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QUESTION WITH SOLUTION

DATE : 12-01-2019 _ MORNING

[CHEMISTRY]

1. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature . The pressure of the gases for equal number of moles are :

(A) $P_A = 2P_B$ (B) $3P_A = 2P_B$ (C) $2P_A = 3P_B$ (D) $P_A = 3P_B$

Sol. **C**

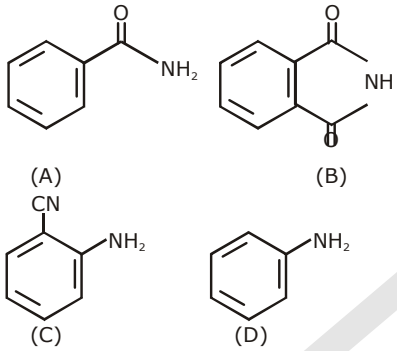
$V_A = 2V_B$

$Z_A = 3Z_B$

$$\frac{P_A V_A}{n_A R T_A} = \frac{3.P_B.V_B q}{n_B.RT_B}$$

$= 2P_A = 3P_B$

2. The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is :

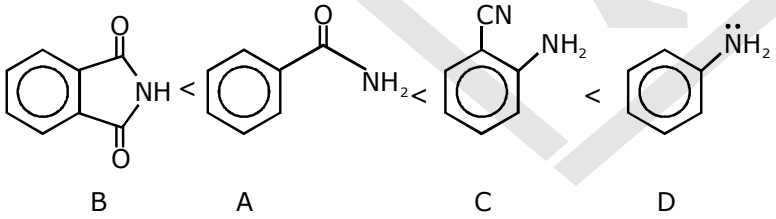


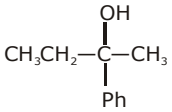
(A) (A)<(B)<(C)<(D) (B) (B)<(A)<(C)<(D)

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

Sol. **B**

Nucleophilicity order

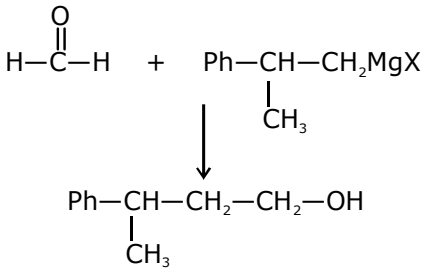


3.  cannot be prepared by :

(A) $HCHO+PhCH(CH_3)CH_2MgX$ (B) $PhCOCH_2CH_3+CH_3MgX$

(C) $PhCOCH_3+CH_3CH_2MgX$ (D) $CH_3CH_2COCH_3+PhMgX$

Sol. **A**



4. Two solids dissociate as follows

$A(s) \rightleftharpoons B(g)+C(g); K_{P_1} = x.atm^2$

$D(s) \rightleftharpoons C(g)+E(g); K_{P_2} = y.atm^2$

The total pressure when both the solids dissociate simultaneously is :

(A) (x+y)atm (B) $x^2 + y^2$ atm

(C) $\sqrt{x+y}$ atm (D) $2\left(\sqrt{x+y}\right)$ atm

Sol. **D**

$A \rightleftharpoons B(g) + C(g)$ $K_{P_1} = x = P_B.P_C$

$P_1 \quad P_1$ $x = P_1(P_1 + P_2)$ ...(1)

$D(s) \rightleftharpoons C(g) + E(g)$ $E_{P_2} = y = P_C.P_E$

$P_2 \quad P_2$ $y = (P_1 + P_2)(P_2)$ ...(2)

Adding (1) and (2)

$x + y = (P_1 + P_2)^2$

Now total pressure

$P_T = P_C + P_B + P_E$

$= (P_1 + P_2) + P_1 + P_2 = 2(P_1 + P_2)$

$P_T = 2\left(\sqrt{x+y}\right)$

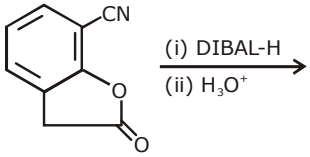
5. In the Hall-Heroult process, aluminium is formed at the cathode. The cathode is made out of :

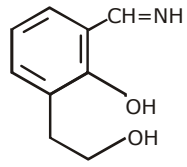
(A) Copper (B) Platinum (C) Pure aluminium (D) Carbon

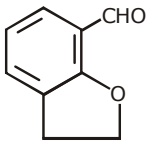
Sol. **D**

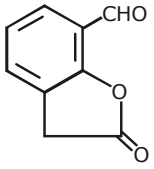
In the Hall-Heroult process the cathode is made of carbon.

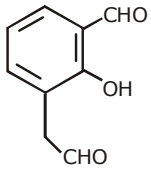
6. The major product of the following reaction is :



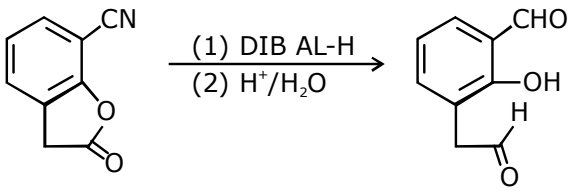
(A) 

(B) 

(C) 

(D) 

Sol. **D**



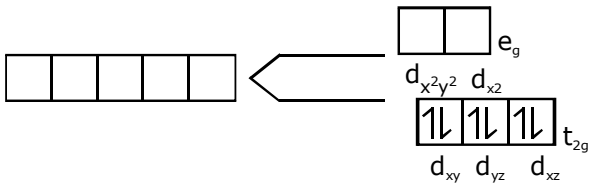
DIBAL-H will reduce cyanides & esters to aldehydes.

7. The molecule that has minimum/no role in the formation of photochemical smog, is :
(A) O_3 (B) N_2 (C) $CH_2=O$ (D) NO

Sol. **B**
Chiefly NO_2, O_3 and hydrocarbon are responsible for build up smog.

8. The metal d-orbitals that are directly facing the ligands in $K_3[Co(CN)_6]$ are :
(A) d_{xy} and $d_{x^2-y^2}$ (B) $d_{x^2-y^2}$ and d_{z^2} (C) d_{xy}, d_{xz} and d_{yz} (D) d_{xz}, d_{yz} and d_{z^2}

Sol. **B**
$K_3[Co(CN)_6]$
$Co^{+3} \rightarrow [Ar]_{18}\ 3d^6$



d^2sp^3

9. A metal on combustion in excess air forms X. X upon hydrolysis with water yields H_2O_2 and O_2 along with another product. The metal is :
(A) Rb (B) Mg (C) Na (D) Li

Sol. **A**
$Rb + O_{2(excess)} \longrightarrow RbO_2$
$2RbO_2 + 2H_2O \longrightarrow 2RbOH + H_2O_2 + O_2$

10. Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of X is A, then molecular weight of Y is :
(A) 3A (B) A (C) 4A (D) 2A

Sol. **A**
For same freezing point, molality of both solution should be same.
$m_x = m_y$

$$\frac{4\times1000}{96\times M_x} = \frac{12\times1000}{88\times M_y}$$

or, $M_y = \frac{96\times12}{4\times88} M_x = 3.27\ A$
Closest option is 3A.

11. Decomposition of X exhibits a rate constant of 0.05 μg/year. How many years are required for the decomposition of 5μg of X into 2.5 μg ?
(A) 50 (B) 25 (C) 40 (D) 20

Sol. **A**
Rate constant (K) = 0.05 μg/year
means zero order reaction

$$t_{1/2} = \frac{a_0}{2K} = \frac{5\mu g}{2\times0.05\mu g/year} = 50\ year$$

12. The element with Z = 120 (not yet discovered) will be an/a :
(A) alkali metal (B) alkaline earth metal
(C) transition metal (D) inner-transition metal

Sol. **B**
Z = 120
Its general electronic configuration may be represented as [Nobal gas] ns2 , like other alkaline earth metals.

13. What is the work function of the metal if the light of wavelength 4000Å generates photoelectrons of velocity 6×10^5 ms^{-1} from it ?
Mass of electron = 9×10^{-31} kg
Velocity of light = 3×10^8 ms^{-1}
Planck's constant = 6.626×10^{-34} Js
Charge of electron = 1.6×10^{-19} JeV^{-1})
(A) 2.1 eV (B) 0.9 eV (C) 3.1 eV (D) 4.0 eV

Sol. **A**

$hv = \phi + hv^o$

$$\frac{1}{2}mv^2 = hc\left(\frac{1}{\lambda}+\frac{1}{\lambda_0}\right)$$

$$hv = \phi + \frac{1}{2}mv^2$$

$$\phi = \frac{6.626\times10^{-34}\times3\times10^8}{4000\times10^{-10}} - \frac{1}{2}\times9\times10^{-31}\times(6\times10^5)^2$$

$\phi = 3.35\times10^{-19}$ J $\Rightarrow \phi \simeq 2.1$ eV

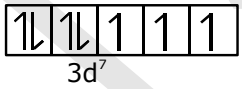
14. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$, is :
(A) Co^{2+} and Fe^{2+} (B) V^{2+} and Fe^{2+} (C) V^{2+} and Co^{2+} (D) Cr^{2+} and Mn^{2+}

Sol. **C**

V^{2+} and Co^{2+}

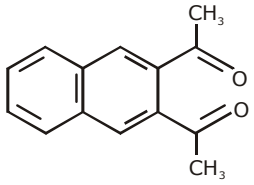
$V^{2+} \rightarrow [V(H_2O)_6]Cl_2$; $[Ar]_{18}$ 

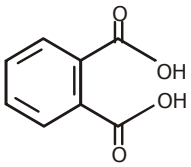
3 unpaired e^-, spin only magnetic moment = 3.89 B.M.

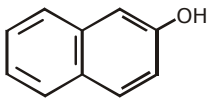
$Co^{2+} \rightarrow [Co(H_2O)_6]Cl_2$; $[Ar]_{18}$ 

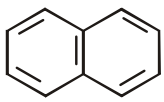
3 unpaired e^-, spin only magnetic moment = 3.89 B.M.

15. Among the following four aromatic compounds, which one will have the lowest melting point ?

(A) 

(B) 

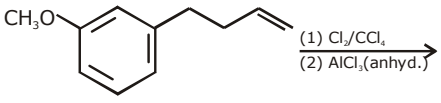
(C) 

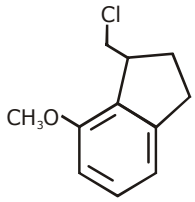
(D) 

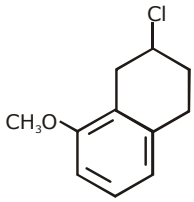
Sol. **D**

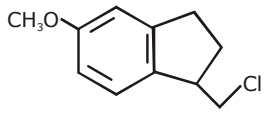
M.P. of Napthalene $\simeq$ 80°C

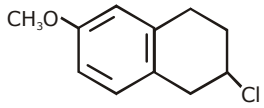
16. The major product of the following reaction is :



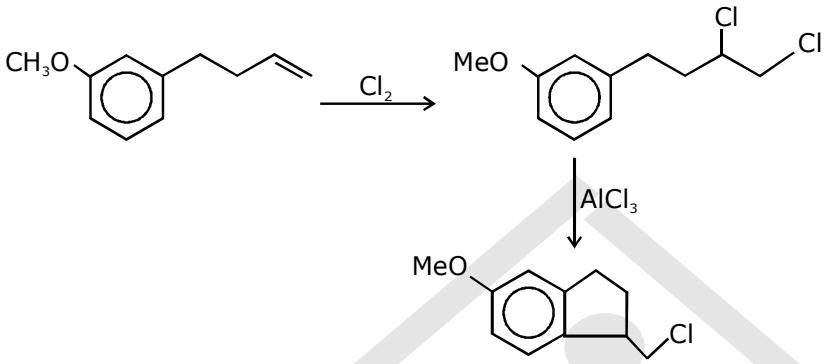
(A) 

(B) 

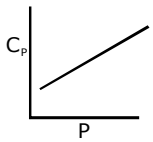
(C) 

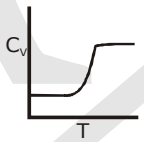
(D) 

Sol. **C**

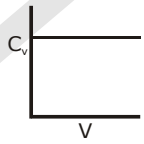


17. For a diatomic ideal gas in a closed system, which of the following plots does not correctly discribe the recation between various thermodynamics quantities ?

(A) 

(B) 

(C) 

(D) 

Sol. **A**

At higher temperature, rotational degree of freedom becomes active.

$C_P = \frac{7}{2} R$ (Independent of P)

$C_V = \frac{5}{2} R$ (Independent of V)

Variation of U vs T is similar as C_V vs T.

18. 50 mL of 0.5 M oxalic acid is needed to neutralize 25 mL of sodium hydroxide solution. The amount of NaOH in 50 mL of the given sodium hydroxide solution is :

(A) 10 g (B) 80 g

(C) 40 g (D) 20 g

Sol. **Bonus**

$H_2C_2O_4 + 2NaOH \longrightarrow Na_2C_2O_4 + 2H_2O$
m_{eq} of $H_2C_2O_4$ = m_{eq} NaOH
$50 \times 0.5 \times 2 = 25 \times MNaOH \times 1$
$\therefore M_{NaOH} = 2$ M
Now 1000 ml solution = 2 × 40 gram NaOH
$\therefore$ 50 ml solution = 4 gram NaOH

19. The correct order for acid strength of compounds
CH = CH, $CH_3-C \equiv CH$ and $CH_3 = CH_2$
is as follows :
(A) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH$
(B) $HC \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2$
(C) $CH_3-C \equiv CH > CH_2 = CH_2 > HC \equiv CH$
(D) $CH_3-C \equiv CH > CH \equiv CH > CH_2 \equiv CH_2$

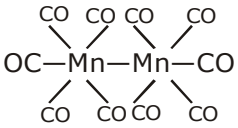
Sol. **B**
$CH \equiv CH > CH_3-C \equiv CH > CH_2=CH_2$
(Acidic strength order)

20. Water samples with BOD values of 4 ppm and 18 ppm, respectively, are :
(A) Highly polluted and Highly polluted
(B) Clean and Clean
(C) Clean and Highly polluted
(D) Highly polluted and Clean

Sol. **C**
Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

21. $Mn_2(CO)_{10}$ is an organometallic compound due to the presence of :
(A) Mn–C bond (B) Mn –O bond (C) C–O bond (D) Mn –Mn bond

Sol. **A**
Compounds having at least one bond between carbon and metal are known as organometallic compounds.

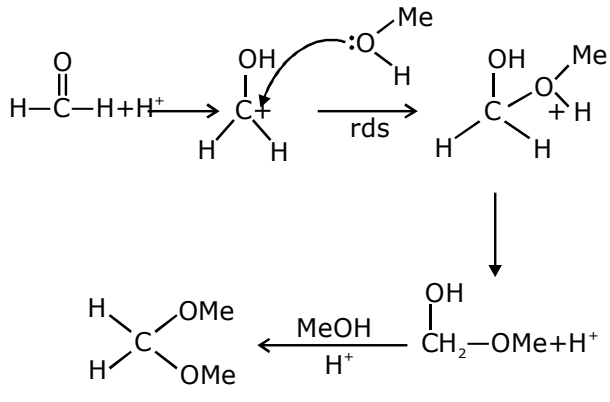


22. In the following reaction
Aldehyde + Alcohol $\xrightarrow{HCl}$ Acetal

Aldehyde	Alcohol
HCHO	t_{BuOH}
CH_3CHO	MeOH

The best combination is :
(A) CH_3CHO and t_{BuOH} (B) HCHO and MeOH
(C) CH_3CHO and MeOH (D) HCHO and t_{BuOH}

Sol. **B**



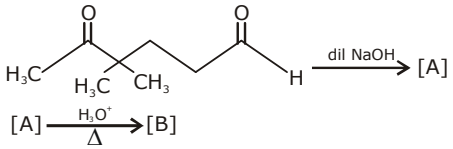
$$\textbf{rate} \propto \frac{1}{\text{steric crowding of aldehyde}}$$

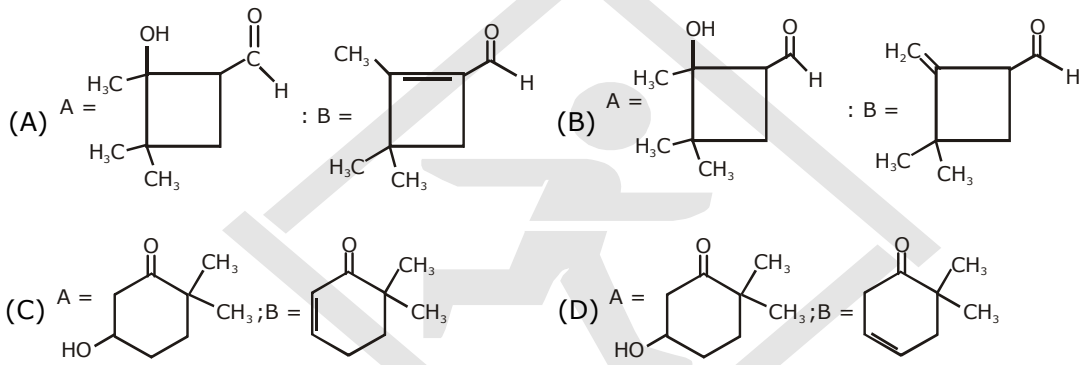
t-butanol can show formation of carbocation in acidic medium

23. Poly-β hydroxybutyrate-co-β-hydroxyvalerate(PHBV) is a copolymer of _____.
(A) 3-hydroxybutanoic acid and 4-hydroxypentanoic acid
(B) 2-hydroxybutanoic acid and 3-hydroxypentanoic acid
(C) 3-hydroxybutanoic acid and 2-hydroxypentanoic acid
(D) 3-hydroxybutanoic acid and 3-hydroxypentanoic acid

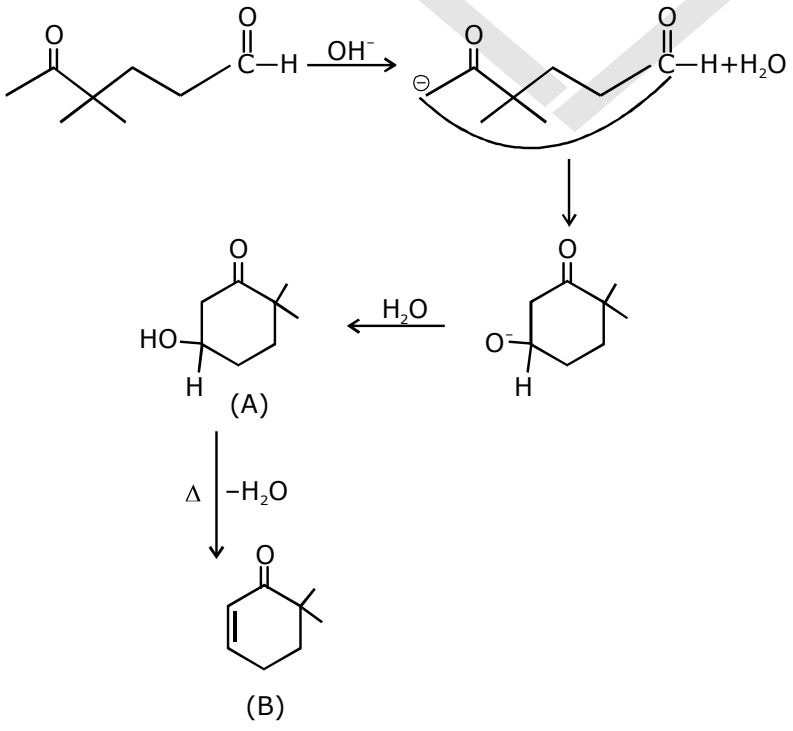
Sol. **D**
PHBV is a polymer of 3-hydroxybutanoic acid and 3-Hydroxy pentanoic acid.

24. In the following reactions, products A and B are :





Sol. **C**



25. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y, is :

(A) 5 (B) 1 (C) 3 (D) 7

Sol. **A**

$I_2 + 10HNO_3 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$

In HIO_3 oxidation state of iodine is +5.

26. Given

Gas	H_2	CH_4	CO_2	SO_2
Critical Temperature/K	33	190	304	630

On the basis of data given above, predict which of the following gases shows least adsorption on a definite amount of charcoal ?

(A) SO_2 (B) CH_4

(C) CO_2 (D) H_2

Sol. **D**

Smaller the value of critical temperature of gas, lesser is the extent of adsorption.

so least adsorbed gas is H_2

27. Among the following compounds most basic amino acid is :

(A) Asparagine (B) Lysine (C) Histidine (D) Serine

Sol. **B**

Lysine

28. In a chemical reaction, $A + 2B \overset{K}{\rightleftharpoons} 2C+D$, thhe initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equillibrium concentrations of A and B were found to be equal . The equalibrium constant(K) for the aforesaid chemical reaction is :

(A) 16 (B) 1 (C) 1/4 (D) 4

Sol. **D**

	A	+	2B	$\rightleftharpoons$	2C	+	D
t=0	a_0		$1.5a_0$		0		0
$t = t_{eq}$	a_0-x		$1.5a_0-2x$		2x		x

At equilibrium [A] = [B]

$a_0 - x = 1.5a_0 - 2x \Rightarrow x = 0.5\ a_0$

$$K_c = \frac{[C]^2[D]}{[A][B]^2} = \frac{(a_0)^2(0.5a_0)}{(0.5a_0)(0.5a_0)^2} = 4$$

29. The standard electrode potential $E^{\ominus}$ and its temperature coeffiicient $(dE^{\ominus}/dT)$ for a cell are 2 V and -5×10^{-4} VK^{-1} at 300 K respectively. The cell reaction is

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

The standard reaction enthalpy ($\Delta,H^{\ominus}$) at 300 K in kJ mol^{-1} is,

[Use R =8JK^{-1} mol^{-1} and F =96,000C mol^{-1}]

(A) –412.8 (B) –384.0 (C) 192.0 (D) 206.4

Sol. **A**

30. The hardness of a water sample (in terms of equivalent of $CaCO_3$) containing 10^{-3} M $CaSO_4$ is : (molar mass of $CaSO_4$ = 136 g mol^{-1})

(A) 10 ppm (B) 100 ppm (C) 50 ppm (D) 90 ppm

Sol. **B**

ppm of $CaCO_3$

$(10^{-3} \times 10^{3}) \times 100 = 100$ ppm