

Covalent Bonding Mark Scheme

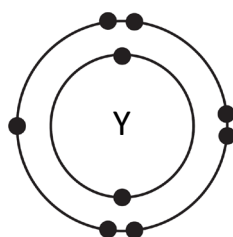


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1. Covalent bonding occurs when two non-metal atoms share pairs of electrons in order to achieve a stable, full outer shell. Circle the letter of the correct answer for each of the following questions.

a. Element Y is in Group 7 of the periodic table.

Which statement describes how an atom of Element Y forms a stable covalent bond?

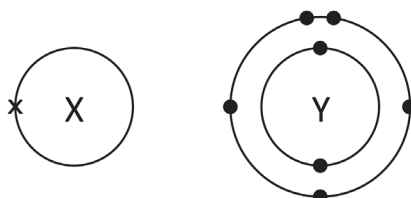


C – is the only correct answer.	(1)
	Total: 1 mark

b. Which statement about the bonding in a molecule of ammonia (NH_3) is not correct?

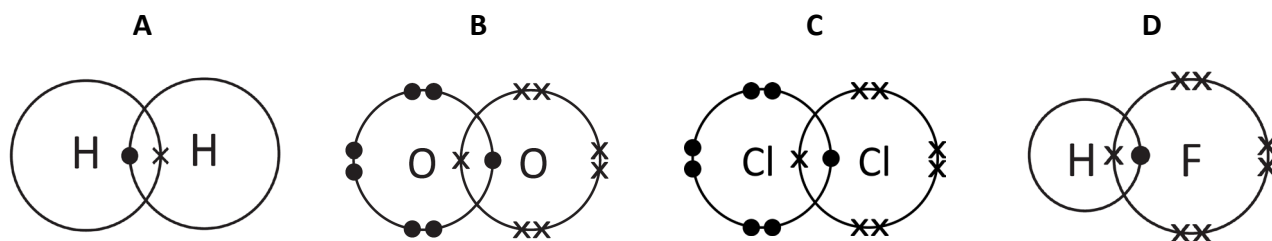
C – is the only correct answer.	(1)
	Total: 1 mark

c. Element X has 1 electron in its outer shell. Element Y is in Group 5 of the periodic table. When they react to form a covalent compound, what is the correct formula?



C – is the only correct answer.	(1)
	Total: 1 mark

d. Which diagram does **not** show the outer shell electrons in the molecule correctly?



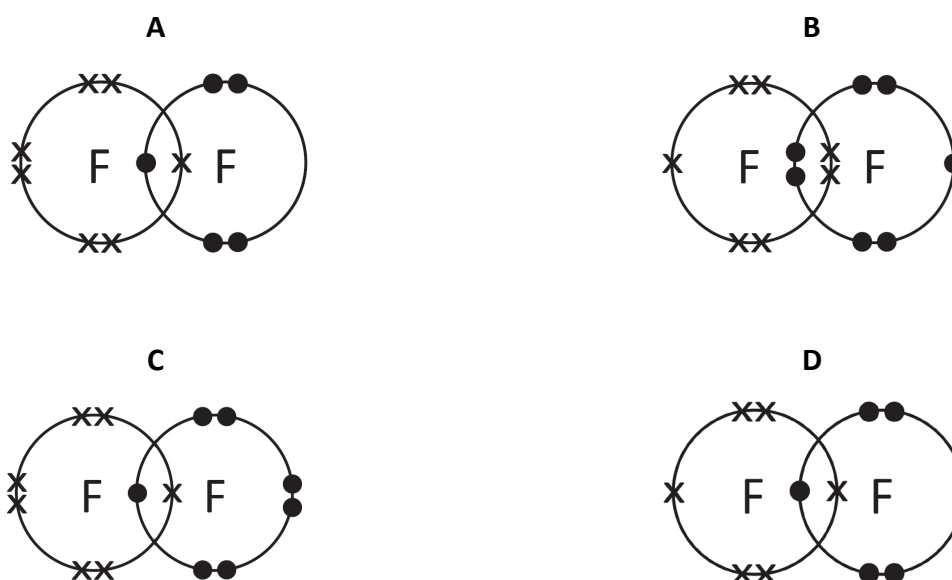
B – is the only correct answer.

(1)

Total: 1 mark

e. Fluorine, F_2 , is in group 7 of the Periodic Table.

Which diagram shows the correct arrangement of the outer-shell electrons in a molecule of fluorine?



C – is the only correct answer.

(1)

Total: 1 mark

f. Element **X** has 4 electrons in its outer shell. Element **Y** has 1 electron in its outer shell. They react to form a covalent compound with the formula XY_4 .

Which statement about the bonding in this molecule is **false**.

D – is the only correct answer.

(1)

Total: 1 mark

(Total for Question 1 is 6 marks)

2. Nitrogen is a non-metal. Unlike metals, it is a poor conductor of electricity.
- a. Describe **two** additional physical differences you would expect to see between Nitrogen and a typical metal.

A description to include any two from:	
- Nitrogen has a lower melting point / boiling point. - Nitrogen has a lower density. - Nitrogen is a gas (at room temperature). - Nitrogen is a poor conductor of thermal energy / heat. - Nitrogen is dull / not shiny. - Nitrogen is brittle / not malleable.	
	Total: 2 marks

- b. Ammonia contains nitrogen. Ammonia is a simple molecule with covalent bonds.

Describe a covalent bond.

A description to include:	
atoms share (electrons).	(1)
a pair of electrons.	(1)
Allow reference to two electrons. Note: "Shared pair of electrons" scores 2 marks.	
	Total: 2 marks

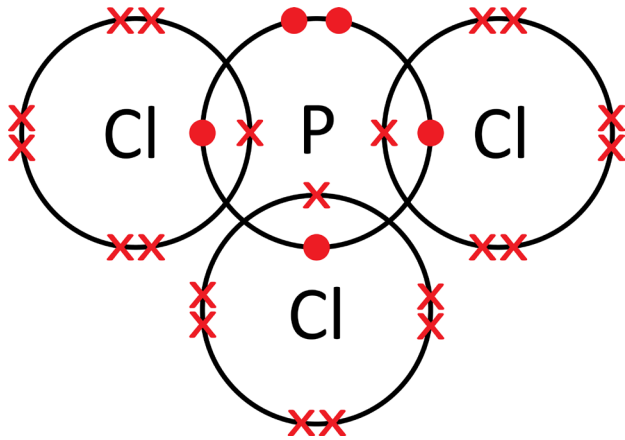
- c. Complete the figure below to show the dot and cross diagram for a molecule of ammonia.
Show outer shell electrons only.

Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct spread of electrons between the atoms.	(1)
Award 1 mark for the lone or unbonded pair of electrons on the nitrogen atom.	(1)
	Total: 2 marks

(Total for Question 2 is 6 marks)

3. Phosphorus is in Group 5 of the periodic table. Chlorine is in Group 7.

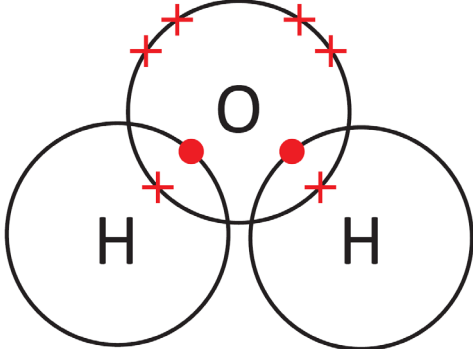
Phosphorus reacts with chlorine to form the covalent compound phosphorus trichloride (PCl_3). Complete the **dot and cross diagram** to show the electron arrangement in a molecule of PCl_3 . Show outer shell electrons only.

 Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct spread of electrons between the atoms.	(1)
Award 1 mark for the lone or unbonded pair of electrons on the phosphorus atom.	(1)
	Total: 2 marks

(Total for Question 3 is 2 marks)

4. Oxygen is in Group 6 of the periodic table. Hydrogen is in Group 1.

Oxygen reacts with hydrogen to form the covalent compound water (H_2O). Complete the **dot and cross diagram** to show the electron arrangement in a molecule of water. Show outer shell electrons only.

 Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct spread of electrons between the atoms.	(1)
Award 1 mark for the lone or unbonded pairs of electrons on the oxygen atom.	(1)
	Total: 2 marks

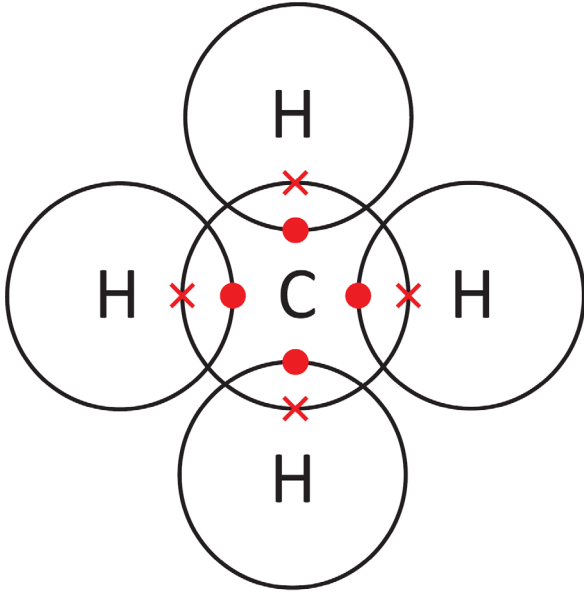
(Total for Question 4 is 2 marks)

5. Carbon is in Group 4 of the periodic table. Hydrogen is in Group 1.

Carbon reacts with hydrogen to form the covalent compound methane (CH_4).

Complete the **dot and cross diagram** to show the electron arrangement in a molecule of methane.

Show outer shell electrons only.

	
Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct spread of electrons between the atoms.	(1)
Award 1 mark for the correct number of electrons on the carbon atom.	(1)
Total: 2 marks	

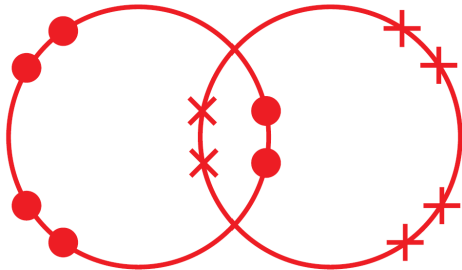
(Total for Question 5 is 2 marks)

6. This question is about covalent bonding in different molecules.

- a) Oxygen (O) is in Group 6 of the periodic table.

Complete the **dot and cross diagram** to show the bonding in a **molecule** of oxygen.

Show outer shell electrons only.

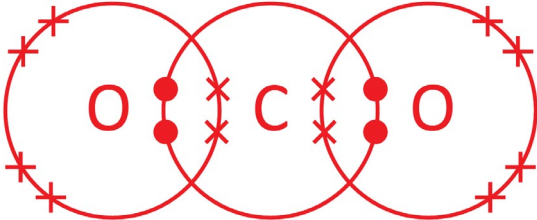
	
Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct number of electrons on each atom.	(1)
Award 1 mark for the correct number of electrons in the double bond – 4 in total.	(1)
Total: 2 marks	

b) Carbon dioxide (CO₂) is a covalent compound.

Carbon is in group 4 of the periodic table and oxygen is in group 6.

Draw the **dot and cross diagram** to show the bonding in a **molecule** of carbon dioxide.

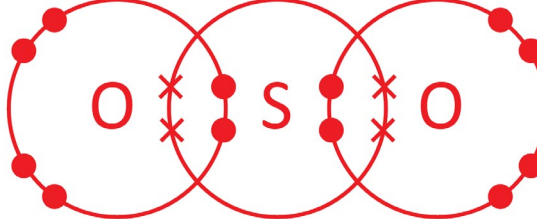
Show outer shell electrons only.

 Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct number of electrons on each atom.	(1)
Award 1 mark for the correct number of electrons in the double bonds – 8 in total.	(1)
	Total: 2 marks

c. Sulfur Dioxide (SO₂). Sulfur and oxygen are both in Group 6.

Draw a **dot and cross diagram** to show the bonding in a **molecule** of sulfur dioxide.

Show outer shell electrons only.

 Note: accept any correct version of this diagram for two marks.	
Award 1 mark for the correct number of electrons on each atom.	(1)
Award 1 mark for the correct number of electrons in the double bonds – 8 in total.	(1)
	Total: 2 marks

(Total for Question 6 is 6 marks)

7. Ethanoic acid is a weak acid found in vinegar. Its formula is CH₃COOH.

a. Ethanoic acid is described as a “**weak**” acid.

Describe what happens to the ethanoic acid molecules when they are dissolved in water.

A description to include the following:	
the molecules ionise / dissociate	(1)
partially / incompletely	(1)
	Total: 2 marks

b. A student reacts ethanoic acid with magnesium metal.

i. State **one** observation that proves a gas is being produced.

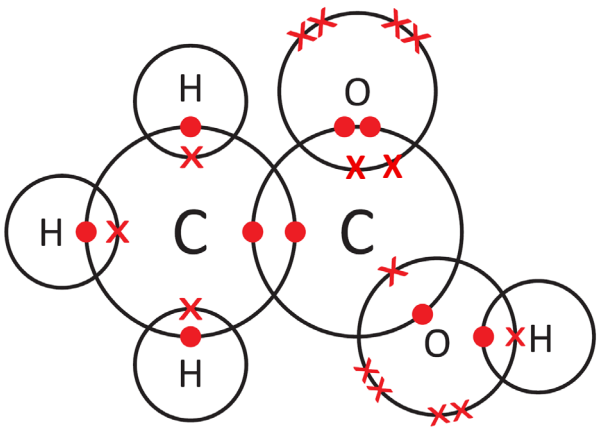
Effervescence / bubbles / fizzing.	(1)
	Total: 1 mark

ii. Complete the balanced symbol equation for this reaction.

$2\text{CH}_3\text{COOH} + \text{Mg} \rightarrow \text{Mg}(\text{CH}_3\text{COO})_2 + \text{H}_2$	
Allow multiples.	
1 mark for the 2 in front of the CH ₃ COOH.	(1)
1 mark for the H ₂ .	(1)
	Total: 2 marks

c. Complete the **dot and cross diagram** to show the electron arrangement in a molecule of ethanoic acid.

The structure has been outlined for you. Show outer shell electrons only.

 Note: accept any correct version of this diagram for three marks.	
Award 1 mark for the correct number of electrons on each atom.	(1)
Award 1 mark for the correct number of electrons shared in each bond.	(1)
Award 1 mark for the correct double bond between the carbon and the oxygen.	(1)
	Total: 3 marks

(Total for Question 7 is 8 marks)