Properties of the halogens

Student activity • desk activity

YEAR 10 / LESSON 20 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

How do colour, state and phase-change data vary down Group 7?

Use RSC reference descriptions and phase-change data for chlorine, bromine and iodine. Deduce states at specified temperatures and identify physical trends. This is a reference-data activity: no halogen samples are opened, smelled, heated or handled. Bulk-element colours must not be confused with aqueous solution colours.

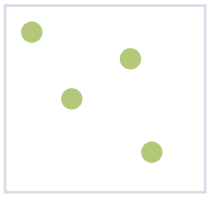
Equipment

- Student booklet, periodic table, pencil and ruler
- Teacher screen or device for the linked RSC element reference pages
- Calculator optional; no chemical samples, chlorine water or litmus paper

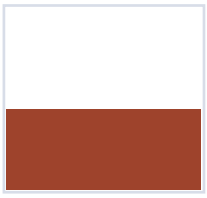
Recorded/reference activity only. Do not obtain, handle, open, heat or smell the substances shown. No live reactions, gas tests or chemical waste are part of this lesson.

Course coverage: 2.5–2.6: colours, physical states and trends for chlorine, bromine and iodine; predictions about other halogens.

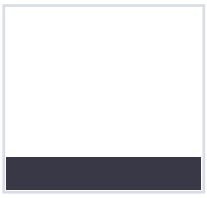
Reference states at 20°C • schematic, not samples



Chlorine gas



Bromine liquid



Iodine solid

Colours are illustrative. Use the written descriptions and sourced phase-change data; no samples are opened.

Method and reasoning

Read the whole sequence before starting

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1. Read the reference colour descriptions and the supplied melting/boiling points. Label your record as reference data, not classroom measurements.

2. At 20°C, compare each temperature with its melting and boiling points. Below melting is solid; between melting and boiling is liquid; above boiling is gas, at approximately standard pressure.

3. Complete the state table for chlorine, bromine and iodine at 20°C and 70°C. Show one inequality as evidence. Avoid temperatures exactly at a phase boundary in this task.

4. Compare bulk colours: chlorine gas is pale green, bromine liquid is red-brown and iodine solid is grey-black. Iodine vapour is violet; do not call the solid purple.

5. Describe the change in melting and boiling points down the three elements. Keep this physical trend separate from chemical reactivity.

6. Use the trend to predict a lower boiling point for fluorine than chlorine and a higher boiling point for astatine than iodine. Label these as trend-based predictions, not measured class values.

7. Explain why a reference photograph or printed colour cannot establish purity, concentration or a precise colour match. Complete the questions without any smell test.

Cleanup

• Keep evidence and corrections together. Return shared cards/counters and equipment; close the recording or reference pages. No chemical waste is generated.

Record your evidence

Blank spaces are for your own work

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Reference and task data

RSC phase-change data at approximately standard pressure: chlorine mp −101.5°C, bp −34.04°C; bromine mp −7.2°C, bp 58.8°C; iodine mp 113.7°C, bp 184.4°C. Bulk-element reference colours: pale-green chlorine gas, red-brown bromine liquid, grey-black iodine solid; iodine vapour is violet. These are literature data and descriptions, not results from this class.

Element / mp / bp (°C)	State at 20°C + reason	State at 70°C + reason
Chlorine: −101.5 / −34.04		
Bromine: −7.2 / 58.8		
Iodine: 113.7 / 184.4		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Deduce all three states at 20°C using the melting and boiling points.

2. Deduce bromine's state at 70°C and iodine's state at 120°C, with reasons.

3. State the melting-point and boiling-point trends down chlorine, bromine and iodine.

4. Predict how fluorine's boiling point compares with chlorine's; label this as a prediction.

5. Correct: "Iodine is a purple liquid at room temperature."

6. Why is smelling a sample unnecessary here, and why must solution colours be distinguished from bulk-element colours?