# End of topic quiz

# Topic C1 & C2: Particles & Elements, compounds and mixtures

## Learner Activity

**Topic: C1 & C2 of J250**

**Total marks: 82**

1. The table shows the melting points and boiling points of a number of different elements and compounds.

| **Substance** | **Melting point (oC)** | **Boiling point (oC)** |
| --- | --- | --- |
| Bromine | -7 | 58 |
| Iodine | 114 | 183 |
| Krypton | -157 | -153 |
| Mercury | -39 | 357 |
| Radon | -70 | -60 |
| pentane | --130 | 36 |

Which substances are liquid at room temperature? **[1 mark]**

| **A** | Iodine, krypton and radon | |  |
| --- | --- | --- | --- |
| **B** | Bromine, krypton and radon | |  |
| **C** | Mercury and pentane only | |  |
| **D** | Bromine, mercury and pentane | |  |
|  |  |  | |

Your answer

1. What is the relative formula mass (Mr) for the compound Na2CO3.10H2O? **[1 mark]**

| **A** | 286 | |  |
| --- | --- | --- | --- |
| **B** | 180 | |  |
| **C** | 106 | |  |
| **D** | 83 | |  |
|  |  |  | |

Your answer

1. The following statements describe the properties of different substances.

Which statement, **A**, **B**, **C** or **D**, describes a metal? **[1 mark]**

| **A** | Shiny, black, brittle, low density, melting point of 3550oC, conducts electricity when solid | |  |
| --- | --- | --- | --- |
| **B** | Shiny, grey, bends easily, melting point of 1538oC, conducts electricity when solid | |  |
| **C** | White, brittle, melting point of 801oC, conducts electricity when molten | |  |
| **D** | Dull grey, brittle, melting point of 114oC, does not conduct electricity | |  |
|  |  |  | |

Your answer

1. Reactions can involve either physical changes or chemical changes.

Which answer contains **chemical** changes **only**? **[1 mark]**

| **A** | Iron rusting, dissolving sugar in water and fireworks exploding | |  |
| --- | --- | --- | --- |
| **B** | Eggs cooking, methane burning and bread rising | |  |
| **C** | Burning a sugar cube, toasting bread and breaking a test tube | |  |
| **D** | Ice-cream melting, iodine changing colour in the presence of starch and milk going sour | |  |
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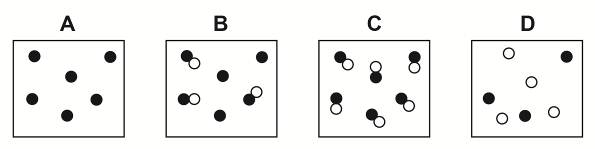
Your answer

1. Which of the statements **A**, **B**, **C** or **D** show the correct order of substances from the smallest to the largest? **[1 mark]**

| **A** | An atom of hydrogen, a molecule of hydrogen gas, a crystal of sodium chloride, a molecule of carbon dioxide | |  |
| --- | --- | --- | --- |
| **B** | A molecule of hydrogen gas, an atom of hydrogen, a crystal of sodium chloride, a molecule of carbon dioxide | |  |
| **C** | A molecule of hydrogen gas, an atom of hydrogen, a molecule of carbon dioxide, a crystal of sodium chloride | |  |
| **D** | An atom of hydrogen, a molecule of hydrogen gas, a molecule of carbon dioxide, a crystal of sodium chloride | |  |
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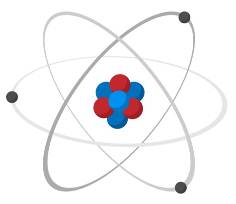
Your answer

1. The diagrams show the particles in four substances.



| **(a)** | **(i)** | Which diagram(s) **A**, **B**, **C** and/or **D** show a ‘pure’ substance in chemical terms? **[1 mark]** |  |
| --- | --- | --- | --- |
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|  | **(ii)** | Why is mineral water not classed as a ‘pure’ substance in chemistry? **[1 mark]** |  |
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|  | **(iii)** | Scientists can use melting point data to distinguish pure from impure substances.  The graph shows the heating curve for a pure substance and an impure substance.  graph  Which substance, **A** or **B**, is an impure substance? Give a reason for your answer. [**2 marks]** |  |
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| **(b)** | **(i)** | Crude oil is a mixture of different substances.  The substances in crude oil can be separated using fractional distillation.  The diagram shows a fractionating column.  Fractioning column  How is crude oil separated into the different fractions? **[4 marks]** |  |
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|  | **(ii)** | How is fraction 1 different to fraction 6? **[4 marks]** |  |
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| **(c)** | **(i)** | Many useful materials, particularly metals are formulations of mixtures.  What name do we give a substance such as brass and bronze that is a mixture of elements, at least one being a metal? **[1 mark]** |  |
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|  | **(ii)** | Mild steel is made by adding up to 0.25% carbon to iron.  Mild steel is more suitable than iron when building bridges, car bodies and ships.  What properties does mild steel have as a result of adding carbon that makes it more suitable for these structural purposes? **[2 marks]** |  |
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|  | **(iii)** | Iron can also be mixed with chromium and nickel to make stainless steel.  Stainless steel is often used to make cutlery (knives, forks and spoons).  What property does the stainless steel have that iron does not, allowing it to be used as cutlery? **[1 mark]** |  |
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1. The image is a diagrammatic representation of an atom.



| **(a)** | **(i)** | An atom of an element is made up of electrons, protons and another sub-atomic particle. What is this other sub-atomic particle? **[1 mark]** |  |
| --- | --- | --- | --- |
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|  | **(ii)** | Where in the atom is this sub-atomic particle found? **[1 mark]** |  |
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| **(b)** | **(i)** | Draw the electron configuration of a potassium atom on the diagram below.  Use the periodic table to help. **[2 marks]** |  |
|  |  | Electron configuration diagram |  |
|  |  |  |  |
|  | **(ii)** | Potassium reacts with chlorine to form the ionic compound potassium chloride. How does this happen? **[5 marks]** |  |
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| **(c)** | **(i)** | Sodium can also react with chlorine to make the ionic compound sodium chloride.  Sodium chloride molecule  Sodium chloride has a high melting point of 801oC and conducts electricity when molten.  A chlorine atom can also react with another chlorine atom to form chlorine gas.  Chlorine atom  Chlorine gas has a low melting point of -101.5oC and does not conduct electricity at all.  Both compounds contain chlorine but sodium chloride has a high melting point and chlorine gas has a low melting point.  Why is this? **[5 marks]** |  |

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|  | **(i)** | Why does sodium chloride conduct electricity when molten or dissolved in solution but chlorine gas does not? **[2 marks]** |  |
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1. Water, H20, can be found in three states, solid ice, liquid water and steam.



**A**

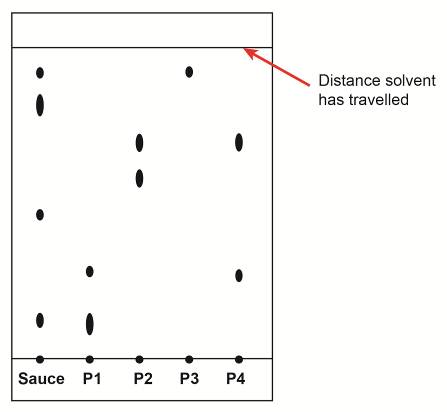
| **(a)** | **(i)** | What is the process labelled **A** on the diagram? **[1 mark]** |  |
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|  | **(ii)** | What are the differences in particles in water compared with particles in steam? **[2 marks]** |  |
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| **(b)** | **(i)** | Melting ice is an example of a physical change.  What are the differences between physical changes and chemical changes? **[2 marks]** |  |
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1. The Food Standards Agency has received complaints that the farmer growing tomatoes used in making an organic pasta sauce is using a pesticide that is banned for organic produce.

Scientists from the Food Standards Agency are investigating whether this pasta sauce contains a banned pesticide.

They use thin-layer chromatography (TLC) to separate out the components of the pasta sauce and compare them with four known, banned pesticides: P1, P2, P3 and P4.

The chromatogram shows their results.



| **(a)** |  | What is used as the stationary phase in thin-layer chromatography? **[1 mark]** |  |
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| **(b)** | **(i)** | Does the pasta sauce contain a banned pesticide? Give a reason for your answer. **[2 marks]** | |
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|  | **(ii)** | Which **two** other conclusions can be drawn from the chromatogram of the pasta sauce and the pesticides? **[2 marks]** |  |
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|  | **(iii)** | The distance travelled by the solvent is 14cm.  The distance moved by the ‘spot’ for pesticide P3 is 12.6cm.  What is the Rf value for this ‘spot’? **[2 marks]** |  |
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| **(c)** |  | Which **two** properties of the sauce and pesticides will affect the speed they separate up the chromatogram? **[2 marks]** |  |
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1. The diagram shows the atomic number and mass number of two isotopes of carbon.



| **(a)** | **(i)** | What are the similarities and differences between the two isotopes? **[3 marks]** |  |
| --- | --- | --- | --- |
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| **(b)** | carbon atoms arrangement A**(i)** | Carbon atoms can be arranged to form different giant covalent structures such as diamond, graphite and buckminsterfullerene.  The diagrams show the arrangement of carbon atoms in these three substances.  **A B C**  carbon atoms arrangement B  carbon atoms arrangement C  Which diagram **A**, **B** or **C** shows the arrangement of carbon in diamond? **[1 mark]** |  |
|  |  |  |  |
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|  | **(ii)** | Which diagram shows the arrangement of carbon in buckminsterfullerene? **[1 mark]** |  |
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|  | **(iii)** | Diamond is often used on drill bits to cut through rock when drilling for oil.  What property makes diamond a suitable material for this and how does diamond’s structure give diamond this property? **[2 marks]** |  |
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|  | **(iv)** | Graphite powder is often used as a lubricant and as ‘lead’ in pencils.  How does the structure of graphite make it suitable for these uses?  **[2 marks]** |  |
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|  | **(v)** | Why can graphite conduct electricity? **[1 mark]** |  |
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|  | **(vi)** | Buckminsterfullerene can be used to make tennis rackets.  What **two** properties does buckminsterfullerene have that makes it suitable for this use? **[1 mark]** |  |
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|  | **(vii)** | There is another form of carbon that takes the form of a single sheet of carbon atoms, one atom thick.  What is the name given to this form of carbon? **[1 mark]** |  |
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1. An atom is the basic unit of an element.

Scientists have refined their ideas about the structure of atoms over time.

In the 1800s, the English chemist, John Dalton believed atoms were the smallest particles and that everything on Earth was made up of them. He believed they could not be broken down into anything simpler and that atoms of a particular element were all the same.

In 1904, Physicist Sir J.J. Thomson refined Dalton’s atomic model and described what was called a ‘plum-pudding’ model of the atom.

| **(a)** |  | What is JJ Thomson’s ‘plum-pudding’ model of the atom? **[1 mark]** |  |
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| **(b)** |  | In 1911, Ernest Rutherford designed an experiment that was carried out by his students, Geiger and Marsden.  They passed positively charged alpha particles through very thin gold leaf.  They found:   1. Most of the alpha particles passed straight through the gold leaf. 2. A small fraction of the alpha particles were deflected at all angles, some bouncing back towards the source of alpha particles.   How did Rutherford change J.J. Thomson’s atomic model based on these findings? **[2 marks]** |  |
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| **(c)** | Electron configuration | In 1913, Niels Bohr changed Rutherford’s atomic model further by suggesting electrons orbit a nucleus in shells of differing energy levels.  The diagrams show the electron configuration of five atoms based on Bohr’s idea.  **A**  **E**  **D**  **C**  **B** |  |
|  | **(i)** | Which atom **A**, **B**, **C**, **D** or **E** shows an element in group 3 of the periodic table? Justify your answer. **[2 marks]** |  |
|  |  |  |  |
|  |  |  |  |
|  | **(ii)** | All of the atoms in the diagram above are of elements in the same period of the periodic table.  Which period can they be found in? Justify your answer. **[2 marks]** |  |
|  |  |  |  |
|  |  |  |  |
|  | **(iii)** | Which of the diagrams **A**, **B**, **C**, **D** and **E** show an atom of a metal? **[1 mark]** |  |
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|  | **(iv)** | Metals have different physical properties to non-metals.  For example metals have high melting and boiling points whereas non-metals tend to have lower melting and boiling points.  What are **three** differences in the physical properties of metals and non-metals? **[3 marks]** |  |

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1. A scientist in a pharmaceutical company has an impure white substance that he wants to purify. The impurities are insoluble in ethanol.

He starts by dissolving the substance in ethanol.

| **(a)** | **(i)** | What are the techniques he would use to separate the impurities from the pure substance **and** describe a method he could use to do this? **[6 marks]** |  |
| --- | --- | --- | --- |
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|  |  |  |  |
|  | **(ii)** | Why is it important to control the purity of chemicals in the pharmaceutical sector? **[2 marks]** |  |
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