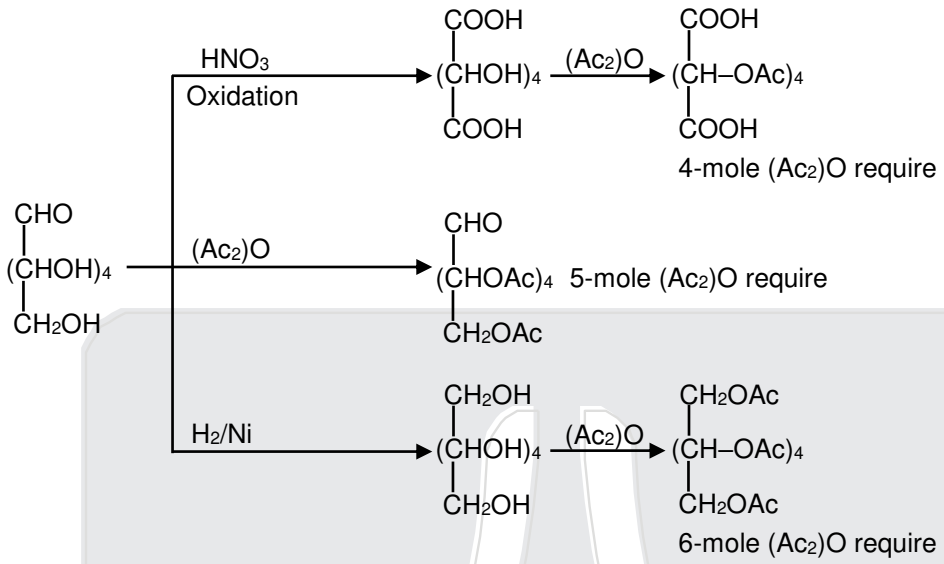
(iii) Glucose $\xrightarrow[(CH_3CO)_2O]{\text{z eq. of}}$ acetyl derivative

'x', 'y' and 'z' in these reactions are respectively.

(1) 5, 6 & 6 (2) 4, 5 & 5 (3) 4, 6 & 5 (4) 5, 4 & 5

Ans. **(3)**

Sol.



SECTION – 2 : (Maximum Marks : 20)

- This section contains **FIVE (05)** questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.
- If the numerical value has more than two decimal places **truncate/round-off** the value upto **TWO** decimal places.
  - Full Marks : **+4** If ONLY the correct option is chosen.
  - Zero Marks : **0** In all other cases

खंड 2 (अधिकतम अंकः 20)

- इस खंड में **पाँच (05)** प्रश्न है। प्रत्येक प्रश्न का उत्तर संख्यात्मक मान **(NUMERICAL VALUE)** हैं, जो द्वि–अंकीय पूर्णांक तथा दशमलव एकल–अंकन में है।
- यदि संख्यात्मक मान में दो से अधिक दशमलव स्थान है , तो संख्यात्मक मान को दशमलव के दो स्थानों तक **ट्रंकेट/राउंड ऑफ (truncate/round-off)** करें।
- अंकन योजना :
  - पूर्ण अंक : **+4** यदि सिर्फ सही विकल्प ही चुना गया है।
  - शून्य अंक : **0** अन्य सभी परिस्थितियों में।

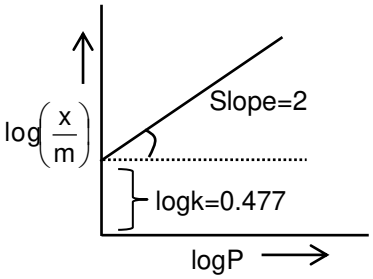
21. The mass of gas adsorbed, x, per unit mass of adsorbate, m, was measured at various pressures, p. A graph between $\log \frac{x}{m}$ and log p gives a straight line with slope equal to 2 and the intercept equal to 0.4771. The value of $\frac{x}{m}$ at a pressure of 4 atm is :

(Given log 3 = 0.4771)

Ans. **(48) [NTA answer is given 6]**

Sol^{n}. $\left(\frac{x}{m}\right) = k(P)^{\frac{1}{n}}$

$\log\left(\frac{x}{m}\right) = \log k + \frac{1}{n}\log P$



Slope = $\frac{1}{n} = 2$ So n = $\frac{1}{2}$.

Intercept $\Rightarrow$ logk = 0.477 So k = Antilog (0.477) = 3

So $\left(\frac{x}{m}\right) = k(P)^{\frac{1}{n}}$

$= 3[4]^2 = 48$

22. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x, y and z is ……

$\underset{(A)}{Na_4[Fe(CN)_5(NOS)]}$ $\underset{(B)}{Na_4[FeO_4]}$ $\underset{(C)}{[Fe_2(CO)_9]}$

Ans. (6)

Sol. The oxidation states of iron in these compounds will be

A = +2

B = +4

C = 0

The sum of oxidation states will be = 6.

23. The internal energy change (in J) when 90 g of water undergoes complete evaporation at 100ºC is……

(Given : ΔH_{vap} for water at 373 K = 41 kJ/mol, R = 8.314 JK^{-1} mol^{-1})

Ans. **(189494)**

Sol. $\Delta H = \Delta U + \Delta n_g RT$

41000 X 5 = ΔU + 5 X 8.314 X 373

205000 = ΔU + 15505.61

$\Delta U = 189494.39\ J = 189494\ J$

24. The Gibbs energy change (in J) for the given reaction at $[Cu^{2+}] = [Sn^{2}+] = 1$ M and 298 K is :

$Cu(s) + Sn^{2+}(aq.) \rightarrow Cu^{2+}(aq.) + Sn(s)$;

($E^0_{Sn^{2+}|Sn} = -0.16$ V, $E^0_{Cu^{2+}|Cu} = 0.34$ V, Take F = 96500 C mol^{-1})

Sol^{n} **96500**

$E^0_{cell} = E^0_{Sn^{2+}/Sn} - E^0_{Cu^{2+}/Cu}$

$= -0.16 - 0.34$

$= -0.50V$

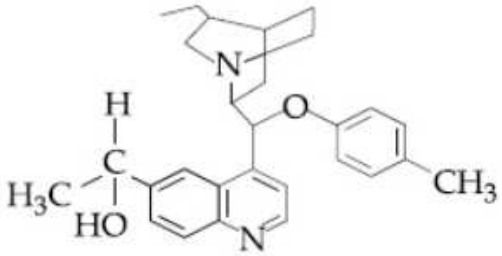
$\Delta G^0 = -nF\,E^0_{cell}$

$= -2 \times 96500 \times (-0.5)$

$= 96500J$

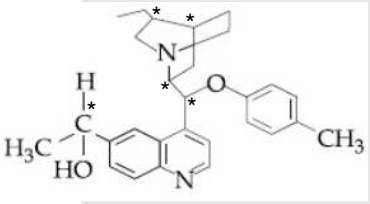
$= 96.5\ KJ = 96500\ J$

25. The number of chiral carbons present in the molecule given below is……



Ans. **(5)**

Sol.



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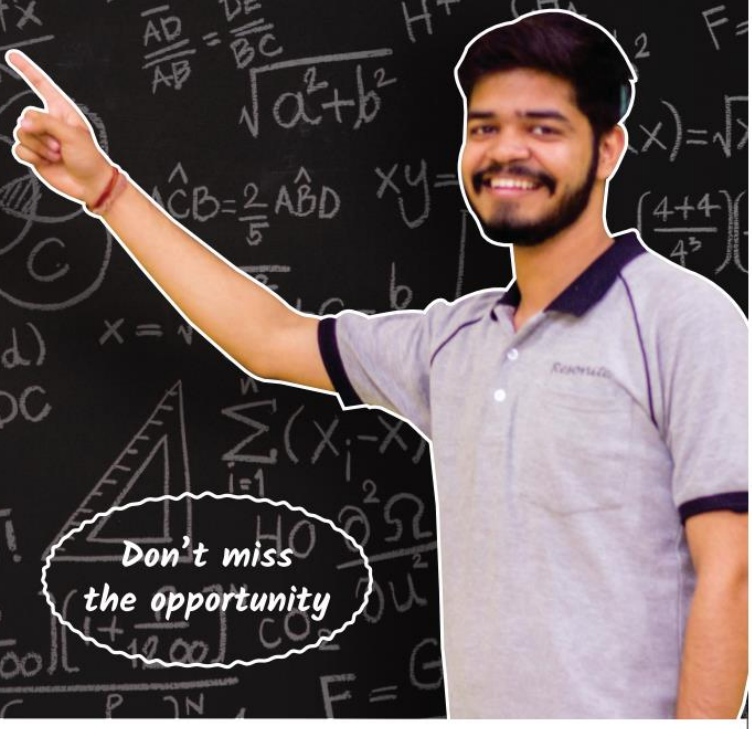

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