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

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 02 September, 2020 (SHIFT-2) | TIME : (03.00 p.m. to 06.00 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. Cast iron is ued for the manufacture of :

(1) wrought iron and steel (2) wrought iron, pig iron and steel

(3) wrought iron and pig iron (4) pig iron, scrap iron and steel

Ans. **(1)**

Sol. Cast iron is made from pig iron which is used for production of wrought iron & steel.

2. Amongst the following statements regarding adsorption, those that are valid are:

(a) ΔH becomes less negative as adsorption proceeds.

(b) On a given adsorbent, ammonia is adsorbed more than nitrogen gas.

(c) On adsorption, the residual force acting along the surface of the adsorbent increases.

(d) With increase in temperature, the equilibrium concentration of adsorbate increases.

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

Ans. **(3)**

Sol. (a) When gas is adsorbed on metal surface.

ΔH become less negative with progress of reaction.

(b) Gas with greater value of critical temperature (T_C) absorbed more. As $T_C(NH_3) > T_C(N_2)$

So NH_3 absorbed more than N_2.

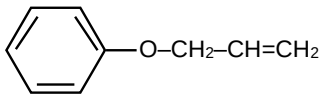
3. The size of a raw mango shrinks to a much smaller size when kept in a concentrated salt solution. Which one of the following process can explain this ?

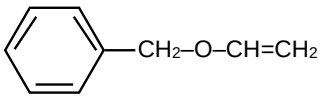
(1) Dialysis (2) Reverse osmosis (3) Osmosis (4) Diffusion

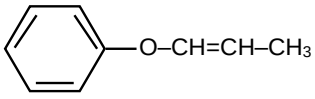
Ans. **(3)**

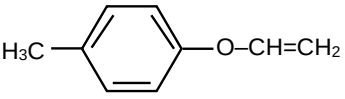
Sol. When mango kept in concentrate salt solution then solvent (water) flow from mango to concentrate solution that's why mango shrinks this is called. "Osmosis"

4. An organic compound 'A' ($C_9H_{10}O$) when treated with conc. HI undergoes cleavage to yield compound 'B' and 'C'. 'B' gives yellow precipitate with $AgNO_3$ where as 'C' tautomerizes to 'D'. 'D' gives positive iodoform test. 'A' could be:

(1) 

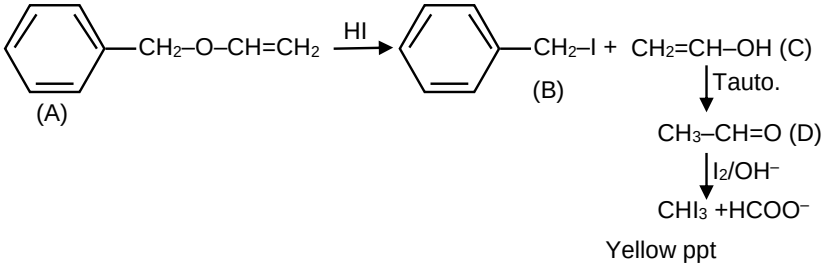
(2) 

(3) 

(4) 

Ans. **(2)**

Sol. $C_9H_{10}O$



5. The number of subshells associated with n = 4 and m = –2 quantum numbers is:

(1) 16 (2) 8 (3) 4 (4) 2

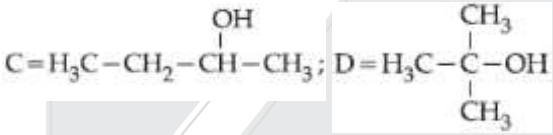
Ans. **(4)**

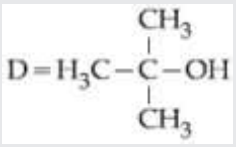
Sol. For n= 4 possible values of ℓ = 0, 1, 2, 3 only ℓ = 2 & ℓ = 3 can have m = –2.
So possible subshells are 2.

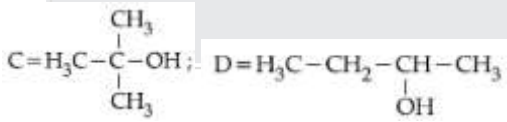
6. Two compounds A and B with same molecular formula (C_3H_6O) undergo Grignard reaction with methylmagnesium bromide to give products C and D. Products C and D show following chemical tests.

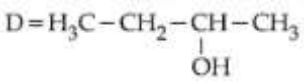
Test	**C**	**D**
Ceric ammonium nitrate Test	Positive	Positive
Lucas Test	Tubridity obtained after five minutes	Turbidity obtained immediately
Iodoform Test	Positive	Negative

C and D respectively are:

(1) 

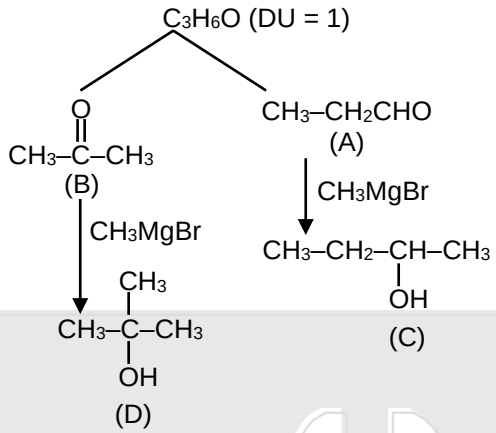
(2) C=$H_3C–CH_2–CH_2–CH_2–OH$; 

(3) 

(4) C = $H_3C–CH_2–CH_2–CH_2–OH$; 

Ans. **(1)**

Sol.



Iodoform Test	–ve	+ve
Lucas Test	Immediate	after 5-10 Mint.
Ceric Ammonium nitrate	+ve	+ve

7. Match the type of interaction in column A with the distance dependence of their interaction energy in column B :

A	B
(i) ion – ion	(a) $\frac{1}{r}$
(ii) Dipole– dipole	(b) $\frac{1}{r^2}$
(iii) Londondispersion	(c) $\frac{1}{r^3}$
	(d) $\frac{1}{r^6}$

(1) (i) – (a); (ii) – (b); (iii) – (c)
(2) (i) – (a); (ii) – (b); (iii) – (d)
(3) (i) – (b); (ii) – (d); (iii) – (c)
(4) (i) – (a); (ii) – (c); (iii) – (d)

Ans. **(Reso Answer 4 Given NTA Answer 2)**

Sol. (i) ion-ion interaction energy is inversely proportional to the distance between ions $\left(\frac{1}{r}\right)$.

(ii) dipole-dipole interaction energy is inversely proportional to the third power of r $\left(\frac{1}{r^3}\right)$.

(iii) The interaction energy of London force is inversely proportional to sixth power of distance between two interaction particles $\left(\frac{1}{r^6}\right)$.

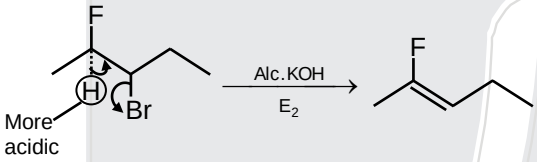
8. The major product obtained from E_2-elimination of 3-bromo-2- fluoropentane is

(1) $CH_3-CH_2-\underset{\displaystyle Br}{\overset{|}{C}}=CH-CH_3$ (2) $CH_3CH_2-\underset{\displaystyle Br}{\overset{|}{CH}}-CH=CH_2$

(3) $CH_3-CH=CH-\underset{\displaystyle F}{\overset{|}{CH}}-CH_3$ (4) $CH_3CH_2CH=\underset{\displaystyle CH_3}{\overset{|}{C}}-F$

Ans. **(4)**

Sol.



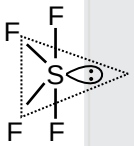
9. The molecular geometry of SF_6 is octahedral. What is the geometry of SF_4 (including lone pair(s) of electrons, if (any)?

(1) Square planar (2) Trigonal bipyramidal

(3) Tetrahedral (4) Pyramidal

Ans. **(2)**

Sol. $SF_4 \Rightarrow$ Steric No = 5 so hybridisation is sp^3d.



Geometry is trigonal bipyramidal but shape is "See Saw".

10. The results given in the below table were obtained during kinetic studies of the following reaction :

$2A + B \rightarrow C + D$

Experiment	$[A]/molL^{-1}$	$[B]/molL^{-1}$	Initial rate $/molL^{-1}min^{-1}$
I	0.1	0.1	6.00×10^{-3}
II	0.1	0.2	2.40×10^{-2}
III	0.2	0.1	1.20×10^{-2}
IV	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively :

(1) 0.3, 0.4 (2) 0.4, 0.3 (3) 0.4, 0.4 (4) 0.3, 0.3

Ans. **(1)**

Sol. Rate = $k[A]^a[B]^b$

from Exp (1) & (2) b = 2

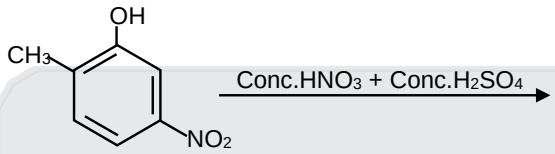
from Exp (1) & (3) a = 1

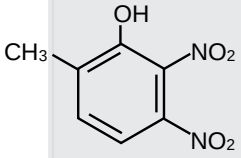
from Exp (2) & (4) $\Rightarrow 3 = \left(\frac{x}{0.1}\right)^1$ so x = 0.3

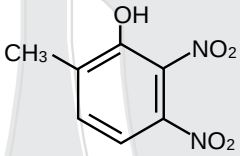
from Exp (1) & (5) $\Rightarrow$ $48 = (3)^1\left(\frac{y}{0.1}\right)^2$

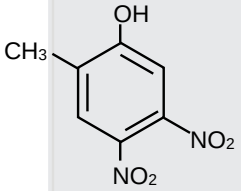
$(4)^2 = \left(\frac{y}{0.1}\right)^2$ so y = 0.4

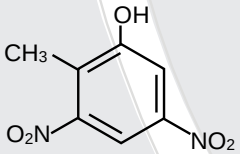
11. The major product of the following reaction is:



(1) 

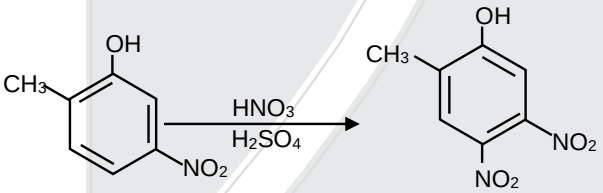
(2) 

(3) 

(4) 

Ans. **(3)**

Sol. This is electrophilic substitution reaction which is determine by electronic effect of OH\CH3\NO2.



12. The one that is not expected to show isomerism is:

(1) $[Ni(NH_3)_2Cl_2]$ (2) $[Ni(NH_3)_4(H_2O)_2]^{2+}$ (3) $[Ni(en)_3]^{2+}$ (4) $[Pt(NH_3)_2Cl_2]$

Ans. **(1)**

Sol. (1) $\overset{+2}{[Ni(NH_3)_2Cl_2]} \Rightarrow Ni^{2+} \Rightarrow 3d^8 4s^0$.

$\Rightarrow$ sp^3 hybridisition.

$\Rightarrow$ tetrahedral.

so $[Ni(NH_3)_2Cl_2]$ do not show isomerism.

(2) $[Ni(NH_3)_4(H_2O)_2]^{2+}$, show geometrical isomerism.

(3) $[Ni(en)_3]^{2+}$, show optical isomerism.

(4) $[Pt(NH_3)_2Cl_2]$, show geometrical isomerism.

13. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively are :

(1) octahedral and square pyramidal (2) trigonal bipyramidal and trigonal bipyramidal

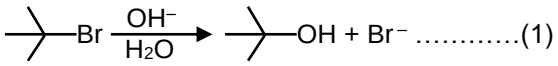
(3) trigonal bipyramidal and pentagonal (4) pentagonal planar and trigonal bipyramidal

Ans. **(4)**

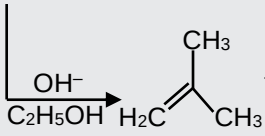
Sol. (i) XeF_5^- St. No. = (5 + 2) = 7
so hybridisation is = sp^3d^3
and structure is pentagonal planar.

(ii) XeO_3F_2 St. No. = 5
so hybridisation is = sp^3d
and structure is trigonal bipyramidal.

14. Consider the reaction sequence given below :



rate = k[t-BuBr]



rate = k[t-BuBr][OH⁻]

Which of the following statements is true:

(1) Changing the concentration of base will have no effect on reaction (1)

(2) Doubling the concentration of base will double the rate of both the reactions

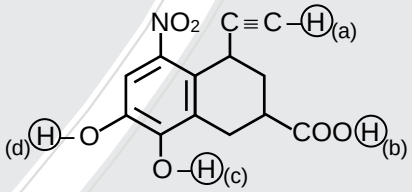
(3) Changing the concentration of base will have no effect on reaction (2)

(4) $^{\ominus}OR$ will have no effect on reaction (2)

Ans. **(1)**

Sol. First reaction is SN^1 in which rate does not depend on conc. of nucleophile. Second reaction is E2 reaction in which rate depends on conc. of base.

15. Arrange the following labelled hydrogens in decreasing order of acidity:



(1) b > c > d > a (2) c > b > a > d (3) b > a > c > d (4) c > b > d > a

Ans. **(1)**

Sol. Acidic strength ∝ Stability of conjugate base

General order of acidic strength

R–COOH > Ph–OH > R–C≡CH

'c' is more acidic due to –M effect of $–NO_2$.

16. If you spill a chemical toilet cleaning liquid on your hand, your first aid would be:

(1) vinegar (2) aqueous NaOH (3) aqueous $NaHCO_3$ (4) aqueous NH_3

Ans. **(3)**

Sol. In toilet cleaning liquid the main constituent is HCl, which can cause skin burn so it should be treated with $NaHCO_3$ which can easily consume the acid.

17. The correct observation in the following reaction is:

$$\text{Sucrose} \xrightarrow[\text{Cleavage (Hydrolysis)}]{\text{Glycosidic bond}} A + B \xrightarrow[\text{Reagent}]{\text{Seliwanoff}} ?$$

(1) Formation of blue colour (2) Formation of violet colour

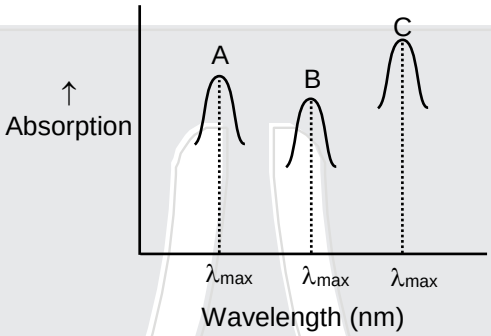
(3) Formation of red colour (4) Gives no colour

Ans. **(3)**

Sol. Seliwanoff reagent → [Resorcinol + Conc. HCl]

Use of Seliwanoff reagent is to distinguish aldoses and ketoses. Ketoses show red colour with Seliwanoff Reagent.

18. Simplified absorption spectra of three complexes ((i) and (ii) and (iii)) of M^{+n} ion are provided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is:



(i) $[M(NCS)_6]^{(-6+n)}$

(ii) $[MF_6]^{(-6+n)}$

(iii) $[M(NH_3)_6]^{n+}$

(1) A-(i), (B)-(ii), C-(iii) (2) A-(ii), (B)-(iii), C-(i)

(3) A-(ii), (B)-(i), C-(iii) (4) A-(iii), (B)-(i), C-(ii)

Ans. (4)

Sol. Stronger the ligand greater is splitting of d orbitals and smaller will be wave length of light absorbed.

The splitting power of ligands is $NH_3 > \overline{NCS} > F^-$

So order of wave length of light absorbed is $\lambda_{NH_3} < \lambda_{\overline{NCS}} < \lambda_{F^-}$

19. Two elements A and B have similar chemical properties. They don't form solid hydrogencarbonates, but react with nitrogen to form nitrides. A and B, respectively, are :

(1) Li and Mg (2) Na and Ca (3) Na and Rb (4) Cs and Ba

Ans. **(1)**

Sol. Li and Mg do not form solid bicarbonate. But react with N_2 to give nitrides.

$6\ Li + N_2 \xrightarrow{\Delta} 2\ Li_3N$

$3\ Mg + N_2 \xrightarrow{\Delta} Mg_3N_2$.

20. Three elements X, Y and Z are in the 3rd period of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic. The correct order of the atomic numbers of X, Y and Z is:

(1) X < Y < Z (2) Z < Y < X (3) X < Z < Y (4) Y < X < Z

Ans. **(1)**

Sol. On moving left to right in a period.
Acidic character of oxides is increase.
3rd period element oxides.

$\underbrace{Na_2O \quad MgO}_{\text{Basic}} \quad \underbrace{Al_2O_3}_{\text{Amphoteric}} \quad \underbrace{SiO_2 \quad P_2O_5 \quad Cl_2O_7}_{\text{Acidic}}$

(i) Acidic character↑
(i) Atomic No↑
So X have minimum Atomic No
& Z have maxima Atomic No
So correct order is X < Y < Z

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

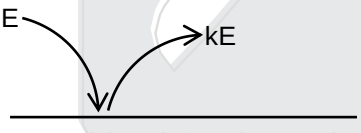
खंड 2 (अधिकतम अंकः 20)

- 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 work function of sodium metal is 4.41×10^{-19} J. If photons of wavelength 300 nm are incident on the metal, the kinetics energy of the ejected electrons will be ($h = 6.63 \times 10^{-34}$Js; $c = 3 \times 10^8$ m/s) _____ $\times 10^{-21}$ J.

Ans. 222

Sol.



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

$\frac{hC}{\lambda} = 4.41 \times 10^{-19} + kE$

$\frac{6.63\times10^{-34}\times3\times108}{300\times10^{-9}} = 4.41 \times 10^{-19} + kE$

So, $(kE)_{max} = 6.63 \times 10^{-19} - 4.41 \times 10^{-19}$
$= 2.22 \times 10^{-19}$
$= 222 \times 10^{-21}$J

22. The ration of the mass percentages of 'C & H' and 'C & O' of a saturated acyclic organic compound 'X' are 4 : 1 and 3 : 4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound 'X' is_____.

Ans. 5

Sol. Mass ratio of C : H is 4 : 1 $\Rightarrow$ 12 : 3

& C : O is 3 : 4 $\Rightarrow$ 12 : 16

		mass	mole	mole ratio
so	C	12	1	1
	H	3	3	3
	O	16	1	1

Empirical formula $\Rightarrow CH_3O$

as compound is saturated acyclic so molecular formula is $C_2H_6O_2$.

$$\underset{\text{mole}}{C_2H_6O_2} + \underset{2\text{ mole}}{\frac{5}{2}O_2(g)} \longrightarrow \underset{5\text{ mole}}{2CO_2(g) + 3H_2O(g)}$$

so required moles of O_2 is $\Rightarrow$ 5

23. The heat of combustion of ethanol into carbon dioxids and water is –327 kcal at constant pressure. The heat evolved (in cal) at constant volume at 27°C (if all gases behave ideally) is (R = 2 cal mol^{-1} K^{-1}) _____.

Ans. **–326400**

Sol. $C_2H_5OH(\ell) + O_2(g) \longrightarrow 2O_2(g) + 3H_2O(\ell)$; $\Delta H_C = -327$ Kcal

$\Delta H_C = \Delta U_C + \Delta n_g RT$

$-327 \times 10^3 = \Delta U_C + 1 \times 2 \times 300$

$\Delta U_C = -326400$ cal

So heat evolved as constant volume is –326400 cal

24. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4, respectively, are x, y and z. The sum of x, y and z is_____.

Ans. **19**

Sol.

	Compound	**Oxidation state of transition element.**
(i)	$K_2Cr_2O_7$	x = +6
(ii)	$KMnO_4$	y = +7
(iii)	K_2FeO_4	z = +6

so (x + y + z) = 19

25. For the disproportionation reaction $2Cu^+(aq) \rightleftharpoons Cu(s) + Cu^{2+}(aq)$ at 298 K, ln K (where K is the equilibrium constant) is_____ $\times 10^{-1}$.

Given : $\left(E^\circ_{Cu^{2+}/Cu^+} = 0.16V \; E^\circ_{Cu^+/Cu} = 0.52V \; \frac{RT}{F} = 0.025\right)$

Ans. **144**

Sol. $E^\circ_{cell} = E^\circ_{Cu^+/Cu} - E^\circ_{Cu^{2+}/Cu^{+1}}$

= 0.52 – 0.16

= 0.36 V

$$\boxed{E^\circ_{cell} = \frac{RT}{nF}\ln K_{eq}}$$

$$0.36 = \frac{0.025}{1}\ln k$$

$\ln k = 14.4$

$= 144 \times 10^{-1}$

Ans. 144

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