

TestGenie
AI-Powered Question Paper Generator

Science — Class 10

Chapter(s): Acids, Bases and Salts

Maximum Marks: 39

Time Allowed: 1 Hour 10 Minutes

Section A — MCQ & Assertion-Reason (1 mark each)

Q1. A student passes CO_2 evolved from reacting Na_2CO_3 with dilute HCl through freshly prepared lime water. The solution first turns milky and then becomes clear on passing excess CO_2 . Which sequence of reactions correctly explains BOTH observations? [1 mark]

- A) $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$; then $\text{CaCO}_3 + \text{CO}_2 \rightarrow \text{CaO} + \text{CO}_2$
- B) $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$; then $\text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{Ca}(\text{HCO}_3)_2$
- C) $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{Ca}(\text{HCO}_3)_2$; then $\text{Ca}(\text{HCO}_3)_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2$
- D) $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaO} + \text{H}_2\text{CO}_3$; then $\text{CaO} + \text{H}_2\text{CO}_3 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$

Q2. In the chlor-alkali process, 10.0 L of dry chlorine gas is collected at STP from electrolysis of brine. Assuming complete collection, what volume of hydrogen gas is produced at STP in the same process? [1 mark]

- A) 5.0 L
- B) 10.0 L
- C) 20.0 L
- D) 40.0 L

Q3. A student accidentally adds water into a beaker containing concentrated H_2SO_4 . The mixture splashes. Which explanation best accounts for this hazard? [1 mark]

- A) Dissolving a concentrated acid in water is highly exothermic; adding water causes local heating and sudden boiling leading to splashing.
- B) Concentrated acids have low density, so water floats and spills out due to buoyancy.
- C) Water reacts with H_2SO_4 to produce hydrogen gas, which pushes the liquid out.
- D) H_2SO_4 instantly freezes water and cracks the beaker, causing splashing.

Q4. Two solutions have pH 3 and pH 6 respectively. By what factor is the hydrogen ion concentration, $[\text{H}^+]$, in the pH 3 solution compared to the pH 6 solution? [1 mark]

- A) 3 times
- B) 10 times
- C) 100 times
- D) 1000 times

Q5. A metal oxide XO reacts with dilute HCl to give a salt XCl_2 and water. Which inference is most scientifically justified? [1 mark]

- A) XO is acidic because it reacts with an acid to give salt and water.
- B) XO is basic because metal oxides generally neutralise acids to give salt and water.
- C) XO must be amphoteric because it forms chloride salt.
- D) XO is neutral because the products include water.

Q6. Assertion (A): Dry hydrogen chloride gas does not change the colour of dry blue litmus paper.

Reason (R): Hydrogen ions are produced from hydrogen chloride only in the presence of water as hydronium ions (H_3O^+). [1 mark]

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

Q7. Assertion (A): When a solution of NaOH is diluted by adding more water, its pH decreases.

Reason (R): Dilution decreases the concentration of OH ions per unit volume in the solution. [1 mark]

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

Q8. Assertion (A): Metallic oxides are generally basic in nature.

Reason (R): Metallic oxides react with acids to produce salt and water, similar to a neutralisation reaction. [1 mark]

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

Q9. Assertion (A): All bases are alkalis.

Reason (R): An alkali is a base that dissolves in water to produce OH ions. [1 mark]

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

Q10. Assertion (A): Salts formed from a strong acid and a strong base have pH 7.

Reason (R): Such salts do not produce H(aq) or OH(aq) ions in water, so their aqueous solutions are neutral. [1 mark]

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

Section B — Very Short Answer (2 marks each)

Q11. A beaker contains 200 mL of a solution with pH = 4. It is diluted to a final volume of 2.0 L with distilled water. Calculate the new pH of the diluted solution. (Assume dilution changes only concentration.) Answer in 2 sentences only. [2 marks]

Q12. Write balanced chemical equations for the following and state ONE confirmatory test (with observation) for the gas evolved: (i) sodium carbonate with dilute hydrochloric acid, (ii) the evolved gas passed through lime water. Answer in exactly 2 sentences. [2 marks]

Q13. A patient with indigestion is advised 10.0 mL of milk of magnesia containing Mg(OH)₂. Explain, using an ionic equation, how it gives relief. Answer in exactly 2 sentences. [2 marks]

Section C — Short Answer (3 marks each)
--

Q14. A student is given two unlabeled aqueous solutions: Solution P is NaCl(aq) and Solution Q is Na₂CO₃(aq), but the student does not know which is which. Design a test scheme in exactly 3 numbered points to identify P and Q using only (i) dilute HCl and (ii) lime water, and write the key chemical equations. (130-160 words) [3 marks]

Q15. You are asked to explain why 'acid rain' is dangerous to aquatic life using pH ideas. In exactly 3 numbered points, analyse what happens when rainwater of pH 5.2 enters a lake initially at pH 7.4. Include one quantitative comparison of [H] and one consequence. (130-160 words) [3 marks]

Q16. Plaster of Paris (POP) is used for setting fractured bones but gypsum is not used directly. In exactly 3 numbered points, explain (i) the chemical change in making POP from gypsum with temperature condition, (ii) the setting reaction of POP with water, and (iii) one reason this is suitable for casting. Include correct chemical formulae. (130-160 words) [3 marks]

Section D — Long Answer (5 marks each)

Q17. The given figure shows an experimental set-up used in a water-treatment unit to generate NaOH by electrolysis of brine (chlor-alkali process). Answer the following in a single, well-structured response:

(a) Identify the products formed at the anode and cathode, and write the balanced overall reaction.

(b) Using the figure data, calculate the amount (in moles and mass) of NaOH formed when a current of 2.0 A is passed for 30 min, assuming 100% current efficiency and that 1 mol of electrons = 96500 C.

(c) State one major safety/handling precaution relevant to any one product obtained and justify it scientifically.

(d) Give two distinct uses (any two) of the products formed in this process, each linked correctly to the product.

(Answer format requirement: Intro 1 sentence + exactly 5 numbered headed points (2 sentences each) + conclusion 1 sentence.) [5 marks]

Q18. A student has three unlabelled colourless solutions in three beakers: Solution A, B and C. The student performs the following tests and records observations:

- With blue litmus: A turns it red; B shows no change; C shows no change.
- With red litmus: A shows no change; B turns it blue; C shows no change.
- On adding a pinch of solid Na_2CO_3 to each: brisk effervescence is seen only in A; the evolved gas turns lime water milky, and on passing excess gas the milkyiness disappears.

Using these observations, answer the following in a single, coherent long-answer:

(a) Identify the nature of A, B and C (acid/base/neutral) with reasons.

(b) Write balanced chemical equations for the reactions producing the gas and for both lime-water changes.

(c) Explain, using ion formation in water, why A and B conduct electricity better than C (assume equal concentration).

(d) State one reason why acids must be added to water during dilution.

(Answer format requirement: Intro 1 sentence + exactly 5 numbered headed points (2 sentences each) + conclusion 1 sentence.) [5 marks]

Section E — Case Study (4 marks each)
--

Q19. Read the following passage and answer the questions that follow: [4 marks]

A school laboratory investigates three local water samples for possible contamination and its effect on acidity/basicity. Sample P is collected from a river downstream of an industrial area; Sample Q is collected from a rainwater storage tank after a thunderstorm; Sample R is collected from a borewell used for drinking. The students use universal indicator and get

pH values: P = 5.2, Q = 5.4, R = 7.3.

To cross-check acidity, they add a small measured amount of powdered calcium carbonate (CaCO_3) to each sample in separate test tubes. They observe vigorous effervescence in P and Q but not in R. They bubble the evolved gas into lime water; it turns milky. On continued bubbling for a longer time, the milkiness reduces and the solution becomes clearer.

The lab assistant cautions students not to add water directly into concentrated acids during any follow-up neutralisation experiments, and instead to add acid slowly to water with stirring. The class discusses how pH affects aquatic organisms and why neutralisation must be controlled rather than excessive.

- (i) Which sample(s) indicate(s) 'acid rain' conditions, and state the criterion used. (1 mark)
- (ii) Write the balanced chemical equation for the reaction causing effervescence when CaCO_3 is added to an acidic sample. (1 mark)
- (iii) Using the passage observations, explain (a) why lime water first turns milky and (b) why it becomes clearer on passing excess gas. Write the equations for both changes. (2 marks)

Science — Class 10
Chapter(s): Acids, Bases and Salts

Section A — MCQ & Assertion-Reason (1 mark each)

A1.

Answer:

Correct option: (B)



Explanation:

Milkiness is due to insoluble CaCO_3 precipitate formed when CO_2 reacts with lime water: $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$. On passing excess CO_2 , CaCO_3 dissolves by forming soluble calcium hydrogencarbonate: $\text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{Ca(HCO}_3)_2$. Hence, option (B) is correct.

A2.

Answer:

Correct option: (B)

10.0 L

Explanation:

Overall reaction: $2\text{NaCl(aq)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)} + \text{Cl}_2\text{(g)} + \text{H}_2\text{(g)}$, so Cl_2 and H_2 are produced in a 1:1 molar ratio. At the same conditions (STP), equal moles occupy equal volumes, hence volume of $\text{H}_2 = 10.0 \text{ L}$. Hence, option (B) is correct.

A3.

Answer:

Correct option: (A)

Dissolving a concentrated acid in water is highly exothermic; adding water causes local heating and sudden boiling leading to splashing.

Explanation:

The dissolution/ionisation of concentrated acids releases a large amount of heat (exothermic). When water is poured into acid, the small amount of water heats rapidly at the surface, may boil explosively, and throws acid out as splashes. Hence, option (A) is correct.

A4.

Answer:

Correct option: (D)

1000 times

Explanation:

$\text{pH} = -\log_{10}[\text{H}^+]$, so a decrease of 1 pH unit means $[\text{H}^+]$ increases by 10 times. From pH 6 to pH 3 is a decrease of 3 units, so factor = $10^3 = 1000$. Hence, option (D) is correct.

A5.

Answer:

Correct option: (B)

XO is basic because metal oxides generally neutralise acids to give salt and water.

Explanation:

A reaction of a metallic oxide with an acid producing salt and water is analogous to neutralisation, showing the oxide behaves as a base. Therefore XO is a basic oxide. Hence, option (B) is correct.

A6.

Answer:

Correct option: (A)

Both A and R are true and R is the correct explanation of A.

Explanation:

The assertion is true because without water, HCl cannot ionise to give $\text{H}^+/\text{H}_3\text{O}^+$ that would affect litmus. The reason correctly states the principle of ion formation in aqueous medium and explains the observation. Hence, option (A) is correct.

A7.

Answer:

Correct option: (A)

Both A and R are true and R is the correct explanation of A.

Explanation:

For a base, higher $[\text{OH}^-]$ means higher pH; dilution lowers $[\text{OH}^-]$, so pH moves toward 7 and decreases. The reason states exactly the mechanism for that pH change. Hence, option (A) is correct.

A8.

Answer:

Correct option: (A)

Both A and R are true and R is the correct explanation of A.

Explanation:

The assertion is true as metallic oxides show basic behaviour. The reason correctly explains this by linking their reaction with acids (salt + water) to neutralisation, which is a defining behaviour of bases. Hence, option (A) is correct.

A9.

Answer:

Correct option: (D)

A is false but R is true.

Explanation:

The assertion is false because many bases (e.g., $\text{Cu}(\text{OH})_2$) are insoluble in water and hence are not alkalis. The reason is true as it states the correct definition of an alkali as a water-soluble base producing OH^- ions. Hence, option (D) is correct.

A10.

Answer:

Correct option: (A)

Both A and R are true and R is the correct explanation of A.

Explanation:

The assertion is true: salts like NaCl (from HCl and NaOH) give neutral solutions. The reason correctly explains neutrality by absence of excess H^+ or OH^- production (no hydrolysis leading to acidic/basic solution at this level). Hence, option (A) is correct.

Section B — Very Short Answer (2 marks each)

A11.

Answer:

Initially, $\text{pH} = 4 \Rightarrow [\text{H}^+] = 10^{-4} \text{ mol L}^{-1}$, and after dilution from 0.200 L to 2.0 L ($10\times$), $[\text{H}^+]$ becomes $10^{-5} \text{ mol L}^{-1}$. Therefore $\text{pH} = -\log_{10}(10^{-5}) = 5$ (unitless).

Dilution decreases ion concentration by the same factor as the increase in volume:

$[\text{H}^+]_{\text{final}} = [\text{H}^+]_{\text{initial}} \times (\text{V}_{\text{initial}}/\text{V}_{\text{final}})$. Substituting $10^{-4} \times (0.200/2.0)$ gives 10^{-5} , and pH increases by 1 because the dilution factor is 10.

A12.

Answer:

$\text{Na}_2\text{CO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$, and the gas is confirmed as CO_2 because it turns lime water milky. $\text{Ca}(\text{OH})_2(\text{aq}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s})\downarrow + \text{H}_2\text{O}(\text{l})$ (white)

precipitate forms).

Carbonates react with acids to produce CO_2 , which is identified by the lime water test producing insoluble CaCO_3 . Writing both balanced equations verifies conservation of atoms and links the observation (milky) to precipitate formation.

A13.

Answer:

Milk of magnesia is a mild base; its OH^- ions neutralise excess H_3O^+ (acid) in the stomach to form water: $\text{H}_3\text{O}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l})$. This reduces acidity (increases pH toward 7), giving relief from irritation caused by excess acid.

Section C — Short Answer (3 marks each)
--

A14.

Answer:

- 1) Add dilute HCl to a small portion of each solution: The sample that shows brisk effervescence is $\text{Na}_2\text{CO}_3(\text{aq})$ because carbonate + acid releases $\text{CO}_2(\text{g})$. Equation: $\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$.
- 2) Confirm the gas: Pass the evolved gas into lime water; turning milky confirms CO_2 due to CaCO_3 precipitate. Equation: $\text{Ca}(\text{OH})_2(\text{aq}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s})\downarrow + \text{H}_2\text{O}(\text{l})$.
- 3) Identify labels: The solution that produced CO_2 and gave the lime-water milkiness is Q = $\text{Na}_2\text{CO}_3(\text{aq})$, and the solution that showed no effervescence with dilute HCl is P = $\text{NaCl}(\text{aq})$ (strong acid-strong base salt, no gas).

A15.

Answer:

- 1) Quantitative change in acidity: pH 5.2 rain has $[\text{H}^+] = 10^{-5.2} \text{ mol L}^{-1}$ and lake water at pH 7.4 has $[\text{H}^+] = 10^{-7.4} \text{ mol L}^{-1}$, so the incoming rain is $10^{(7.4-5.2)} = 10^{2.2} \approx 158$ times more acidic in terms of $[\text{H}^+]$.
- 2) Effect on lake pH: Mixing introduces extra H ions, so the lake pH decreases from 7.4 toward acidic values; even a moderate drop can push conditions outside the narrow pH tolerance range of many organisms.
- 3) Biological consequence: Lower pH stresses aquatic life by affecting enzyme activity and survival; as stated, when pH falls sufficiently, survival becomes difficult, so acid rain can reduce biodiversity and cause fish mortality.

A16.

Answer:

- 1) Preparation (controlled dehydration): Gypsum is $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and on heating at about 373 K it loses water to form Plaster of Paris, calcium sulphate hemihydrate. Equation:



2) Setting (rehydration): POP reacts with water and converts back to gypsum, forming a hard mass. Equation: $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}(\text{s}) + 3/2\text{H}_2\text{O}(\text{l}) \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}(\text{s})$.

3) Suitability for casting: POP forms a smooth paste with water and then hardens quickly due to gypsum crystallisation, so it can mould to the bone's shape and provide rigid support; gypsum itself is already fully hydrated and does not show this rapid setting behaviour.

Section D — Long Answer (5 marks each)

A17.

Answer:

The chlor-alkali process is the electrolysis of aqueous NaCl (brine) that simultaneously produces a strong base and two gases.

1) Products at electrodes: At the anode (+), chloride ions are oxidised to chlorine gas, $\text{Cl}_2(\text{g})$. At the cathode (-), water is reduced to hydrogen gas, $\text{H}_2(\text{g})$, and OH^- ions remain in solution.

2) Overall reaction (balanced): The net reaction is $2\text{NaCl}(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{Cl}_2(\text{g}) + \text{H}_2(\text{g})$. This shows NaOH forms near the cathode while gases are liberated at the electrodes.

3) Charge and moles of electrons:

Given: $I = 2.0\text{ A}$, $t = 30\text{ min} = 1800\text{ s}$, so $Q = It = 2.0 \times 1800 = 3600\text{ C}$. Moles of electrons = $[Q] / [F] = 3600/96500 = 0.0373\text{ mol e}^-$.

4) Moles and mass of NaOH formed: At cathode, 2e^- produce 2OH^- , and each NaOH needs 1 OH^- , so $n(\text{NaOH}) = n(\text{e}^-) = 0.0373\text{ mol}$ (100% efficiency). Mass = $nM = 0.0373 \times 40.0 = 1.49\text{ g NaOH}$.

5) Precaution + uses: Chlorine is poisonous and corrosive, so it must be collected with good ventilation and leak-proof piping to prevent respiratory injury and chemical irritation. Uses: NaOH is used for making soaps/detergents, and Cl_2 is used to disinfect drinking water (alternatively, H_2 is used as a fuel).; Thus, the figure data predict 0.0373 mol (1.49 g) NaOH with Cl_2 at the anode and H_2 at the cathode under ideal conditions.

A18.

Answer:

Indicator tests and carbonate reactions together allow us to deduce acidity/basicity and identify the gas as CO_2 through lime-water behaviour.

1) Nature of A: A turns blue litmus red and reacts with Na_2CO_3 to release a gas, so A is acidic. Acids in water furnish $\text{H}_3\text{O}^+/\text{H}^+(\text{aq})$, which also explains their typical indicator

change.

2) Nature of B: B turns red litmus blue and does not effervesce with Na_2CO_3 , so B is basic. Bases in water furnish $\text{OH}^-(\text{aq})$, and carbonates generally do not release CO_2 with bases.

3) Nature of C: C does not change either litmus, so C is neutral under these tests. It also shows no carbonate effervescence, consistent with absence of excess $\text{H}(\text{aq})$.

4) Equations (gas + lime water): Gas formation in A: $\text{Na}_2\text{CO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ (any acid HX gives similar products). Lime water: $\text{Ca}(\text{OH})_2(\text{aq}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$; excess CO_2 : $\text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}) \rightarrow \text{Ca}(\text{HCO}_3)_2(\text{aq})$.

5) Conductivity and dilution safety: A and B conduct better because they produce ions ($\text{H}_3\text{O}^+/\text{Cl}^-$ or Na^+/OH^-), which carry current, while neutral solutions have far fewer ions at the same concentration. During dilution, acid is added to water because dissolution is highly exothermic and adding water to concentrated acid can cause violent splashing due to local heating.; Hence, A is acidic, B is basic and C is neutral, with CO_2 confirmed by the lime-water test and explained through aqueous ion formation.

Section E — Case Study (4 marks each)
--

A19.

(i) Which sample(s) indicate(s) 'acid rain' conditions, and state the criterion used.

Answer:

Sample Q indicates acid rain because acid rain is defined when rainwater $\text{pH} < 5.6$, and Q has $\text{pH} = 5.4$.

(ii) Write the balanced chemical equation for the reaction causing effervescence when CaCO_3 is added to an acidic sample.

Answer:

$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ (any acid HX gives: $\text{CaCO}_3 + 2\text{HX} \rightarrow \text{CaX}_2 + \text{H}_2\text{O} + \text{CO}_2$).

(iii) Using the passage observations, explain (a) why lime water first turns milky and (b) why it becomes clearer on passing excess gas. Write the equations for both changes.

Answer:

(a) Milkyness is due to insoluble CaCO_3 precipitate: $\text{Ca}(\text{OH})_2(\text{aq}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$. **(b) With excess CO_2 , CaCO_3 converts to soluble calcium hydrogencarbonate, so the mixture clears:** $\text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}) \rightarrow \text{Ca}(\text{HCO}_3)_2(\text{aq})$.