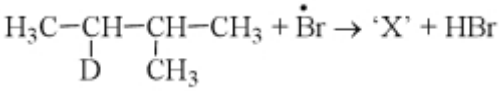
Exam Code: JEEADVFULL

Mock Test_Chem_JEE_Advanced_Full Syllabus - 04/12/20 1:38 pm

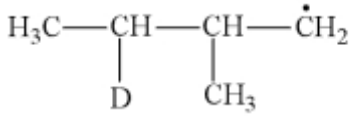
Test Booklet Code

1. Consider the follwing reaction:

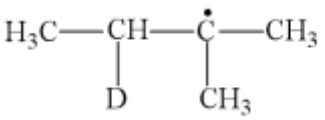


Identify the structure of the major product **'X'**

(a)



(b)



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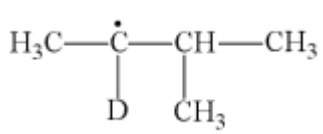
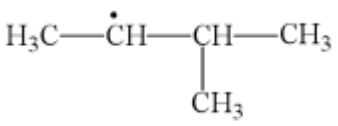


(d)



2. When concentrated H_2SO_4 is added to dry KNO_3, brown fumes evolve. These brown fumes are of

(a) SO_2
(b) SO_3
(c) NO
(d) NO_2

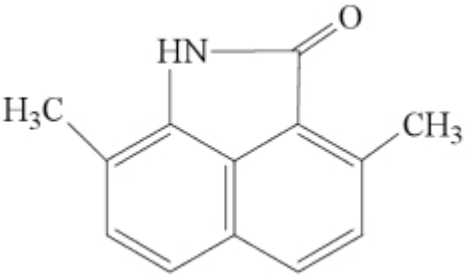
3. In the presence of peroxide, hydrogen chloride and hydrogen iodide do not give anti-Markovnikov addition to alkenes because

(a) both are highly ionic
(b) one is oxidising and the other is reducing
(c) one of the steps is endothermic in both the cases
(d) all the steps are exothermic in both the cases

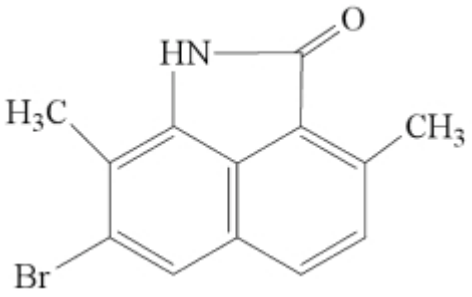
4. Identify a reagent from the following list which can easily distinguish between 1-butene and 2 -butyne:

(a) bromine, CCl_4
(b) H_2, Lindlar catalyst
(c) dilute $H_2SO_4, HgSO_4$
(d) ammoniacal Cu_2Cl_2 solution

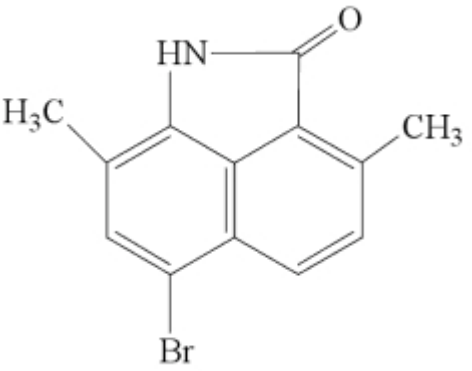
5. The major product obtained when Br_2/Fe is treated with



(a)



(b)



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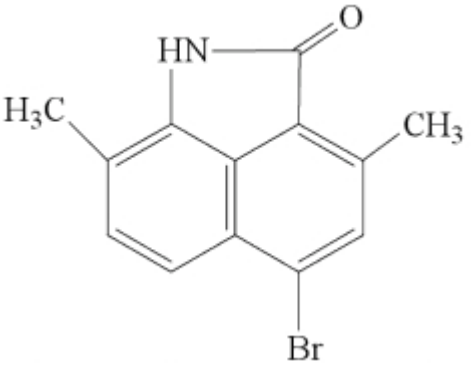
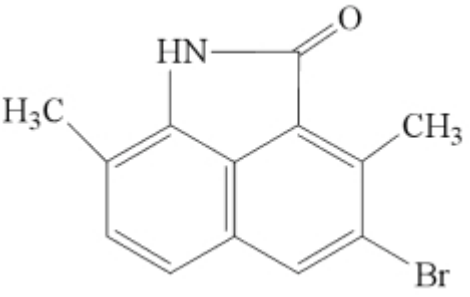


(d)



6. (i) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, K_1

(ii) $\left(\frac{1}{2}\right)_{N_1(g)} + \left(\frac{1}{2}\right)_{O_1(g)} \rightleftharpoons NO(g)$; K_1

(iii) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$; K_3

(iv) $NO(g) \rightleftharpoons \left(\frac{1}{2}\right)_{N_2(g)} + \left(\frac{1}{2}\right)_{O_2(g)}$; K_4

Correct relation between K_1, K_2, K_3 and K_4 is/are :

(a) $K_1 \times K_3 = 1$

(b) $\sqrt{K_1} \times K_4 = 1$

(c) $\sqrt{K_3} \times K_2 = 1$

(d) None

7. Hydrogen bonding plays a central role in the following phenomena:

(a) Ice floats in water

(b) Higher Lewis basicity of primary amines than tertiary amines in aqueous solutions

(c) Formic acid is more acidic than acetic acid

(d) Dimerization of acetic acid in benzene.

8. Propyne and propene can be distinguished by

(a) conc. H_2SO_4

(b) Br_2 in CCl_4

(c) dil. $KMnO_4$

(d) $AgNO_3$ in ammonia

9. What is the decreasing order of strength of the bases $OH^-, NH_2^-, HC \equiv \bar{C}$ and $CH_3CH^-{}_2$

(a) $CH_3 - CH_2^- > NH_2^- > H - C \equiv C^- > OH$

(b) $H - C = C^- > CH_3 - CH_2^- > NH_2^- > OH^-$

(c) $OH^- > NH_2^- > HC \equiv C^- > CH_3 - CH^-{}_2$

(d) $NH_2^- > H - C \equiv C^- > OH^- > CH_3 - CH_2^-$

10. The oxidation number of sulphur in S_8, S_2F_2, H_2S respectively, are

(a) $0, +1$ and -2

(b) $+2, +1$ and -2

(c) $0, +1$ and $+2$

(d) $-2, +1$ and -2

11. A gaseous mixture contains oxygen and nitrogen in the ratio of 1:4 by weight. Therefore the ratio of their number of molecules is

(a) 1:4

(b) 1:8

(c) 7:32

(d) 3:16

12. The sum of the number of neutrons and proton in the isotope of hydrogen is :

(a) 6

(b) 2

(c) 4

(d) 3

13. If the nitrogen atom has electronic configuration $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2 2s^2 2p^3$, because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed because it violates.

(a) Heisenberg uncertainty principle

(b) Hund's rule

(c) Pauli exclusion principle

(d) Bohr postulate of stationary orbits

14. Which one of the following is the smallest in size?

(a) N^{3-}

(b) O^{2-}

(c) F^-

(d) Na^+

15. The option(s) with only amphoteric oxides is (are)

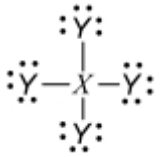
(a) Cr_2O_3, BeO, SnO, SnO_2

(b) Cr_2O_3, CrO, SnO, PbO

(c) NO, B_2O_3, PbO, SnO_2

(d) ZnO, Al_2O_3, PbO, PbO_2

16. For the dot structure shown the most likely elements are $X = \ldots$ and $Y = \ldots$



(a) Carbon, hydrogen

(b) Carbon, oxygen

(c) Fluorine, carbon

(d) Carbon, fluorine

17. The species having bond order different from that in CO is

(a) NO^-

(b) NO^+

(c) CN^-

(d) N_2

18. When an ideal gas undergoes unrestrained expansion, no cooling occurs because the molecules

(a) are above the inversion temperature

(b) exert no attractive forces on each other

(c) do work equal to loss in kinetic energy

(d) collide without loss of energy

19. To an evacuated vessel with movable piston under external pressure of $1atm$, $0.1mol$ of He and $1.0mol$ of an unknown compound (vapour pressure $0.68atm$ at $0°C$) are introduced. Considering the ideal gas behaviour, the total volume (in litres) of the gases at $0°C$ is close to

20. The initial rate of hydrolysis of methyl acetate $(1M)$ by a weak acid $(HA, 1M)$ is $1/100^{th}$ of that of a strong acid (HX $1M)$, $at 25°C$. The K_a of HA is

(a) 1×10^{-4}

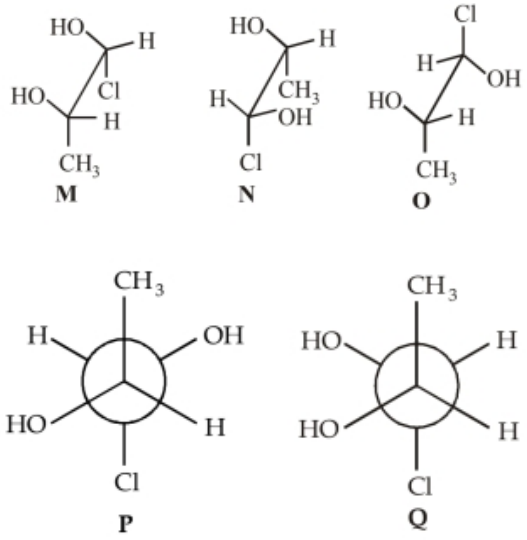
(b) 1×10^{-5}

(c) 1×10^{-6}

(d) 1×10^{-3}

21. You have given 100 ml of buffer solution containing weak acid HA ($K_a = 10^{-5}$) and its salt with strong base NaA at the concentration of 0.1(M) each. If 5×10^{-3} moles of HCOOH ($K_a = 10^{-4}$) is added to this solution what will be value in the change in pH $\times 10^3$ in nearest possible integers. Given : $\sqrt{76} = 8.71$; log 2.34 = 0.369

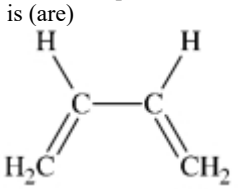
22. Which of the given statement(s) about **N, O, P** and **Q** with respect to **M** is (are) correct?



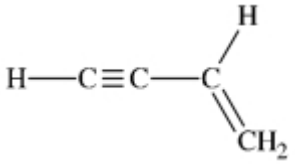
(a) ***M*** and ***N*** are non-mirror image stereoisomers
(b) ***M*** and ***O*** identical
(c) ***M*** and ***P*** are enantiomers
(d) ***M*** and ***Q*** are identical

23. Amongst the given options, the compound(s) in which all the atoms are in one plane in all the possible conformations (if any), is (are)

(a)



(b)



(c) $H_2C = C = O$
(d) $H_2C = C = CH_2$

24. When cyclohexane is poured on water, it floats, because:
(a) cyclohexane is in 'boat' form
(b) cyclohexane is in 'chair' form
(c) cyclohexane is in 'crown' form
(d) cyclohexane is less dense than water.

25. Which of the following statement is correct?
(a) Fe^{2+} gives brown colour with ammonium thiocyanate
(b) Fe^{2+} gives blue precipitate with potassium ferricyanide
(c) Fe^{3+} gives brown colour with potassium ferrocyanide
(d) Fe^{3+} gives red colour with potassium ferrocyanide

Answer Key

1. Answer: b
Solution
The choice (b) involves 3° radical.

2. Answer: d
Solution
The brown fumes are of NO_2.

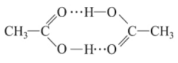
3. Answer: c

4. Answer: d
Solution
1-Butyne contains acetylinic hydrogen atom. It will form insoluble acetylides.

5. Answer: b
Solution
The phenyl group attached to the —NH— group gets activated and thus bromination at the *para* position occurs in this phenyl group.

6. Answer: a , b , c
Solution
From given reactions.
(i) = - (iii) ; $\frac{1}{2}$ (i) = - (iv) ; $\frac{1}{2}$ (iii) = - (ii)

7. Answer: a , b , d
Solution
Ice floats in water because it is less dense than the liquid water due to its open crystal structure because of hydrogen bondings.
Because of the positive charge carried by the conjugate acid of an amine, it is stabilised by the hydrogen bonding with the solvent water. The larger the number of hydrogens attached to the nitrogen in the conjugate acid, the larger is its stability and thus larger is the basicity of the corresponding base. Thus, primary amines are more basic than tertiary amines in aqueous solution.
Acetic acid dimerise in benzene due to hydrogen bonding.



8. Answer: d
Solution
Propyne forms insoluble acetylides with ammoniacal silver nitrate solution. Propene does not form acetylides.

9. Answer: a
Solution
The strength of conjugate acids follows the order $CH_3CH_3 < NH_3 < HC{\equiv}CH < H_2O$
The strength of given bases follows the order $CH_3CH_2^- > NH_2^- > HC{\equiv}C^- > OH^-$

10. Answer: a
Solution
TIPS/Formulae :
(i) Oxidation state of element in its free state is zero.
(ii) Sum of oxidation states of all atoms in compound is zero.
O.N. of S in $S_8 = 0$; O.N. of S in $S_2F_2 = +1$;
O.N. of S in $H_2S = -2$;

11. Answer: c
Solution
Let mass of oxygen = 1g, Then mass of nitrogen = 4g
Mol. wt. of $N_2 = 28$g, Mol. wt. of $O_2 = 32$g
28 g of N_2 has $= 6.02 \times 10^{23}$ molecules of nitrogen

$$4 \text{ g of } N_2 \text{ has} = \frac{6.02 \times 10^{23}}{28} \times 4 \text{ molecules of nitrogen}$$

$$= \frac{6.02 \times 10^{23}}{7} \text{ molecules of nitrogen}$$

$32 \text{ g of } O_2 \text{ has} = 6.02 \times 10^{23}$ molecules of oxygen

$$\therefore \quad 1\text{g of } O_2 \text{ has} = \frac{6.02 \times 10^{23}}{32} \times 1 = \frac{6.02 \times 10^{23}}{32} \text{ molecules of oxygen}$$

Thus, ratio of molecules of oxygen : nitrogen

$$= \frac{6.02 \times 10^{23}/32}{6.02 \times 10^{23}/7} = 7:32$$

12. Answer: b , d
Solution
In tritium (the isotope of hydrogen) nucleus there is one proton and 2 neutrons. $\therefore n + p = 3$. In deuterium nucleus there is one proton and one neutron $\therefore n + p = 2$.

13. Answer: c
Solution
As per Pauli Exclusion Principle "no two electrons in the same atom can have all the four quantum numbers equal or an orbital cannot contain more than two electrons and it can accommodate two electrons only when their directions of spins are opposite".

14. Answer: d
Solution
TIPS/Formulae :

$$\text{For isoelectronic ions, ionic size} \propto \frac{1}{\text{atomic number}}$$

Species	No. of e^-	At. No.
N^{-3}	10	7
O^{-2}	10	8
F^-	10	9
Na^+	10	11

$\therefore$ Na^+ is largest in size.

15. Answer: a , d
Solution

$NO \Rightarrow$ Neutral
$B_2O_3 \Rightarrow$ Acidic
$CrO \Rightarrow$ Basic
All other oxides are amphoteric

16. Answer: d
Solution

Atom X has complete octet and Y has three lone-pair and one $(X-Y)$ bond. Thus,
X is C and Y is F

17. Answer: a
Solution

Molecular electronic configuration of

$CO: \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \{\pi 2p_y{}^2 = \pi 2p_z{}^2, \sigma 2p_x{}^2$

Therefore, bond order $= \frac{N_b - N_a}{2} = \frac{10-4}{2} = 3$

$NO^+ : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x{}^2, \{\pi 2p_y{}^2 = \pi 2p_z{}^2$

Bond order $= \frac{10-4}{2} = 3$

$CN^- = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2,$

$\{\pi 2p_y{}^2 = \pi 2p_z{}^2, \sigma 2p_x{}^2$

Bond order $= \frac{10-4}{2} = 3$

$N_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \{\pi 2p_y^2 = \pi 2p_z^2, \sigma 2p_x^2$

Bond order $= \frac{10-4}{2} = 3$

$NO^- : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2,$

$\{\pi 2p_y^2 = \pi 2p_z^2, \{\pi^* 2p_y^1 = \pi^* 2p_z^1$

Bond order $= \frac{10-6}{2} = 2$

$\therefore$ NO^- has different bond order from that in CO.

18. Answer: b
Solution

When a non-ideal gas suddenly expands from a high pressure to a low pressure, there is a temperature change. This is called Joule-Thomson effect. It is an adiabatic effect. The temperature of a real gas is either decreased or increased by letting the gas expand freely at constant enthalpy. When a real gas expands freely at constant enthalpy, the temperature may either decrease or increase, depending on the initial temperature and pressure. For any given pressure, a real gas has an inversion temperature above which the expansion at constant enthalpy causes the temperature to rise, and below which the expansion at constant enthalpy causes cooling. For most gases at atmospheric pressure, the inversion temperature is fairly high (above room temperature), and so most gases at those temperature and pressure conditions are cooled by isenthalpic expansion. For an ideal gas, are no intermolecular forces, so no temperture change is expected when the distance between the molecules changes.

19. Answer: 7
Solution

For the piston to be at equilibrium position, the pressure in the vessel must be equal to the external pressure, i.e. 1 atm. The partial pressure of unknown compound will be equal to its vapour pressure. Hence, the partial pressure of helium will be

$p_{He} = 1 \text{ atm} - 0.68 \text{ atm} = 0.32 \text{ atm}$

The volume of the vessel for $n = 0.1$ mol of helium at 0 °C and 0.32 atm would be

$$V = \frac{nRT}{p} = \frac{(0.1\,\text{mol})(0.082\,\text{L atm K}^{-1}\text{mol}^{-1})(273\,\text{K})}{(0.32\,\text{atm})} \simeq 7\,\text{L}$$

20. Answer: a
Solution

As ester hydrolysis is first order with respect $[H^+]$.

$R_{HA} = K[H^+]_{HA}[\text{ester}]$
$R_{HX} = K[H^+]_{HX}[\text{ester}]$

$\therefore \frac{R_{HA}}{R_{HX}} = \frac{[H^+]_{HA}}{[H^+]_{HX}}; \frac{1}{100} = [H^+]_{HA} = 0.01$

$$\underset{1-0.01=1}{HA} \rightleftharpoons \underset{0.01}{H^+} + \underset{0.01}{A^-}$$

$K_a = \frac{0.01 \times 0.01}{1} = 10^{-4}$

21. Answer: 369
Solution
The initial pH of solution = 5

$A^- + HCOOH \underset{}{\overset{K_{eq}}{\rightleftharpoons}} HA + HCOO^-$

10^{-2} 5×10^{-3} 10×10^{-3} -

$(10 \times 10^{-3} - x)$ $(5 \times 10^{-3} - x)$ $(10 \times 10^{-3} + x)$ x

$$K_{eq} = \frac{[HA][HCOO^-]}{[A^-][HCOOH]} = \frac{[HCOO^-][H^+]}{[HCOOH]} \times \frac{[HA]}{[A^-][H^+]}$$

$$\text{or } K_{eq} = \frac{10^{-4}}{10^{-5}} = 10$$

$$\frac{x(10^{-2} + x)}{(10^{-2} - x)(5 \times 10^{-3} - x)} = 10$$

or $x^2 + 10^{-2} \times x$
$= 10 (5 \times 10^{-5} - 5 \times 10^{-3} \times x - 10 \times 10^{-3} \times x + x^2)$
or $x^2 + 10 \times 10^{-3} \times x$
$= 10 (x^2 - 15 \times 10^{-3} \times x + 5 \times 10^{-5})$
or $x^2 + 10 \times 10^{-3} \times x$
$= 10\ x^2 - 150 \times 10^{-3} \times x + 5 \times 10^{-4}$
or $9x^2 - 160 \times 10^{-3} \times x + 5 \times 10^{-4} = 0$

$$\text{or } x = \frac{+160 \times 10^{-3} \pm \sqrt{(16)^2 \times 10^{-4} - 4 \times 9 \times 5 \times 10^{-4}}}{2 \times 9}$$

$$\text{or } x = \frac{+16 \times 10^{-2} \pm \sqrt{(256 - 180) \times 10^{-4}}}{2 \times 9}$$

$$= \frac{+16 \times 10^{-2} \pm 8.71 \times 10^{-2}}{2 \times 9}$$

or $x = 4.05 \times 10^{-3}$
in the final solution moles of $HCOO^- = 4.05 \times 10^{-3}$
and moles of HCOOH = 0.95×10^{-3}

$$HCOOH \underset{}{\overset{10^{-4}}{\rightleftharpoons}} H^+ + HCOO^-$$

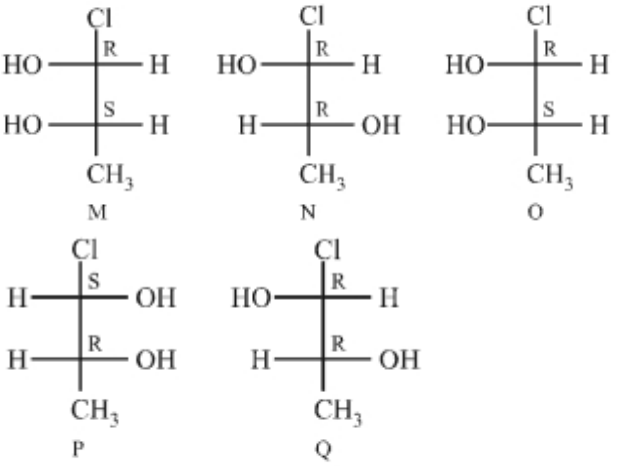
$$10^{-4} = \frac{[H^+][HCOO^-]}{[HCOOH]}$$

$$\text{or } [H^+] = \frac{10^{-4} \times [HCOOH]}{[HCOO^-]} = \frac{10^{-4} \times 0.95 \times 10^{-3}}{4.05 \times 10^{-3}}$$

$$\text{or } [H^+] = \frac{0.95}{4.05} \times 10^{-4} = 0.234 \times 10^{-4}$$

$= 2.34 \times 10^{-5}$ (M)
pH = 5 - log 2.34 = 5 - 0.369 = 4.631
ΔpH = 5 - 4.631 = 0.369
$\Delta(pH) \times 10^3 = 369$

22. Answer: a , b , c
Solution
Converting all the structures in the Fischer projection



M and N are diastereoisomers
M and O are identical
M and P are enantiomers
M and Q are diastereoisomers
Hence, the correct options are a, b, c.

23. Answer: b , c

24. Answer: d

25. Answer: b
Solution

$$Fe^{2+} + K_3Fe(CN)_6 \longrightarrow \underset{\text{Turnbull's Blue}}{KFe[Fe(CN)_6]}$$