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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8368254683

COMBINED SCIENCE **5129/31**

Paper 3 Experimental Skills and Investigations **October/November 2024**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

[Turn over

1 (a) A student investigates the effect of temperature on the rate of digestion of starch by the enzyme amylase.

Iodine solution is a yellow brown liquid that goes blue-black in the presence of starch.

procedure

The student:

- places 1 cm^3 of 1% amylase solution into a test-tube
- places 5 cm^3 of 1% starch solution into a different test-tube
- places both test-tubes into the same water bath at 25.0 °C
- prepares a spotting tile by placing five drops of iodine solution into each of the wells as shown in Fig. 1.1
- mixes the amylase and starch solutions together when the solutions reach 25.0 °C
- immediately adds five drops of the mixture to well 1. The colour of the iodine solution changes to blue-black. This is the result for 0 s
- after 25 s, adds 5 drops of the amylase and starch mixture to well 2
- continues to add the amylase and starch mixture to the remaining wells every 25 s until the colour of the iodine solution does **not** change when the mixture is added
- repeats the procedure for temperatures of the water bath of 35.0 °C, 45.0 °C, and 55.0 °C.

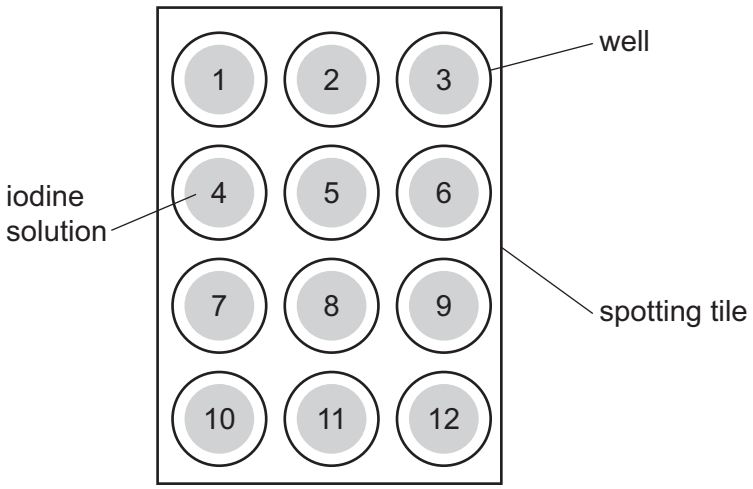


Fig. 1.1

(i) Fig. 1.2 shows part of the scale of the thermometer used to measure the initial temperature of the starch solution.

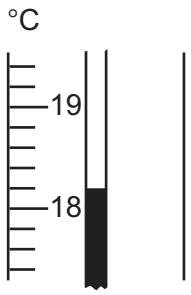


Fig. 1.2

Record the temperature shown on the thermometer.

..... °C [1]

(ii) The student's results for 25.0 °C are shown in Fig. 1.3.

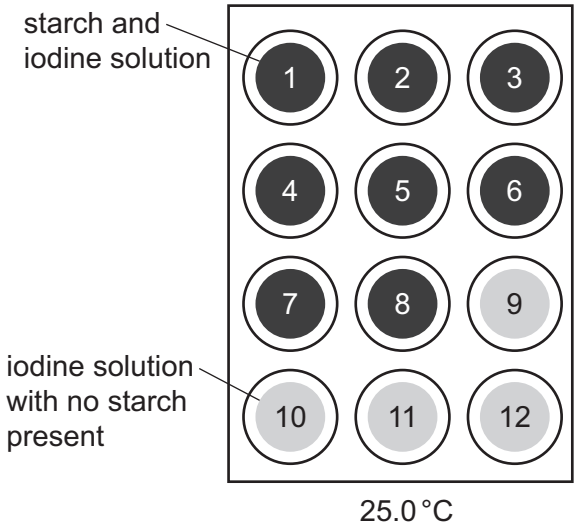


Fig. 1.3

The student's results for the higher temperatures of the water bath are shown in Fig. 1.4.

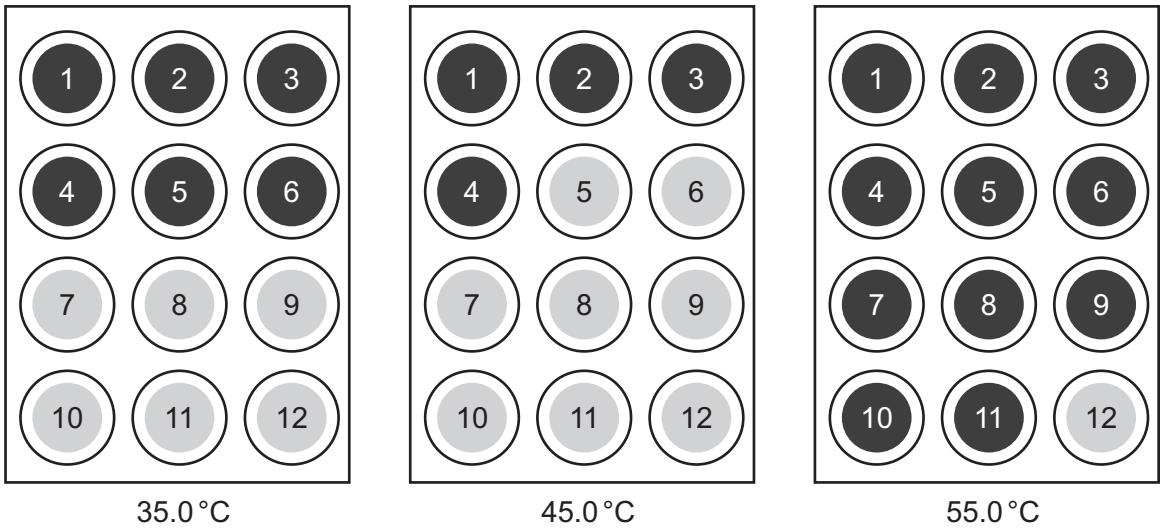


Fig. 1.4

Use the information in Fig. 1.4 to complete Table 1.1.

Table 1.1

temperature of water bath / °C	minimum time taken for starch to be broken down by amylase / s
25.0	175
.....	.....
.....	.....
.....	.....

[2]

(b) The student is trying to find the temperature at which the enzyme amylase works most quickly to break down starch.

(i) From your results in Table 1.1, determine the temperature at which the amylase works most quickly to break down starch.

temperature at which amylase works most quickly = ... °C [1]

(ii) Suggest how the student can improve the **repeatability** of the result.

.....

..... [1]

(iii) Other than improving repeatability, suggest how the student can change the procedure to improve the **accuracy** of the result.

.....

..... [1]

(c) At the end of the investigation, the student tests the mixture which has been kept at 45 °C to see if it contains glucose.

State the name of the test the student uses.

Include details of how the student does the test, and state the positive result.

name of test .....

details .....

.....

positive result of test .....

[3]

(d) (i) The student notices a large ant on one of the spotting tiles and decides to draw it.

Fig. 1.5 shows the student's drawing of the ant.

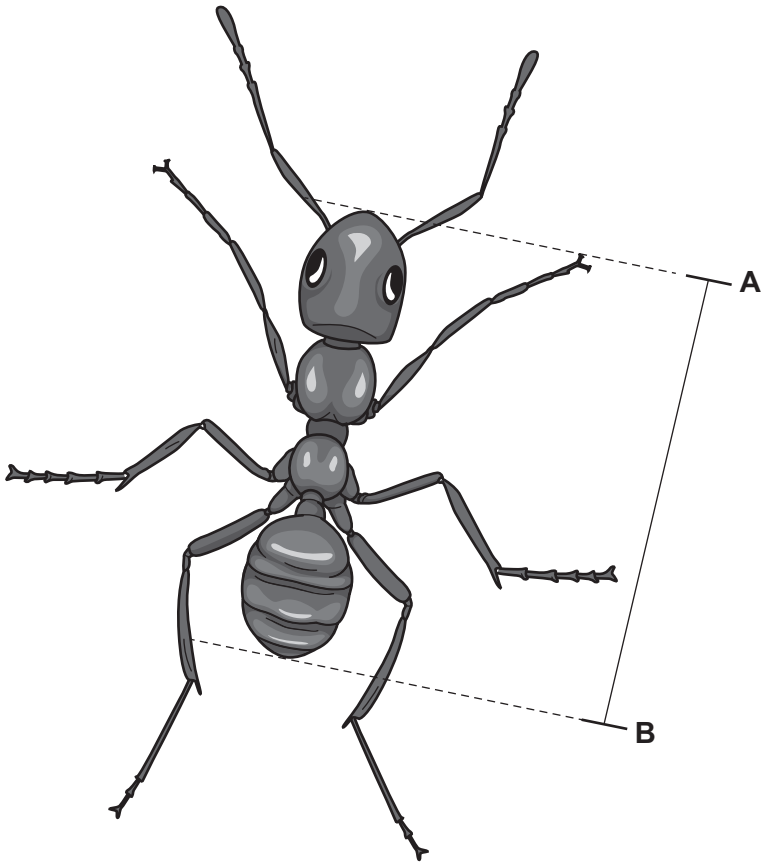


Fig. 1.5

Line **AB** shows the length of the drawing of the body of the ant.

Measure and record the length of the line **AB** in Fig. 1.5.

length of line **AB** = ... mm [1]

(ii) The actual length of the body of the ant is 5 mm.

Calculate the magnification of the student's drawing using the equation:

$$\text{magnification} = \frac{\text{length of line } \mathbf{AB}}{\text{actual length}}$$

magnification = × ..... [1]

[Total: 11]

2 Ethanol is a fuel.

A student investigates the energy released when different masses of ethanol are burnt.

Fig. 2.1 shows the apparatus used for the experiment.

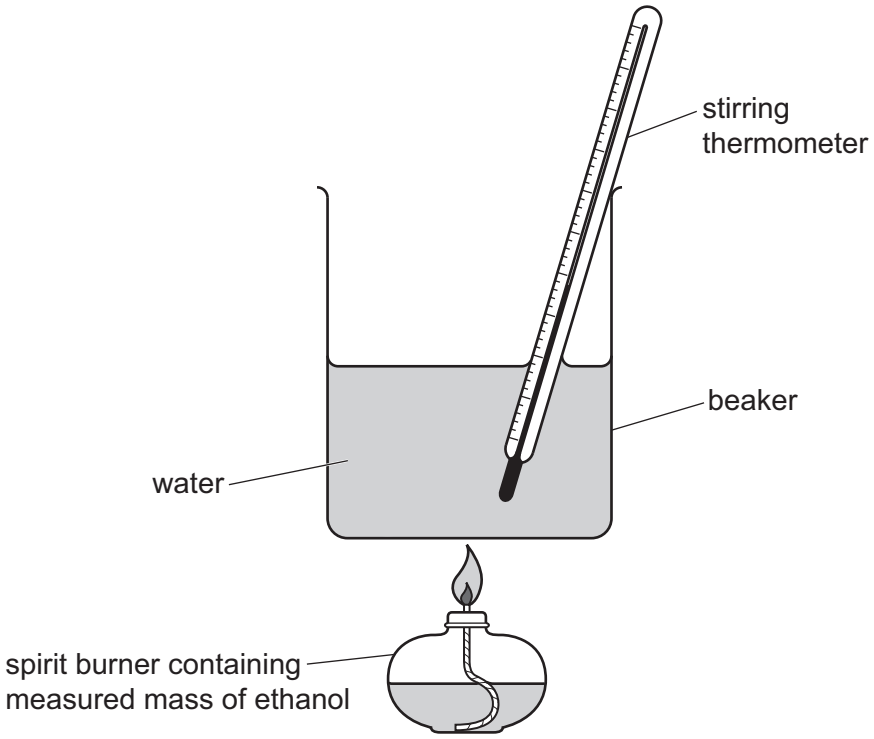


Fig. 2.1

A spirit burner is a piece of apparatus used to burn liquid fuels.

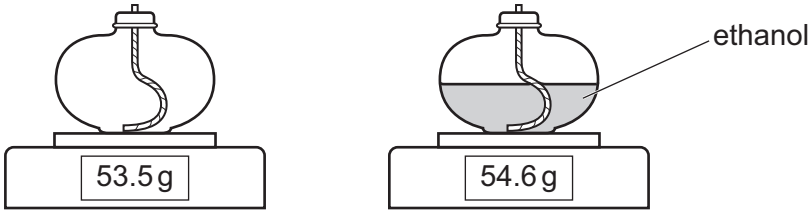
procedure

The student:

- places a known mass of ethanol in the spirit burner
- places 150 cm^3 of water in the beaker
- measures the initial temperature of the water in the beaker
- lights the spirit burner and heats the water
- stirs the water continuously while it is heated
- measures the final temperature of the water after all the ethanol has burnt
- records the results in Table 2.1
- repeats the procedure using different known masses of ethanol.

(a) (i) To measure the mass of the ethanol, the student measures the mass of the empty spirit burner and then the mass of the spirit burner containing ethanol.

Fig. 2.2 shows the empty spirit burner and a spirit burner containing some ethanol on a balance.



empty burner burner with ethanol

Fig. 2.2

Read and record the mass of the empty burner and the mass of the spirit burner with ethanol.

mass of empty burner = ... g

mass of burner with ethanol = ... g
[1]

(ii) Using your results in **(a)(i)**, calculate the mass of ethanol in the burner.

Record your answer below and in the appropriate space in Table 2.1.

mass of ethanol in burner = ... [1]

(iii) Complete Table 2.1 by calculating and recording the temperature change for 0.5 g of ethanol.

[1]

Table 2.1

mass of ethanol used / g	initial temperature / °C	final temperature / °C	temperature change / °C
0.5	21.0	31.5	.....
.....	21.5	39.0	17.5
1.6	21.5	49.0	27.5
2.0	22.0	62.5	40.5
2.4	21.5	70.5	49.0

(iv) Plot a graph of temperature change on the *y*-axis against mass of ethanol used on the *x*-axis on the grid in Fig. 2.3.

Draw the straight line of best fit.

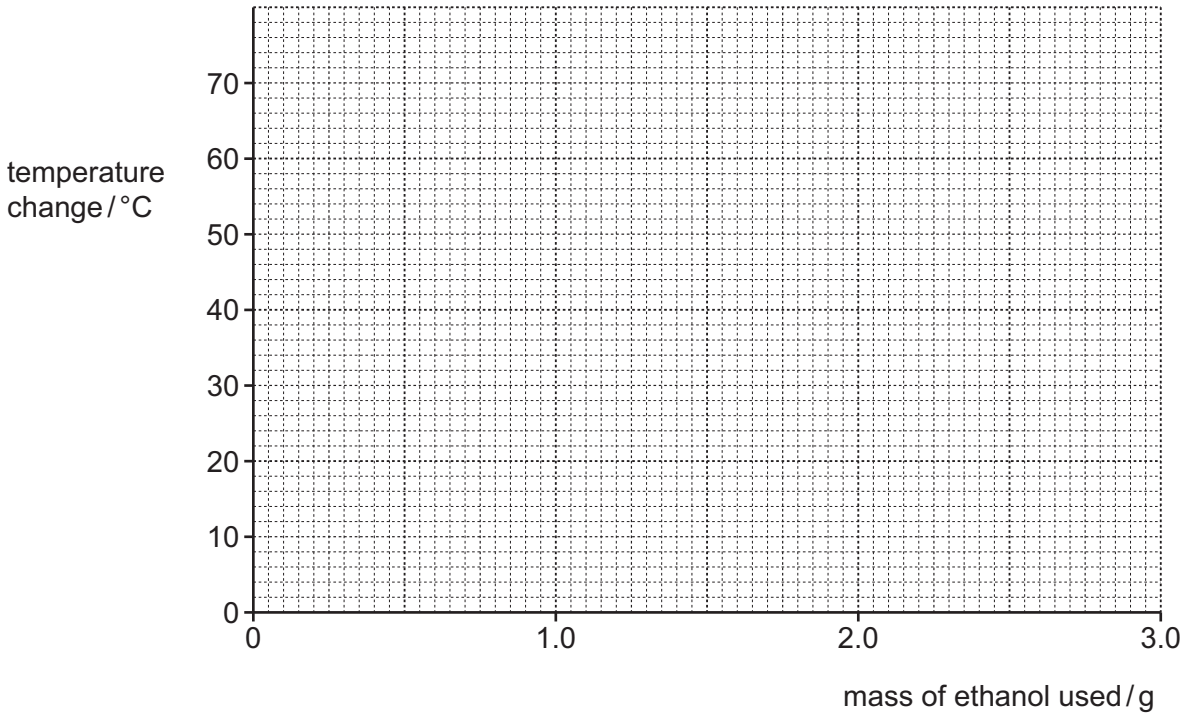


Fig. 2.3

[3]

(v) State the mass of ethanol used for which an anomalous result is obtained.

mass of ethanol = ... g [1]

(vi) On your graph, show how to find the temperature that is obtained when 2.9 g of ethanol is burnt.

Record this temperature.

temperature obtained when 2.9 g of ethanol burnt = ... °C [2]

(b) The results for the temperature changes are all lower than the true values.

Give a reason for the temperature changes being lower than the true values, and suggest a change to the procedure to reduce this error.

reason .....

.....

change to procedure .....

.....

[2]

[Total: 11]

3 A student investigates the horizontal distance travelled by a light ball after it bounces from a ramp.

The ball is dropped onto the ramp and follows the path shown by the arrows in Fig. 3.1.

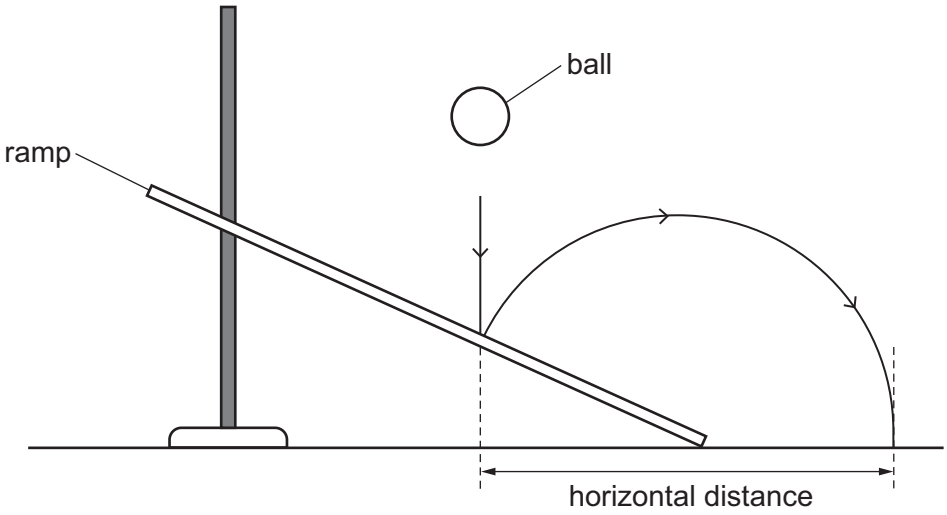


Fig. 3.1

(a) On Fig. 3.1, draw a metre rule in a position where it is used to measure the height of the ball above the ramp before the ball is dropped. The ruler should be placed to measure the height as accurately as possible. [2]

(b) The student measures the mass of the ball using an electronic balance.

She places a small piece of modelling clay on the balance to stop the ball rolling off the balance, and then presses the TARE button.

Then she places the ball on the balance as shown in Fig. 3.2.

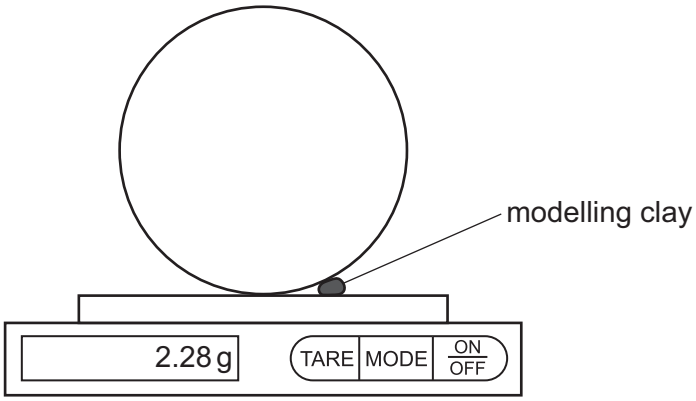


Fig. 3.2

(i) Explain why the student must press the TARE button **after** she puts the modelling clay on the balance and before she puts the ball on the balance.

.....

..... [1]

(ii) The student repeats the mass measurement 3 times for a total of 4 results.

Her results are shown in Table 3.1.

Table 3.1

result	1	2	3	4
mass / g	2.28	2.30	2.39	2.25

One of the results is anomalous. Draw a (ring) around the anomalous result. [1]

(iii) Calculate the average mass *m* of the ball.

Record your value of *m* to 3 significant figures.

Show your working.

m = ... g [2]

(iv) Measure and record an accurate average diameter *d* of the ball in Fig. 3.2.

Show your working.

d = ... mm [2]

(c) The student varies the height from which the ball is dropped and measures the horizontal distance between the point on the ramp where the ball bounces and the point on the floor where the ball lands.

Fig. 3.3 shows the graph of her results.

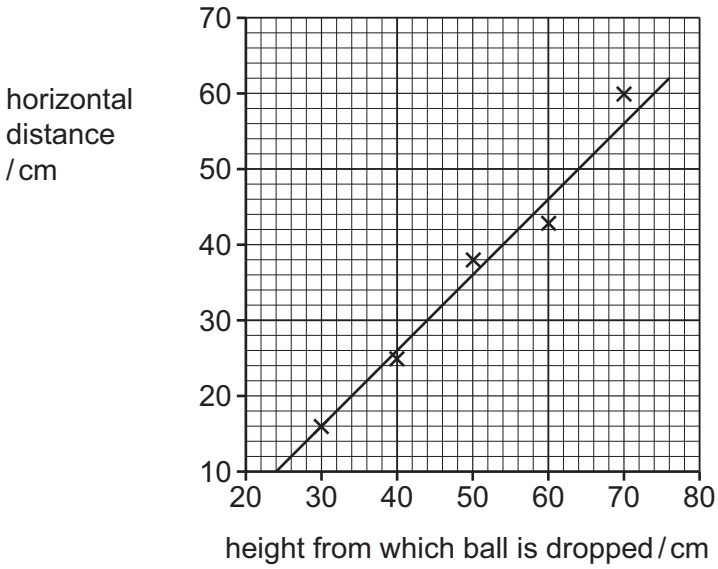


Fig. 3.3

Describe the trend in the graph shown in Fig. 3.3.

.....

..... [1]

(d) After bouncing off the ramp, the ball lands on a hard floor and quickly bounces away.

Suggest one improvement that the student can make to help her measure where the ball lands more accurately.

..... [1]

(e) Another student does the same investigation but gets different results.

Identify **one** variable in the properties or arrangement of the apparatus shown in Fig. 3.1 that may change and cause the results to be different.

.....

..... [1]

[Total: 11]

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4 A student states ‘A person’s heart rate is higher after exercise than before exercise’.

Plan an investigation to test whether this statement is correct.

You are provided with a stop-watch and any other apparatus usually found in a school laboratory.

Include in your answer:

- a brief description of the method and the measurements you will make
- what you will keep constant, and what you will change
- a table in which you could record your results, with headings
- how you will use your results to draw a conclusion.

You do not have to include any results in your table.

A diagram of apparatus is **not** required but you may include it if it helps to explain your plan.

.....

.....

.....

.....

.....

.....

[7]

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Notes for use in qualitative analysis

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	–
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	‘pops’ with a lighted splint
oxygen, O_2	relights a glowing splint

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac