Worksheet 4.1
Electron dot diagrams of molecules

NAME: **CLASS:**

INTRODUCTION

Covalent bonding occurs between non-metal atoms and involves the sharing of one or more electrons between these atoms to (generally) ensure that each atom shares eight outer-shell electrons (octet rule). Multiple bonds may be formed to ensure that the octet rule is met. Electron dot diagrams can be used to represent molecules.

No.	Question	Answer
1	Complete the table below by placing a tick in the relevant column to indicate the type or types of bonding exhibited by each substance:	

Substance	Ionic	Covalent	Metallic
Copper			
Oxygen (O_2)			
Ammonia (NH_3)			
Calcium sulfide			
Potassium carbonate			

2	Which of the following list of substances can be accurately described as being composed of molecules? **a** Helium **b** Glucose ($C_6H_{12}O_6$) **c** Brass **d** Nitrogen monoxide **e** Aluminium chloride	
3	Draw electron dot diagrams for the following molecules, and so determine the number of bonding and non-bonding electron pairs in each.	

Molecule	F_2	CO_2	H_2S
Electron dot diagram			
Bonding pairs			
Non-bonding pairs			

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4 Explain why, when carbon combines with hydrogen, the molecules formed have a formula of CH_4 and not CH_3 or CH_5. Include an electron dot diagram in your answer.

5 Draw electron dot diagrams for the following:

H_2O	H_2O_2	OH^-	NO_3^-

6 Choose a substance from the list below to match its description.

- Ethyne (C_2H_2)
- Trichloromethane ($CHCl_3$)
- Sulfur dioxide (SO_2)
- Phosphorus trichloride (PCl_3)

a Contains three single bonds
b Nine lone pairs of electrons
c Contains a double bond
d Contains a triple bond

7 Consider the molecules O_2 and N_2. Which of these two molecules has the:
a longer bond length?
b stronger bond?

8 **a** Draw an electron dot diagram for $CaCO_3$.
b Describe the bonding in this compound.

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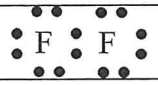
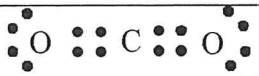
No. | **Answer**

1

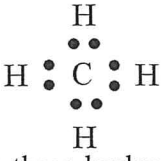
Compound	Ionic	Covalent	Metallic
Copper			•
Oxygen (O_2)		•	
Ammonia (NH_3)		•	
Calcium sulfide	•		
Potassium carbonate	•	•	

2 Only glucose (**b**) and nitrogen monoxide (**d**) are molecules. Helium is monatomic, brass is a metal and aluminium chloride is ionic.

3

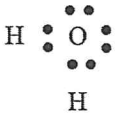
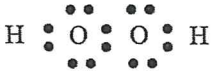
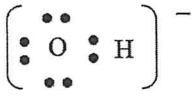
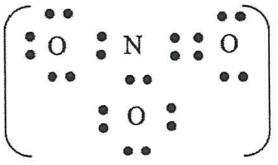
Molecule	F_2	CO_2	H_2S
Electron dot diagram			
Bonding pairs	1	4 (2 double)	2
Non-bonding pairs	6	4	2

4 Carbon has an electron configuration of 2, 4. It will react with other atoms to gain a share of another four electrons to give it eight electrons in its outermost shell. Each hydrogen atom has one electron. Carbon will therefore combine with four hydrogen atoms to gain a share of eight electrons and to form a molecule with the formula of CH_4:



If each carbon atom only combined with three hydrogen atoms, there would only be 7 electrons in the outermost shell of the carbon atom. If the carbon combined with five hydrogen atoms there would be 9 electrons in the outermost shell. The most stable number of electrons in carbon's outer shell is 8 electrons.

5

H_2O	H_2O_2	OH^-	NO_3^-
			

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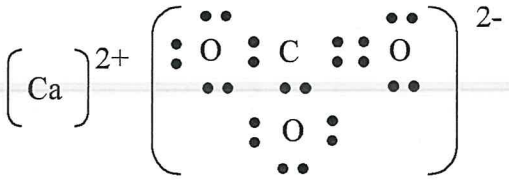
6	**a** phosphorus trichloride **b** trichloromethane **c** sulfur dioxide **d** ethyne
7	**a** O_2, as a double bond is longer than a triple bond. **b** N_2, as a triple bond is stronger than a double bond.
8	**a**  **b** Between the positive calcium ions and the negative carbonate ions there is ionic bonding. Between the carbon atoms and the oxygen atoms in the carbonate ions there is covalent bonding.