Past-paper walk-through

The characteristic properties of acids and bases ▪ 7.1

eXercise

Questions in this set

- 0620/21 N25 Q20 ▪ 1 mark
- 0620/22 N25 Q22 ▪ 1 mark
- 0620/23 N25 Q21 ▪ 1 mark
- 0620/23 N25 Q24 ▪ 1 mark
- 0620/23 N25 Q34 ▪ 1 mark
- 0620/42 N25 Q4 ▪ 15 marks
- 0620/21 J25 Q18 ▪ 1 mark
- 0620/22 J25 Q19 ▪ 1 mark
- 0620/22 M25 Q22 ▪ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 20

0620/21 N25 ▪ Q20 ▪ 1 mark

20 Which statement describes a property of ethanoic acid?

A It does **not** produce carbon dioxide when added to sodium carbonate.

B It does **not** produce hydrogen when added to magnesium.

C It only donates some of its protons when added to excess aqueous sodium hydroxide.

D It only partially dissociates when added to water.

Solution 20

Answer: **D**

Why

- Ethanoic acid is a *weak* acid: only a small fraction of its molecules dissociate at any moment.
- It still behaves as an acid, so it does give carbon dioxide with a carbonate and hydrogen with magnesium.
- Only the –COOH hydrogen is acidic; the three on the CH_3 group are never released.

Question 22

0620/22 N25 ▪ Q22 ▪ 1 mark

22 The equation shows the reaction between aqueous hydrogen bromide and aqueous ammonia.

$$HBr(aq) + NH_3(aq) \rightarrow NH_4^+(aq) + Br^-(aq)$$

Which statement describes the role of aqueous hydrogen bromide?

A It is a catalyst.

B It is a reducing agent.

C It is a proton acceptor.

D It is a proton donor.

Solution 22

Answer: **D**

Why

- HBr gives its proton to the ammonia, which becomes NH_4^+.
- A proton donor is an acid on the Br\o{}nsted–Lowry definition.
- It is used up in the reaction, so it cannot be a catalyst.

Question 21

0620/23 N25 ▪ Q21 ▪ 1 mark

21 Which statement describes a base?

A It reacts with ammonium chloride to produce ammonia gas.

B It reacts with calcium carbonate to produce carbon dioxide gas.

C It reacts with copper to produce hydrogen gas.

D It turns blue litmus red.

Solution 21

Answer: **A**

Why

- A base reacts with an ammonium salt to release ammonia gas.
- It is *acids* that give carbon dioxide from a carbonate and hydrogen from a metal.
- And copper is below hydrogen, so it gives no hydrogen with acid either.

Question 24

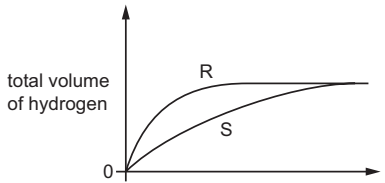
0620/23 N25 ▪ Q24 ▪ 1 mark

24 Dilute acid R and dilute acid S have the same concentration.

The same volume of each dilute acid is reacted separately with the same mass of magnesium ribbon. Both reactions are carried out at room temperature and pressure.

The volume of hydrogen produced is measured.

A graph of the results is shown.



Question 24

Which statement about the reactions is correct?

A Acid S reacts faster than acid R.

B The final volume of hydrogen produced in each reaction is different.

C Acid R is a stronger acid than acid S.

D Acid S is a stronger acid than acid R.

Solution 24

Answer: **C**

Why

- The concentrations are equal, so any difference in rate must come from the *strength* of the acid.
- A strong acid is fully dissociated, so it has more H^+ and reacts faster.
- But the total volume of hydrogen is the same, because the moles of acid available are the same.

Question 34

0620/23 N25 ▪ Q34 ▪ 1 mark

34 Which statement about aqueous ethanoic acid is correct?

A It reacts with magnesium to form oxygen gas.

B It reacts with sodium carbonate to form carbon dioxide gas.

C It turns red litmus paper blue.

D It turns methyl orange yellow.

Solution 34

Answer: **B**

Why

- Ethanoic acid is an acid, so it gives carbon dioxide with a carbonate.
- With magnesium it gives *hydrogen*, not oxygen.
- Being acidic, it turns blue litmus red and methyl orange red – not the other way round.

Question 4

0620/42 N25 ▪ Q4 ▪ 15 marks

4 Nitric acid, HNO_3, and sulfuric acid, H_2SO_4, are strong acids. Ethanoic acid, CH_3COOH, is a weak acid.

(a) One mole of each acid is added separately to 1000 cm^3 of distilled water to form a dilute solution. All three acids dissociate in distilled water.

(i) State the formula of the common cation produced when each of the three acids dissociates in water.

Question 4

(ii) Explain, in terms of dissociation, why:

- nitric acid is described as a strong acid

Question 4

- ethanoic acid is described as a weak acid.

Question 4

[2]

(iii) State which of the three dilute acids will have the highest pH value.

Question 4

(iv) State the colour of thymolphthalein in all three dilute acids.

Question 4

(v) Give the formula of the anion formed when:

- sulfuric acid dissociates in water

Question 4

- ethanoic acid dissociates in water.

Question 4

[2]

(vi) Name the **two** gaseous products formed during the electrolysis of dilute sulfuric acid using inert electrodes.

Question 4

(vii) Name the salt formed when calcium reacts with ethanoic acid.

Question 4

(b) Aluminium nitrate, $Al(NO_3)_3$, is made when dilute nitric acid reacts with aluminium hydroxide, $Al(OH)_3$.

(i) $Al(OH)_3$ acts as a base in this reaction.

Define the term base.

Question 4

(ii) $Al(OH)_3$ is **not** an alkali.

State what this tells you about the solubility of $Al(OH)_3$.

Question 4

(iii) Name **one other** compound which forms aluminium nitrate when added to dilute nitric acid.

Question 4

(iv) The oxidation number of the O atoms in $Al(NO_3)_3$ is –2.
The formula of the aluminium ion in $Al(NO_3)_3$ is Al^{3+}.

Determine the oxidation number of the N atoms in $Al(NO_3)_3$.
Show your working.

Question 4

[Total: 15]

Solution 4

(a)(i)

Mark scheme

- $H+$
- 1

Solution 4

(a)(ii)

Mark scheme

- M1 complete (dissociation) M2
- partial (dissociation)
- 2
- 0620/42
- October/November 2025

Solution 4

(a)(iii)

Mark scheme

- ethanoic (acid)
- 1

(a)(iv)

Mark scheme

- colourless
- 1

Solution 4

(a)(v)

Mark scheme

- M1 SO42– M2
- CH3COO –
- 2

Solution 4

(a)(vi)

Mark scheme

- M1 hydrogen M2
- oxygen
- 2

Solution 4

(a)(vii)

Mark scheme

- calcium ethanoate
- 1

Solution 4

(b)(i)

Mark scheme

- proton acceptor
- 1

(b)(ii)

Mark scheme

- insoluble
- 1

Solution 4

(b)(iii)

Mark scheme

- aluminium oxide
- 1

Solution 4

(b)(iv)

Mark scheme

- M1 use of -18 or (9×-2) or $(3 \times 3 \times -2)$ M2
- $+5$
- 2

Question 18

0620/21 J25 ▪ Q18 ▪ 1 mark

18 Two experiments involving acids R or S are done.

- 0.10 mol of acid R completely dissolves in 500 cm^3 of water. 0.0048 mol of acid R is dissociated in the solution.
- 0.10 mol of acid S completely dissolves in 500 cm^3 of water. 0.0179 mol of acid S is dissociated in the solution.

Which statement about acids R and S is correct?

A Acid R is a strong acid, and acid S is a weak acid.

B Acid R is a weak acid, and acid S is a strong acid.

C Acid R and acid S are both strong acids.

D Acid R and acid S are both weak acids.

Solution 18

Answer: **D**

Why

- What makes an acid strong or weak is the *fraction* that dissociates, not how much dissolves.
- Only 0.0048 of R's 0.10 mol dissociates, so R is a weak acid.
- Compare that fraction with S's to decide which solution has the lower pH.

Question 19

0620/22 J25 ▪ Q19 ▪ 1 mark

19 Which row shows the equations for the dissociation of hydrochloric acid and of ethanoic acid in aqueous solution?

	hydrochloric acid	ethanoic acid
A	$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$
B	$HCl(aq) \rightleftharpoons H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$
C	$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightarrow H^+(aq) + CH_3COO^-(aq)$
D	$HCl(aq) \rightleftharpoons H^+(aq) + Cl^-(aq)$	$CH_3COOH(aq) \rightarrow H^+(aq) + CH_3COO^-(aq)$

Solution 19

Answer: **A**

Why

- Hydrochloric acid is strong, so it dissociates completely – a single forward arrow.
- Ethanoic acid is weak, so only some molecules dissociate – a reversible double arrow.
- It is the arrows, not the formulae, that distinguish strong from weak.

Question 22

0620/22 M25 ▪ Q22 ▪ 1 mark

22 Some information about two dilute acids is shown.

dilute acid	acid concentration in mol/dm^3	pH
nitric acid	0.1	1.0
propanoic acid	0.4	2.6

Three statements about the acids are listed.

1 Nitric acid has a lower pH because it dissociates more than propanoic acid.

2 Propanoic acid has a lower concentration of hydrogen ions than nitric acid.

Question 22

3 Propanoic acid has a higher pH because it has a higher concentration.

Which statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

Solution 22

Answer: **A**

Why

- Nitric acid is strong, so it dissociates completely and gives a high H^+ concentration.
- Propanoic acid is weak: only partly dissociated, so even at four times the concentration its pH is higher.
- pH reflects the H^+ concentration, not the concentration of acid put in.