NOTE: When asked to give a suitable indicator to use for an investigation, always state methyl orange

Acid: proton donor
Weak acid: partially/weakly ionises/dissociates

1. **How would you show that an aqueous solution of ethanoic acid is an acid without using an indicator or measuring the pH?**
   - Reagent: Suitable metal e.g. magnesium / any carbonate / any base
   - Suitable observation: e.g. insoluble base / insoluble carbonate / metal dissolve or disappear or metal / carbonate bubbles
   - Balanced equation

2. **Give 2 observations for reaction that occurs when dilute HCl reacts with magnesium.**
   - bubbles / fizzing / effervescence
   - magnesium or solid dissolves / disappears / forms solution

3. **Why solid is added in excess to the acid while making salts**
   To ensure all of the acid reacts/ is used up

4. **Observations that would show that the solid is in excess**
   - No more fizzing //
     Effervescence stops on addition of more solid (newer MS)
   - Solid stops dissolving / solid remains / is visible (in the mixture) //
     undissolved solid (nearer MS)

5. A student wanted to make hydrated iron(II) sulfate crystals, $FeSO_4 \cdot xH_2O$, by adding excess iron(II) carbonate to dilute sulfuric acid. The student followed the procedure shown.

   step 1 Add dilute sulfuric acid to a beaker.

   step 2 Add small amounts of iron(II) carbonate to the dilute sulfuric acid in the beaker until the iron(II) carbonate is in excess.

   step 3 Filter the mixture formed in **step 2**.

   step 4 Heat the filtrate until it is a saturated solution. Allow to cool.

   step 5 Once cold, pour away the remaining solution. Dry the crystals between filter papers.

   What should be done in step 3 to ensure maximum yield of crystals
   Rinse the residue with distilled water

6.

(b) Ethanoic acid is a weak acid and hydrochloric acid is a strong acid.

Complete the table to show the similarities and differences in the properties of samples of these two acids of equal concentration.

	dilute ethanoic acid	dilute hydrochloric acid
extent of dissociation		
colour after adding universal indicator solution		
observation when magnesium ribbon is added		

- partial (dissociation) (1)
- full / 100% (dissociation) (1)
- both acid colours (1)
- HCl indicating a lower pH acid colour than CH3COOH (1)
- fizzing OR dissolving / disappearing in both (1)
- either observation happens quicker with HCl (1)

7. compounds that react with dilute sulfuric acid to produce aqueous zinc sulfate.

- Zinc oxide
- Zinc hydroxide
- Zinc carbonate

8.

When hydrated magnesium sulfate crystals, $MgSO_4 \cdot xH_2O$, are heated they give off water.

$$MgSO_4 \cdot xH_2O(s) \rightarrow MgSO_4(s) + xH_2O(g)$$

A student carries out an experiment to determine the value of x in $MgSO_4 \cdot xH_2O$.

Step 1 Hydrated magnesium sulfate crystals were weighed.

Step 2 Hydrated magnesium sulfate crystals were heated.

Step 3 The remaining solid was weighed.

Describe how to ensure that all the water is given off.

- Repeat steps 2 & 3 // heat again & weigh again

- Until mass is constant

9.

The following substances can be reacted together to prepare salts.

1 copper(II) oxide and excess hydrochloric acid

2 hydrochloric acid and excess sodium hydroxide

3 hydrochloric acid and excess zinc carbonate

In which reactions can the excess reactant be separated from the solution by filtration?

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

Answer: D

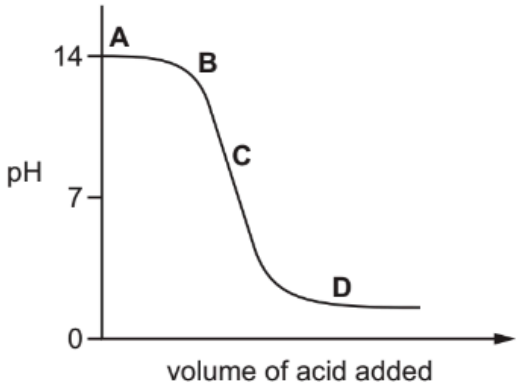
Because the copper oxide is not in excess, the hydrochloric acid is

10.

The graph shows how the pH of a solution changes as an acid is added to an alkali.

$$\text{acid} + \text{alkali} \rightarrow \text{salt} + \text{water}$$

Which letter represents the area of the graph where both acid and salt are present?



Answer: D

11.

Lead(II) sulfate is an insoluble salt.

Which method is suitable for obtaining solid lead(II) sulfate?

A Mix aqueous lead(II) nitrate and aqueous potassium sulfate, heat to evaporate all of the water, collect the solid and then wash and dry it.

B Mix aqueous lead(II) nitrate and aqueous potassium sulfate, filter, collect the filtrate, crystallise, then wash and dry the crystals.

C Mix aqueous lead(II) nitrate and dilute sulfuric acid, filter, then wash and dry the residue.

D Titrate aqueous lead(II) hydroxide with dilute sulfuric acid, crystallise, then wash and dry the crystals.

Answer: C

12. **Chemical equation to show changes which occur when weak acid, ethanoic acid is added to water.**

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

13. **Excess HCl and excess CH_3COOH is added to separate samples of lumps of CaCO3. Observations which would show that HCl is a stronger acid than CH_3COOH.**
    - faster rate of fizzing
    - solid dissolves quicker / disappears quicker / gets smaller quicker
    - fizzing stops quicker
    - dissolving stops quicker

14. **To prepare crystals of MgCl2, excess of MgCO3 is added to HCl.**
    The residue is filtered and rinsed. Why is it rinsed?
    - To ensure all the filtrate/salt/MgCl2 goes through // no MgCl2 is left behind

    Describe how to obtain pure crystals of MgCl2 from the filtrate
    - Evaporate the filtrate
    - Until crystallisation starts/ until saturation point
    - Cool & dry the crystals

15. **Define precipitate**
    - A solid formed
    - When 2 solutions are mixed/ reacted together

16. **Ammonia acts as a base when it reacts with sulfuric acid. Write a chemical equation for the reaction between ammonia and sulfuric acid.**

$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

17. **Why salt formed should not be heated to dryness**

- This would remove the water of crystallisation.
- This would form anhydrous (salt)

18. Why crystals form when a saturated solution is cooled

The solubility of the solid decreases as temperature decreases

19. Process: Excess zinc powder + dilute HCl to form aq ZnCl2. Remove unreacted zinc powder from aq ZnCl2. Heat until saturated, cool & remove crystals. If excess calcium metal is used instead of excess Zn powder, pure calcium chloride crystals don't form. Why?

Calcium will also react with water

20.

A student determines the concentration of a solution of dilute sulfuric acid, H_2SO_4, by titration with aqueous sodium hydroxide, NaOH.

step 1 25.0 cm^3 of 0.200 mol/dm^3 NaOH is transferred into a conical flask.

step 2 Three drops of methyl orange indicator are added to the conical flask.

step 3 A burette is filled with H_2SO_4.

step 4 The acid in the burette is added to the conical flask until the indicator changes colour. The volume of acid is recorded. This process is known as titration.

step 5 The titration is repeated several times until a suitable number of results is obtained.

State how the student decides that a suitable number of results have been obtained.

- At least 2 of the results are within 0.2 cm3 or less

21. State the colour of litmus in a strong alkali

Blue

NOTE: universal indicator would be violet in a strong alkali, but litmus can only be blue.

22. State a pH number that indicates the presence of a strong alkali

pH 14

23. When NaOH (aq) is added to aqueous iron(III) chloride a solid product is formed. Name this product

iron(III) hydroxide

NOTE: always mention the oxidation state within the name of the compound, in case of transition element compounds.

24.

This question is about salts.

(a) Salts that are insoluble in water are made by precipitation.

- Lead(II) iodide, PbI_2, is insoluble in water.
- All nitrates are soluble in water.
- All sodium salts are soluble in water.

You are provided with solid lead(II) nitrate, $Pb(NO_3)_2$, and solid sodium iodide, NaI.

Describe how you would make a pure sample of lead(II) iodide by precipitation.

Your answer should include:
- practical details
- a chemical equation for the precipitation reaction.

(add) **water** (to both salts) (1)
dissolve both salts / make **solutions** (1)
filter (lead(II) iodide)(1)
wash (residue of lead(II) iodide) with **water AND dry** e.g. with filter paper / description of washing and drying (1)
$Pb(NO_3)_2 + 2\ NaI \rightarrow 2NaNO_3 + PbI_2$
OR $Pb^{2+} + 2I^- \rightarrow PbI_2$ (1)

NOTE: whenever hydrogen is formed at cathode, observation should be "fizzing", NOT effervescence/ bubbling.

25. Name a substance which can be used to confirm the pH of a solution of a strong alkali

Universal indicator

26. Name a solution that can be added to aqueous ammonium sulphate to produce a precipitate of lead (II) sulphate

Lead (II) nitrate

Write an ionic equation for this precipitation reaction. Include state symbols

Pb^{2+} (aq) + SO_4^{2-} (aq) → PbSO4 (s)

NOTE: specify the oxidation number

27. Colour of thymolphthalein in basic solution

Blue

28. Name a metal oxide that reacts with NaOH(aq)

Zinc oxide/ aluminium oxide

NOTE: remember to state the term oxide!

29. **Complete the symbol equation to show the dissociation of ethanoic acid**
    $CH3COOH \rightleftharpoons CH3COO^- + H^+$

NOTE: remember to use the $\rightleftharpoons$ sign for all weak acid dissociation equations

30. **equation to show the complete dissociation of sulfuric acid in water:**
    $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$

31. **Write the ionic equation for the reaction when an acid neutralises a soluble base**
    $H^+ + OH^- \rightarrow H2O$

    NOTE: this equation is an example of a neutralisation reaction

32. **Complete the chemical equation for the reaction of butanoic acid and sodium carbonate, Na2CO3.**
    $2C_3H_7COOH + Na_2CO_3 \rightarrow 2C_3H_7COONa + H_2O + CO_2$

    NOTE: $2C_3H_7COONa$ should be given as the product, despite however the reactant is given (whether it is given as structural formula or in the form above)

33. **20.0cm3 of dilute sulfuric acid neutralises 25.0cm3 of 1.00mol/dm3 aqueous sodium hydroxide. At the end of the titration the conical flask contains aqueous sodium sulfate with the dissolved indicator as an impurity. (b) Describe how to prepare a pure sample of sodium sulfate crystals from the original solutions of dilute sulfuric acid and aqueous sodium hydroxide of the same concentrations. You are not required to give details of how to carry out the titration.**
    - M1 repeat without indicator using same volumes OR remove indicator by adding charcoal or carbon and filtering (1)
    - M2 evaporate / heat / warm/ boil/leave in hot place (1)
    - M3 until most of the water is gone / some water left / saturation(point) / crystallisation (point) / evaporate some of the water (1)
    - M4 cool / leave to crystallise(1)
    - M5 description of drying (1)

34. **Water of crystallisation**
    - Water molecules
    - In hydrated crystals