

HOLIDAY CHEMISTRY SCENARIO ITEMS: TERM II,2026

S.2

ITEM 1:

During a practical science lesson, a teacher gives learners samples of three elements labelled **A, B and C**. The teacher does not reveal their names because she wants the learners to use their knowledge of the Periodic Table to predict their properties. The electronic arrangements of the elements are given as follows:

- **A:** 2, 8, 1
- **B:** 2, 8, 2
- **C:** 2, 8, 7

The learners observe that A is a shiny solid that reacts vigorously with water, while B is a less reactive solid. Element C is a non-metal and exists naturally as a diatomic molecule. The teacher explains that the three elements are found in the same period of the Periodic Table and asks the learners to use their knowledge of periodic trends to explain the observations.

TASK:

- Identify the **period and group** of each of the elements A, B and C.
- Explain why element A is more likely to **lose electrons**, while element C is more likely to **gain an electron** when forming ions.
- Predict which of the three elements would have the **largest atomic radius** and give a scientific reason for your answer.
- When A reacts with C, predict the type of bonding and formula of the compound formed. **Explain your answer using the electronic arrangements of A and C.**
- If an element D with electronic arrangement **2, 8, 6** were added to the investigation, predict how its properties would compare with those of C.

ITEM 2:

A company is developing a new type of rechargeable battery and needs an element that can easily lose electrons and therefore participate in chemical reactions that produce electrical energy. The scientists consider four elements, **P, Q, R and S**, whose positions in the Periodic Table are shown below:

- **P:** Group 1, Period 3
- **Q:** Group 2, Period 3
- **R:** Group 17, Period 3
- **S:** Group 18, Period 3

A trainee scientist argues that element R would be the best choice because it is highly reactive. Another scientist argues that P would be more suitable because elements in its group readily lose their outermost electron. A third scientist suggests S because it is chemically stable and does not react easily.

The scientists decide that the final choice should be based on an understanding of **group properties, electronic structure and periodic trends**, rather than simply choosing the most reactive element.

TASK:

- Name the elements represented by P, Q, R and S.
- Which of the four elements would be expected to have the **greatest tendency to lose an electron**? Give a reason based on its position in the Periodic Table.
- Explain why S is chemically unreactive compared with P and R.
- The company needs an element that can readily form a **positive ion**. Which element would you recommend and why?

ITEM 3:

A research team studying pollution around an industrial area discovers an unknown element **X** in a sample of soil. Preliminary analysis shows that an atom of X has **three occupied electron shells** and **five electrons in its outermost shell**. The

researchers are concerned because elements with similar electronic arrangements can have related chemical properties.

A student studying the sample suggests that X should be placed in the same group as an element having **two electrons in its outermost shell**, because both elements have three electron shells. Another student disagrees and argues that the number of occupied shells determines the **period**, while the number of outermost electrons helps determine the **group**.

The research team asks the students to settle the disagreement by applying their knowledge of the arrangement of elements in the Periodic Table.

TASK:

- a) Write the electronic arrangement of X and use it to determine its **group and period**.
- b) Explain why X belongs to the same **period** as an element with three electron shells, even though the two elements may have very different chemical properties.
- c) Predict whether X is more likely to **gain, lose or share electrons** during chemical reactions. Give a reason for your answer.
- d) Another element Y is found directly below X in the same group. Predict how the **atomic size and metallic character** of Y would compare with those of X. Explain your reasoning.
- e) The student claims that because X has five electrons in its outermost shell, it must be more reactive than every element in its period. **Do you agree? Use periodic trends to justify your answer.**

ITEM 4

The Agriculture Club at a school noticed that vegetables in one section of the school garden were growing poorly. A soil test showed that the soil was **too acidic**. The learners were given dilute hydrochloric acid, sodium hydroxide solution, calcium carbonate powder, blue and red litmus papers, and universal indicator to investigate acids, bases and neutralisation.

TASK

1. Using the substances and indicators provided, describe how the learners could identify the **acid and the base**, including the expected colour changes with the indicators.
2. The learners mixed hydrochloric acid with sodium hydroxide solution until a neutral solution was obtained.
 - a) Name the type of reaction that occurred.
 - b) Name the products formed and write a balanced chemical equation for the reaction.
3. The learners added calcium carbonate to the acidic soil and observed fizzing.
 - a) Explain why calcium carbonate is suitable for correcting acidic soil.
 - b) Name the gas produced and describe a test for it.
 - c) Write a balanced chemical equation for the reaction between calcium carbonate and hydrochloric acid.
4. The soil in Plot A had a **pH of 4**, while Plot B had a **pH of 6**. The crop to be planted grows best at **pH 6.5**. Which plot would require more treatment with calcium carbonate? Give a reason for your answer.
5. A learner suggested adding a large amount of sodium hydroxide directly to the garden soil to neutralise the acid. **Evaluate this suggestion** and explain why calcium carbonate would be a safer and more appropriate choice.