DPP–1 Solution [Classification of Acid and Base]

Chapter: Ionic Equilibrium

"Mehnat dikhayi nahi deti... lekin result mein chilla ke bolti hai."

Q1. Gaseous hydrogen chloride is a very poor conductor of electricity but a solution of hydrogen chloride in water is a good conductor. This is due to the fact :-

(1) Water is a good conductor of electricity
(2) Hydrogen chloride ionises in water
(3) A gas cannot conduct electricity but a liquid can
(4) HCl does not obey Ohm's law where as the solution does

Explanation / Approach

Arrhenius concept: An acid is a substance that **produces H ions in water**. HCl(g) does NOT ionise → no ions → no conduction. HCl(aq) → H + Cl → **good conductor**.

Solution

HCl ionises only in aqueous medium, therefore solution conducts electricity. Hence, the correct reason = "HCl ionises in water".

Correct Option: (2)

Q2. Which is acid in the following pairs according to Arrhenius concept?

(1) HCl(g) and HCl(aq)
(2) CH_3COOH(l) and CH_3COOH(aq)

Explanation / Approach

Arrhenius acid must produce **H ions in water**. • HCl(g) does NOT produce ions → NOT Arrhenius acid. • HCl(aq) gives H → YES. Similarly: • CHCOOH(l) does not ionise. • CHCOOH(aq) H + CHCOO → YES.

Solution

Only aqueous forms act as Arrhenius acids: HCl(aq) and CHCOOH(aq).

Correct Answer: HCl(aq) and CH_3COOH(aq)

Q3. Arrhenius theory does not explain acidic nature of $AlCl_3$.

(1) True
(2) False

Explanation / Approach

Arrhenius theory explains acidity ONLY if H is released. But AlCl behaves as an acid because: Al^3 + 6HO → $[Al(HO)]^3$ This complex **donates protons**, not AlCl itself. Hence Arrhenius cannot explain it.

Solution

Yes — Arrhenius theory fails to explain acidity of AlCl.

Correct Option: (1) True

Q4. **In the process: $NH_3 + NH_3 \;\; NH_2^- + NH_4^+$, the nature of ammonia is :-**

(1) Acidic
(2) Basic
(3) Amphoteric
(4) None

Explanation / Approach

One NH_3 molecule donates a proton → becomes NH_2^-. Other NH_3 accepts the proton → becomes NH_4^+.
Thus NH_3 shows both behaviors → proton donor AND proton acceptor.

Solution

Since NH_3 can act as acid as well as base → it is **amphoteric**.

Correct Option: (3)

Q5. **Which of the following is a Bronsted acid? (i) HCN (ii) $H_2PO_4^-$ (iii) NH_4^+ (iv) HCl**

(1) (i),(ii),(iii)
(2) (i),(ii),(iii),(iv)
(3) (ii),(iii)
(4) (i),(iii),(iv)

Explanation / Approach

A Bronsted acid = proton donor. (i) HCN → can donate H → YES (ii) $H_2PO_4^-$ → amphiprotic → can donate H → YES (iii) NH_4^+ → can donate H → YES (iv) HCl → strong proton donor → YES

Solution

All four species can donate a proton → all are Bronsted acids.

Correct Option: (2)

Q6. **Which of the following can act both as Bronsted acid as well as Bronsted base?**

(1) H_2SO_4
(2) HCO_3^-
(3) O^{2-}

(4) NH_4^+

Explanation / Approach

Amphiprotic species must both donate accept protons. HCO_3^- H_2CO_3 (accepts H) HCO_3^- CO_3^{2-} (donates H) $\rightarrow$ Amphiprotic.

Solution

Only HCO_3^- can act as both proton donor acceptor.

Correct Option: (2)

Q7. Which of the following is not a Bronsted acid :-

(1) $CH_3NH_4^+$
(2) CH_3COO^-
(3) H_2O
(4) HSO_4^-

Explanation / Approach

A Bronsted acid must donate H. CH_3COO has no H to donate $\rightarrow$ NOT an acid.

Solution

CH_3COO cannot donate proton $\rightarrow$ not a Bronsted acid.

Correct Option: (2)

Q8. Which of the following is Bronsted–Lowry acid :-

(1) SO_4^{2-}
(2) H_3O^+
(3) OH^-
(4) Cl^-

Explanation / Approach

HO is the strongest Bronsted acid $\rightarrow$ universal proton donor.

Solution

HO donates H $\rightarrow$ Bronsted acid.

Correct Option: (2)

Q9. According to Bronsted concept, the acids in $NH_3 + H_2O$ $NH_4^+ + OH^-$ are :-

(1) NH_3 and NH_4^+
(2) H_2O and OH^-
(3) H_2O and NH_4^+
(4) NH_3 and OH^-

Explanation / Approach

Bronsted acid = proton donor. HO donates H → becomes OH → acid. NH can donate H → acid.

Solution

Acids = HO and NH.

Correct Option: (3)

Q10. **In $HC_2O_4^- + PO_4^{3-}$ $HPO_4^{2-} + C_2O_4^{2-}$ the Bronsted bases are :-**

(1) $HC_2O_4^-$ and PO_4^{3-}
(2) HPO_4^{2-} and $C_2O_4^{2-}$
(3) $HC_2O_4^-$ and HPO_4^{2-}
(4) PO_4^{3-} and $C_2O_4^{2-}$

Explanation / Approach

Bronsted base = proton acceptor. PO^3 accepts H → HPO^2 CO^2 accepts H → HCO

Solution

Bases = PO^3 and CO^2.

Correct Option: (4)

Q11. **Which explains the nature of boric acid in water?**

(1) $H_3BO_3 + H_2O \rightarrow H_3O^+ + H_2BO_3^-$
(2) $H_3BO_3 + 2H_2O \rightarrow 2H_3O^+ + HBO_3^{2-}$
(3) $H_3BO_3 \rightarrow 3H_3O^+ + BO_3^{3-}$
(4) $H_3BO_3 + H_2O \rightarrow B(OH)_4^- + H^+$

Explanation / Approach

Boric acid is a **Lewis acid**, not Bronsted acid. It doesn't lose H → instead, it **accepts OH** from water.

Solution

Correct representation: HBO + HO → B(OH) + H.

Correct Option: (4)

Q12. **Which of the following behave both as Bronsted acid as well as Bronsted bases? H_2O, HCO_3^-, H_2SO_4, H_3PO_4, HS^-, NH_3**

Explanation / Approach

Species that can both donate AND accept protons: HO (amphoteric) HCO (amphiprotic) HS (can accept or donate) NH (weak base but can accept proton → NH) HSO HPO → act mainly as acids only.

Solution

Amphoteric/Amphiprotic set = HO, HCO, HS, NH.

Q13. Which of the following is a Bronsted base? (i) NH_3 (ii) CH_3NH_2 (iii) HCO_3^- (iv) SO_4^{2-}

(1) (i),(ii),(iii),(iv)
(2) (i),(ii)
(3) (i),(iii)
(4) (i),(ii),(iv)

Explanation / Approach

A Bronsted base = proton acceptor. (i) NH accepts H → NH (ii) CHNH accepts H → CHNH (iii) HCO accepts H → HCO (iv) SO² accepts H → HSO → YES

Solution

All four are Bronsted bases.

Correct Option: (1)

Q14. Which is a base according to Lowry–Bronsted concept?

(1) I^-
(2) H_3O^+
(3) HCl
(4) NH_4^+

Explanation / Approach

Base must accept H. I is good H acceptor → forms HI.

Solution

I acts as Bronsted base.

Correct Option: (1)

Q15. Which one of the following species acts only as a base?

(1) H_2S
(2) HS^-
(3) S^{2-}
(4) H_2O

Explanation / Approach

S² has no proton to donate → only accepts proton → only base.

Solution

S² acts exclusively as a base.

Correct Option: (3)

Q16. **Which of the following can act both as Bronsted acid and Bronsted base :-**

(1) Na_2CO_3
(2) O^{2-}
(3) CO_3^{2-}
(4) NH_3

Explanation / Approach

NH → can accept H (base) and in rare cases donate H (acid in liquid NH).

Solution

NH is amphiprotic → can act as both.

Correct Option: (4)

Q17. **Water is a :-**

(1) Protogenic solvent
(2) Protophilic solvent
(3) Amphiprotic solvent
(4) Aprotic solvent

Explanation / Approach

Water can donate H (acid) and accept H (base) → amphiprotic.

Solution

Water is amphiprotic.

Correct Option: (3)

Q18. **Species which do not act both as Bronsted acid and base is :-**

(1) HSO_4^-
(2) Na_2CO_3
(3) NH_3
(4) OH^-

Explanation / Approach

OH cannot donate proton (no H present).

Solution

OH acts only as base → cannot be amphiprotic.

Correct Option: (4)

Q19. **The conjugated base for bicarbonate ion is :-**

(1) CO_3^{2-}
(2) HCO_3^-
(3) CO_2
(4) H_2CO_3

Explanation / Approach

Conjugate base is formed when a species **loses a proton (H)**. HCO_3^- → loses H → CO_3^{2-}.

Solution

Conjugated base = CO_3^{2-}.

Correct Option: (1)

Q20. For the reaction $NH_4^+ + S^{2-}$ $NH_3 + HS^-$, NH_3 and S^{2-} are :-

(1) Acids
(2) Bases
(3) Acid-base pair
(4) None of these

Explanation / Approach

Identify proton transfer: NH_4^+ → donates H → NH_3 (conjugate base) S^2 → accepts H → HS (Bronsted base)
Thus: NH = conjugate base S^2 = Bronsted base

Solution

Both NH_3 and S^{2-} behave as **bases**.

Correct Option: (2)

Q21. In $HC_2O_4^- + PO_4^{3-}$ $HPO_4^{2-} + C_2O_4^{2-}$ the pair acting as Bronsted bases only is :-

(1) $HC_2O_4^-$ and PO_4^{3-}
(2) HPO_4^{2-} and $C_2O_4^{2-}$
(3) $HC_2O_4^-$ and HPO_4^{2-}
(4) PO_4^{3-} and $C_2O_4^{2-}$

Explanation / Approach

Bronsted base = **proton acceptor**.
PO_4^{3-} accepts H → HPO_4^{2-} → BASE $C_2O_4^{2-}$ accepts H → $HC_2O_4^-$ → BASE
So these two act only as bases.

Solution

Bronsted bases only = PO_4^{3-} and $C_2O_4^{2-}$.

Correct Option: (4)

Q22. Conjugated base of OH^- is :-

(1) H_2O
(2) H_3O^+
(3) H^+
(4) O^{2-}

Explanation / Approach

Conjugate base = species formed after **losing H**. OH → loses H → O^2.

Solution

OH → O^2 (conjugate base)

Correct Option: (4)

Q23. An example of Lewis acid is :-

(1) CaO
(2) CH_3NH_2
(3) SO_3
(4) None of these

Explanation / Approach

Lewis acid = electron-pair acceptor.
SO_3 has an electron-deficient S atom → can accept lone pair → Lewis acid.

Solution

SO_3 behaves as a Lewis acid.

Correct Option: (3)

Q24. Which of the following behave as Lewis acid :- BF_3, $SnCl_2$, $SnCl_4$

(1) Stanous chloride, stanic chloride
(2) BF_3, Stanous chloride
(3) Only BF_3
(4) BF_3, stanous chloride, stanic chloride

Explanation / Approach

Lewis acids are electron pair acceptors. • BF_3 → electron deficient (6 electrons) → strong Lewis acid • $SnCl_2$ → has empty orbitals → Lewis acid • $SnCl_4$ → central Sn can accept e pair → Lewis acid

Solution

All three (BF_3, $SnCl_2$, $SnCl_4$) are Lewis acids.

Correct Option: (4)

Q25. In $AlCl_3 + Cl^- \rightarrow [AlCl_4]^-$, $AlCl_3$ is :-

(1) Salt
(2) Lewis base
(3) Bronsted acid
(4) Lewis acid

Explanation / Approach

$AlCl_3$ accepts a lone pair from Cl to form $[AlCl_4]$.
Electron-pair acceptor → Lewis acid.

Solution

AlCl is a **Lewis acid**.

Correct Option: (4)

Q26. Aluminium chloride is :-

(1) Bronsted Lowry acid
(2) Arrhenius acid
(3) Lewis acid
(4) Lewis base

Explanation / Approach

$AlCl_3$ accepts electron pairs → Lewis acid. It does NOT donate H → not Arrhenius or Bronsted acid.

Solution

Aluminium chloride is a Lewis acid.

Correct Option: (3)

Q27. Which of the following species can act as Lewis base :-

(1) Cu^{2+}
(2) $AlCl_3$
(3) NH_3
(4) BF_3

Explanation / Approach

Lewis base = electron pair donor. NH has a lone pair → Lewis base. Cu^2, BF, AlCl → electron-pair acceptors → Lewis acids.

Solution

Only NH_3 acts as Lewis base.

Correct Option: (3)

Q28. BF_3 is acid according to :-

(1) Lewis
(2) Arrhenius
(3) Bronsted and Lowery
(4) Madam Curie

Explanation / Approach

BF accepts electron pair (empty p-orbital) → Lewis acid. Does NOT release H → Not Arrhenius or Bronsted acid.

Solution

Only Lewis theory explains BF acidity.

Correct Option: (1)

Q29. The compound that is not a Lewis acid :-

(1) $AlCl_3$
(2) BF_3
(3) NF_3
(4) $SnCl_4$

Explanation / Approach

Lewis acid must accept e pair. NF has a complete octet lone pair already involved → cannot accept electrons.

Solution

NF is NOT a Lewis acid.

Correct Option: (3)

Q30. BF_3 is :-

(1) Lewis acid
(2) Lewis base
(3) Bronsted acid
(4) Arrhenius acid

Explanation / Approach

BF is electron-deficient → accepts electron pair → Lewis acid.

Solution

BF → Lewis acid.

Correct Option: (1)

Q31. Which of the following is not a Lewis acid?

(1) SiF_4
(2) C_2H_4
(3) BF_3
(4) $FeCl_3$

Explanation / Approach

CH has no electron deficiency, no empty orbitals → cannot accept lone pair → NOT Lewis acid.

Solution

CH is not a Lewis acid.

Correct Option: (2)

Q32. Which of the following molecules acts as a Lewis acid?

(1) $(CH_3)_3N$
(2) $(CH_3)_3B$
(3) $(CH_3)_2O$
(4) $(CH_3)_3P$

Explanation / Approach

$(CH_3)_3B$ has electron-deficient boron (6 electrons) → classical Lewis acid. The others have lone pairs → Lewis bases.

Solution

$(CH_3)_3B$ is Lewis acid.

Correct Option: (2)

Q33. Which of the following acid-base reactions cannot be explained by the Bronsted theory?

(1) $CO_2 + CaO \rightarrow CaCO_3$
(2) $BF_3 + NH_3 \rightarrow BF_3NH_3$
(3) $Ni + 4CO \rightarrow Ni(CO)_4$
(4) All of these

Explanation / Approach

Bronsted theory requires H transfer. None of these reactions involve proton transfer → all explained only by Lewis concept.

Solution

All are outside Bronsted scope → Lewis acid-base reactions.

Correct Option: (4)

Q34. Which pair is Lewis acid & Lewis base product is also Lewis base :-

(1) BF_3, NH_3
(2) $SiCl_4$, $2Cl^-$
(3) CH_3^+, OOC_2H_5
(4) All of these

Explanation / Approach

Each reaction involves electron-pair donation–acceptance: BF (acid) + NH (base) → adduct (still base) SiCl + 2Cl → $SiCl_6^2$ (Lewis base) CH (acid) + OOCH (base) → ester anion (base)

Solution

All pairs satisfy the condition.

Correct Option: (4)

Q35. In $NH_3 + H_2O$ $NH_4^+ + OH^-$, water acts as :-

(1) Acid
(2) Base
(3) Neutral
(4) Both acid & base

Explanation / Approach

HO donates H to NH → becomes OH. Proton donor = Bronsted acid.

Solution

Water behaves as an acid.

Correct Option: (1)

Q36. NH_3 gas dissolves in water to give NH_4OH. Water acts as :-

(1) An acid
(2) A base
(3) A salt
(4) A conjugate base

Explanation / Approach

Water donates H → NH is formed. Hence HO acts as Bronsted **acid**.

Solution

Water = acid.

Correct Option: (1)

Q37. In $HCl + HF \rightarrow H_2Cl^+ + F^-$, HCl behaves as :-

(1) Strong acid
(2) Strong base
(3) Weak acid
(4) Weak base

Explanation / Approach

HCl donates H to HF → forms HCl. Proton donor → acid. Strong acid because HCl is strong.

Solution

HCl behaves as a **strong acid**.

Correct Option: (1)

Q38. HCl does not behave as acid in :-

(1) NH_3
(2) C_2H_5OH
(3) H_2O
(4) C_6H_6

Explanation / Approach

HCl behaves as acid only when medium can accept H. Benzene (CH) cannot accept H $\rightarrow$ no ionisation $\rightarrow$ HCl not acidic.

Solution

HCl is NOT an acid in **CH**.

Correct Option: (4)

Q39. In which of the following reactions NH_3 acts as acid :-

(1) $NH_3 + HCl \rightarrow NH_4Cl$
(2) $NH_3 + H^+ \rightarrow NH_4^+$
(3) $NH_3 + Na \rightarrow NaNH_2 + \frac{1}{2}H_2$
(4) NH_3 cannot act as acid

Explanation / Approach

NH acts as acid when it **donates H**. Only in reaction with Na: NH + Na $\rightarrow$ NaNH + $\frac{1}{2}$H NH donates H $\rightarrow$ becomes NH.

Solution

NH is acid in reaction (3).

Correct Option: (3)

Q40. Ammonium ion is :-

(A) Lewis acid
(B) Lewis base
(C) Bronsted acid
(D) Bronsted base

Explanation / Approach

NH has H to donate $\rightarrow$ proton donor $\rightarrow$ Bronsted acid. Cannot accept electron pair $\rightarrow$ not Lewis acid.

Solution

NH is a **Bronsted acid**.

Correct Option: (C)

Q41. In which reaction does NH_3 act as an acid?

(A) $NH_3 + H^+ \rightarrow NH_4^+$
(B) $NH_3 + HCl \rightarrow NH_4Cl$
(C) $NH_3 + Na \rightarrow NaNH_2 + \frac{1}{2}H_2$

(D) None, as NH_3 is a base

Explanation / Approach

NH acts as acid only when losing H → occurs with Na metal.

Solution

Reaction (C) shows NH as acid.

Correct Option: (C)

Q42. Sulphanilic acid is a/an :-

(1) Arrhenius acid
(2) Lewis base
(3) Neither (A) or (B)
(4) Both (A) & (B)

Explanation / Approach

Sulphanilic acid has –SOH (acidic) and –NH (Lewis base). Hence it can act as both Arrhenius acid (releases H) and Lewis base (lone pair on N).

Solution

Sulphanilic acid is BOTH acid Lewis base.

Correct Option: (4)

Q43. H_3BO_3 is not an Arrhenius acid.

(1) True
(2) False

Explanation / Approach

Boric acid does NOT release H. It accepts OH → Lewis acid. Hence Arrhenius concept fails.

Solution

Statement is TRUE.

Correct Option: (1)

Q44. Match the Column. (Single matching)

Column-I	Column-II
(A) HCl	(q) Arrhenius acid
(B) KOH	(s) Arrhenius base
(C) NH_3	(r) Lewis base
(D) BF_3	(p) Lewis acid

Explanation / Approach

HCl → Arrhenius acid KOH → Arrhenius base NH → Lewis base BF → Lewis acid

Solution

(A)–q , (B)–s , (C)–r , (D)–p

Q45. Which of the following is not a correct statement :-

(1) Arrhenius theory can explain acidic nature in solvents other than water

(2) Arrhenius theory does not explain acidic nature of $AlCl_3$

(3) Aqueous Na_2CO_3 is alkaline even without OH^-

(4) Aqueous CO_2 is acidic even without H^+

Explanation / Approach

Arrhenius theory works ONLY for aqueous solutions. Thus statement (1) is incorrect.

Solution

Incorrect statement = (1)

Correct Option: (1)

Q46. The acid $C_7H_6O_3$ forms salts $C_7H_5O_3Na$, $C_7H_4O_3Na_2$, $C_7H_3O_3Na_3$. Its basicity is :-

(1) One

(2) Two

(3) Three

(4) Six

Explanation / Approach

A tribasic acid forms 3 types of salts by losing 1, 2, or 3 H ions. Here three sodium salts exist → basicity = 3.

Solution

Basicity = **3**.

Correct Option: (3)