

# GCSE Combined Science: Trilogy

## Worksheet: Covalent bonding

|                       |                          |                              |                                   |
|-----------------------|--------------------------|------------------------------|-----------------------------------|
| TIME<br><b>30 min</b> | TOTAL<br><b>30 marks</b> | CALCULATOR<br><b>Allowed</b> | DIFFICULTY<br><b>Easy, Medium</b> |
|-----------------------|--------------------------|------------------------------|-----------------------------------|

**Topics:** Covalent bonding

|                   |                    |                   |
|-------------------|--------------------|-------------------|
| <b>NAME</b> _____ | <b>CLASS</b> _____ | <b>DATE</b> _____ |
|-------------------|--------------------|-------------------|

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Covalent bonds form between non-metal atoms.

0 1 . 1

What is a covalent bond?

Tick (✓) **one** box.

A shared pair of electrons between two atoms

☐

The attraction between oppositely charged ions

☐

The attraction between positive ions and delocalised electrons

☐

A weak force between molecules

☐

[1 mark]

0 1 . 2

Which substance consists of small molecules?

Tick (✓) **one** box.

Ammonia

☐

Diamond

☐

Poly(ethene)

☐

Sodium chloride

☐

[1 mark]

0 1 . 3

How many covalent bonds are there in one molecule of methane, CH<sub>4</sub>?

---

---

---

[1 mark]

0 1 . 4

Silicon dioxide contains covalent bonds.

What type of structure does silicon dioxide have?

Tick (✓) **one** box.

Giant covalent

☐

Giant ionic

☐

Giant metallic

☐

Small molecules

☐

[1 mark]

0 2

The electronic structure of hydrogen is 1 and the electronic structure of chlorine is 2,8,7. A hydrogen molecule, H<sub>2</sub>, and a hydrogen chloride molecule, HCl, each contain one single covalent bond.

0 2 . 1

Draw a dot and cross diagram for a molecule of hydrogen, H<sub>2</sub>.

---

---

[1 mark]

0 2 . 2

Draw a dot and cross diagram for a molecule of hydrogen chloride, HCl. Show the outer-shell electrons only.

---

---

---

---

[2 marks]

0 3

Some molecules contain double or triple covalent bonds.

0 3 . 1

An oxygen atom has 6 outer electrons.

Explain why there is a double bond in an oxygen molecule,  $O_2$ .

.....

.....

.....

.....

[2 marks]

0 3 . 2

How many electrons are shared between the two atoms in a nitrogen molecule,  $N_2$ ?

.....

.....

.....

[1 mark]

0 3 . 3

Sulfur is in Group 6.

Predict the number of covalent bonds and the number of non-bonding pairs of electrons on the sulfur atom in hydrogen sulfide,  $H_2S$ .

.....

.....

.....

.....

[2 marks]

0 3 . 4

Describe the dot and cross diagram for a chlorine molecule, Cl<sub>2</sub>.

.....

.....

.....

.....

[2 marks]

0 4

Table 1 shows the number of shared pairs of electrons in one molecule of some substances.

Table 1

| Substance                             | Number of shared pairs of electrons |
|---------------------------------------|-------------------------------------|
| Hydrogen chloride, HCl                | 1                                   |
| Water, H <sub>2</sub> O               | 2                                   |
| Ammonia, NH <sub>3</sub>              | 3                                   |
| Ethene, C <sub>2</sub> H <sub>4</sub> | 6                                   |

0 4 . 1

Ethene contains one C=C double bond and four C–H single bonds.  
Explain why one molecule of ethene has 6 shared pairs of electrons.

.....

.....

.....

.....

[2 marks]

0 4 . 2

A nitrogen molecule, N<sub>2</sub>, contains a triple bond.  
How many shared pairs of electrons are there in one nitrogen molecule?

.....

.....

.....

.....  
[1 mark]

0 4 . 3

Explain why an oxygen atom forms two covalent bonds but a hydrogen atom forms only one.

---

---

---

---

[2 marks]

0 5

A teacher shows a class a space-filling model of a water molecule and the displayed formula of water, H–O–H.

0 5 . 1

Give **one** advantage and **one** limitation of the space-filling model compared with the displayed formula.

---

---

---

---

[2 marks]

0 6

The electronic structure of hydrogen is 1, of oxygen is 2,6 and of chlorine is 2,8,7.

0 6 . 1

Draw a dot and cross diagram for a molecule of chlorine, Cl<sub>2</sub>. Show the outer-shell electrons only.

---

---

---

---

[2 marks]

0 6 . 2

Draw a dot and cross diagram for a molecule of water,  $\text{H}_2\text{O}$ . Show the outer-shell electrons only.

.....

.....

.....

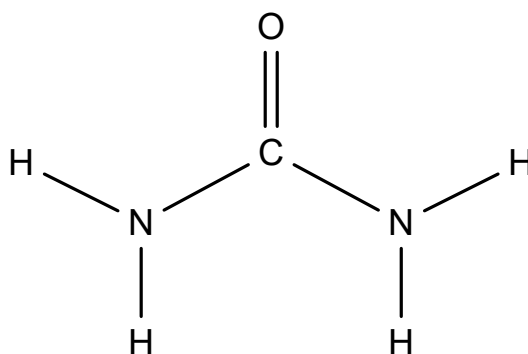
.....

[2 marks]

0 7

Figure 1 shows the displayed formula of urea.

Figure 1



0 7 . 1

Give the molecular formula of urea.

.....

.....

[1 mark]

0 7 . 2

How many pairs of electrons are shared in one molecule of urea?

.....

.....

.....

.....

[1 mark]

0 7 . 3

What is shown by the double line between the carbon atom and the oxygen atom?

---

---

[1 mark]

0 7 . 4

A nitrogen atom has 5 outer electrons.  
How many non-bonding pairs of electrons does each nitrogen atom have in urea?

---

---

---

[1 mark]

0 7 . 5

Give **one** limitation of using a displayed formula to represent a molecule.

---

---

[1 mark]

---

## END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

# Mark scheme

## GCSE Combined Science: Trilogy · Worksheet: Covalent bonding · 30 marks

---

---

### Question 1 (4 marks)

01.1 [1 mark]

**Correct:** A shared pair of electrons between two atoms

---

01.2 [1 mark]

**Correct:** Ammonia

---

01.3 [1 mark]

**Answer:** 4

- 4 (1)
- 

01.4 [1 mark]

**Correct:** Giant covalent

---

---

### Question 2 (3 marks)

02.1 [1 mark]

**Answer:** One shared pair of electrons between the two hydrogen atoms, and no other electrons.

- one pair of electrons shared between the two hydrogen atoms, with no other electrons shown (1)

**Notes:** Any symbols (dots or crosses) may be used for the electrons, and circles for the shells are not required. Ignore inner-shell electrons if drawn correctly. Bonding pairs must be shown between (or in the overlap of) the two atoms they join.

---

02.2 [2 marks]

**Answer:** One shared pair between H and Cl; six more (non-bonding) electrons on chlorine.

- one pair of electrons shared between the hydrogen atom and the chlorine atom (1)
- six more (non-bonding) electrons on the chlorine atom, so chlorine has 8 in its outer shell (1)

**Notes:** Any symbols (dots or crosses) may be used for the electrons, and circles for the shells are not required. Ignore inner-shell electrons if drawn correctly. Bonding pairs must be shown between (or in the overlap of) the two atoms they join.

---

---

### Question 3 (7 marks)

#### 03.1 [2 marks]

**Answer:** Each oxygen atom needs 2 more electrons to fill its outer shell, so the atoms share two pairs of electrons.

- each oxygen atom needs 2 more electrons (to fill its outer shell) (1)
- so the atoms share two pairs of electrons (1)

---

#### 03.2 [1 mark]

**Answer:** 6

- 6 (1)

**Notes:** Do not accept 3.

---

#### 03.3 [2 marks]

**Answer:** 2 covalent bonds and 2 non-bonding pairs

- 2 covalent bonds (1)
- 2 non-bonding pairs (1)

---

#### 03.4 [2 marks]

**Answer:** One pair of electrons is shared (one from each atom); each chlorine atom also has three non-bonding pairs.

- one shared pair of electrons (one electron from each atom) (1)
  - each chlorine atom has three non-bonding pairs / 8 electrons in its outer shell (1)
-

---

## Question 4 (5 marks)

### 04.1 [2 marks]

**Answer:** The double bond contains 2 shared pairs and the four single bonds contain 4, making 6.

- a double bond contains 2 shared pairs of electrons (1)
- 4 C–H bonds contain 4 shared pairs, so  $2 + 4 = 6$  (1)

---

### 04.2 [1 mark]

**Answer:** 3

- 3 (1)

---

### 04.3 [2 marks]

**Answer:** Oxygen has 6 outer electrons and needs 2 more to fill its outer shell; hydrogen has 1 electron and its shell is full with 2.

- an oxygen atom has 6 outer electrons, so it needs to share 2 more electrons to fill its outer shell (1)
- a hydrogen atom has 1 electron and its (first) shell holds only 2, so it needs to share only 1 more (1)

---

## Question 5 (2 marks)

### 05.1 [2 marks]

**Answer:** Advantage: it shows the three-dimensional (bent) shape and the relative sizes of the atoms. Limitation: it does not show the covalent bonds clearly.

- advantage: it shows the 3D shape of the molecule / the relative sizes of the atoms (1)
- limitation: it does not show the covalent bonds (shared pairs) clearly / which atoms are bonded together (1)

**Notes:** Allow for the limitation: it does not show the electrons.

---

---

## Question 6 (4 marks)

### 06.1 [2 marks]

**Answer:** One shared pair between the Cl atoms; six non-bonding electrons on each Cl atom.

- one pair of electrons shared between the two chlorine atoms (1)
- six non-bonding electrons (three pairs) on each chlorine atom (1)

**Notes:** Any symbols (dots or crosses) may be used for the electrons, and circles for the shells are not required. Ignore inner-shell electrons if drawn correctly. Bonding pairs must be shown between (or in the overlap of) the two atoms they join.

---

### 06.2 [2 marks]

**Answer:** Two shared pairs, one between O and each H; four non-bonding electrons (two pairs) on O.

- two shared pairs, one between the oxygen atom and each hydrogen atom (1)
- four non-bonding electrons (two pairs) on the oxygen atom (1)

**Notes:** Any symbols (dots or crosses) may be used for the electrons, and circles for the shells are not required. Ignore inner-shell electrons if drawn correctly. Bonding pairs must be shown between (or in the overlap of) the two atoms they join.

---

---

## Question 7 (5 marks)

07.1 [1 mark]

**Answer:**  $\text{CH}_4\text{N}_2\text{O}$

- $\text{CH}_4\text{N}_2\text{O}$  (1)

**Notes:** Atoms may be in any order. Allow  $\text{CO}(\text{NH}_2)_2$ .

---

07.2 [1 mark]

**Answer:** 8

- 8 (1)
- 

07.3 [1 mark]

**Answer:** A double bond: two shared pairs of electrons.

- a double bond / two shared pairs of electrons (1)
- 

07.4 [1 mark]

**Answer:** 1

- 1 (1)
- 

07.5 [1 mark]

**Answer:** It does not show the three-dimensional shape of the molecule.

- does not show the 3D shape / bond angles / non-bonding electrons / which atom the electrons came from (1)
-