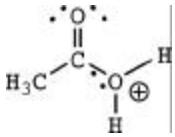
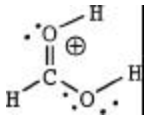
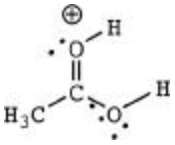
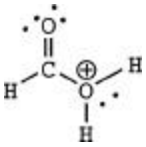
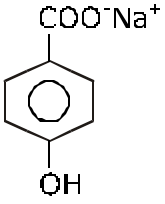
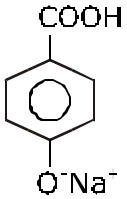
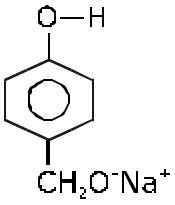
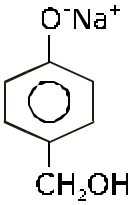
ACID BASE REACTIONS

Q.1 Give one of the major products of the reaction between acetic acid (CH_3CO_2H, pKa ~ 4.5) and formic acid (HCO_2H, pKa ~ 3.5)

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

Q.2 Which of the following structures are correct ?

(a)  (b)  (c)  (d) 

(A) a, b (B) b, c (C) a, d (D) b, d

Q.3 For the following two acid base reactions, which is true ?

I $CH_3CH_2^-$ + CH_3NH_2 $\rightleftharpoons$ CH_3CH_3 + CH_3NH^-

pKa = 35 pKa = 50

II F^- + H_2O $\rightleftharpoons$ HF + HO^-

pKa = 15.7 pKa = 3.2

(A) I is favored to the right, II is favored to the left
(B) I is favored to the left, II is favored to the right
(C) I is favored to the right, II is favored to the right
(D) I is favored to the left, II is favored to the left

Q.4 From the following reactions

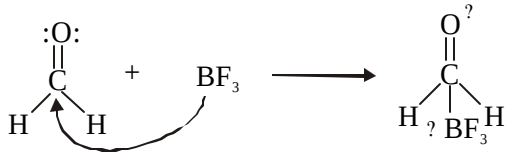
HC ? CH + $LiNH_2$? NH_3 + HC ? CLi

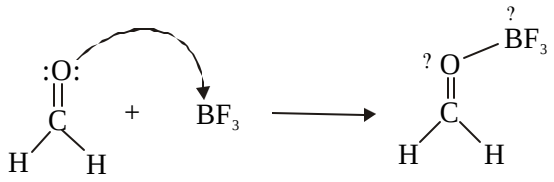
H_2O + CH ? CLi ? HC ? CH + LiOH

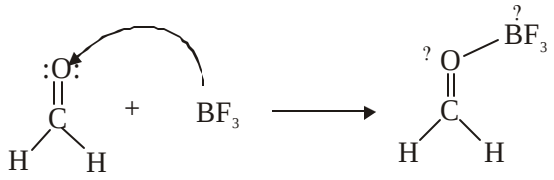
predict which of the following orders regarding the acid strength is correct.

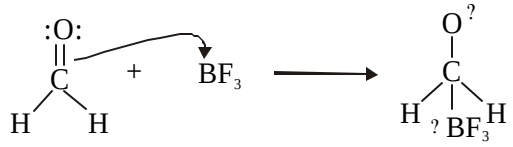
(A) HC ? CH > H_2O > NH_3 (B) HC ? CH > NH_3 > H_2O
(C) H_2O > HC ? CH > NH_3 (D) H_2O > NH_3 > HC ? CH

Q.5 The correct mechanism of reaction between formaldehyde and boron trifluoride given by-

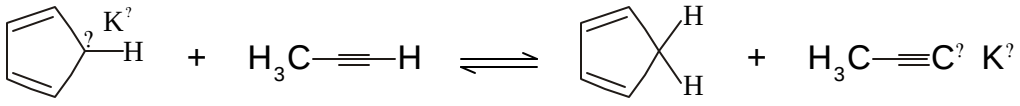
(A) 

(B) 

(C) 

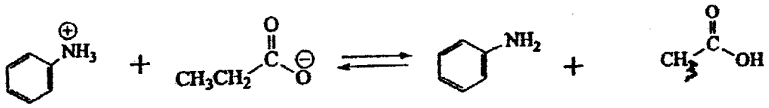
(D) 

Q.6 What is true about the following equilibrium ?



(A) It will be almost completely shifted to the left.
(B) It will be almost completely shifted to the right.
(C) The equilibrium constant is very close to one.
(D) The equilibrium constant is zero.

Q.7 What is the ranking of the equilibrium constants for the following reactions ?

(A) 

(B) 

(A) A > B > 1 (B) 1 > A > B (C) A > 1 > B (D) B > 1 > A

Q.8 Identify each species in the following equilibrium according to the code :

SA = stronger acid; SB = stronger base;

WA = weaker acid; WB = weaker base

The pK_a of $(CH_3)_2$ NH is 36; the pK_a of CH_3OH is 15.2.

$$\underset{\text{1}}{CH_3OH} + \underset{\text{2}}{(CH_3)_2NK} \quad l$$

1	2		1	2		1	2
(A)	WA	WB	(B)	WB	WA	(C)	SA SB
(D)	SB	SA	(E)	WA	WA		

Q.9 Referring to the following equilibrium (R = alkyl group)

$$RCH_2CH_3 + RC?C:^- \rightleftharpoons RCH_2\dot{C}H_2 + RC?C—H$$

(A) K < 1; the equilibrium would lie to the left.

(B) K > 1; the equilibrium would lie to the right.

(C) K = 1; equal amounts of all species would be present

(D) Not enough information is given; the structure of R must be known.

Q.10 Which of the following produces a significant amount of acetylide ion on reaction with acetylene ?

(A) Conjugate base of CH_3OH (pK_a = 16)

(B) Conjugate base of H_2 (pK_a = 35)

(C) Conjugate base of H_2O (pK_a = 16)

(D) Both (a) and (c)

ANSWER KEY

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	C	C	A	C	B	A	C	C	A	B

SOLUTIONS (ACID BASE REACTION)

Ans.1 $pK_a \propto \frac{1}{\text{acidity}}$; HCOOH acts as an acid while CH_3COOH acts as on base.

Ans.2 Above are sodium salt produced by neutralization and first neutrilization always takes plack at most acidic H.

Ans.3 Equilibrium is favoured in that direction in which weak acid & weak base are formed.

Ans.4

$$\underset{SA}{HC \equiv CH} + \underset{SB}{LiNH_2} \rightleftharpoons \underset{wA}{NH_3} + \underset{wB}{HC \equiv CLi}$$

$$\underset{SA}{H_2O} + \underset{SB}{CH \equiv CLi} \rightleftharpoons \underset{wA}{HC \equiv CH} + \underset{wB}{LiOH}$$

Ans.5 It is an Lewis Acid-Base Reaction

BF_3 = Lewis Acid

$H-\underset{\underset{O}{\|}}{C}-H$ = Lewis Base

Head of the arrow is pointing towards BF_3 & tail is present on the oxygen atom of the $H-\underset{\underset{O}{\|}}{C}-H$ which donates its lone pair.

Ans.6 A reaction is feasible if

strong Acid + strong Base $\rightarrow$ weak Acid + weak Base

Ans.7 In (A) equilibrium is shifted to the forward direction so K > 1.
In (B) equilibrium is shifted to the backward direction so K < 1.

Ans.8 $pK_a \propto \frac{1}{\text{acidity}}$;

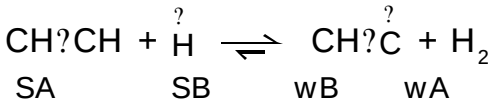
$\therefore$ CH_3OH is stronger acid than $(CH_3)_2NH$.

* Conjugate base of weaker acid is strong

$$\underset{\text{weak acid}}{(CH_3)_2NH} \rightarrow \underset{\text{strong base}}{(CH_3)_2NK}$$

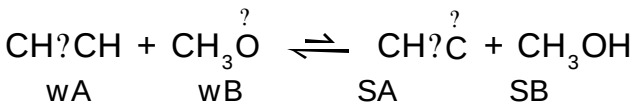
Ans.9 On the left side of reaction, weak acid and weak base are formed so equilibrium is shifted to backward direction so K < 1.

Ans.10 Conjugate base of H_2 is $\overset{?}{H}$.



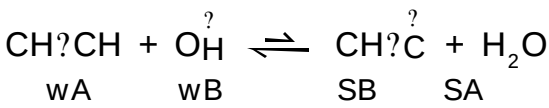
Reaction is favoured to the right.

Conjugate base of CH_3OH is $CH_3\overset{?}{C}$.



Reaction is favoured to the left.

Conjugate base of H_2O is $O\overset{?}{H}$.



Reaction is favoured to the left.