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

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 05 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 Ans.wer, 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. Consider the following reaction :

$N_2O_4 \rightleftharpoons 2NO_2$ (g) ; $\Delta H^o = +58$ kJ

For each of the following cases (a,b), the direction in which the equilibrium shifts is :

(a) Temperature is decreased.

(b) Pressure is increased by adding N_2 at constant T.

(1) (a) towards reactant, (b) no change

(2) (a) towards product, (b) no change

(3) (a) towards product, (b) towards reactant

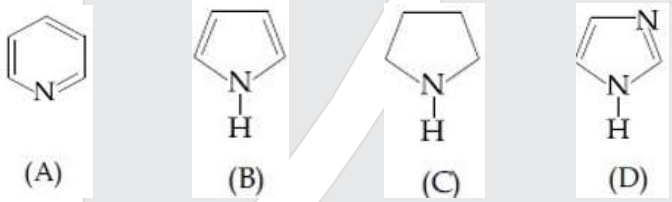
(4) (a) towards reactant (b) towards product

Ans. (1)

Sol. (i) As reaction is endothermic so on decrease in temperature equilibrium shift in reactant side.

(ii) On increase in pressure by adding inert gas at same temperature, no shifting will take place

2. The increasing order of basicity of the following compounds is :



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

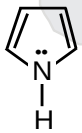
(2) (A) < (B) < (C) < (D)

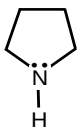
(3) (D) < (A) < (B) < (C)

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

Ans. (4)

Sol. (A)  Nitrogen atom is sp^2 hybridised and lone pair is localised

(B)  Nitrogen atom is sp^2 hybridised and lone pair is delocalised

(C)  Nitrogen atom is sp^3 hybridised and lone pair is localised

(D)  Nitrogen atom is sp^2 hybridised and lone pair is localised with partial negative charge.

3. If a person is suffering from the deficiency of nor-adrenaline, what king of drug can be suggested ?

(1) Antihistamine (2) Analgesic (3) Anti-inflammatory (4) Antidepressant

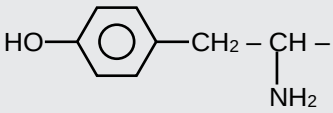
Ans. (4)

Sol. If the level of noradrenaline is low for some reason, then the signal-sending activity becomes low, and the person suffers from depression. In such situations, antidepressant drugs are required.

4. Which of the following is not an essential amino acid ?

(1) Tyrosine (2) Valine (3) Leucine (4) Lysine

Ans. **(1)**

Sol. Tyrosine  is a non-essential amino acid.

5. An Ellingham diagram provides information about :

(1) the kinetics of the reduction process.

(2) the conditions of pH and potential under which a species is thermodynamically stable.

(3) the pressure dependence of the standard electrode potentials of reduction reactions involved in the extraction of metals.

(4) the temperature dependence of the standard Gibbs energies of formation of some metal oxides.

Ans. (4)

Sol. Ellingham diagram is graph of ΔG^o vs T of any metal / element oxide. Since

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

for most metal oxide formation

metal (s) + oxygen (g) $\rightarrow$ metal oxide (s)

ΔH^o = – ve

ΔS^o = – ve

so graph will be a straight line with – ve y- intracept & +ve slope.

6. The condition that indicates a polluted environment is :

(1) 0.03% of CO_2 in the atmosphere (2) eutrophication

(3) pH of rain water to be 5.6 (4) BOD value of 5 ppm

Ans. (2)

Sol. (2) Clean water would have B.O.D value of less than 5 ppm whereas highly polluted water coluld have a B.O.D value of 17 ppm or more.

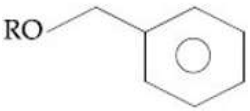
(3) The process in which nutrient enriched water bodies support a dense plant population which kill animal life by depriving it of oxygen results in subsequent loss of biodiversity is known as Eutrophication.

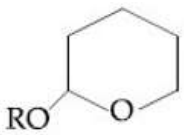
(4) If the concentration of dissolved oxygen of water is below 6 ppm, the growth of fish get inhibited.

7. Which of the following derivatives of alcohols is unstable in an aqueous base?

(1) 

(2) RO – CMe_3

(3) 

(4) 

Ans. (1)

Sol. Esters are hydrolysed in basic medium(saponification)

8. The equation that represents the water-gas shift reaction is :

(1) $CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673K} CO_2(g) + H_2(g)$

(2) $2C(s) + O_2(g) + 4N_2(g) \xrightarrow{1273K} 2CO(g) + 4N_2(g)$

(3) $C(s) + H_2O(g) \xrightarrow{1270K} CO(g) + H_2(g)$

(4) $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270K} CO(g) + 3H_2(g)$

Ans. (1)

Sol. $CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673K} CO_2(g) + H_2(g)$

Reaction is called water gas shift reaction

9. A flask contains a mixture of compounds A and B. Both compounds decompose by first-order kinetics. The half-lives for A and B are 300 s and 180 s, respectively. If the concentrations of A and B are equal initially, the time required for the concentration of A to be four times that of B (in s) is : (use ln 2 = 0.693)

(1) 120 (2) 300 (3) 180 (4) 900

Ans. (4)

Sol. $C_t = C_0\, e^{-kt}$ $\qquad k_A = \dfrac{\ln 2}{180}$ $\qquad \left(k = \dfrac{\ln 2}{T_{1/2}}\right)$

$(C_t)_A = (C_0)_A\, e^{-k_A t}$ $\qquad k_B = \dfrac{\ln 2}{300}$

$(C_t)_B = (C_0)_B\, e^{-k_B t}$

$$\frac{(C_t)_B}{(C_t)_A} = \frac{(C_0)_B}{(C_0)_A} \times e^{(k_A - k_B)t}$$

$$4 = e^{(k_A - k_B)t}$$

$$2\ln 2 = \left[\frac{\ln 2}{180} - \frac{\ln 2}{300}\right] t$$

$$2 = \left(\frac{120}{180 \times 300}\right) t$$

$$t = \frac{2 \times 180 \times 300}{120} = 900 \text{sec}$$

10. The value of the crystal field stabilization energies for a high spin d^6 metal ion in octahedral and tetrahedral fields, respectively, are:

(1) $-2.4\Delta_0$ and $-0.6\Delta_t$ (2) $-1.6\Delta_0$ and $-0.4\Delta_t$

(3) $-0.4\Delta_0$ and $-0.27\Delta_t$ (4) $-0.4\Delta_0$ and $-0.6\Delta_t$

Ans. (4)

Sol. For d^6 configuration, high spin

(i) In case of octahedral complex

$t_{2g}^{2,1,1}$, $e_g^{1,1}$

$CFSE = [-0.4nt_{2g} + 0.6n_{eg}]\Delta_0 + n(P)$

$= [-0.4 \times 4 + 0.6 \times 2]\Delta_0 + 0$

$= -0.4\Delta_0$

(i) In case of tetrahedral complex

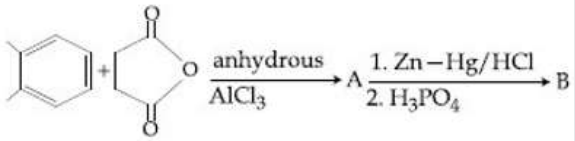
$e^{2,1}$, $t_2^{1,1,1}$

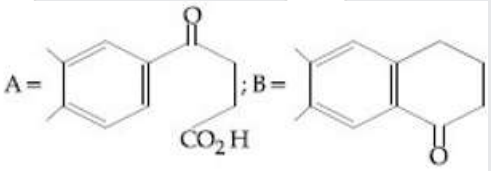
$CFSE = [-0.6n_e + 0.4nt_2]\Delta_t$

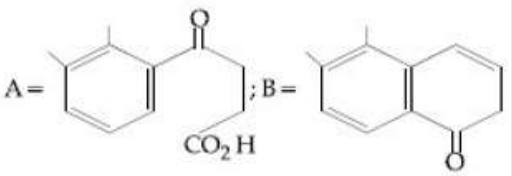
$= [-0.6 \times 3 + 0.4 \times 3]\Delta_t$

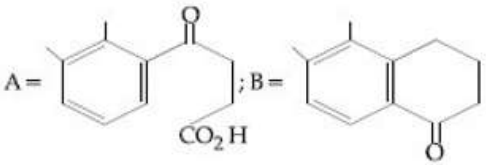
$= -0.6\Delta_t$

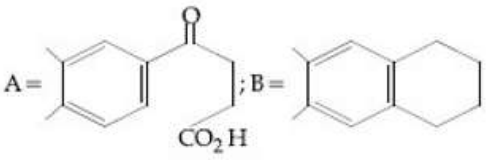
11. In the following reaction sequence the major product A and B are :



(1) 

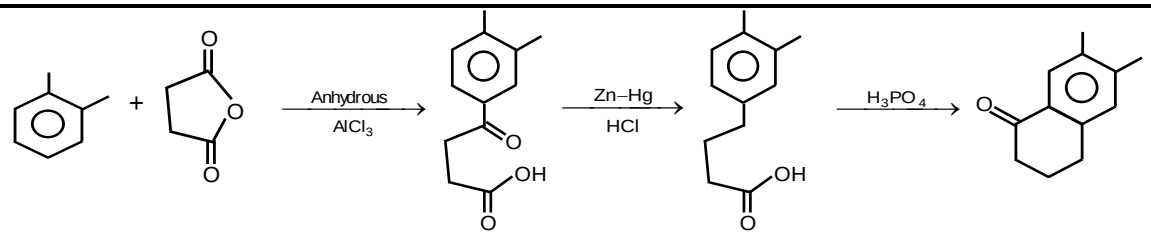
(2) 

(3) 

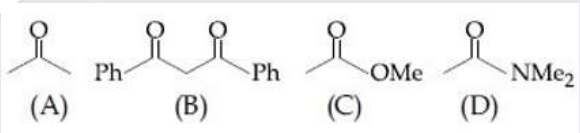
(4) 

Ans. **(1)**

Sol.



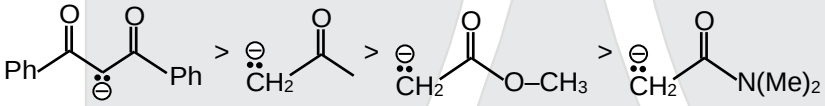
12. The increasing order of the acidity of the α-hydrogen of the following compounds is:



(1) (C) < (A) < (B) < (D) (2) (B) < (C) < (A) < (D)
(3) (A) < (C) < (D) < (B) (4) (D) < (C) < (A) < (B)

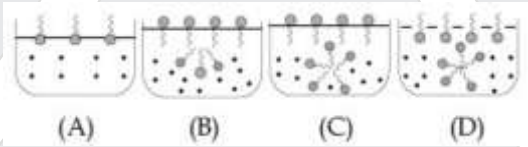
Ans. (4)

Sol. Acidity α stability of conjugate base



(Stability of conjugate bases)

13. Identify the correct molecular picture showing what happens at the critical micellar concentration (CMC) of an aqueous solution of a surfactant (⦸ polar head; 〰 non-polar tail ● water)



(1) (A) (2) (B) (3) (D) (4) (C)

Ans. (3)

Sol. In micelle formation, above "CMC" hydrocarbon chains are pointing towards the centre of sphere with COO^- part remaining outward on the surface.

14. In the sixth period, the orbitals that are filled are:

(1) 6s, 5f, 6d, 6p (2) 6s, 5d, 5f, 6p (3) 6s, 6p, 6d, 6f (4) 6s, 4f, 5d, 6p

Ans. (4)

Sol. In 6^{th} period 6s, 4f, 5d and 6p orbitals are gradually filled.

15. A diatomic molecule X_2 has a body-centred cubic (bcc) structure with a cell edge of 300 pm. The density of the molecule is 6.47 g cm^{-3}. The number of molecules present in 200 g of X_2 is:

(1) $4N_A$ (2) $2N_A$ (3) $40N_A$ (4) $8N_A$

Ans. (1)

Sol. For BCC Z = 2

$$d = \frac{Z \times M}{N_A \times Volume}$$

$$6.17 = \frac{2\times M}{6.02\times10^{23}\times[3\times10^{-8}]^3}$$

$$6.17 = \frac{2\times M}{6.02\times 2.7}$$

M = 50

No. of mole = $\frac{200}{50} = 4$

No. of molecule = 4 N_A

16. The structure of PCl_5 in the solid state is :

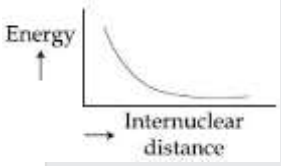
(1) tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$ (2) trigonal bipyramidal

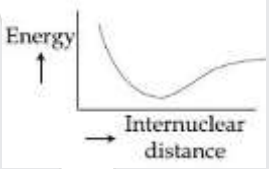
(3) square planar $[PCl_4]^+$ and octahedral $[PCl_6]^-$ (4) square pyramidal

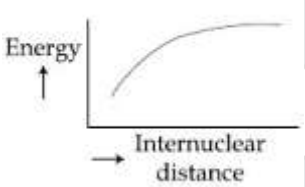
Ans. (1)

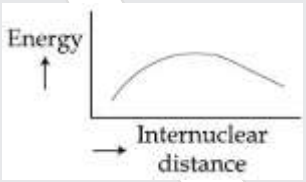
Sol. $2PCl_5(s) \longrightarrow \underset{\text{Tetrahedral}}{[PCl_4]^+}\ \ \underset{\text{Octahedral}}{[PCl_6]^-}$

17. The potential energy curve for the H_2 molecule as a function of internuclear distance is:

(1) 

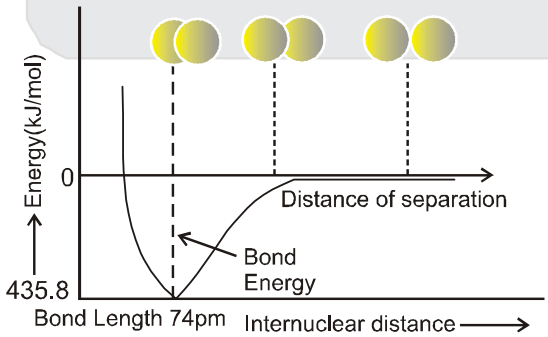
(2) 

(3) 

(4) 

Ans. **(2)**

Sol. The potential energy curve for the formation of H_2 molecule as a function of internuclear distance of the H atoms. The minima in the curve corresponds to the most stable state of H_2.



18. The correct electronic configuration and spin-only magnetic moment (BM) of Gd^{3+} (Z=64), respectively, are:

(1) [Xe] $5f^7$ and 7.9 (2) [Xe] $5f^7$ and 8.9 (3) [Xe] $4f^7$ and 7.9 (4) [Xe] $4f^7$ and 8.9

Ans. (3)

Sol. Electronic configuration of

$_{64}Gd$ = [Xe] $4F^7\ 5d^1\ 6s^2$

$_{64}Gd^{3+}$ = [Xe] $4F^7$

No. of unpaired electron = 7

$\mu = \sqrt{n(n+2)}\ BM$

$= \sqrt{63}$

= 7.93 BM

19. The difference between the radii of 3rd and 4th orbitals of Li^{2+} is ΔR_1. The difference between the radii of 3rd and 4th orbits of He^+ is ΔR_2. Ratio $\Delta R_1 : \Delta R_2$ is :

(1) 2 : 3 (2) 3 : 8 (3) 3 : 2 (4) 8 : 3

Ans. (1)

Sol. $r = 0.529 \frac{n^2}{Z}$ Å

For Li^{2+}

$(r_{Li^{2+}})_{n=4} - (r_{Li^{2+}})_{n=3} = \frac{0.529}{3}[16 - 9] = \Delta R_1$

For He^+

$(r_{He^+})_{n=4} - (r_{He^+})_{n=3} = \frac{0.529}{2}[16 - 9] = \Delta R_2$

;

$$\frac{\Delta R_1}{\Delta R_2} = \frac{2}{3}$$

20. The most appropriate reagent for conversion of C_2H_5CN into $CH_3CH_2CH_2NH_2$ is :

(1) $NaBH_4$ (2) $LiAlH_4$ (3) CaH_2 (4) $Na(CN)BH_3$

Ans. (2)

Sol. $CH_3CH_2–C\equiv N \xrightarrow{LiAlH_4} CH_3CH_3–CH_2–NH_2$

$NaBH_4$ does not reduce R–CN.

Numerical Value Type (संख्यात्मक प्रकार)

This section contains **5 Numerical value type questions.**

इस खण्ड में **5 सख्यात्मक प्रकार के प्रश्न** हैं।

21. An oxidation-reduction reaction in which 3 electrons are trAns.ferred has a ΔG^o of 17.37 kJ mol^{-1} at 25ºC.

The value of E^0_{cell} (in V) is …….× 10^{-2}. (1F = 96,500 C mol^{-1})

Ans.. **–6**

Sol. $\Delta G^o = -nF E^o_{cell}$

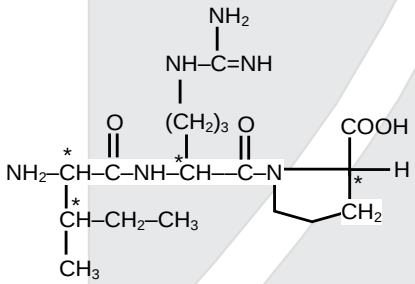
$17.37 \times 10^3 = -3 \times 96500 \times E^0_{cell}$

$E_{cell} = -0.06$ V

22. The number of chiral carbon(s) present in peptide, Ile-Arg-Pro, is…….

Ans. **4**

Sol.



23. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is…….

Ans.. **18**

Sol. (1) Combustion of propane.

$$\underset{1\text{ mole}}{C_3H_8} + \underset{5\text{ mole}}{5O_2(g)} \longrightarrow 3CO_2(g) + 4H_2O$$

(2) Combustion of butane

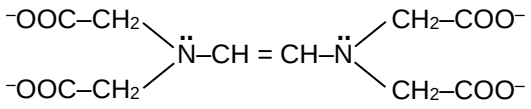
$$\underset{1\text{ mole}}{C_4H_{10}} + \underset{\frac{13}{2}\text{ mole}}{\frac{13}{2}O_2} \longrightarrow 4CO_2(g) + 5H_2O$$

so total mole of O_2 required = 5 + 13 = 18

24. The total number of coordination sites in ethylenediaminetetraacetate($EDTA^{4-}$) is…….

Ans.. **6**

Sol.



25. A soft drink was bottled with a partial pressure of CO_2 of 3 bar over the liquid at room temperature. The partial pressure of CO_2 over the solution approaches a value of 30 bar when 44 g of CO_2 is dissolved in 1 kg of water at room temperature. The approximate pH of the soft drink is……. × 10^{-1}.

(First dissociation constant of H_2CO_3 = 4.0 × 10^{-7}; log2 = 0.3; density of the soft drink = 1 g mL^{-1})

Ans. 37

Sol. Amount of CO2 in one liter of solution = 4.4. gram = 0.1 Mole

pH = 1/2 {pKa - log C} For a weak acid solution

pH = 1/2 { 6.4 +1 } = 3.7

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