



Previous Year Solved Question Paper
of

G.A.T.E. (XL) 2004

LIFE SCIENCES

XL: Chemistry

Examination

(Original Question Paper with Answer Key)

GRADUATE APTITUDE TEST IN ENGINEERING



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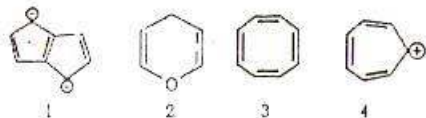
H : Chemistry (Compulsory)

[Useful data : Gas constant, $R = 8.3143 \text{ J K}^{-1} \text{ mol}^{-1}$; Faraday, $F = 96500 \text{ C mol}^{-1}$]

Q.1 – 10 carry one mark each

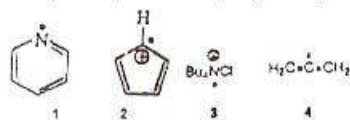
- Q.1 For a second order reaction, $2B \rightarrow \text{Products}$, if the initial concentration of the species B is $[B]_0$ and the rate constant is k , then $t_{1/2}$ can be expressed as:
- (A) $1/[B]_0 k$ (B) $1/k$
 (C) $[B]_0 k$ (D) $1/2[B]_0 k$
- Q.2 If the heats of reaction of the following transformations $C + O_2(g) \rightarrow CO_2(g)$, $C + \frac{1}{2} O_2(g) \rightarrow CO(g)$ and $CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g)$ are Q , 11.5 and 10.5 joules respectively, then Q in joules is equal to:
- (A) 120.75 (B) 1
 (C) -1 (D) 22
- Q.3 The spontaneity of a reaction can be judged from the sign of the emf (E) and the free energy (G) of the cell. The criteria are:
- (A) $\Delta G = +ve, E = -ve$ (B) $\Delta G = 0, E = 0$
 (C) $\Delta G = -ve, E = +ve$ (D) $\Delta G = -ve, E = -ve$
- Q.4 The function $\cos(ax)$ is an eigenfunction of d^2/dx^2 with an eigenvalue of:
- (A) $-a$ (B) $-a^2$
 (C) a (D) $-a^{-2}$
- Q.5 The heteronuclear diatomic molecule that is isoelectronic to HCN is:
- (A) NO (B) CO
 (C) BO (D) SO
- Q.6 The bond order in Be_2 molecule can be expected to be:
- (A) 0 (B) 1
 (C) 2 (D) 3
- Q.7 The intense color of $KMnO_4$ is due to:
- (A) electronic transition from one energy level to another in Mn
 (B) electronic transition from one energy level to another in O
 (C) charge transfer from Mn to O
 (D) charge transfer from O to Mn

Q.8 Of the following, the compounds that are aromatic are:



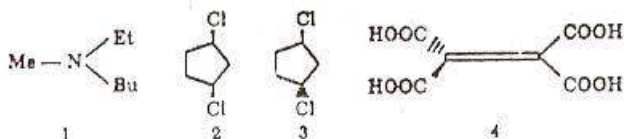
- (A) 1, 4
(B) 1, 2, 4
(C) 2, 3, 4
(D) 2, 4

Q.9 The hybridization of the atoms indicated by an asterisk in the following compounds in a sequence (from 1 to 4) is given by:



- (A) sp^3, sp^2, sp^3, sp
(B) sp^2, sp^2, sp^3, sp^2
(C) sp^2, sp^2, sp^3, sp
(D) sp^2, sp^3, sp^3, sp

Q.10 Which of the following compounds can have enantiomers?



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

Q.11 – 30 carry two marks each

Q.11 The rate constant for a certain reaction is found to be doubled when the temperature is raised from 27 to 37 °C. The activation energy for this reaction in kJ is:

- (A) 26.8
(B) 107.2
(C) 53.6
(D) 50.0

Q.12 The standard potential for the electrodes $Hg|Hg_2^{+2}$ and $Hg|Hg^{+2}$ are -0.799 and -0.855 volts at 25 °C, respectively. The equilibrium constant for the reaction $Hg + Hg^{+2} \rightleftharpoons Hg_2^{+2}$ is:

- (A) 85.12
(B) 79.12
(C) 70
(D) 90.20

Q.13 The freezing point of pure benzene is 5.44°C and that of a solution containing 2.092 g of A in 100 g of benzene is 4.44°C . The molal depression constant (k_f) for benzene is 5.1 . From this data, the molecular weight of A can be calculated to be:

- (A) 106.7 (B) 206.6
(C) 213.4 (D) 53.2

Q.14 The ion conductance of the alkali metal cations at a given concentration follow the following order:

- (A) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$ (B) $\text{Li}^+ < \text{Na}^+ < \text{K}^+ > \text{Rb}^+$
(C) $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+$ (D) $\text{Li}^+ = \text{Na}^+ > \text{K}^+ > \text{Rb}^+$

Q.15 A system undergoes a certain change in state by path I. The heat absorbed and the work done for this process are 10 kcal mol^{-1} and 0 ergs mol^{-1} , respectively. The respective quantities for the same change in state by path II are 11 kcal mol^{-1} and $0.5 w_{\text{max}}$, where w_{max} is the work done if the change were reversibly carried out. The magnitude of w_{max} in kJ mol^{-1} ($1\text{ cal} = 4.2\text{ J}$) is:

- (A) 4.2 (B) 2
(C) 1 (D) 8.4

Q.16 The total pressure for the reaction $\text{C(s)} + \text{CO}_2(\text{g}) \rightleftharpoons 2\text{CO}(\text{g})$ under the equilibrium condition is 15 atm . The value of K_p is:

- (A) 16 (B) 10
(C) 20 (D) 25

Q.17 The order of increasing bond order for the diatomic species O_2 , O_2^+ , O_2^- , O_2^{2+} is:

- (A) $\text{O}_2^{2+} < \text{O}_2^- < \text{O}_2 < \text{O}_2^+$ (B) $\text{O}_2 < \text{O}_2^+ < \text{O}_2^- < \text{O}_2^{2+}$
(C) $\text{O}_2^+ < \text{O}_2 < \text{O}_2^- < \text{O}_2^{2+}$ (D) $\text{O}_2^- < \text{O}_2^{2+} < \text{O}_2 < \text{O}_2^+$

Q.18 The bond angle in I_3^- is:

- (A) 90° (B) 104°
(C) 120° (D) 180°

Q.19 The number of ions present in the unit cell of cesium chloride (CsCl) is:

- (A) 6 (B) 4
(C) 2 (D) 8

Q.20 The crystal field stabilization energy and the spin-only magnetic moment of $[\text{CoF}_6]^{3-}$ are, respectively:

- (A) $0.4 \Delta_0$ and 4.9 B.M. (B) $0.8 \Delta_0$ and 3.8 B.M.
(C) $1.8 \Delta_0$ and 1.7 B.M. (D) $2.4 \Delta_0$ and 0 B.M.

Q.21 The reaction of H_2BO_3 with H^+ yields a product, which upon introduction into a flame gives a characteristic green coloration. The product is:

- (A) BH_3 (B) B_2H_6
 (C) H_2O_3 (D) BH_3^+

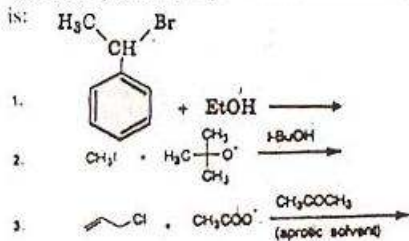
Q.22 Graphite sublimes at a very high temperature (3700 °C). This is due to:

- (A) weak covalent interactions in the solid and stronger or more covalent interactions in the gas phase
 (B) strong covalent interactions in the solid and weaker or fewer covalent interactions in the gas phase
 (C) strong covalent interactions in the solid and strong covalent interactions in the gas phase
 (D) weak covalent interactions in the solid and stronger ionic interactions in the gas phase

Q.23 The nickel(II) complex $[\text{NiCl}_2(\text{PPh}_3)_2]$ is paramagnetic. The analogous complex of palladium(II) is diamagnetic. The number of isomers that will exist for each of these formulations respectively are:

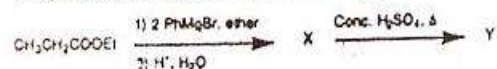
- (A) 1,1 (B) 2,2
 (C) 1,2 (D) 2,1

Q.24 The order (from 1 to 3) in which the reactions below follow $\text{S}_\text{N}1$ and $\text{S}_\text{N}2$ mechanisms is:



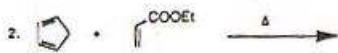
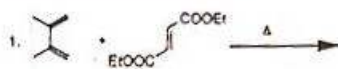
- (A) $\text{S}_\text{N}1, \text{S}_\text{N}2, \text{S}_\text{N}2$ (B) $\text{S}_\text{N}2, \text{S}_\text{N}1, \text{S}_\text{N}2$
 (C) $\text{S}_\text{N}1, \text{S}_\text{N}2, \text{S}_\text{N}1$ (D) $\text{S}_\text{N}2, \text{S}_\text{N}2, \text{S}_\text{N}1$

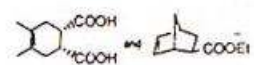
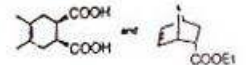
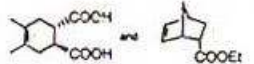
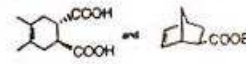
Q.25 The products 'X' and 'Y' of the following reaction are:



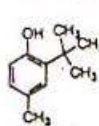
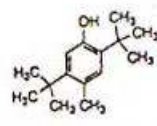
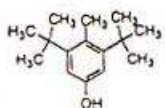
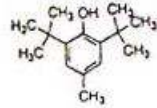
- (A) $\text{CH}_3\text{CH}_2\text{-C}(\text{OH})(\text{Ph})_2$ and $\text{H}_2\text{C}=\text{C}(\text{Ph})_2$ (B) $\text{CH}_3\text{CH}_2\text{-C}(\text{O})(\text{Ph})_2$ and $\text{CH}_3\text{CH}_2\text{-C}(\text{OH})(\text{Ph})_2$
 (C) $\text{CH}_3\text{CH}_2\text{-C}(\text{OH})(\text{H})(\text{Ph})_2$ and $\text{CH}_3\text{CH}_2\text{-C}(\text{OH})(\text{Ph})_2$ (D) $\text{CH}_3\text{CH}_2\text{-C}(\text{OH})(\text{Ph})_2$ and $\text{CH}_2=\text{C}(\text{Ph})_2$

Q.26 The *major* products of the following Diels-Alder cycloaddition reactions 1 and 2 with the *correct* stereochemistry are:

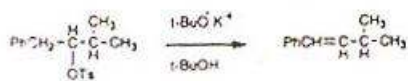


- (A)  (B) 
- (C)  (D) 

Q.27 *p*-Cresol (4-methylphenol) reacts with two molar equivalents of isobutylene in the presence of HCl and AlCl₃ to give a product, which is an excellent antioxidant. The structure of the product is:

- (A)  (B) 
- (C)  (D) 

Q.28 Which of the following statements is correct about the elimination reaction given below?

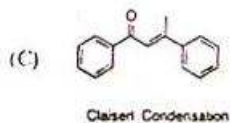
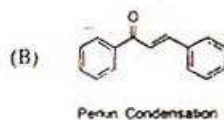
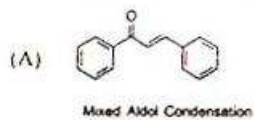
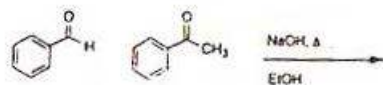


- (A) the product shown will not be formed, because Saytzeff rule necessitates the formation of the alternative more substituted olefin
- (B) the product shown will be formed predominantly, because the conjugation of the double bond with the phenyl ring leads to thermodynamic stability
- (C) the product shown will be formed as a minor one. This follows from Saytzeff rule
- (D) the product shown is correct and it follows from Saytzeff rule

Q.29 The perhydroxylation of maleic and fumaric acids using KMnO_4 leads respectively to the following tartaric acids:

- (A) meso and meso (B) *dl* racemate and meso
 (C) meso and *dl* racemate (D) *dl* racemate and *dl* racemate

Q.30 The product of the following reaction and the name reaction that leads to its formation are:



ANSWERS

H-1 CHEMISTRY - 2004

1. (A) 2. (D) 3. (C) 4. (*) 5. (B) 6. (A) 7. (A) 8. (B) 9. (C) 10. (A)
 11. (B) 12. (A) 13. (A) 14. (C) 15. (*) 16. (C) 17. (A) 18. (A) 19. (*) 20. (B)
 21. (C) 22. (B) 23. (B) 24. (B) 25. (B) 26. (C) 27. (*) 28. (B) 29. (B) 30. (D)

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