# Assessment for feedback and grade: Composition and properties of matter

Student name: _____ Date: _____

| Unit | Unit title | Level/Mark | Percentage of term work |
|---|---|---|---|
| 1 | Composition and properties of matter | | _____/12.5% |

This unit has three overall expectations:

- investigate physical and chemical properties of elements and compounds, and use various methods to visually represent them;
- demonstrate an understanding of periodic trends in the periodic table and how elements combine to form chemical bonds.
- demonstrate an understanding of the mole concept and its significance to the quantitative analysis of chemical (compounds).

**You will be assessed based on your understanding of these overall expectations which are equally weighted. Your teacher will provide you with an achievement level for each overall expectation, and give you feedback about your strengths, needs, and next steps. Before beginning the assignment you may choose to view the rubric at the end**

**Overall expectation 1:** I can investigate physical and chemical properties of elements and compounds, and use various methods to visually represent them.

1. a) Atoms, ions, and molecules are the three types of particles that make up matter. How are they similar? How are they different? Share at least 3 similarities and/or differences in your response. Point form is acceptable.

b) Give one example (name and formula) of each type of particle discussed in part a).

2. Nitrogen has two naturally occurring isotopes: nitrogen-14 and nitrogen-15. The average atomic mass of nitrogen is 14.0064 μ, which isotope is in the largest abundance? Explain your reasoning.

3. Describe **three** differences between the bonding in ionic and molecular substances. Point form is acceptable.

4. Draw a neat Lewis structure for each of the following compounds. (**Note:** Both ionic and covalent types have been included.) Make sure your diagram clearly distinguishes the type of bonding. Label your structure as "ionic" or "covalent." If it is covalent, identify the single, double, and triple bonds, if present.

**a)** $BeF_2$

**b)** $CBr_4$

**c)** $AsF_3$

**d)** HCN

5. Examine the following table and identify which of the substances A to C are ionic, which are polar covalent, and which are non-polar covalent. Give a reason for your choice in each case.

| Substance | Melting Point (°C) | Solubility in water |
|---|---|---|
| A | –178 | insoluble |
| B | –101 | soluble |
| C | 730 | soluble |

6. Some of the names below are incorrect. Beside each name, write an "X" for an incorrect name and a "✔" for a correct name. For each incorrect name, explain what is wrong and why it is incorrect.

| Chemical Formula and Name | X or ✔ | If incorrect, explain what is wrong and why it is incorrect | If incorrect, what is the correct name? |
|---|---|---|---|
| $MgCl_2$<br>Magnesium chlorine | | | |
| $Co(NO_3)_3$<br>Cobalt nitrogen oxide | | | |
| $N_2O_3$<br>Nitrogen trioxide | | | |
| $CrCO_3$<br>Chromium carbonate | | | |
| $Ag_2SO_4$<br>Silver sulfite | | | |

7. Explain how you would determine the chemical formula of each of the following:

**a)** antimony (III) oxide

**b)** nitrogen trifluoride

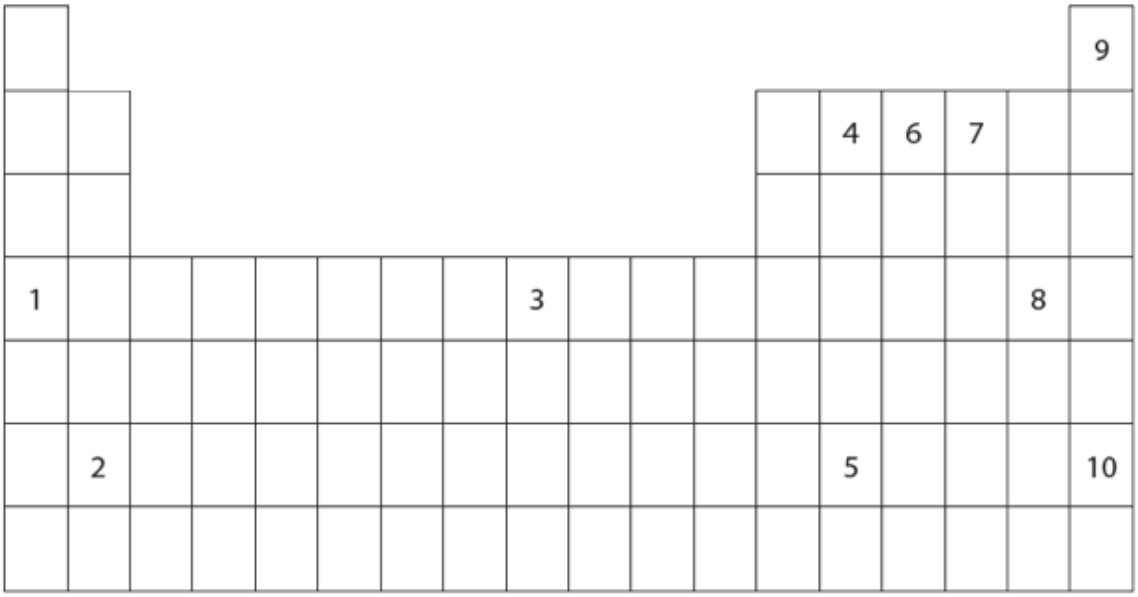
**c)** calcium hydroxide

**d)** sodium phosphide

8. **a)** If the strontium ion has a charge of 2+, and the oxygen ion has a charge of 2-, why is the formula $Sr_2O_2$ incorrect for strontium oxide?

**b)** What is the correct formula for strontium oxide?

**Overall expectation 2:** I can demonstrate an understanding of periodic trends in the periodic table and how elements combine to form chemical bond




1. The blank periodic table has some numbers inserted into the spaces for certain elements. These numbers identify which element to consider. (**Note:** You do not have to identify these elements.)

List *all* of the numbers in the table that refer to

**i)** an alkali metal.

**ii)** a halogen.

**iii)** an alkaline earth metal.

**iv)** a noble gas.

**v)** elements in period 4.

**b)** Which numbers refer to non-metals?

2. Draw a complete Bohr-Rutherford diagram showing all the parts of the atom for $^{14}_{7}N$.

Refer to the Periodic Table when answering questions 3–6. Remember to consider atomic structure when explaining your choice of order.

3. Place the atoms N, Mg, and P in **decreasing** order of atomic radius. Explain your choice of order.

4. Place the atoms Cl, Si, and Ge in **decreasing** order of ionization energy. Explain your choice of order.

5. Place the atoms Br, In, and I in **decreasing** order of electronegativity. Explain your choice of order.

6. Explain why the periodic trends for metal and non-metal reactivity are opposites.

7. The following observations were made during a chemical reaction involving three unknown metals. Analyse the table here to help you answer the questions that follow:

| Metal | Reaction with water | Reaction with vinegar | Reaction with hydrochloric acid |
|---|---|---|---|
| **X** | no reaction | Small bubbles formed on the surface of the metal | immediate, rapid production of bubbles on the surface of the metal; the entire piece of metal had reacted within 5 minutes |
| **Y** | no reaction | rapid production of bubbles on the surface of the metal | a large amount of gas was immediately produced and the entire piece of metal reacted within 1 minute |
| **Z** | no reaction | no reaction | some bubbles were observed on the surface of the metal after 2 minutes |

**a)** List the metals in order from most reactive to least reactive.

**b)** Write a short statement justifying your answer to part (a).

**c)** If all of the metals were located in the same period on the periodic table but in different groups, which would have the highest group number? Explain your answer with a short statement related to periodic trends.

**Overall expectation 3:** I can demonstrate an understanding of the mole concept and its significance to the quantitative analysis of chemical compounds.

1. Perform the calculations required to answer each of the following questions. Pay attention to significant figures.

**a)** What has the greater mass, 3.8 mol of silicon or 5.6 mol of sulphur?

**b)** What is the mass of $3.64 \times 10^{30}$ atoms of magnesium?

2. The current dietary recommendation is to consume less than 0.10 mol of sodium per day. This is about one teaspoon of table salt. It includes all salt and sodium consumed, including sodium used in cooking and at the table.

The sodium content of a popular type of fast-food hamburger is 730 mg.

**a)** How many moles of sodium ions are present in one of these hamburgers?

**b)** How many of these hamburgers can you eat in a day to fulfil all of your sodium dietary requirements?

3. Nitrogen, when combined with oxygen, can form various oxides. 3.5 g of nitrogen gas is burned in oxygen to form 11.5 g of an oxide of nitrogen.

**a)** Determine the mass of oxygen burned. (Hint: The oxide contains ONLY nitrogen and oxygen!)

**b)**Using the data from the experiment, find the percent of nitrogen by mass in the oxide.

**c)** Using the data from the experiment, find the percent of oxygen by mass in the oxide.

**d)** Use the data from this experiment to find the empirical formula of the oxide of nitrogen.

**e)** If you were given a 100. mg sample of the oxide, how many milligrams of nitrogen would be in your sample?

## Rubric

Before submitting your tasks, review the rubric below to self-assess. Look at each criteria that your teacher will follow to assess your work. Using the description, which level is your work meeting? What can you do to improve your work? Take the time now to make any improvements to your work before submitting. Review this Rubric Deconstruction for help understanding rubrics or levels.

**Overall expectation 1:** I can investigate physical and chemical properties of elements and compounds, and use various methods to visually represent them.

| **Success criteria** | **Related questions** | **Level assigned**<br>L4: 80–100 High degree<br>L3: 70–79 Considerable<br>L2: 60–69 Some<br>L1: 50–59 Limited<br>Less Than 50 | **Comments** |
|---|---|---|---|
| **Describe and give examples of the three main subatomic particles with accuracy and clarity. (K)** | 1 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Explain that average atomic mass is determined using the masses and relative abundances of isotopes in nature with clarity and logic. (T)** | 2 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |

| | | | |
|---|---|---|---|
| **Distinguish between the bonding in ionic and molecular substances with clarity. (K,C)** | 3 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Use Lewis dot diagrams to represent ionic and covalent bonding, including multiple covalent bonds with precision. (K,C,A)** | 4 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Infer the bonding type in a chemical compound by considering its properties with accuracy and logic. (A)** | 5 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Write names for ionic and molecular compounds with accuracy. (K, C)** | 6 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |

| | | | |
|---|---|---|---|
| **Write formulas for ionic and molecular compounds with accuracy. (K, C)** | 7, 8 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Feedback** | | | |
| **Strengths** | **Areas for improvement** | **Next steps** | |
| | | □ Incomplete<br>□ Repeat | |

**Overall expectation 2:** I can demonstrate an understanding of periodic trends in the periodic table and how elements combine to form chemical bond.

| **Success criteria** | **Related questions** | **Level assigned**<br>L4: 80–100 High degree<br>L3: 70–79 Considerable<br>L2: 60–69 Some<br>L1: 50–59 Limited<br>Less Than 50 | **Comments** |
|---|---|---|---|
| **Locate element families, metals, and non-metals on the periodic table with accuracy. (K)** | 1 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |

| | | | |
|---|---|---|---|
| **Use the periodic table to determine the number of protons, neutrons, and electrons present in an element with accuracy and precision. (K, C)** | 2 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Explain the reasons for periodic trends in atomic size, ionization energy, and electronegativity with depth and logic. (A,C)** | 3, 4, 5, 6 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Use experimental observations of metal reactivity to create an activity series with accuracy and logic. (T,C)** | 7 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Feedback** | | | |

| **Strengths** | **Areas for improvement** | **Next steps** | |
|---|---|---|---|
| | | □ Incomplete<br>□ Repeat | |

**Overall expectation 3:** I can demonstrate an understanding of the mole concept and its significance to the quantitative analysis of chemical compounds.

| **Success criteria** | **Related questions** | **Level assigned**<br>L4: 80–100 High degree<br>L3: 70–79 Considerable<br>L2: 60–69 Some<br>L1: 50–59 Limited<br>Less Than 50 | **Comments** |
|---|---|---|---|
| **Convert mole amounts to mass amounts, and vice-versa with accuracy. (K)** | 1a, 1b, 2 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Convert mole amounts to entity amounts, and vice-versa accuracy. (K)** | 1b | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Calculate the percentage composition of a chemical compound using either theoretical or experimental data with accuracy (T)** | 3a, b, c, e | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |

| | | | |
|---|---|---|---|
| **Calculate the empirical or molecular formula for a compound given percent composition (and molar mass in the case of molecular formula) with accuracy (K,A)** | 3d | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Communicate my answers to word problems, showing all steps and including units with clarity (C)** | 1, 2, 3 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Determine the number of significant digits in a measured value and use this information to report calculated answers to the correct amount of significant digits with precision (A)** | 1, 2, 3 | □ L4: 80–100 High degree<br>□ L3: 70–79 Considerable<br>□ L2: 60–69 Some<br>□ L1: 50–59 Limited<br>□ Less Than 50 | |
| **Feedback** | | | |
| **Strengths** | **Areas for improvement** | **Next steps** | |
| | | □ Incomplete<br>□ Repeat | |