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8. IONIC EQUILIBRIUM THEORY OF ACIDS AND BASES

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

Single Answer Type

1. In the following reaction $HC_2O_4^-(aq) + PO_4^{3-}(aq) \rightleftharpoons HPO_4^{2-}(aq) + C_2O_4^{2-}(aq)$, which are the two Bronsted bases?

A) $HC_2O_4^-$ and PO_4^{3-} **B) HPO_4^{2-} and $C_2O_4^{2-}$**

C) $HC_2O_4^-$ and HPO_4^{2-} **D) PO_4^{3-} and $C_2O_4^{2-}$**

Answer: D

Solution:A Brønsted base is a proton acceptor. In the reaction, PO_4^{3-} accepts a proton to form HPO_4^{2-}, and $C_2O_4^{2-}$ is the deprotonated form of $HC_2O_4^-$ (which acts as an acid here).

2. Boric acid H_3BO_3 is a :

A) Arrhenius acid **B) Bronsted acid** **C) Lewis acid** **D) All of these**

Answer: C

Solution:Boric acid (H_3BO_3) does not donate a proton (Brønsted acid) but accepts an OH^- (Lewis acid) to form $[B(OH)_4]^-$.

3. Identify the amphoteric species from the following :

(I) H_2O **(II) NH_3** **(III) $H_2PO_4^-$** **(IV) HCO_3^-**

A) I, II **B) III, IV** **C) I, II, III** **D) I, II, III, IV**

Answer: D

Solution:H_2O (I): Can donate (acid) or accept (base) a proton.
NH_3 (II): Can accept a proton (base) or donate one (acid) in some cases.
$H_2PO_4^-$ (III): Can donate or accept a proton.
HCO_3^- (IV): Can act as an acid (forming CO_3^{2-}) or a base (forming H_2CO_3).

4. The following equilibrium is established when hydrogen chloride is dissolved in acetic acid

$HCl(aq) + CH_3COOH(aq) \rightleftharpoons Cl^-(aq) + CH_3COOH_2^+(aq)$.

The set that characterises the conjugate acid-base pairs is

A) (HCl, CH_3COOH) and ($CH_3COOH_2^+$, Cl^-)

B) (HCl, $CH_3COOH_2^+$) and (CH_3COOH, Cl^-)

C) ($CH_2COOH_2^+$, HCl) and (Cl^-, CH_3COOH)

D) (HCl, Cl^-) and ($CH_3COOH_2^+$, CH_3COOH).

Answer: D

Solution: Conjugate pairs differ by a proton. HCl donates a proton to form Cl^-, and CH_3COOH accepts a proton to form $CH_3COOH_2^+$

5. In the equilibrium $CH_3COOH + HF \rightleftharpoons CH_3COOH_2^+ + F^-$, which of the following statement(s) is/are correct:

A) F^- is the conjugate acid of CH_3COOH

B) F^- is the conjugate base of HF

C) CH_3COOH is the conjugate acid of $CH_3COOCH_2^+$

D) $CH_3COOCH_2^+$ is the conjugate acid of CH_3COOH

Answer:B

Solution: F^- is formed when HF loses a proton (so it's the conjugate base of HF). $CH_3COOH_2^+$ (incorrectly written as $CH_3COOCH_2^+$ in option C/D) is not relevant here.

6. In the following reaction:

$[Cu(H_2O)_3(OH)]^+ + [Al(H_2O)_6]^{3+} \longrightarrow [Cu(H_2O)_4]^{2+} + [Al(H_2O)_5(OH)]^{2+}$

A) B) C) D)

A) A) is an acid and B) is a base

B) A) is a base and B) is an acid

C) C) is the conjugate acid of A)

D) A) is the conjugate base of B)

Answer:B

Solution:OH^- group is transferred from Cu to Al

So A acts as base (donates OH^-), B as acid (accepts OH^-)

7. Consider the complete ionization of H_2SO_4 (strong acid) and $(COOH)_2$, oxalic acid (weak acid) in liquid NH_3.

$$H_2SO_4 + 2NH_3 \longrightarrow 2NH_4^+ + SO_4^{2-}$$

$$(COOH)_2 + 2NH_3 \longrightarrow 2NH_4^+ + (COO^-)_2$$

Liquid NH_3 is called :

A)proton-acceptor **B)leveling solvent**

C)both **D)none of these.**

Answer:B

Solution: In liquid NH_3, strong and weak acids fully ionize, making it a leveling solvent (all acids appear equally strong).

8. Which statement is/are correct:

A) All Bronsted bases are also Lewis bases

B) All Bronsted acids are not Lewis acids

C) All cations are acids and anions are bases

D) All of these

Answer:A

Solution:Brønsted bases (proton acceptors) must have a lone pair (Lewis base).

Not all Brønsted acids are Lewis acids (e.g., HCl is Brønsted but not Lewis).

Not all cations are acids (e.g., Na^+ is neutral).

9. The conjugate base of $H_2PO_4^-$ is [AIEEE-2004]

A) PO_4^{3-} B) P_2O_5 C) H_3PO_4 D) HPO_4^{2-}

Answer:D

Solution:The conjugate base of $H_2PO_4^-$ is formed by losing a proton, giving HPO_4^{2-}.

10. What is the conjugate base of OH^-? [AIEEE-2005]

A) O_2 B) H_2O C) O^- D) O^{2-}

Answer:D

Solution: OH^- loses a proton (H^+) to form O^{2-}.

11. Three reactions involving $H_2PO_4^-$ are given below : [AIEEE-2010]

(i) $H_3PO_4 + H_2O \longrightarrow H_3O^+ + H_2PO_4^-$

(ii) $H_2PO_4^- + H_2O \longrightarrow HPO_4^{2-} + H_3O^+$

(iii) $H_2PO_4^- + OH^- \longrightarrow H_3PO_4 + O^{2-}$

In which of the above does $H_2PO_4^-$ act as an acid ?

A) (ii) only B) (i) and (ii) C) (iii) only D) (i) only

Answer:A

Solution: In (ii), $H_2PO_4^-$ donates a proton (H^+) to form HPO_4^{2-} $\rightarrow$ acts as an acid (Brønsted acid).

In (i), $H_2PO_4^-$ is formed (product) when H_3PO_4 acts as an acid.

In (iii), $H_2PO_4^-$ accepts a proton (from OH^-) to form H_3PO_4 $\rightarrow$ acts as a base.

12. Select the species which can act as an acid and as Base

A) SO_4^{2-} **B)** HS^- **C)** HCO_3^- **D)** HSO_4^-

Answer:B,C

Solution: Both HS^- (hydrogen sulfide ion) and HCO_3^- (bicarbonate ion) are amphoteric, meaning they can act as both Brønsted acids (donate a proton) and Brønsted bases (accept a proton).

13. Which of the following statements is/are correct?

A) Arrhenius acids are also Bronsted acids but all Arrhenius bases are not Bronsted bases

B) All Bronsted bases are also Lewis bases

C) All Bronsted acids are also Lewis acids

D) A strong acid has a weak conjugate base but a strong base has a strong conjugate acid

Answer:B

Solution:

(A) Incorrect: All Arrhenius acids are Brønsted acids, but all Arrhenius bases (e.g., NaOH) are Brønsted bases (since they accept H^+ in water).

(B) Correct: Brønsted bases must have a lone pair to accept H^+ $\rightarrow$ hence, they are also Lewis bases.

(C) Incorrect: Brønsted acids (e.g., HCl) donate H^+ but may not accept electrons (not Lewis acids).

(D) Incorrect: A strong base has a weak conjugate acid, not a strong one.

14. Which of the following statements is/are correct regarding Lewis acids?

A) Molecules having a central atom with an incomplete octet in it can act as Lewis acids

B) Molecules in which atoms of dissimilar eiectronegativity are joined by multiple bonds can act as Lewis acids

C) SiF_4, PF_5 and $FeCl_3$ are Lewis acids

D) Neutral species having at least one lone pair of electrons can act as Lewis acids

Answer:A,B,C

Solution:

(A) Correct: Molecules with incomplete octets (e.g., BF_3, $AlCl_3$) accept electrons $\rightarrow$ Lewis acids.

(B) Correct: Molecules with polar multiple bonds (e.g., CO_2, SO_3) can accept electrons.

(C) Correct: SiF_4 (Si has empty d-orbitals).

PF_5 (can expand octet).

$FeCl_3$ (electron-deficient metal center).

(D) Incorrect: Lone-pair-bearing species (e.g., NH_3) are Lewis bases, not acids.

15. Which of the following behave as Bronsted acids as well as Bronsted bases?

A) H_2O **B) HS^-** **C) H_2SO_4** **D)** HCO_3^-

Answer:A,B,D

Solution: H_2O (water) , HS^- (hydrogen sulfide ion) and HCO_3^- are amphoteric, meaning they can act as both Brønsted acids (proton donors) and Brønsted bases (proton acceptors).

16. Which of the following is wrong?

A) Arrhenius theory could explain relative strength of acids and bases.

B) Bronsted theory could explain relative strength of acids and bases.

C)Lewis theory could explain relative strength of acids and bases

D) Lewis theory cannot explain relative strength of acids and bases.

Answer:C

Solution: (A) & (B) Correct: Arrhenius and Brønsted theories explain relative acid/ base strength via dissociation constants (Ka/Kb).

(C) Incorrect: Lewis theory does not quantify acid/base strength (no pKa/pKb scale).

(D) Correct: Lewis theory lacks a quantitative measure for strength.

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

17. Which of the following aqueous solurions of compounds are acidic in nature

A)K_2SO_4 B)$NaNO_3$ C)$CuSO_4$ D)$FeCl_3$

Answer:C,D

Solution:Cu^{2+} (from $CuSO_4$) is a Lewis acid (electron-deficient).
In water, Cu^{2+} hydrolyzes to form H^+ ions, making the solution acidic
Fe^{3+} (from $FeCl_3$) is a strong Lewis acid.
Hydrolyzes in water to produce H^+ ions, making the solution acidic

18. Which of the following are amphiprotic solvents

A)Water B)Ammonia C)HF D)CCl_4

Answer:A,B

Solution: Amphiprotic solvents are substances that can act as both proton donors (acids) and proton acceptors (bases).
Water (H_2O) is a classic example, as it can donate a proton to form OH^- (hydroxide) or accept a proton to form H_3O^+ (hydronium).
Ammonia (NH_3) also exhibits amphiprotic behavior. It can donate a proton to form NH_2^- (amide) and accept a proton to form NH_4^+ (ammonium).
HF (hydrogen fluoride) primarily acts as an acid, donating protons, although it can also act as a base in certain situations.
CCl_4 (carbon tetrachloride) is a nonpolar solvent and does not exhibit amphiprotic behavior.

Assertion and Reason Type:

A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true and R is not the correct explanation of A
C) A is true and R is false
D) A is false and R is true

19. Assertion)A) : A substance that can either act as an acid as well as a base is called ampholyte.

Reason (R) : Bisulphide ion (HS^-) and biscarbonate ion (HCO_3^-) are ampholytes.

Answer:A

Solution:Assertion (A) is correct because an ampholyte (or amphoteric substance) can behave as both an acid and a base.
Reason (R) provides correct examples (HS^- and HCO_3^-) of ampholytes, directly supporting (A)

20. Assertion (A) : Accoridng to Bronsted concept H_2O is an amphoteric substance

Reason (R) : H_2O molecule can accept as well as donate a proton

Answer:A

Solution:Assertion (A) is true because H_2O can act as both a Brønsted acid (donates

H^+ to form OH^-) and a Brønsted base (accepts H^+ to form H_3O^+).
Reason (R) explains why H_2O is amphoteric (it can both donate and accept protons).

21. Assertion (A) : In the reaction, $I_2+I^- \rightarrow I_3^-$, I_2 acts as Lewis base.
Reason (R) : In this reaction I^- donates an electron pair for sharing with iodine

Answer:D
Solution:Assertion (A) is false because I_2 acts as a Lewis acid (electron-pair acceptor), not a base.
Reason (R) is true because I^- donates an electron pair to I_2 to form I_3^-.
The correct statement would be: "I_2 acts as a Lewis acid since it accepts an electron pair from I^-."

Matrix matching type:

21.	**Column I**	**Column II**
	A) OH^-	**(p)Conjugate acid of 0^{-2}**
	B) $HClO_4$	**(q)Conjugate acid of H_2O**
	C) H_3O^+	**(r)Conjugate base of H_2O**
	D) ClO_4^- is weak conjugate base	**(s)strongest bronsted acid**

Answer:A-r,B-s,C-q,D-p
Solution:

A) OH^-	(r)Conjugate base of H_2O
B) $HClO_4$	(s)strongest bronsted acid
C) H_3O^+	(q)Conjugate acid of H_2O
D) ClO_4^- is weak conjugate base	(p)Conjugate acid of 0^{-2}

22.	**Column-I**	**Column-II**
	A. HSO_4^-	**p. Lewis acid**
	B. BF_3	**q. Lewis base**
	C. NH_3	**r. Bronsted acid**
	D. OH^-	**s. Bronsted base**

Answer:A-r,B-p,C-q,D-s
Solution:

A. HSO_4^-	r. Bronsted acid
B. BF_3	p. Lewis acid
C. NH_3	q. Lewis base
D. OH^-	s. Bronsted base

Comprehension type:

In the reaction $HCl+H_2O \rightleftharpoons H_30^+ + Cl^-$, HCl and H_30^+ are bronsted lowry acids.

23. Review the equilibrium and choose the correct statement

$HClO_4+H_2O \rightleftharpoons H_30^+ + ClO_4^-$

A)$HClO_4$ is the conjugate acid of H_2O

B)H_30^+ is the conjugate base of H_2O

C)H_2O is the conjugate acid of H_30^+

D) ClO_4^- is the conjugate base of $HClO_4$

Answer:D

Solution:$HClO_4$ donates a proton (H^+) to H_2O, making:
$HClO_4$ the acid (becomes ClO_4^-, its conjugate base).
H_2O the base (becomes H_3O^+, its conjugate acid).

24. Which one of the following can be classified as abronsted base.

A)NO_3^- B)H_3O^+ C) NH_4^+ D) HCl

Answer:A

Solution:Those compound which accept H^+ is called Bronsted base NO_3^- accept H^+ and form HNO_3 . So it is a base.

25. The conjugate base of NH_2^- is..

A)NH_3 B) NH^{2-} C) NH_3^+ D)N_3

Answer:B

Solution: $NH^-_2 \Leftrightarrow NH^{-2} + H^+$

Conjugate acid, base pair.

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS

1. Arrhenius theory fails to explain the following.

A) HCl B) CH_3COOH C)H_2S D) SO_3

Answer:D

Solution:Arrhenius theory defines acids as substances that release H^+ ions in water. SO_3 (sulfur trioxide) is a Lewis acid (electron-pair acceptor) but does not contain H^+, so it cannot be explained by Arrhenius theory.

2. Conjugate base of hydrozoic acid is

A) N_2H_4 B)$N_2H_5^+$ C)N_3^- D)NH_2OH

Answer:C

Solution:Hydrozoic acid (HN_3) loses H^+ to form its conjugate base, N_3^- (azide ion).

3. The following which has no conjugate base

A)$H_2PO_4^-$ B)$H_2PO_2^-$ C)$H_2PO_3^-$ D)CH_3COOH

Answer:B

Solution: $H_2PO_2^-$ has no conjugate base because it lacks any acidic hydrogen atoms that can be donated to form a conjugate base.

4. When acid is added to water the concentration of which ions increases

A)H^+ B)OH^- C)H_3O^- D)O_2^-

Answer:A,C

Solution:Acids increase H^+ concentration, which combines with H_2O to form H_3O^+ (hydronium ions).

OH^- decreases due to neutralization.

5. Which of the following is/are Lewis acid(s)?

A) NH_3 B) Mg^{2+} C) $AlCl_3$ D) Ag^+

Answer:B,C,D

Solution:Lewis acids accept electron pairs:

Mg^{2+}, Ag^+: Electron-deficient metal ions.

$AlCl_3$: Incomplete octet (Al can accept electrons).

NH_3 (A) is a Lewis base (electron-pair donor).

6. Which of the following will qualify as Lewis base?

A) $BC1_3$ B) CH_4 C) PH_3 D) NH_3

Answer:C,D

Solution:Lewis bases donate electron pairs:

NH_3 and PH_3 have lone pairs on N and P, respectively.

BCl_3 (A) is a Lewis acid, and CH_4 (B) has no lone pairs.

7. Which of the following is not a Lewis acid

A)BF_3 B)$FeCl_3$ C)SiF_4 D)C_2H_4

Answer:D

Solution:BF_3, $FeCl_3$, SiF_4 are Lewis acids (electron acceptors).

C_2H_4 is a neutral hydrocarbon with no electron deficiency.

8. Which of the following is not Lewis acid

A)BF_3 B)$AlCl_3$ C)$FeCl_3$ D)PH_3

Answer:D

Solution:BF_3, $AlCl_3$, $FeCl_3$ are Lewis acids.

PH_3 is a Lewis base (lone pair on phosphorus).

9. Cl^- is the conjugate base of

A)$HClO_4$ B)HCl C)HOCl D)$HClO_3$

Answer:B

Solution:Cl^- is formed by loss of H^+ from HCl

10. Which of the following cannot act as a Lewis or Bronsted acid

A)BF_3 B)$AlCl_3$ C)$SnCl_4$ D)CCl_4

Answer:D
Solution: BF_3, $AlCl_3$, $SnCl_4$ are Lewis acids (electron acceptors).
CCl_4 has no vacant orbitals or H^+ to donate, so it cannot act as an acid.

JEE MAINS LEVEL QUESTIONS

Single Answer Type

11. An acid is a substance which:
A) accepts a lone pair of electron (Lewis concept)
B) donates a proton (Lowry and Bronsted concept)
C) acts as an acid only in presence of a base
D) none of the above

Answer:A,B
Solution:According to Brønsted-Lowry theory, an acid is a proton (H^+) donor.
Lewis acid $\rightarrow$accepts a lone pair

12. A base is a substance which:
A) donates a lone pair of electron (Lewis concept)
B) accepts a proton
C) acts as a base only in presence of a acid
D) none of the above

Answer:A,B,C
Solution:In Lewis theory, a base is an electron-pair donor. While B) is correct for Brønsted bases, A) covers both Lewis and some Brønsted bases.
Statement C is also true in a reactive sense (every base needs acid to donate a proton).

13. Which of the following is a conjugated acid-base pair
A)HCl, NaOH B)NH_4Cl, NH_4OH C)H_2SO_4,HSO_4^- D)KCN,HCN

Answer: C
Solution: They differ by one proton (H^+). H_2SO_4 (acid) $\rightarrow$ HSO_4^- (its conjugate base).

14. Which of the following can give base OH^-
A)H_2O B)H_3O^+ C)H_2 D)HCl

Answer : A
Solution:Water can dissociate to form OH^-

15. Which of the following is not a Bronsted acid
A)$CH_3NH_4^+$ B)CH_3COO^- C)H_2O D)HSO_4^-

Answer:B
Solution:CH_3COO^- is a conjugate base (of CH_3COOH) and cannot donate protons.

16. Which one of the following compounds is a Lewis acid
A)PCl_3 B)BCl_3 C)NCl_3 D)$CHCl_3$

Answer:B
Solution:BCl_3 has an incomplete octet and can accept electron pairs.

17. Which of the following is not a Lewis acid
A)CO B)$SiCl_4$ C)SO_3 D)Zn^{2+}

Answer:A
Solution:CO is a Lewis base (electron-pair donor), not an acid. The others ($SiCl_4$, SO_3, Zn^{2+}) are Lewis acids.

18. Conjugate acid base pairs in the aqueous solution of ammonia are

A) $H_3^+O, H_2O \;\&\; NH_3, NH_2^-$ **B)** $NH_4^+, H_2O \;\&\; NH_3, OH^-$

C) $NH_4^+, NH_3 \;\&\; H_2O, OH^-$ **D)** $H_2O, NH_3 \;\&\; OH^-, NH_4^+$

Answer:C

Solution: $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

NH_4^+ (conjugate acid) is formed when NH_3 (base) accepts H^+.
OH^- (conjugate base) is formed when H_2O (acid) donates H^+.

19. In the reaction $AlCl_3 + Cl^- \rightarrow AlCl_4^-$**;** $AlCl_3$ **is**

A) Lewis acid **B) Lewis base** **C) Lewis salt** **D) Arrhenius acid**

Answer:A
Solution:$AlCl_3$ accepts an electron pair from Cl^- to form $AlCl_4^- \rightarrow$ Lewis acid (electron-pair acceptor).

20. Which of the following is a weak acid according to protonic concept of acids and bases?

A) NO_3^- **B)** $Cl\,O_4^-$ **C)** NH_4^+ **D)** CO_3^{2-}

Answer:C
Solution:NH_4^+ (ammonium ion) is a weak acid (partially dissociates to $NH_3 + H^+$).
NO_3^- (neutral, conjugate base of HNO_3).

ClO_4^- (neutral, conjugate base of $HClO_4$).

CO_3^{2-} (base, conjugate base of HCO_3^-).

21. $H_2\,CO_3$ ionises in two stages as represented below

$$H_2CO_3 + H_2O \rightleftharpoons H_3O^+ + HCO_3^-$$

$$H_2CO_3^- + H_2O \rightleftharpoons H_3O^+ + CO_3^{2-}$$

The number of conjugate acid-base pairs in the above reactions are

A) 2 **B) 4** **C) 5** **D) 3**

Answer:B
Solution:For the two-stage ionization:
H_2CO_3/HCO_3^- (acid/conjugate base).
H_3O^+/H_2O (conjugate acid/base from H_2O).
HCO_3^-/CO_3^{2-} (acid/conjugate base).
H_3O^+/H_2O (again, from the second step).

22. The conjugate base of $[Co(NH_3)_6]^{+3}$ is

A) $[Co\ (NH_3)_5NH_4]^{+4}$ **B)** $[Co(NH_3)_5NH_2]^{+2}$

C) $[Co\ (NH_3)_5NH_4]^{+3}$ **D)** $[Co\ (NH_3)_5N_2H_4]^{+2}$

Answer:B

Solution:The conjugate base forms by losing $H^+$from one NH_3 ligand:

$[Co(NH_3)_6]^{3+} \rightarrow [Co(NH_3)_5NH_2]^{2+} + H^+$

23. Which of the following is not a conjugate acid- base pair?

A) $HPO_4^{-2}; PO_4^{-3}$ **B)** $H_2PO_4^-; HPO_4^{-2}$ **C)** $H_2PO_4^-; H_3PO_4$ **D)** $H_2PO_4^-; PO_4^{-3}$

Answer:D

Solution: $H_2PO_4^-; PO_4^{-3}$ requires losing two protons, not one. Valid pairs mustdiffer by one H^+

24. Glycine exists as the zwitter ion (double ion) $\overset{+}{N}H_3CH_2COO^-$ **. its conjugate base is**

A) NH_2CH_2COOH **B)** $NH_2CH_2COO^-$ **C)** $^+_{NH_3}\ CH_2\ COOH$ **D)** $NH_2\ CH_2\ COOH^+$

Answer:B

Solution:Its conjugate base forms by losing H^+ from the NH_3^+ group:

$\overset{+}{N}H_3CH_2COO^- \rightarrow NH_2CH_2COO^- + H^+$

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

25. Which of the following statements are correct

A) According to Bronsted concept H_2O is an amphoteric substance.

B) H_2O molecule can accept as well as donate a proton.

C) According to Lewis concept, NaCl is a salt.

Answer:A,B

Solution:

A) True: H_2O can act as both a Brønsted acid (donates H^+ to form OH^-) and a Brønsted base (accepts H^+ to form H_3O^+).

B) True: This is the definition of amphoterism, directly supporting statement (A).

C) False: The Lewis concept focuses on electron-pair donation/acceptance (acids/ bases), not salt classification. NaCl is an Arrhenius salt (ionic compound), but this classification is unrelated to Lewis theory.

Assertion and Reason type

A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true and R is not the correct explanation of A
C) A is true and R is false
D) A is false and R is true

25. Assertion (A) : According to lowry – Bronsted theory, a substance can function as an acid as well as a base
Reason (R) : Acid reacts with a base to produce a salt.

Answer:B

Solution:Assertion (A) is true because the Brønsted-Lowry theory defines amphoteric substances (e.g., H_2O, HCO_3^-) that can act as both acids (proton donors) and bases (proton acceptors).
Reason (R) is true (neutralization reactions produce salts), but it does not explain why a substance can be both acid and base. It describes a general acid-base reaction, not amphoterism.

26. Assertion (A) : HCO_3^- is a conjugate acid of H_2CO_3.
Reason (R) : HCO_3^- changes to H_2CO_3 by accepting a Proton.

Answer:D

Solution:Assertion (A) is false because HCO_3^- is the conjugate base of H_2CO_3(not conjugate acid). When H_2CO_3 loses H^+, it forms HCO_3^- .

Reason (R) is true because HCO_3^- can accept a proton to revert to H_2CO_3, but this makes it the base in that pair, not the conjugate acid.

27. Assertion (A) : SF_4 can act as Lewis acid.
Reason (R) : The compound which contains vacant d-orbitals can act as Lewis acid.

Answer:A

Solution:Assertion (A) is true because SF_4 (sulfur tetrafluoride) has a vacant d-orbital on sulfur, allowing it to accept electron pairs (Lewis acid behavior).
Reason (R) is true and directly explains (A): Vacant d-orbitals enable electron-pair acceptance (Lewis acidity).

Matrix matching type:

28.

List-I	**List-II**
A) Protophilic solvents	**1) Neither donate nor accept protons**
B) Aprotic solvents	**2) Generates protons**
C) Protogenic Solvents	**3) Either donate(or) accept protons**
D) Amphiprotic Solvents	**4) High tendency to accept protons**
	5) Do not have solvent properties

The correct match:

	A	B	C	D		A	B	C	D
A)	**1**	**3**	**2**	**5**	**B)**	**4**	**1**	**2**	**3**
C)	**4**	**1**	**3**	**2**	**D)**	**2**	**3**	**1**	**5**

Answer:B

Solution:

A) Protophilic solvents	4) High tendency to accept protons
B) Aprotic solvents	1) Neither donate nor accept protons
C) Protogenic Solvents	2) Generates protons
D) Amphiprotic Solvents	3) Either donate(or) accept protons

Comprehension type:

According to Lewis theory, an acid is any molecule, ion or atom which can accept a pair of electron to form a co-ordinate covalent bond. Base is a substance which can donate a pair of electrons to form a co-ordinate covalent bond.

29. Which of the following is neither a Lewis acid nor a Lewis base.

A) HSO_4^- **B) $ZnCl_2$** **C)** NH_4^+ **D)** CH_3^+

Answer:C

Solution:NH_4^+ – Already has a complete octet, no lone pairs to donate, no vacant orbitals $\rightarrow$neither acid nor base

30. In the reaction $SnCl_2 + 2Cl^- \rightarrow SnCl_4 + 2e^-$ the Lewis acid is

A) SnCl **B) $SnCl_3$** **C) $SnCl_2$** **D)** $SnCl_4$

Answer:C

Solution:Lewis acid = Electron-pair acceptor.

Here, $SnCl_2$ accepts electron pairs from Cl^- to form $SnCl_4$ (expands its octet).

$SnCl_4$ is the product, not the acid.

KEY

				TEACHING TASK					
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
D	C	D	D	B	B	B	A	D	D
11	12	13	14	15	16				
A	B,C	B	A,B,C	A,B,D	C				
			JEE ADVANCED LEVEL QUESTIONS						
17	18	19	20	21	21		22		23
C,D	A,B	A	A	D	A-r,B-s,C-q,D-p		A-r,B-p,C-q,D-s		D
24	25								
A	B								
				LEARNERS TASK					
			Conceptual understanding Questions						
1	2	3	4	5	6	7	8	9	10
D	C	B	A,C	B,C,D	C,D	D	D	B	D
			JEE MAINS LEVEL QUESTIONS						
11	12	13	14	15	16	17	18	19	20
A,B	A,B,C	C	A	B	B	A	C	A	C
21	22	23	24						
B	B	D	B						
			JEE ADVANCED LEVEL QUESTIONS						
25	25	26	27	28	29	30			
A,B	B	D	A	B	C	C			