GCSE Chemistry

Titration Practical

Mark Scheme

Time available: 62 minutes
Marks available: 58 marks

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Mark schemes

1. (a) **B** 1

(b) **C** 1

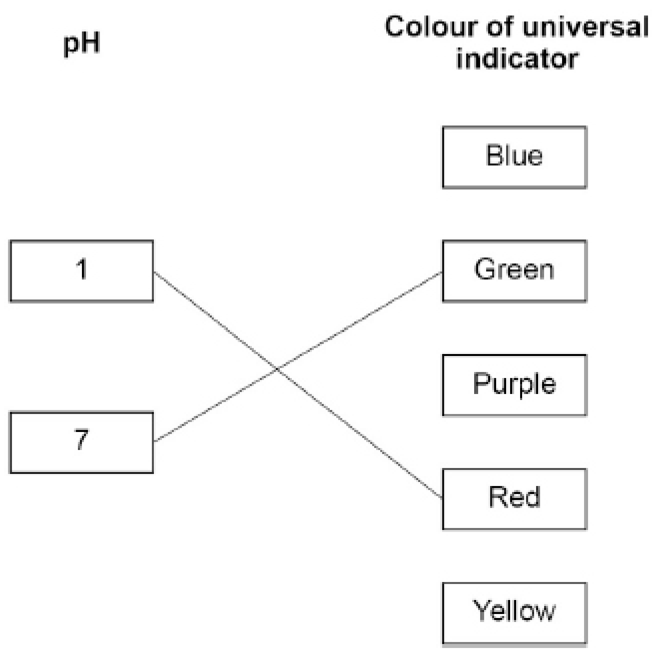
(c) zinc (oxide)

allow ZnO 1

sulfuric (acid)

allow H_2SO_4 1

(d)



*do **not** accept more than one line from a box on the left* 2

(e) neutralisation 1

(f) burette 1

[8]

2. (a) H^+ 1

(b) neutralisation 1

(c) $H_2SO_4 + 2\ KOH \rightarrow K_2SO_4 + 2\ H_2O$

allow multiples 1

(d) 14

1

(e) pipette

1

(f) add potassium hydroxide (solution) to the (conical) flask

1

add (a few drops of) indicator

1

add the (sulfuric) acid (from the burette)

1

until the colour (of the indicator) changes

1

read the volume from the burette

1

[10]

3. (a) nitric acid

1

(b) zinc oxide

1

(c) magnesium bromide

1

(d) (from 0) to 20 cm^3 the pH increases (gradually)

allow a tolerance of 1 cm^3 on volumes
allow a tolerance of 0.2 on pH values

allow increase from pH 1 to pH 3

1

at 20 cm^3 the pH changes from pH 3 to pH 11

allow sudden / steep increase at 20 cm^3
allow sudden / steep increase from pH 3 to pH 11

1

from 20 cm^3 the pH increases (gradually)

allow (gradual) increase from pH 11

*if no other marks awarded allow **1** mark for a description of the three stages with no values used.*

1

(e) 20 (cm^3)

allow 20.0 (cm^3)

1

(f) red

1

(g)

$$\frac{0.06}{25(.0)} \times 100$$

1

= 0.24 (%)

1

(h) (pipette) measures volume more accurately
or
(pipette has a) smaller (percentage) uncertainty

allow (pipette is) more accurate

1

[11]

4. (a) didn't stir (the solution enough)

allow measured the temperature before the temperature stopped falling
allow measured the temperature too soon

1

(b) the temperature decreases (initially) because energy is taken in (by the reaction from the solution)

allow temperature decreases (initially) because the reaction is endothermic

when 1.5 g (of citric acid) is added the sodium hydrogencarbonate has all reacted

allow when the temperature reaches 11.6 °C the sodium hydrogencarbonate has all reacted

or
from 1.5 g the citric acid is in excess

allow after the temperature reaches 11.6 °C the citric acid is in excess

or
when 1.5 g (of citric acid) is added the reaction is complete

allow when the temperature reaches 11.6 °C the reaction is complete

(so) the temperature increases as energy is transferred from the room to the solution

allow (so) the temperature increases as energy is transferred from the excess citric acid to the solution

1

(c) less steep line starting at 16.8 °C **and** reaching 1.00 g (of citric acid)

ignore any part of the line drawn beyond 1.00 g

1

(as) metal is a better conductor

allow (as) polystyrene is a better insulator

1

(so) more energy is absorbed (from the surroundings)

allow (so) more heat is absorbed (from the surroundings)

1

(d) (M_r citric acid =) 192

(moles = $\frac{250}{1000}$ × 0.0500) = 0.0125

(mass = 0.0125 × 192 =) 2.4 (g)

1

allow correct use of an incorrectly calculated M_r
allow correct use of an incorrectly calculated number of moles

1

alternative approach:

(M_r citric acid =) 192 (1)

(concentration = 0.0500 × 192)
= 9.6 (g/dm^3) (1)

allow correct use of an incorrectly calculated M_r

(mass = $\frac{250}{1000}$ × 9.6 =) 2.4 (g) (1)

allow correct use of an incorrectly calculated concentration in g/dm^3

(e) add the citric acid (to the flask) until there is a (permanent) colour change

ignore colours of indicator

1

measure / record the volume (of citric acid) added

allow take the final (and initial) burette reading

1

any **one** from:

- swirl
- use a white tile
- add the citric acid dropwise (near the end-point)
- repeat **and** calculate a mean

allow add the citric acid slowly (near the end-point)

1

(f) any **two** from:

- can add (the citric acid) in small increments

  allow can add (the citric acid) drop by drop

  allow can add (the citric acid) slowly

- can measure variable volumes

  allow has a scale 2

- more accurate than a measuring cylinder

2

(g) (moles citric acid = $\frac{13.3}{1000}$ × 0.0500) = 0.000665

1

(moles NaOH = 3 × 0.000665) = 0.001995

allow correct use of an incorrectly calculated number of moles of citric acid

1

(conc = $\frac{1000}{25}$ × 0.001995) = 0.0798 (mol/dm^3)

allow 0.08 or 0.080 (mol/dm^3)

allow correct use of an incorrectly calculated number of moles of NaOH

1

alternative approach:

$\frac{25.0 \times \text{conc NaOH}}{13.3 \times 0.0500} = \frac{3}{1}$ (1)

allow $\frac{13.3 \times 0.0500}{25.0 \times \text{conc NaOH}} = \frac{1}{3}$

(conc NaOH =) 3 × $\frac{13.3 \times 0.0500}{25.0}$ (1)

= 0.0798 (mol/dm^3) (1)

allow 0.08 or 0.080 (mol/dm^3)

[18]

5. (a) H^+

1

(b) hydrochloric (acid)

allow HCl

1

water

allow H_2O

1

(c) burette

*do **not** accept biuret*

1

(d) 27.6 (cm^3)

allow 27.60 (cm^3)

1

(e) **Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

3–4

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

allow converse using acid added to alkali

Key steps

- measure the volume of acid
- add indicator to the acid
- add sodium hydroxide solution
- until the colour changes
- record volume of sodium hydroxide solution added
- repeat procedure with the other acid

Use of results

- compare the two volumes of sodium hydroxide solution to find which sample **P** or **Q** is more concentrated

Other points

- pipette to measure volume of acid
- use a few drops of indicator
- swirl
- use a white tile
- rough titration to find approximate end point
- add dropwise near the endpoint
- read volume from bottom of meniscus
- repeat and take a mean

[11]