# Year 11 Science: Physical properties and the uses of materials

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

## Practice

1. A frying pan has an aluminium body, a PTFE non-stick coating on the inside, and a plastic handle. (a) Name the type of material for the aluminium body and for the PTFE coating. (b) Explain why aluminium is suitable for the body of the pan. (c) Discuss why the handle is made from a polymer rather than from aluminium.

2. Using the melting point and density table, which metal there has the lowest melting point, and what is its melting point?

3. Why does solid salt not conduct electricity, while salt water does?

4. A crystal of salt is hit with a hammer and shatters. Why?

5. Why is graphite used in pencils but diamond in drill tips?

6. Why is a magnesium alloy used for a wheel instead of pure magnesium?

## Fix the mistake

7. Correct this statement: "Solid salt conducts electricity because it is made of ions."

8. Correct this statement: "Alloys are harder because the bonds in them are stronger."

9. Correct this statement: "Salt dissolves because water breaks the covalent bonds in the NaCl molecules."

10. Correct this statement: "Magnesium wheels are better because magnesium is lighter."

## Answer key (for parents and tutors)

1. A frying pan has an aluminium body, a PTFE non-stick coating on the inside, and a plastic handle. (a) Name the type of material for the aluminium body and for the PTFE coating. (b) Explain why aluminium is suitable for the body of the pan. (c) Discuss why the handle is made from a polymer rather than from aluminium.
   **(a) Aluminium is a metallic solid; PTFE is a polymer. (b) Aluminium is a lattice of cations surrounded by delocalised electrons, held by strong metallic bonding. The delocalised electrons carry heat energy quickly from the element to the food, so the pan heats evenly. The strong metallic bonding means a lot of energy is needed to melt it, so it stays solid on the stove. The non-directional bonding lets layers slide, so aluminium can be pressed into a pan shape. Its low density for a metal (2.70 g/cm³) keeps the pan light to lift. Describing one property with its use is Achieved; explaining it from the particles and forces is Merit. (c) The handle must stay cool enough to hold. A polymer is long chain molecules held by covalent bonds along the chain and weak forces between chains; it has no delocalised electrons, so it conducts heat poorly. Aluminium would carry heat straight to the hand. The trade-off is that most polymers soften at far lower temperatures than aluminium, so the handle is kept away from the heat. Comparing both materials, linking each one's particles and forces to how well it conducts heat, and making a judgement is Excellence.**
2. Using the melting point and density table, which metal there has the lowest melting point, and what is its melting point?
   **Sodium, 98 °C.**
3. Why does solid salt not conduct electricity, while salt water does?
   **In the solid the ions are held in fixed positions in the lattice; in salt water they are free to move and carry charge.**
4. A crystal of salt is hit with a hammer and shatters. Why?
   **The blow shifts a layer of ions so like charges line up; they repel and the lattice splits.**
5. Why is graphite used in pencils but diamond in drill tips?
   **Graphite's layers have only weak forces between them, so they slide off onto paper; in diamond every atom is held by four strong covalent bonds in 3D, making it extremely hard.**
6. Why is a magnesium alloy used for a wheel instead of pure magnesium?
   **The different-sized atoms in the alloy disrupt the layers so they cannot slide as easily, making it harder and less likely to dent or bend.**
7. Correct this statement: "Solid salt conducts electricity because it is made of ions."
   **Ions in solid salt are fixed in the lattice; it conducts only when melted or dissolved, when the ions are free to move.**
8. Correct this statement: "Alloys are harder because the bonds in them are stronger."
   **Alloys are harder because different-sized atoms disrupt the layers, so the layers cannot slide as easily.**
9. Correct this statement: "Salt dissolves because water breaks the covalent bonds in the NaCl molecules."
   **Salt has no molecules or covalent bonds; water molecules attract the $Na^+$ and $Cl^-$ ions and pull them out of the lattice.**
10. Correct this statement: "Magnesium wheels are better because magnesium is lighter."
    **Say why: magnesium has a lower density (1.74 g/cm³) because its atoms are lighter, so a wheel of the same size has less mass.**