

## Practical planning: spot the mistakes

This resource accompanies the article **A practical solution** in *Education in Chemistry* which can be viewed at: <https://rsc.li/3EewCA9>.

### Learning objectives

- 1 Identify the mistakes in methods for planned practical experiments.
- 2 Explain why the mistakes you have found would not lead to a valid outcome.
- 3 Select the appropriate equipment needed to carry out a given investigation.
- 4 Plan a method that would lead to a valid outcome.

### Introduction

This resource is a set of exam-style questions designed to check learners' understanding of experimental skills and strategies. It can be used to see if learners can evaluate given methods, make suggestions for improvements to methods, select appropriate apparatus and plan experiments. All of these are fundamental parts of working scientifically. The questions are based on chromatography, making salts and neutralisation.

### How to use the resource

There are several ways you could use this resource:

- As part of a revision lesson on required practicals or working scientifically.
- As part of separate lessons on chromatography, making salts or titrations (neutralisation). Giving the questions at the end of a practical lesson or at the start of the following lesson.

You may wish to use one or more of the techniques below:

- Complete the questions as a 'walking talking' mock. Explain how to determine what the question is asking and prompt learners to highlight the key words/command words.
- Get learners to complete the questions under timed exam conditions, go through the answers and have them make improvements.
- Use cold calling to choose learners and check for understanding.
- Show learner answers under a visualiser and discuss with the class.

## Scaffolding

Use the support worksheet (indicated with an 'S' icon in the header) for learners who may need some additional support with the questions.

## Answers

### 1.

(a) Water is used as the solvent (1) – the solvent should be ethanol as the pigments are insoluble in water but soluble in ethanol (1).

The start line is drawn in ink (1) – the ink dissolves in water (1).

(b) The water is above the start line (1) – the inks will dissolve in water (1).

(c) Pencil is insoluble in water (1).

### 2.

(a) Nitric acid was used when it should be sulfuric acid (1).

Calcium oxide was used when it should be copper oxide (1).

The solution is not filtered to remove the excess base (1).

(b) To ensure the sulfuric acid has fully reacted (the sulfuric acid is the limiting reactant) (1).

(c) Increase the rate of reaction (1).

### 3.

(a)

- Burette (1)
- Pipette (1)
- White tile (1)
- Conical flask (1)
- Indicator (eg, methyl orange/phenolphthalein) (1)
- Potassium hydroxide (1)
- Sulfuric acid (1)

(b)

Level 3 (5–6 marks): all the key steps are included and several of the points shown in bold below.

Level 2 (3–4 marks): all the key steps are included. For 4 marks it will include at least one point in bold.

Level 1 (1–2 marks): some key steps or points in bold are listed. They may not be in the correct order.

0 marks: no relevant content.

Key steps:

- Fill a burette with potassium hydroxide.
- Add 25.0 cm<sup>3</sup> of sulfuric acid to a conical flask **and place on a white tile.**
- Add **a few drops of** indicator to the conical flask.
- Add the potassium hydroxide from the burette to the sulfuric acid and indicator **while swirling the conical flask.**
- Add the potassium hydroxide **dropwise as the indicator colour is starting to change (nearing the endpoint).**
- Stop adding potassium hydroxide when the indicator colour changes.
- Read the volume used from the burette and record it.
- **Repeat until you have concordant results** (results within 0.1 cm<sup>3</sup> of each other).
- **Take an average of the concordant results** – this is the volume needed to react.

## Answers for support worksheet

1.

- (a) Water is used as the solvent (1) – the solvent should be ethanol as the pigments are insoluble in water but soluble in ethanol (1).  
The start line is drawn in ink (1) – the ink dissolves in water (1).
- (b) The inks will dissolve in water (1).
- (c) Pencil is insoluble in water (1).

2.

- (a) Nitric acid was used when it should be sulfuric acid (1).  
Calcium oxide was used when it should be copper oxide (1).  
The solution is not filtered to remove the excess base (1).
- (b) To ensure the sulfuric acid has fully reacted (1).
- (c) Increase the rate of reaction (1).

3.

- (a)
- Burette (1)
  - Pipette (1)
  - Conical flask (1)
  - Indicator (eg, methyl orange/phenolphthalein) (1)
  - White tile (1)
  - Safety goggles (1)

(b)

1. **Fill a burette with potassium hydroxide.**
5. Add 25.0 cm<sup>3</sup> of sulfuric acid to a conical flask and place on a white tile.
4. Add a few drops of indicator to the conical flask.
7. Add the potassium hydroxide from the burette to the sulfuric acid and indicator while swirling the conical flask.
8. Add the potassium hydroxide dropwise as the indicator colour is starting to change (nearing the endpoint).
6. Stop adding potassium hydroxide when the indicator colour changes.
3. Read the volume used from the burette and record it.
2. Repeat until you have concordant results (results within 0.1 cm<sup>3</sup> of each other).
9. **Take an average of the concordant results – this is the volume needed to react.**

(1 mark for each correct step placement, 7 marks in total).