

BioMedical Admissions Test (BMAT)

Section 2: Chemistry

Questions by Topic

C2 - The Periodic Table

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C2: The Periodic Table - Question by Topic

(Mark Scheme and explanations at the end)

1 The following statements are about the chemical bonding, structure and properties.

- 1 Pure substances contain many elements/compounds.
- 2 Only one type of atom is present in an element.
- 3 More than one element or compound are present in mixtures.
- 4 Elements can be decomposed into simpler substances.
- 5 Different elements are bonded together in a compound.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 2, 3 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 2, 3 and 5
- F 2 and 4
- G 1 and 2
- H 2 and 5

2 The following statements are about chemical bonding, structure and properties.

- 1 All the noble gases have a full outermost shell.
- 2 All compounds are formed by transferring electrons.
- 3 When atoms form compounds they have full outer shells.
- 4 Metal atoms gain electrons to form compounds.
- 5 NaCl is a compound.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 2, 3 and 5
- C 1, 2 and 4
- D 1, 3 and 5
- E 1, 2 and 5
- F 2 and 4
- G 1 and 2
- H 2 and 5





3 The following statements are about chemical bonding, structure and properties.

- 1 Ionic compounds are formed through the transfer of electrons.
- 2 Ionic compounds form a giant lattice of positive ions.
- 3 Strong electrostatic forces are present in ionic compounds.
- 4 Non-metals react by sharing electrons.
- 5 Covalent bonds are formed when non-metals react.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 3, 4 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 1, 2 and 5
- F 2 and 4
- G 1 and 2
- H 2 and 5

4 The following statements are about chemical bonding, structure and properties.

- 1 Ions formed from the transfer of electrons have the configuration of a noble gas.
- 2 Group 1 atoms form ions with a 1+ charge.
- 3 Group 16 atoms form ions with a 2+ charge.
- 4 Group 2 atoms form ions with a 2+ charge.
- 5 Aluminium atoms form an ion with 1+ charge.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 3, 4 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 1, 2 and 4
- F 2 and 4
- G 1 and 2
- H 2 and 5





5 The following statements are about chemical bonding, structure and properties.

- 1 In an ionic compound the positive and negative charges must balance out.
- 2 Iron (III) bromide has the formula FeBr_2 .
- 3 At room temperature ionic compounds are generally solids.
- 4 Ionic compound lattices are irregular structures.
- 5 Ionic compounds have low melting points.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 3, 4 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 1, 2 and 4
- F 2 and 4
- G 1 and 3
- H 2 and 5

6 The following statements are about chemical bonding, structure and properties.

- 1 Ionic compounds always conduct electricity.
- 2 Solutions of ionic compounds conduct electricity.
- 3 H_2S is an ionic compound.
- 4 Iron (III) is present in FeO .
- 5 Li_2S is the formula of lithium sulphide.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 3, 4 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 1, 2 and 4
- F 2 and 4
- G 1 and 3
- H 2 and 5





- 7 The following statements are about chemical bonding, structure and properties. Beryllium (Be) is a metal and bromide (Br) is a non-metal. A beryllium ion has a charge of +2 with an oxidation state of 2+ and bromide ion has a charge of -1.

What is the formula of the ionic compound beryllium bromide?

- A BeBr
- B Be₂Br
- C BeBr₂
- D BeBr₃

- 8 The following statements are about chemical bonding, structure and properties.

- 1 When non-metals react they both lose electrons.
- 2 Covalent bonds are formed between two atoms when electrons are shared.
- 3 There are many molecules present in most covalent substances.
- 4 Molecular substances have high melting points and low boiling points.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 3 and 4
- C 1, 2 and 4
- D 1 and 3
- E 1 and 4
- F 2 and 3





9 The following statements are about chemical bonding, structure and properties.

- 1 Molecular substances conduct electricity when liquid.
- 2 Giant covalent structures have high melting and boiling points.
- 3 Graphite has a single, giant lattice.
- 4 Graphite conducts electricity.
- 5 Diamond is hard due to the strong covalent bonds.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 3, 4 and 5
- C 2, 4 and 5
- D 1, 3 and 4
- E 2, 3 and 4
- F 2 and 3
- G 1 and 3
- H 2 and 5

10 The following statements are about chemical bonding, structure and properties.

- 1 The outer electrons are delocalised only in solid metals.
- 2 All the ions in a metal lattice are positive.
- 3 Metals are malleable.
- 4 Most metals have low melting points.
- 5 Metals conduct electricity.

Which of these statements are correct?

- A 1, 2, 3 and 5
- B 1, 3, 4 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 2, 3 and 4
- F 2 and 3
- G 1 and 4
- H 2 and 5





11 Which of the following atoms and ions have the same number of electrons?

- 1 ${}^6_{12}\text{C}$
- 2 ${}^{16}_{32}\text{S}^{2-}$
- 3 ${}^8_{16}\text{O}^{2-}$
- 4 ${}^{14}_{28}\text{Si}$
- 5 ${}^{18}_{40}\text{Ar}$

- A 1 only
- B 1, 2 and 4 only
- C 1 and 2 only
- D 5 only
- E 1, 2 and 4 only
- F 4 and 5 only
- G 2 and 5 only

12 The metal uranium has many isotopes, including uranium-232, uranium-233, uranium-234, and uranium-235, which is used in nuclear reactors.

Which of the above isotopes contains the same number of protons as the element Americium?

- A Uranium-232
- B Uranium-233
- C Uranium-234
- D Uranium-235
- E None of the above





- 13 Displacement reactions can occur when a more reactive halogen reacts with a less reactive halogen in a metal halide compound.

In which of the following cases would a displacement reaction not occur?

| | Halogen | Metal halide |
|---|----------|-----------------|
| 1 | Chlorine | Sodium bromide |
| 2 | Chlorine | Sodium iodide |
| 3 | Bromine | Sodium chloride |
| 4 | Bromine | Sodium iodide |
| 5 | Iodine | Sodium chloride |
| 6 | Iodine | Sodium bromide |

- A 1, 2 and 3
B 1, 3 and 6
C 2, 3 and 4
D 2, 4 and 5
E 3, 4 and 5
F 3, 5 and 6
G 4, 5 and 6





Answers and Explanations

1 The correct answer is E

- 1 is incorrect - this is because **pure substances** contain only **one element or compound**, not many.
- 2 **is correct** - it is true that an **element** will only contain **one type of atom**.
- 3 **is correct** - it is true that a **mixture** will contain **one or more types of element or compound**. E.g. **air** includes oxygen, nitrogen, argon etc.
- 4 is incorrect - this is because **elements cannot be decomposed into simpler substances** by chemical methods.
- 5 **is correct** - it is true that a **compound** is made by **different elements** being **bonded together**.

Since 2, 3 and 5 are the correct statements, **E** must be the correct answer.

2 The correct answer is D

- 1 **is correct** - it is true that all the **noble gases have a full outermost shell**. E.g. neon (2,8) or argon (2,8,8).
- 2 is incorrect - it is true that some compounds are formed by **transferring electrons** e.g. ionic compounds. However not all compounds are formed by transferring electrons. Some elements react and form compounds by **sharing electrons**.
- 3 **is correct** - it is true that when atoms form compounds they **gain a full outer shell**, by either **sharing or transferring electrons**.
- 4 is incorrect - this is because **metal atoms** often **lose electrons** in order to **form compounds**.
- 5 **is correct** - it is true that **NaCl is a compound**. Na (sodium) atoms react with Cl (chlorine) atoms. This occurs through a transfer of electrons, as Na **transfers one electron** to Cl. Both the Na⁺ ions and Cl⁻ ions in NaCl have full outer shells.

Since 1, 3 and 5 are the only correct statements, **D** must be the correct answer.





3 The correct answer is B

- 1 is correct** - it is true that **ionic compounds** are formed by the **transfer of electrons**. The atoms transfer electrons. This occurs when **metals and non-metals react**. The non-metals atoms that gain electrons have a negative charge, and the metal atoms that lose electrons have a positive charge.
- 2 is incorrect** - it is true that ionic compounds form a **giant lattice**, however this lattice is made up of **positive and negative ions**, not only positive ions.
- 3 is correct** - it is true that there are **strong electrostatic forces** that are present in the giant **lattices** that **ionic compounds** form. These forces are between the **positive and negative ions**, which is known as **ionic bonding**.
- 4 is correct** - it is true that **non-metals** react with each other by **sharing electrons**. **Molecules** are formed when the atoms of nonmetals share electrons.
- 5 is correct** - it's true that **covalent bonds** are formed when **nonmetals react** with each other.

Since **1, 3, 4** and **5** are the only correct statements, **B** must be the correct answer.

4 The correct answer is C

- 1 is correct** - the transfer of electrons involves an atom **gaining electrons** and the other atom **losing its electrons**. The ions that are formed from this transfer of electrons have a **full outermost shell**, this means they have the **configuration of noble gases**. This is because noble gases have a full outer shell of electrons.
- 2 is correct** - it is true that atoms that are in **group 1** form **ions with a 1+ charge**. This is because group one atoms need to **lose one electron** in order to **gain a full outer shell**, therefore group one ions have a 1+ charge.
- 3 is incorrect** - this is because **group 16 atoms** form ions that have a **2- charge** not 2+. Atoms in group 16 require **2 electrons** in order to gain a **full outer shell**, therefore when they form ions they have a 2- charge.
- 4 is correct** - it is true that **group 2 atoms** form ions that have a **2+ charge**. This is because group 2 atoms need to **lose 2 electrons** in order to form an ion with a **full outer shell**, this means they have a 2+ charge.
- 5 is incorrect** - this is because aluminium is in group 13, therefore it forms an **ion with a 3+ charge**. Group 3 atoms need to **lose three electrons** in order to form ions with a **full outer shell**, this means they will have 3+ charge.

Since **1, 2** and **4** are the only correct statements, **C** must be the correct answer.





5 The correct answer is G

- 1 **is correct** - it is true that the **positive and negative charges** in an ionic compound must **balance out**, this means that the overall ionic compound has **no charge**.
- 2 is incorrect - this is because the compound **iron (III) bromide** has the formula **FeBr₃**. The ion iron (III) has a **3+ charge** therefore **3 Br ions (Br⁻)** will be required. This is because an **ionic compound has no charge**, therefore the positive and negative charges need to be balanced out. Three Br⁻ ions will balance out the 3+ charge of iron (III).
- 3 **is correct** - it is true that ionic compounds at **room temperature** are generally **solids**.
- 4 is incorrect - it is true that ionic compounds form **lattices**, however they are of a **regular structure** not an irregular structure. Ionic compound lattices are **big** and **continuous**.
- 5 is incorrect - this is because ionic compounds have **high melting points**, not low. Ionic compounds have **strong electrostatic forces** of attraction between the positive and negative ions, this requires a **lot of energy** to break the forces of attraction in order to melt the ionic compounds. Therefore they have high melting points.

Since 1 and 3 are the only correct statements, **G** must be the correct answer.

6 The correct answer is H

- 1 is incorrect - this is because ionic compounds **do not conduct electricity when solid** as the ions are in fixed positions, this means they cannot carry a charge.
- 2 **is correct- solutions of ionic compounds can conduct electricity** as the ions are no longer in fixed positions like in a solid. The ions are **free to move**, therefore they can carry a charge. The argument is the same for molten ionic compounds.
- 3 is incorrect- H₂S is not an ionic compound as both Sulfur and Hydrogen are non metals and it is bonded by the sharing of electrons, this is **covalent bonding** not ionic bonding.
- 4 is incorrect - oxygen is in group 16 of the periodic table, this means it needs to gain two electrons to gain a full outer shell. As the charge of an ion is the same as the number of electrons gained oxygen will be a 2- ion. As **ionic compounds have an overall charge of zero**, the iron must have a 2+ charge, so iron is Fe(II) in this compound.
- 5 **is correct-** Lithium forms a 1+ ion as it is in group 1 of the periodic table, sulfur forms a 2- ion as it is in group 16 of the periodic table. They form these ions to gain a full outer shell of electrons. As an ionic compound has an overall charge of zero, the compound forms with two lithium ions and one sulfur ion, Li₂S.

Since 2 and 5 are correct statements, **H** must be the correct answer.





7 **The correct answer is C**

- A** is incorrect- Ionic compounds always have an overall charge of zero, Be has the charge 2+ and Br has the charge 1- . The compound BeBr would have an overall charge of +1 (2-1).
- B** is incorrect- Ionic compounds always have an overall charge of zero, Be has the charge 2+ and Br has the charge 1- . The compound Be₂Br would have a charge of +3 (2(+2)-1).
- C** **is correct**- Ionic compounds always have an overall charge of zero, Be has the charge 2+ and Br has the charge 1- . The compound BeBr₂ would have a charge of 0 (2+2(-1)).
- D** is incorrect- Ionic compounds always have an overall charge of zero, Be has the charge 2+ and Br has the charge 1- . The compound BeBr₃ would have a charge of -1 (2+3(-1)).

Since **A**, **B** and **D** are incorrect statements, **C** must be the correct answer.

8 **The correct answer is F**

- 1** is incorrect - non metals need to **gain electrons** to achieve a full outer shell, as they are on the right hand side of the periodic table.
- 2** **is correct**- a covalent bond is formed by the **attraction** of the nucleus of two atoms to a shared pair of electrons.
- 3** **is correct**- most covalent substances are simple molecular structures, and some are giant covalent structures like diamond or graphite. Simple molecular covalent structures are made up of lots of small molecules.
- 4** is incorrect - molecular substances have **low melting and low boiling points** as there are weak intermolecular forces which are easy to overcome so they can be easily boiled.

Since **2** and **3** are the only correct statements, **F** must be the correct answer.





9 The correct answer is C

- 1 is incorrect - molecular substances have no delocalised/free electrons or ions that can carry a charge so they cannot conduct electricity. Ionic structures however can conduct electricity when molten or aqueous, as the ions in a liquid are free to move and carry a charge.
- 2 **is correct**- Giant covalent structures have strong covalent bonds between atoms, these bonds require a lot of energy to overcome. Therefore giant covalent structures have high melting and boiling points.
- 3 is incorrect - each carbon atom in graphite is covalently bonded to three other carbon atoms. These are arranged in a flat honeycomb formation, these flat structures are layered on top of each other to form graphite. So graphite is not one single giant lattice, it is lots of smaller giant lattices layered on top of each other.
- 4 **is correct** - each carbon atom in graphite is covalently bonded to three other carbon atoms. These are arranged in a flat honeycomb formation, these flat structures are layered on top of each other to form graphite. As each carbon is only bonded to three other carbons (normally 4) there is one electron not bonded. This becomes a delocalised/free electron and can move between the layers. This free electron can move and carry a charge, making graphite able to carry a charge.
- 5 **is correct**- Diamond is a very hard material, this is due to the strong covalent bonds between each carbon atom. These are very hard to break.

Since 2, 4 and 5 are correct statements, C must be the correct answer.





10 The correct answer is A

- 1 **is correct** - metallic bonds form due to the **electrostatic attraction between the positive metal ions and a sea of delocalised electrons**. Only the outer electrons become able to move across the whole metallic structure and are no longer attracted to a single atom
- 2 **is correct** - metallic bonds form due to the electrostatic attraction between the positive metal ions and a sea of delocalised electrons. **Metals form positively charged ions** as they need to lose electrons to form a full outer shell of electrons, this means they have more protons than electrons.
- 3 **is correct** - metals are malleable as the positive ions in a metallic structure form linear **layers** which can slide over each other when the metal is hammered or bent.
- 4 is incorrect - metals have high melting points as there is a strong electrostatic attraction between the positive metal ions and the delocalised electrons. This attraction is hard to overcome therefore the melting points are high.
- 5 **is correct** - to conduct electricity there needs to be either electrons or ions which are free to carry a charge. **Metallic structures have delocalised electrons** that can do this, so they can conduct electricity.

Since 1, 2, 3 and 5 are correct statements, **A** must be the correct answer.

Exam Tip - it is essential to know the rules for electron configuration which apply to the first 20 elements in the periodic table.

- 1st shell maximum number of electrons: 2
- 2nd shell maximum number of electrons: 8
- 3rd shell maximum number of electrons: 8
- Commas are used to separate the number of electrons in each shell, when writing the electron configuration.

11 The answer is G

- 1 has 6 electrons (proton number 6, no charge)
- 2 **has 18 electrons** (proton number 16, 2- charge)
- 3 has 10 electrons (proton number 8, 2- charge)
- 4 has 14 electrons (proton number 14, no charge)
- 5 **has 18 electrons** (proton number 18, no charge)

Hence **2 and 5** both have 18 electrons.



12 **The answer is E** - None of the above.

Recall that an element is defined by its atomic number (the number of protons present in the nucleus of an atom of that element). If two atoms had the same number of protons, they would be atoms of the same element. Only the number of neutrons (changing mass number) and number of electrons (changing charge) can differ if the element is to remain the same.

13 **The correct answer is F**

In **1**, **2** and **4**, the more reactive halogen will replace the less reactive halogen in the compound. However, in **3**, **5** and **6**, the most reactive halogen is already part of the compound with sodium, so no displacement reaction will occur. See the table below for details of each reaction.

| | Halogen | Metal halide | The most reactive halogen | Reaction |
|---|----------|-----------------|---------------------------|---|
| 1 | Chlorine | Sodium bromide | Chlorine | Chlorine + sodium bromide → sodium chloride + bromine |
| 2 | Chlorine | Sodium iodide | Chlorine | Chlorine + sodium iodide → sodium chloride + iodine |
| 3 | Bromine | Sodium chloride | Chlorine | No reaction |
| 4 | Bromine | Sodium iodide | Bromine | Bromine + sodium iodide → sodium bromide + iodine |
| 5 | Iodine | Sodium chloride | Chlorine | No reaction |
| 6 | Iodine | Sodium bromide | Bromine | No reaction |

Exam Tip - For halogen displacement reactions, remember that the **reactivity of the halogens decreases as you move down the group** (group 7). This is in contrast to group 1, where reactivity **INCREASES** as you go down the group. It will help you to remember this pair of facts, as you may confront similar questions relating to either group 1 or group 7.

