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

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 03 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

Single Choice Type (एकल विकल्पीय प्रकार)

This section contains **20 Single 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 एकल विकल्पी प्रश्न** हैं। प्रत्येक प्रश्न के 4 विकल्प (1), (2), (3) तथा (4) हैं, जिनमें से **सिर्फ एक सही** है।

1. The mechanism of S_N1 reaction is given as:

$$R-X \longrightarrow \underset{\text{Ion pair}}{R^{\oplus}X^{\ominus}} \longrightarrow \underset{\text{Solvent Separated ion pair}}{R^{\oplus} \parallel X^{\ominus}} \xrightarrow{Y^{\ominus}} R-Y+X^{\ominus}$$

A student writes general characteristics based on the given mechanism as :
(a) The reaction is favoured by weak nucleophiles.
(b) $R^{\oplus}$ would be easily formed if the substituents are bulky
(c) The reaction is accompanied by recemization
(d) The reaction i`s favoured by non-polar solvents.
Which observations are correct ?
(1) (b) and (d) (2) (a) and (c) (3) (a) and (b) (4) (a), (b) and (c)

Ans. **(4)**

Sol. Above reaction is S_N1 reaction as it proceed via formation of carbocation. Polar protic solvent is more suitable for S_N1 and racemisation takes place.

2. The atomic number of the element unnilennium is :
(1) 119 (2) 109 (3) 108 (4) 102

Ans. **(2)**

Sol. un = 1
nil = 0
enn = 9
So Atomic number = 109

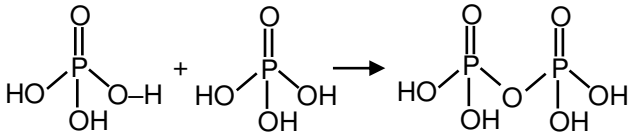
3. Thermal power plants can lead to :
(1) Eutrophication (2) Acid rain (3) Ozone layer depletion (4) Blue baby syndrome

Ans. **(2)**

Sol. burning of fossil fuels (which contain sulphur and nitrogenous matter) such as coal and oil in power stations and furnaces produce sulphur dioxide and nitrogen oxides which causes acid rain.

4. In a molecule of pyrophosphoric acid, the number of P – OH, P = 0 and P – O – P bonds/moiety(ies) respectively are :
(1) 4, 2 and 1 (2) 3, 3 and 3 (3) 4, 2 and 0 (4) 2, 4 and 1

Ans. **(1)**

Sol.  Pyrophosphoric acid

No. of P = 0 bond = 2.
P–OH bond = 4.
P–O–P bond = 1.

5. It is true that :
(1) A first order reaction is always a single step reaction
(2) A second order reaction is always a multistep reaction
(3) A zero order reaction is a single step reaction
(4) A zero order reaction is a multistep reaction

Ans. **(4)**

Sol. Zero order reaction is always multi step reaction.

6. Let C_{naCl} and C_{BaSO_4} be the conductances (in S) measured for saturated aqueous solutions of NaCl and $BaSO_4$ respectively, at a temperature T. Which of the following is false?
(1) Ionic mobilities of ions from both salts increase with T.
(2) $C_{NaCl} >> C_{BaSO_4}$ at a given T
(3) $C_{BaSO_4}(T_2) > C_{BaSO_4}(T_1)$ for $T_2 > T_1$
(4) $C_{NaCl}(T_2) > C_{NaCl}(T_1)$ for $T_2 > T_1$

Ans. **(1) {NTA answer given is (4)}**

Sol. (i) Ionic mobilities decrease with increase in temperature due to increase in random motion and hence decrease in relaxation time so decrease in drift speed.
(i) NaCl is completely soluble salt while $BaSO_4$ is sparingly soluble salt so $C_1 >> C_2$.
(ii) On increase in temperature conductance increase.

7. Tyndall effect is observed when :
(1) The diameter of dispersed particles is similar to the wavelength of light used.
(2) The refractive index of dispersed phase is greater than that of the dispersion medium.
(3) The diameter of dispersed particles is much smaller than the wavelength of light used
(4) The diameter of dispersed particles is much larger than the wavelength of light used.
NCERT page : 139 (Surface chemistry)

Ans. **(1)**

Sol. **According to NCERT text**
*The diameter of the dispersed particles is not much smaller than the wavelength of the light used
*The intensity of scattered light depends on the difference between the refractive indice of the D.P and D.M., In lyophobic colloids, this difference is appreciable and therefore the tyndal effect is quite well defined but in lyophilic sols the difference is very small and the tyndal effect is very weak.
So, to show Tyndall effect the refractive indices of the dispersed phase and dispersion medium differ greatly in magnitude.

8. An acidic buffer is obtained on mixing :
(1) 100 mL of 0.1 M CH_3COOH and 200 mL of 0.1 M NaOH
(2) 100 mL of 0.1 M CH_3COOH and 100 mL of 0.1 M NaOH
(3) 100 mL of 0.1 M HCl and 200 mL of 0.1 M CH_3COONa
(4) 100 mL of 0.1 M HCl and 200 mL of 0.1 M NaCl

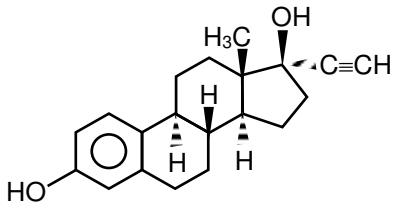
Ans. **(3)**

Sol. Mixture of weak acid and its salt with strong base acts as buffer solution.

9. the antifertility drug "Novestrol" can react with :
(1) $ZnCl_2$ / HCl ; $FeCl_3$; Alcoholic HCN
(2) Alcoholic HCN ; NaOCl ; $ZnCl_2$ / HCl
(3) Br_2 / water, $ZnCl_2$ / HCl ; NaOCl
(4) Br_2 / water, $ZnCl_2$ / HCl ; $FeCl_3$

Ans. **(4)**

Sol.



Novestrol (Anti Fertility Drugs)

Novestrol has phenolic functional group, alcoholic functional group and Terminal alkyne.

10. The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at 20,300 cm^{-1}. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1}, is : (1 kJ mol^{-1} = 83.7 cm^{-1})

(1) 242.5 (2) 145.5 (3) 83.7 (4) 97

Ans. **(4)**

Sol. $[Ti(H_2O)_6]^{3+} \Rightarrow Ti^{3+} = 3d^1\ 4s^0$

$\Rightarrow t_{2g}^{1,0,0}, e_g^{0,0}$

$CFSE = [-0.4n_{t2g} + 0.6n_{eg}]\ \Delta_0 + n(p)$

$= [-0.4 \times 1]\ 20300$

$= -8120\ cm^{-1}$

$= \frac{-8120}{83.7}$ kJ/mole

$= -97$ kJ/mole

11. Glycerol is separated in soap industries by :

(1) Steam distillation (2) Differential distillation

(3) Fractional distillation (4) Distillation under reduced pressure

Ans. **(4)**

Sol. Glycerol can be separated from spent-lye in soap industry by using Reduce pressure Distillation technique.

(NCERT - Class-IX,Unit-XII, Page.358)

12. Henry's constant (in kbar) for four gases α, β, γ and δ in water at 298 K is given below :

	α	β	γ	δ
K_H	50	2	2×10^{-5}	0.5

(density of water = 10^3 kg m^{-3} at 298 K) This table implies that :

(1) Solubility of γ at 308 K is lower than at 298 K

(2) The pressure of a 55.5 molal solution of γ is 1 bar

(3) The pressure of a 55.5 molal solution of δ is 250 bar

(4) α has the highest solubility in water at a given pressure

Ans. **(3)**

Sol. (i) Though solubility of gas will decrease with increase in temperature but this conclusion can not be drawn from the given table.

(ii) For γ

$$(P)_\gamma = (p_H)_\gamma \,.\, (X)_\gamma$$

$$= 2\times10^{-2}\left[\frac{55.5}{55.5+\frac{1000}{18}}\right] = 10^{-2} \text{ bar}$$

(iii) For $\delta \Rightarrow P_\delta = (k_H)_\delta \,.\, (X)_\delta$

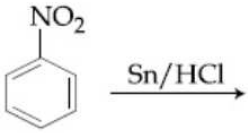
$$= 0.5 \times 10^3 \times \frac{1}{2} = 250 \text{ bar.}$$

(iv) From Henery's law

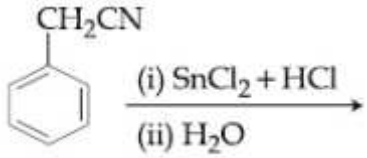
$$P = k_H(X)$$

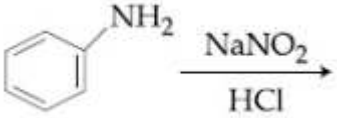
Higher the value of k_H smaller will be solubility so γ is more soluble.

13. The Kjeldahl method of Nitrogen estimation fails for which of the following reaction products ?

(a) 

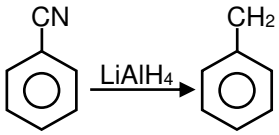
(b) 

(c) 

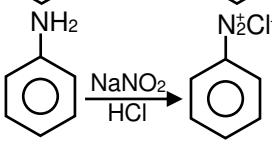
(d) 

(1) (a) and (d) (2) (a), (c) and (d) (3) (b) and (c) (4) (c) and (d)

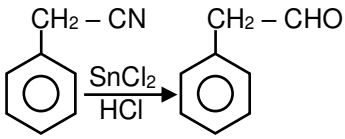
Ans. **(4)**

Sol. (a) 

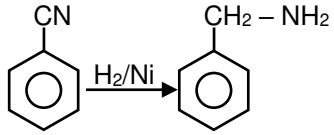
(N – present in product so will show Kjeldhal Test)

(b) 

($-N_2^+$ Never show Kjeldhal Test)

(c) 

(N–abscent, wo will not show Kjeldhal Test)

(d) 

(will give positive Kjeldhal test due to presence of $-NH_2$ group)

14. If the boiling point of H_2O is 373 K, the boiling point of H_2S will be :
(1) equal to 373 K
(2) greater than 300 K but less than 373 K
(3) less than 300 K
(4) more than 373 K

Ans. **(3)**

Sol. At room temperature water is liquid and has boiling point 373 K due to hydrogen bonding. Where as H_2S is gas and it has no hydrogen bonding. Hence boiling point of H_2S is less than 300 K [Boiling point of H_2S is -60^oC]

15. Of the species, NO, NO^+, NO^{2+} and NO^-, the one with minimum bond strength is :
(1) NO (2) NO^{2+} (3) NO^{-1} (4) NO^+

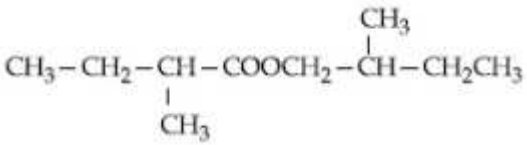
Ans. **(3)**

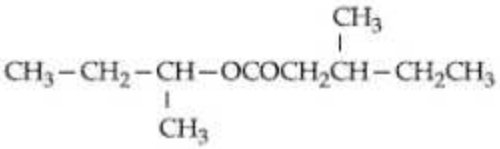
Sol.

	Species	Bond order
(1)	NO^+	3
(2)	NO^{2+}	2.5
(3)	NO^-	2
(4)	NO	2.5

Bond strength α bond order

16. An organic compound [A], molecular formula $C_{10}H_{20}O_2$ was hydrolysed with dilute sulphuric acid to given a carboxylic acid [B] and an alcohol [C]. Oxidation of [C] with $CrO_3 - H_2SO_4$ produced [B]. Which of the following structures are not possible for [A]

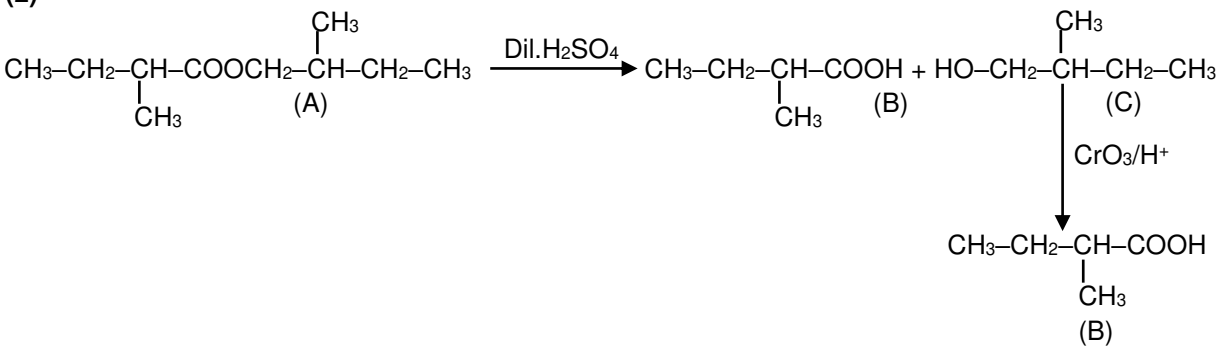
(1) 

(2) 

(3) $(CH_3)_3-C-COOCH_2C(CH_3)_3$

(4) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$

Ans. **(2)**

Sol. 

Same as (3) & (4) options.

17. The complex that can show optical activity is :

(1) trans-$[Cr(Cl_2)(ox)_2]^{3-}$

(2) trans-$[Fe(NH_3)_2(CN)_4]^-$

(3) cis-$[Fe(NH_3)_2(CN)_4]^-$

(4) cis-$[CrCl_2(ox)_2]^{3-}$ (ox = oxalate)

Ans. **(4)**

Sol. Only cis-$[CrCl_2(OX)_2]^{3-}$ show optical isomerism while its trans form do not show optical isomerism due to presence of plane of symmetry.

18. Aqua regia is used for dissolving noble metals (Au, Pt, etc.). The gas evolved in this process is :

(1) N_2 (2) NO (3) N_2O_5 (4) N_2O_3

Ans. **(2)**

Sol. Aqua regia is HNO_3 : HCl

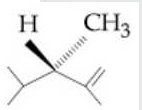
1 : 3

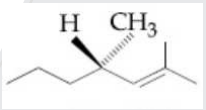
$$HNO_3 + 3HCl \longrightarrow 2H_2O + NO + 3[Cl]$$

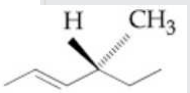
(i) $Au + 3[Cl] \longrightarrow AuCl_3 \xrightarrow{HCl} HAuCl_4$

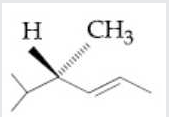
(ii) $Pt + 4[Cl] \longrightarrow PtCl_4 \xrightarrow{HCl} H_2PtCl_6$

19. Which of the following compounds produces an optically inactive compound on hydrogenation ?

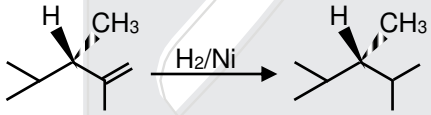
(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

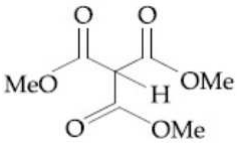
Sol. 

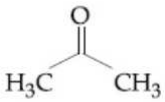
Optically inactive

20. Which one of the following compounds possesses the most acidic hydrogen ?

(1) $H_3C - C \equiv C - H$

(2) 

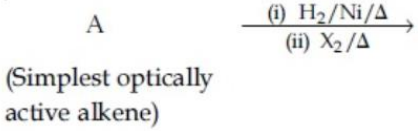
(3) 

(4) 

Ans. **(3)**

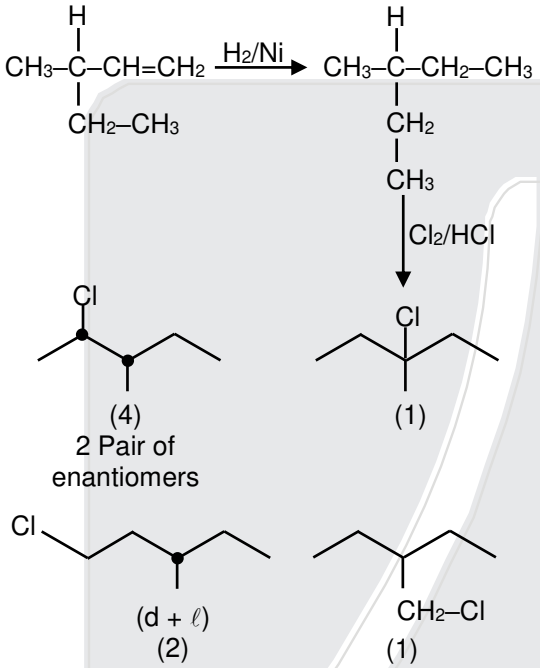
Sol. Acidic strength $\propto$ –I, –M effect due to strong –I, –M effect of 3 – $COOCH_3$, it has most acidic Hydrogen.

21. The total number of monohalogenated organic products in the following (including stereoisomers) reaction is_____.



Ans. **(8)**

Sol.



22. The photoelectric current from Na (work function, w_0 = 2.3 eV) is stopped by the output voltage of the cell

$Pt(s)|H_2(g, 1bar) | HCl(aq., pH = 1) | AgCl(s) | Ag(s)$

the pH of aq. HCl required to stop the photoelectric current from K(w_0 = 2.25 eV), all other conditions remaining the same, is ..... × 10^{-2} (to the nearest integer).

Given

$$2.303\frac{RT}{F} = 0.06\ V;\ E^0_{AgCl|Ag|Cl^-} = 0.22V$$

Ans. **142 {NTA answer given is 58}**

Sol. Sodium metal :

$E = E_0 + (KE)_{max}$; $E^0_{cell} = 0.22$ V

Cell reaction

Cathode : $AgCl(s) + e^- \longrightarrow Ag(s) + Cl^-(aq)$

Anode : $\frac{1}{2}H_2(g) \longrightarrow H^+(aq) + e^-$

Overall : $AgCl(s) + \frac{1}{2}H_2(g) \longrightarrow Ag(s) + H^+(aq) + Cl^-(aq)$

$$E_{cell} = E^0_{cell} - \frac{0.06}{1}\log [H^+][Cl^-]$$

$$E_{cell} = 0.22 - \frac{0.06}{1}\log [10^{-1}][10^{-1}] = 0.22 + 0.12 = 0.34\ V$$

$(KE)_{max} = E_{cell} = 0.34$ eV

So $E = 2.3 + 0.34 = 2.64$ eV = Energy of photon incident

For potassium metal :

$E = E_0 + (KE)_{max}$

$2.64 = 2.25 + (KE)_{max}$

$(KE)_{max} = 0.39 = E_{cell}$

Cell reaction

Cathode : $AgCl(s) + e^- \longrightarrow Ag(s) + Cl^-(aq)$

Anode : $\frac{1}{2}H_2(g) \longrightarrow H^+(aq) + e^-$

Overall : $AgCl(s) + \frac{1}{2}H_2(g) \longrightarrow Ag(s) + H^+(aq) + Cl^-(aq)$

$$E_{cell} = E^0_{cell} - \frac{0.06}{1}\log [H^+][Cl^-]$$

$0.39 = 0.22 - 0.12 \log [H^+]$

$0.17 = 0.12 \times pH$

$pH = 17/12 = 1.4166 = 1.42$

23. The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is .....

Ans. **47**

Sol. Let total mole of solution = 1

so mole of glucose = 0.1

mole of H_2O = 0.9

$$\% \text{ (w/w) of } H_2O = \left[\frac{0.9\times18}{0.9\times18+0.1\times180}\right]\times100$$

$= 47.368$

$= 47.37$

24. The volume strength of 8.9 M H_2O_2 solution calculated at 273 K and 1 atm is ..... (R = 0.0821 L atm K^{-1} mol^{-1}) (rounded off to the nearest integer)

Ans. **100**

Sol. Molarity of H_2O_2 solution = $\left\{\frac{\text{Volume strength}}{11.2}\right\}$

Volume strength = 8.9×11.2

$= 99.68$ V

25. An element with molar mass 2.7×10^{-2} kg mol^{-1} forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^{3} kg m^{-3}, the radius of the element is approximately ..... $\times 10^{-12}$ m (to the nearest integer)

Ans. 143

Sol. $d = \dfrac{Z \times M}{Na \times Volume}$

$$2.7 = \frac{Z \times 27}{6.02 \times 10^{23} \times [4.05 \times 10^{-3}]^3}$$

$Z = 4 \quad \Rightarrow$ fcc unit cell

For fcc unit cell $4r = \sqrt{2}a$

$$r = \frac{1.414 \times 405}{4}$$

$= 143.1675$ pm

$= 143.17$ pm

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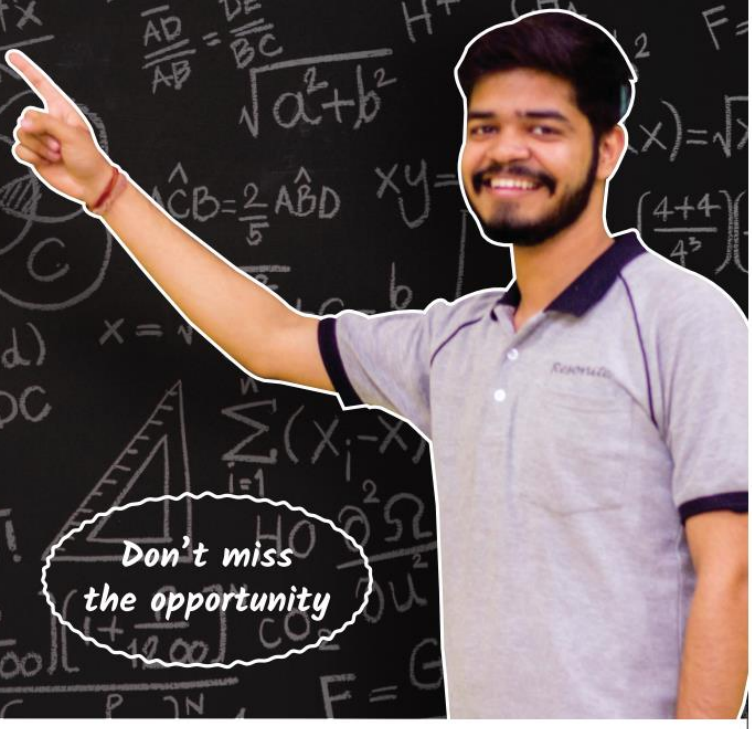

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Course Brief

The Rank Booster Part-2 course is recommended for students aiming a top rank in JEE (Advanced) 2020. The course structure is tailored to better the chances through rigorous practice of 18 Advanced Worksheets and their exhaustive conceptual discussion. Also, unit wise worksheets for self practice to strengthen tough and important concepts.

Boosting Aspirations to Reality

Course Starts	Course Duration	Course Mode	Course Fee (Inclusive of GST)
07 Sept.	3 Weeks	Online	₹5000/- Non Refundable

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