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JEE (Main)

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

2022

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 29 July, 2022 (SHIFT-2) | TIME : (3.00 a.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

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PART : CHEMISTRY

1. Consider the reaction

$4\,HNO_3(l) + 3\,KCl(s) \rightarrow Cl_2(g) + NOCl(g) + 2\,H_2O(g) + 3\,KNO_3(s)$

The amount of HNO_3 required to produce 110.0 g of KNO_3 is

(Given: Atomic masses of H, O, N and K are 1, 16, 14 and 39, respectively.)

(A) 32.2 g (B) 69.4 g (C) 91.5 g (D) 162.5 g

Ans. (C)

Sol. $3KCl + 4HNO_3 \longrightarrow Cl_2(g) + 3KNO_3 + NOCl$

$\frac{4}{3}\left[\frac{110}{101}\right]$ mole $\left(\frac{110}{101}\right)$ mole

Mass of HNO_3 used = $\left[\frac{4}{3}\times\frac{110}{101}\right]\times 63$

= 91.485

2. Given below are the quantum numbers for 4 electrons.

A. $n = 3, l = 2, m_l = 1, m_s = +1/2$

B. $n = 4, l = 1, m_l = 0, m_s = +1/2$

C. $n = 4, l = 2, m_l = -2, m_s = -1/2$

D. $n = 3, l = 1, m_l = -1, m_s = +1/2$

The correct order of increasing energy is

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

Ans. (B)

Sol. Greater the value of $(n + \ell)$ greater is energy.

3. $C(s) + O_2(g) \rightarrow CO_2(g) + 400\ kJ$

$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g) + 100\ kJ$

When coal of purity 60% is allowed to burn in presence of insufficient oxygen, 60% of carbon is converted into 'CO' and the remaining is converted into 'CO_2'.

The heat generated when 0.6 kg of coal is burnt is _____.

(A) 1600 kJ (B) 3200 kJ (C) 4400 kJ (D) 6600 kJ

Ans. (D)

Sol. Mass of carbon = $(0.6 \times 10^3)\ \frac{60}{100} = \frac{600\times 60}{100} = 360$ gram

60% of carbon $\Rightarrow \frac{360\times 60}{100} = 216$ gram

(1) $C(s) + \frac{1}{2}O_2 \longrightarrow CO(g)$; $\Delta H^o = -100$ kJ/mole

$\left(\frac{216}{12}\right)$ $\Delta H = (-100)\ \frac{216}{12}$

$= -1800$ kJ

(2) $C(s) + O_2 \longrightarrow CO_2(g)$; $\Delta H^o = -400$ kJ/mole

$\left(\frac{144}{12}\right)$ $\Delta H = (-400) \times \frac{144}{12} = -4800$ kJ

Total heat released = (1800 + 4800) = 6600 kJ

4. 200 mL of 0.01 M HCl is mixed with 400 mL of 0.01M H_2SO_4. The pH of the mixture is __.

Given: log 2 = 0.30, log 3 = 0.48, log 5 = 0.70, log 7 = 0.84, log 11 = 1.04

(A) 1.14 (B) 1.78 (C) 2.34 (D) 3.02

Ans. (B)

Sol. $[H^+] = \frac{0.01\times 200 + 2\times 0.01\times 400}{600}$

$= \frac{0.01 + 2\times 0.01\times 2}{3}$

$= \frac{0.01 + 0.04}{3}$

$= \frac{5}{3}\times 10^{-2}$

$pH = -\log [H^+]$

$= -\log \left(\frac{5}{3}\times 10^{-2}\right)$

$= -[\log \frac{5}{3} + \log 10^{-2}]$

$= -[\log 5 - \log 3 - 2]$

$= -0.7 + 0.48 + 2$

$= 2.48 - 0.7$

$= 1.78$

5. Given below are the critical temperatures of some of the gases:

Gas	Critical temperature (K)
He	5.2
CH_4	190.0
CO_2	304.2
NH_3	405.5

The gas showing least adsorption on a definite amount of charcoal is

(A) He (B) CH_4 (C) CO_2 (D) NH_3

Ans. (A)

Sol. Greater the value of critical temperature greater is adsorption as He has least critical temperature so it adsorb least.

6. In liquation process used for tin (Sn), the metal

A is reacted with acid.

B is dissolved in water.

C is brought to molten form which is made to flow on a slope.

D is fused with NaOH

Ans. (C)

Sol. **Liquation**

In this method a low melting metal like tin can be made to flow on a sloping surface. In this way it is separated from higher melting impurities

7. Given below are two statements.

Statement I: Stannane is an example of a molecular hydride.

Statement II: Stannane is a planar molecule.

In the light of the above statement, choose the ***most appropriate*** answer from the options given below.

A Both Statement I and Statement II are true.

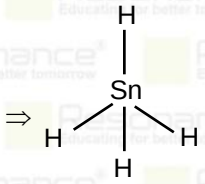
B Both Statement I and Statement II are false.

C Statement I is true but Statement II is false.

D Statement I is false but Statement II is true.

Ans. (C)

Sol. Stannane $\Rightarrow SnH_4$



$\Rightarrow$ It is tetrahedral molecule

8. Portland cement contains 'X' to enhance the setting time. What is 'X'?

A $CaSO_4 \cdot \frac{1}{2}H_2O$

B $CaSO_4 \cdot 2H_2O$

C $CaSO_4$

D $CaCO_3$

Ans. (B)

Sol. Gypsum is added in portland cement to slow down the process of setting of the cement so that it gets sufficient time to hardened.

9. When borax is heated with CoO on a platinum loop, blue coloured bead formed is

A B_2O_3

B $Co(BO_2)_2$

C CoB_4O_7

D $Co[B_4O_5(OH)_4]$

Ans. (B)

Sol. $CoO + B_2O_3 \longrightarrow Co(BO_2)_2$

10. Which of the following 3d-metal ion will give the lowest enthalpy of hydration ($\Delta_{hyd}H$) when dissolved in water ?

A Cr^{2+}

B Mn^{2+}

C Fe^{2+}

D Co^{2+}

Ans. (B)

Sol.

	Ion	$\Delta H^{o}_{Hyd.}$ (kJ/mole)
(i)	Cr^{2+}	– 1925
(ii)	Mn^{2+}	– 1862
(i)	Fe^{2+}	– 1998
(i)	Co^{2+}	– 2079

11. Octahedral complexes of copper(II) undergo structural distortion (Jahn-Teller). Which one of the given copper (II) complexes will show the maximum structural distortion?(en – ethylenediamine: $H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2$)

A $[Cu(H_2O)_6]SO_4$

B $[Cu(en)(H_2O)_4]SO_4$

C cis-$[Cu(en)_2Cl_2]$

D trans-$[Cu(en)_2Cl_2]$

Ans. (A)

Sol. According to John teller any nonlinear molecular system in a degenerate electronic state will be unstable and will undergo some kind of distortion which will lower its symmetry and energy and split the degenerate state.

In case of octahedral d^9 configuration, the last electron may occupy either dz^2 or $d_{x^2y^2}$ orbitals of e_g set.

If it occupies dz^2 orbital most of the electron density will be concentrated between the metal and the two ligands on the z axis. Thus there will be greater electrostatic repulsion associated with these ligands than with the other four on xy plane.

The Jahn Teller effect is mostly observed in octahedral environments. The considerable distortions are usually observed in high spin d^4, low spin d^7 and d^9 configuration.

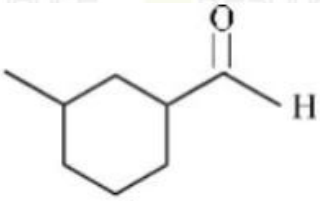
12. Dinitrogen is a robust compound, but reacts at high altitudes to form oxides. The oxide of nitrogen that can damage plant leaves and retard photosynthesis is

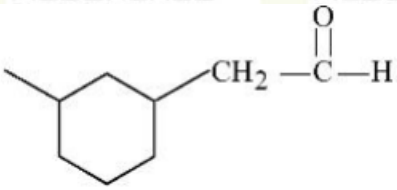
(A) NO (B) NO_3^- (C) NO_2 (D) NO_2^-

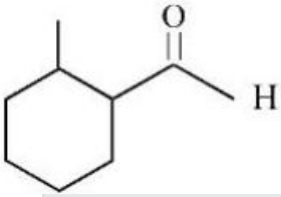
Ans. (C)

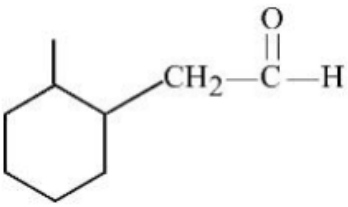
Sol. High concentration of NO_2 can damage plant leaves and retard photosynthesis.

13. Correct structure of γ-methylcyclohexane carbaldehyde is

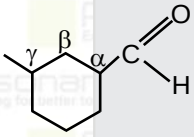
(A) 

(B) 

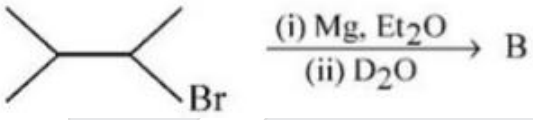
(C) 

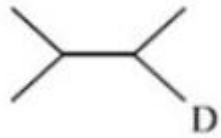
(D) 

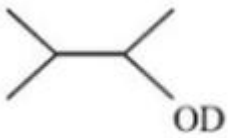
Ans. **(A)**

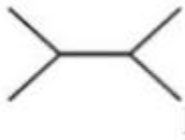
Sol. 

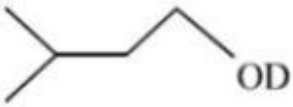
14. Compound '*A*' undergoes following sequence of reactions to give compound '*B*'. The correct structure and chirality of compound 'B' is
[where Et is $-C_2H_5$]



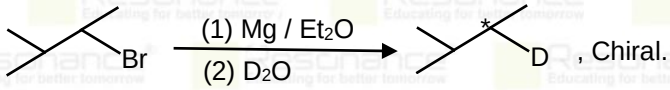
(A)  , Achiral

(B)  , Chiral

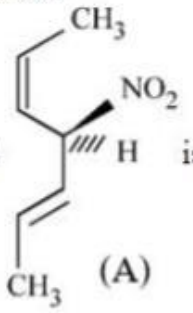
(C)  , Chiral

(D)  , Achiral

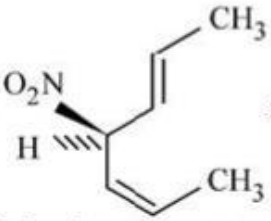
Ans. **(C)**

Sol.  , Chiral.

15. Given below are two statements.

Statement I: The compound  is optically active.

(A)

Statement II:  is mirror image of above compound A.

In the light of the above statement, choose the ***most appropriate*** answer from the options given below.

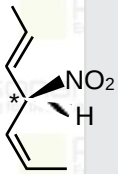
(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect.

(C) Statement I is correct but Statement II is incorrect.

(D) Statement I is incorrect but Statement II is correct.

Ans. (C)

Sol.  (A) is optically active.

16. When enthanol is heated with conc. H_2SO_4, a gas is produced. The compound formed, when this gas is treated with cold dilute aqueous solution of Baeyer's reagent, is

A formaldehyde

B formic acid

C glycol

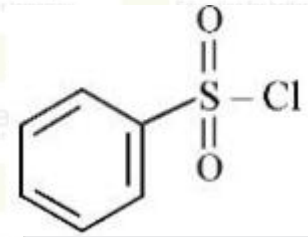
D ethanoic acid

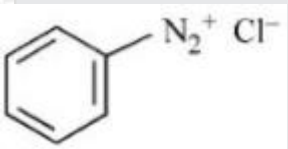
Ans. (C)

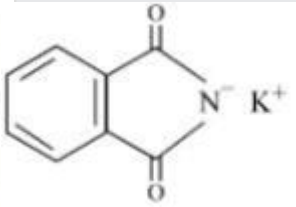
Sol. $CH_3–CH_2–OH \xrightarrow[\Delta]{Conc.\ H_2SO_4} CH_2=CH_2 \xrightarrow[Bayers\ reagent]{Cold\ dil\ solution\ of} OH–CH_2–CH_2–OH$

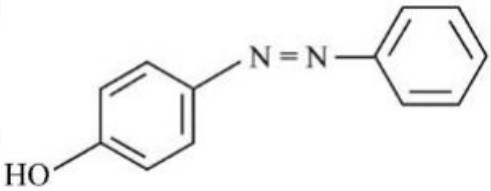
(glycol)

17. The Hinsberg reagent is

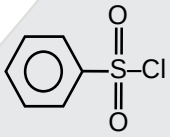
(A) 

(B) 

(C) 

(D) 

Ans. **(A)**

Sol. Hinsberg reagent is  .

18. Which of the following is **NOT** a natural polymer?

A Protein

B Starch

C Rubber

D Rayon

Ans. **(D)**

Sol. Starch, Protein, Rubber are natural polymer.

Rayon is a semi-synthetic fiber, made from natural sources of regenerated cellulose, such as wood and related agricultural products.

19. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: Amylose is insoluble in water.

Reason R: Amylose is a long linear molecule with more than 200 glucose units.

In the light of the above statements, choose the ***correct*** answer from the options given below.

A Both **A** and **R** are correct and **R** is the correct explanation of **A.**

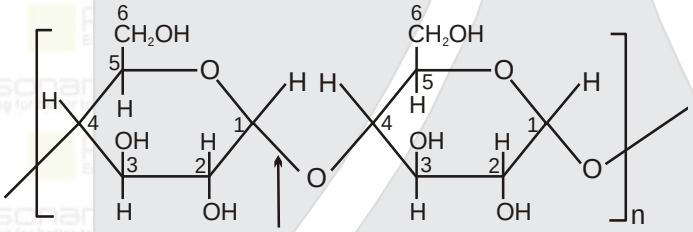
B Both **A** and **R** are correct but **R** is NOT the correct explanation of **A.**

C **A** is correct but **R** is not correct

D **A** is not correct but **R** is correct.

Ans. **(D)**

Sol. Amylose is soluble in water and long unbranched chain polymer with more than 200 glucose units.



$\alpha(1 \rightarrow 4)$ Glucosidic linkage

Amylose

20. A compound 'X' is a weak acid and it exhibits colour change at pH close to the equivalence point during neutralization of NaOH with CH_3COOH. Compound 'X' exists in ionized form in basic medium. The compound 'X' is

A methyl orange

B methyl red

C phenolphthalein

D erichrome Black T

Ans. **(C)**

21. 'x' g of molecular oxygen (O_2) is mixed with 200 g of neon (Ne). The total pressure of the non-reactive mixture of O_2 and Ne in the cylinder is 25 bar. The partial pressure of Ne is 20 bar at the same temperature and volume. The value of 'x' is ___.

[Given: Molar mass of $O_2 = 32\ g\ mol^{-1}$.

Molar mass of $Ne = 20\ g\ mol^{-1}$]

Ans. **(80)**

Sol. $P_{Ne} = [P_{Total}]\ X_{Ne}$

$20 = 25\ [X_{Ne}]$

$[X_{Ne}] = \frac{4}{5}$

$$\Rightarrow -\left[\frac{\frac{200}{20}}{\frac{200}{20}+\frac{x}{32}}\right] = \frac{4}{5}$$

$$\frac{10}{10+\left(\frac{x}{32}\right)} = \frac{4}{5}$$

$50 = 40 + \frac{x}{8}$

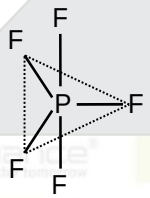
$400 = 320 + x$

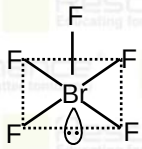
$x = 80$ gram

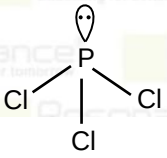
22. Consider, PF_5, BrF_5, PCl_3, SF_6, $[ICl_4]^-$, ClF_3 and IF_5.

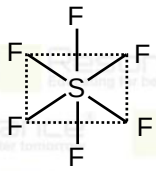
Amongst the above molecule(s)/ion(s), the number of molecule(s)/ion(s) having sp^3d^2 hybridisation is ____.

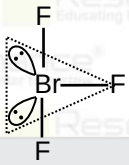
Ans. **(4)**

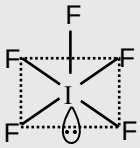
Sol. **(i)** PF_5  (sp^3d) Trigonal bipyramidal

(ii) BrF_5  (sp^3d^2) Square pyramidal

(iii) PCl_3  (sp^3) Pyramidal

(iv) SF_6  (sp^3d^2) Octahedral

(v) ClF_3  (sp^3d) T-shape

(vi) IF_5  (sp^3d^2) Square pyramidal

23. 1.80 g of solute A was dissolved in 62.5 cm^3 of ethanol and freezing point of the solution was found to be 155.1 K. The molar mass of solute A is __ g mol^{-1}.
[Given: Freezing point of ethanol is 156.0 K.
Density of ethanol is 0.80 g cm^{-3}.
Freezing point depression constant of ethanol is 2.00 K kg mol^{-1}]

Ans. **(80)**

Sol. Mass of solvent = dxv = 0.8 × 62.5 = 50 gram

$\Delta T_f = k_f \times m$

$$0.9 = 2\left[\frac{1.8\times1000}{M_{Solute}\times50}\right]$$

$$M_{Solute} = \left(\frac{2\times1.8\times1000}{0.9\times50}\right) = 80$$

24. For a cell, $Cu(s) \mid Cu^{2+}(0.001M) \,||\, Ag^{+}(0.01M) \mid Ag(s)$ the cell potential is found to be 0.43 V at 298 K. The magnitude of standard electrode potential for Cu^{2+}/Cu is ____ × 10^{-2} V.

$$\left[\text{Given : } E^{\ominus}_{Ag^+/Ag} = 0.80 \text{ V and } \frac{2.303RT}{F} = 0.06\,\text{V}\right]$$

Ans. **(34)**

Sol. Anode : $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$

Cathode : $Ag^+ + e^- \longrightarrow Ag(s)]2$

$Cus(s) + 2Ag^+(aq) \longrightarrow Cu^{2+}(aq) + 2Ag(s)$

$$E_{cell} = E^0_{cell} - \frac{0.06}{2}\log\frac{[Cu^{2+}]}{[Ag^+]^2}$$

$$0.43 = E^0_{cell} - \frac{0.06}{2}\log\left(\frac{10^{-3}}{(10^{-2})^2}\right)$$

$$0.43 = E^0_{cell} - 0.03\log 10$$

$$E^0_{cell} = 0.46\ V$$

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

$$E^0_{Cu^{2+}/Cu} = (0.80 - 0.46) = 0.34\ V = 34 \times 10^{-2}$$

25. Assuming 1μg of trace radioactive element X with a half life of 30 years is absorbed by a growing tree. The amount of X remaining in the tree after 100 years is ____ $\times 10^{-1}$μg.
[Given: ln 10 = 2.303; log 2 = 0.30]

Ans. **(1)**

Sol. $t = \frac{1}{\lambda}\ln\left(\frac{a}{a-x}\right)$

$$100 = \left(\frac{30}{\ln 2}\right)\left[\ln\left(\frac{1}{w}\right)\right]$$

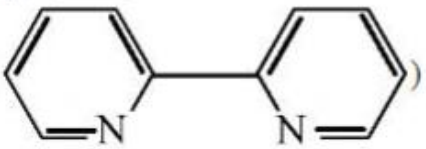
$$\left[\frac{100\times\log.2}{30}\right] = \log\left(\frac{1}{w}\right)$$

$$1 = \log\left(\frac{1}{w}\right)$$

$$\frac{1}{w} = 10$$

So $w = 0.1\ \mu g$

26. Sum of oxidation state (magnitude) and coordination number of cobalt in $Na[Co(bpy)Cl_4]$ is ____.

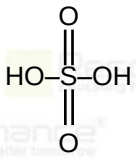
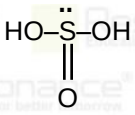
(Given: bpy = )

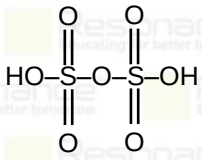
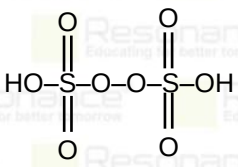
Ans. **(9)**

27. Consider the following sulphur based oxoacids.
H_2SO_3, H_2SO_4, $H_2S_2O_8$ and $H_2S_2O_7$.

Amongst these oxoacids, the number of those with peroxo (O-O) bond is _____

Ans. **(1)**

Sol. H_2SO_4  H_2SO_3 

$H_2S_2O_7$  $H_2S_2O_8$ 

28. A 1.84 mg sample of polyhydric alcoholic compound 'X' of molar mass 92.0 g/mol gave 1.344 mL of H_2 gas at STP. The number of alcoholic hydrogens present in compound 'X' is _____.

Ans. **(3)**

Sol. Volume of H_2 gas = 1.344 mL.

Mole of H_2 gas = $\frac{1.344}{22400} = 6 \times 10^{-5}$.

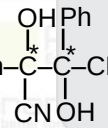
No of H atoms per molecule of H_2 = 2.

No. of moles of organic compound = $\frac{1.84\times10^{-3}}{92} = 2 \times 10^{-5}$

No. of –OH (hydroxyl group in one molecule) = $\frac{6\times10^{-5}}{2\times10^{-5}} = 3$

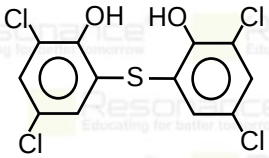
29. The number of stereoisomers formed in a reaction of $(\pm)Ph(C{=}O)C(OH)(CN)Ph$ with HCN is _____.
[where Ph is $-C_6H_5$]

Ans. (3)

Sol.  RR, RS & SS three products are formed.

30. The number of chlorine atoms in bithionol is _____.

Ans. (4)

Sol. 

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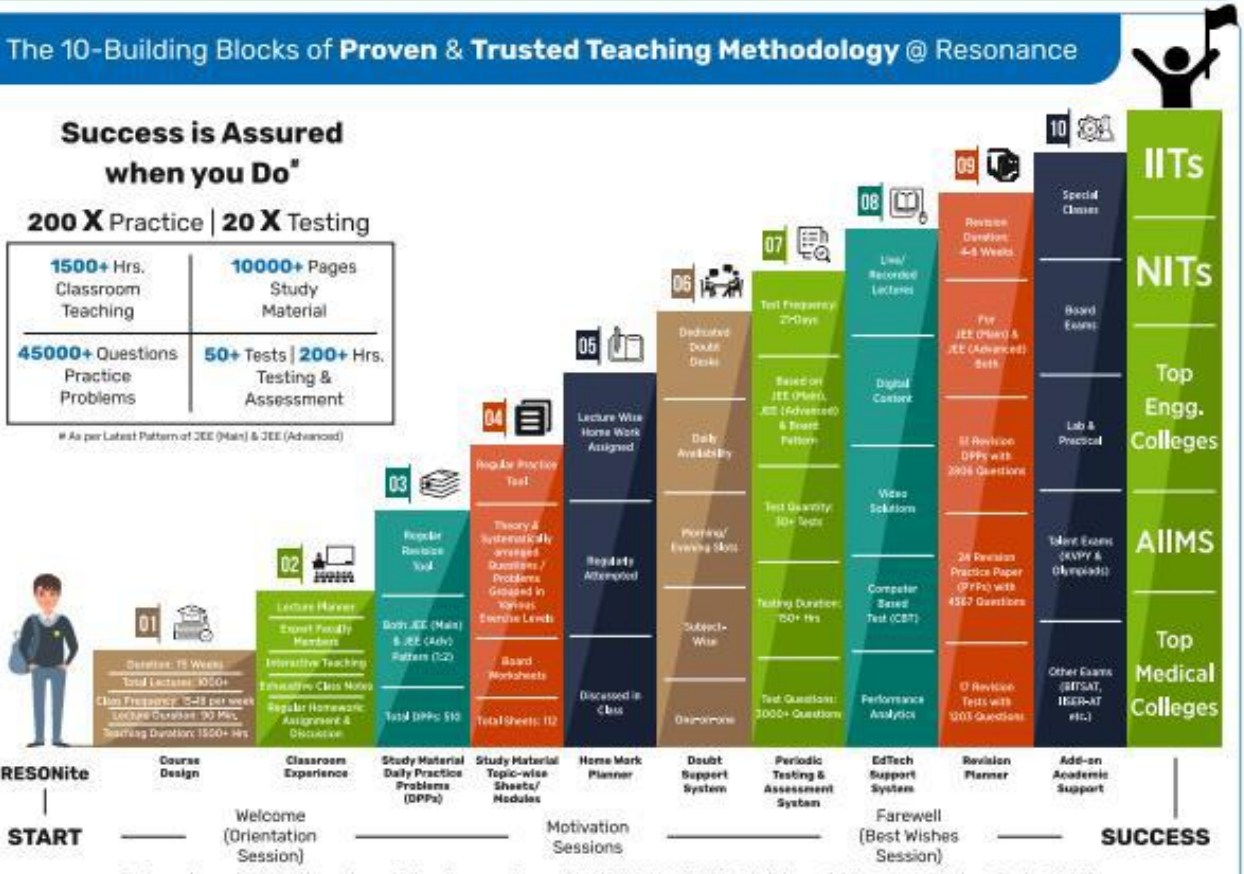

The figures (approx.) shown in the graph are of 2 Years Classroom Program (VIKAAS-XI & VIJETA-XII) for JEE (Advanced) @ Resonance in Academic Session 2021-22.
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Photo Taken on 20th June 2022 | Some Faculty Members were not present in the Photo Session.

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