AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.2.1 CHEMICAL BONDS: IONIC, COVALENT AND METALLIC (PACK 4)

SCORE	PERCENTAGE
/118	%

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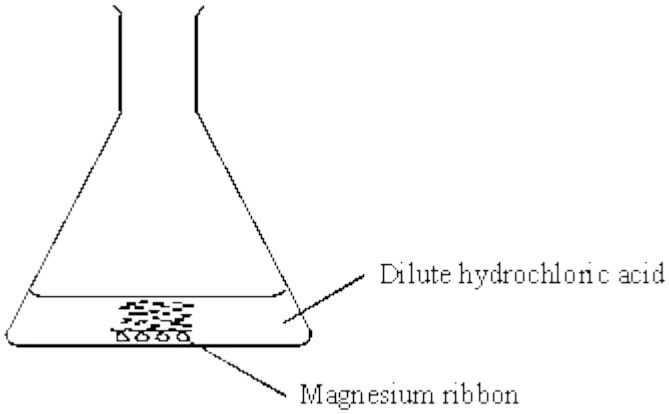
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Q1.

In this question you will need to use the following information:

Relative atomic masses: H 1; O 16; Mg 24. The volume of one mole of any gas is 24 $dm^{>3}$ at room temperature and atmospheric pressure.

The diagram shows a chemical reaction taking place in a conical flask.



The balanced equation for this reaction is:

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

(a) Write a balanced ionic equation for this reaction.

_____

(2)

(b) Calculate the mass of magnesium required to produce 0.50 g of hydrogen.

Show clearly how you work out your final answer and give the unit.

_____

_____

Mass = _____

(2)

(c) (i) Draw a diagram to show how the electrons are arranged in a hydrogen molecule.

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(1)

(ii) What is the name of the type of chemical bond between the hydrogen atoms in a hydrogen molecule?

_____

(1)

(d) The chemical formula for hydrogen peroxide is H_2O_2.

Calculate, to the nearest whole number, the percentage, by mass, of hydrogen in hydrogen peroxide. Show clearly how you work out your answer.

_____

_____

Percentage = _____ %

(2)

(Total 8 marks)

Q2.

(a) Atoms are made of sub-atomic particles. Complete the **six** spaces in the table.

Name of sub-atomic particle	Relative mass	Relative charge
_____	$\frac{1}{1840}$	_____
Neutron	_____	_____
_____	1	_____

(3)

(b) Complete the spaces in the sentences.

(i) The atomic number of an atom is the number of _____ in its nucleus and is equal to the number of _____ if the atom is not charged.

(1)

(ii) The mass number of an atom is the total number of _____ and _____ in its nucleus.

(1)

(c) The table gives information about the atoms of three elements.

		Number of electrons in:

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Name of element	Chemical symbol	1st shell	2nd shell	3rd shell
Fluorine	F	2	7	0
Neon	Ne	2	8	0
Sodium	Na	2	8	1

Two of these elements can react together to form a chemical compound.

(i) What is the name and the formula of this compound?

Name _____ Formula _____

(2)

(ii) What type of bonding holds this compound together?

_____

(1)

(iii) Explain, in terms of electron transfer, how the bonding occurs in this compound.

_____

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

Q3.

The drawing shows a container of a compound called magnesium chloride.



(i) How many elements are joined together to form magnesium chloride?

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_____

(1)

(ii) Magnesium chloride is an ionic compound. What are the names of its ions?

_____ ions and _____ ions

(1)

(iii) How many **negative** ions are there in the formula for magnesium chloride?

_____

(1)

(iv) Complete the sentence.

Ions are atoms, or groups of atoms, which have lost or gained

_____ .

(1)

(v) Suggest **three** properties which magnesium chloride has because it is an ionic compound.

Property 1 _____

_____

Property 2 _____

_____

Property 3 _____

_____

(3)

(Total 7 marks)

Q4.

Part of the Periodic Table showing the symbols for the first twenty elements is given below.



(a) Draw diagrams showing the arrangement of electrons (electronic structures) in:

(i) an aluminium atom;

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(ii) a chlorine atom.

(2)

(b) (i) Use electronic structures to help you show why the formula of sodium oxide is Na_2O.

(3)

(ii) State why the formation of sodium ions is classified as an oxidation.

_____

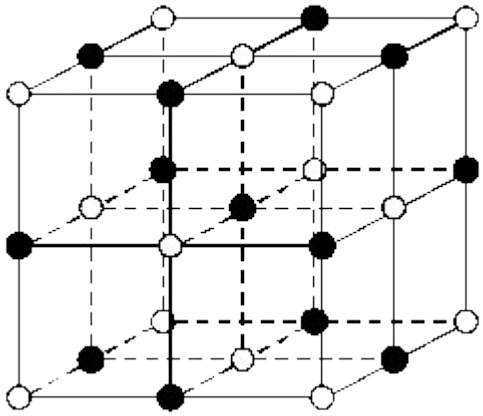
_____

(1)

(Total 6 marks)

Q5.

(a) The diagram shows part of the ionic lattice of a sodium chloride crystal.



(i) Complete the spaces in the table to give information about **both** of the ions in this lattice.

Name of ion	Charge

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_____	_____
_____	_____

(2)

(ii) When it is solid, sodium chloride will not conduct electricity. However, molten sodium chloride will conduct electricity. Explain this difference.

_____

_____

_____

_____

(2)

(iii) Complete the sentence.

Sodium chloride conducts electricity when it is molten and when it is

_____

(1)

(b) The symbol for a calcium atom can be shown like this:

$$^{40}_{20}Ca$$

(i) What is the mass number of this atom?

_____

(1)

(ii) What information is given by the mass number?

_____

_____

(1)

(c) Calcium burns in oxygen with a brick-red flame. The product is a white solid. It is calcium oxide and its formula is CaO.

(i) Balance the chemical equation for the reaction.

$$Ca(s) + O_2(g) \rightarrow CaO(s)$$

(1)

(ii) Describe, in terms of electrons, what happens to a calcium atom when it becomes a calcium ion.

_____

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_____

_____

_____

(2)

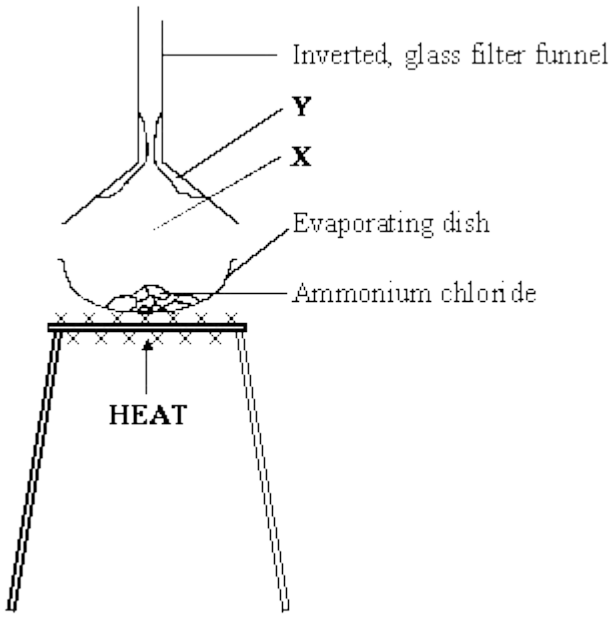
(Total 10 marks)

Q6.

(a) The equation for the reaction that takes place when ammonium chloride is heated is:

$$\underset{\text{ammonium chloride}}{NH_4Cl(s)} \rightleftharpoons \underset{\text{ammonia}}{NH_3(g)} + \underset{\text{hydrogen chloride}}{HCl\ (g)}$$

The diagram shows how a teacher demonstrated this reaction. The demonstration was carried out in a fume cupboard.



(i) Apart from the gases normally in the atmosphere, which two gases would be at **X**?

_____ and _____

(1)

(ii) Name the white solid that has formed at **Y**.

_____

(1)

(iii) Why was the demonstration carried out in a fume cupboard?

_____

_____

(1)

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(iv) Complete the **four** spaces in the passage.

The chemical formula of ammonia is NH_3. This shows that there is one atom of _____ and three atoms of _____ in each _____ of ammonia. These atoms are joined by bonds that are formed by sharing pairs of electrons. This type of bond is called a _____ bond.

(4)

(b) Electrons, neutrons and protons are sub-atomic particles.

(i) Complete the **three** spaces in the table.

Name of sub-atomic particle	Relative mass	Relative charge
_____	1	+1
_____	1	0
_____	$\frac{1}{1840}$	–1

(2)

(ii) Which **two** sub-atomic particles are in the nucleus of an atom?

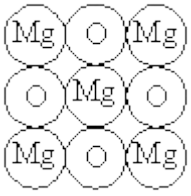
_____ and _____

(1)

(Total 10 marks)

Q7.

Magnesium oxide is a compound, made up of magnesium ions and oxide ions.



(a) What is the charge on each magnesium ion? _____

(1)

(b) Explain how the magnesium ions get this charge.

_____

_____

_____

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(2)
(Total 3 marks)

Q8.

(a) By reference to their structure, explain how the particles in a piece of metal are held together and how the shape of the metal can be changed without it breaking.

(You may use a diagram in your answer.)

(5)

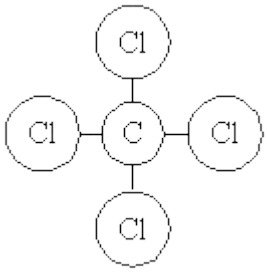
(b) Explain why metals are good conductors of electricity and suggest why this conductivity increases across the periodic table from sodium to magnesium to aluminium.

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(4)
(Total 9 marks)

Q9.

Chlorine will combine with the non-metal element, carbon, to form this molecular compound.



(a) What is the type of bond in this molecule?

_____

(1)

(b) Explain how these bonds are formed. (You may use a diagram).

_____

_____

_____

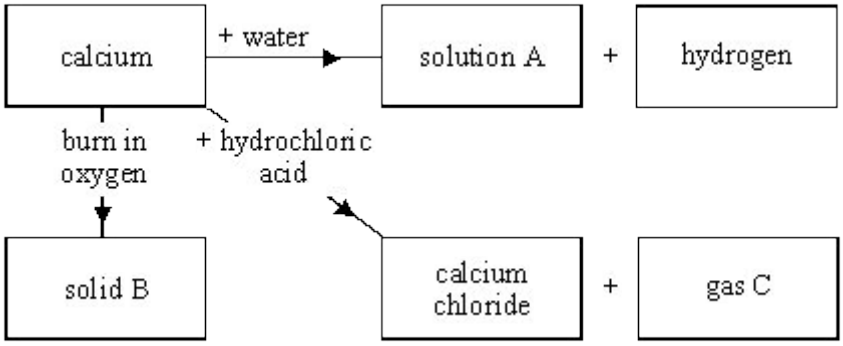
_____

(2)
(Total 3 marks)

Q10.

(a) The chart shows the reactions of the metal calcium with water, oxygen and dilute hydrochloric acid.

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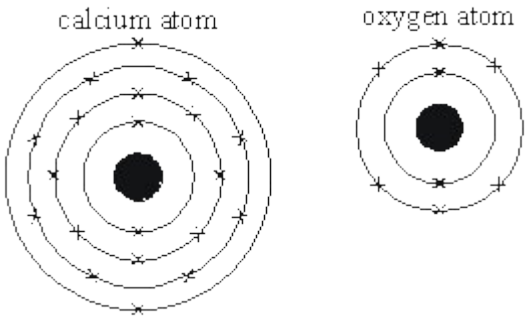
Name (i) solution A _____

(ii) solid B _____

(iii) gas C _____

(3)

(b) The diagrams below show the electronic structure of an atom of calcium and an atom of oxygen.



Describe fully what happens to its electrons when:

(i) a calcium atom forms a calcium ion. State the charge on the calcium ion formed.

_____

_____

_____

(3)

(ii) an oxygen atom forms an oxygen ion. State the charge on the oxygen ion formed.

_____

_____

_____

(3)

(c) Calcium oxide is an ionic compound. Why do ionic compounds have high melting points?

_____

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_____

_____

(2)

(Total 11 marks)

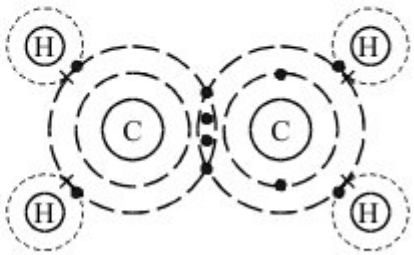
Q11.

The questions which follow refer to the element hydrogen.

(a) Draw a diagram to show the bonding in one molecule of hydrogen.

(2)

(b) The table gives information about two compounds which contain hydrogen.

NAME	FORMULA	STRUCTURE
dilute sulphuric acid	H_2SO_4	$[H]^+[SO_4]^{2-}[H]^+$
ethene	C_2H_4	

Use the information in the table to explain why it is difficult to classify hydrogen as a metal or a non metal.

_____

_____

_____

_____

_____

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_____

(4)

(Total 6 marks)

Q12.

(a) Balance these chemical equations.

(i) H_2 + O_2 → H_2O

(1)

(ii) Al + O_2 → Al_2O_3

(1)

(b) Briefly explain why an unbalanced chemical equation cannot fully describe a reaction.

_____

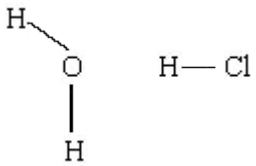
_____

_____

_____

(2)

(c) Explain, as fully as you can, why a water molecule contains two hydrogen atoms but a hydrogen chloride molecule contains only one.



(You may use a diagram in your answer if you wish).

_____

_____

_____

_____

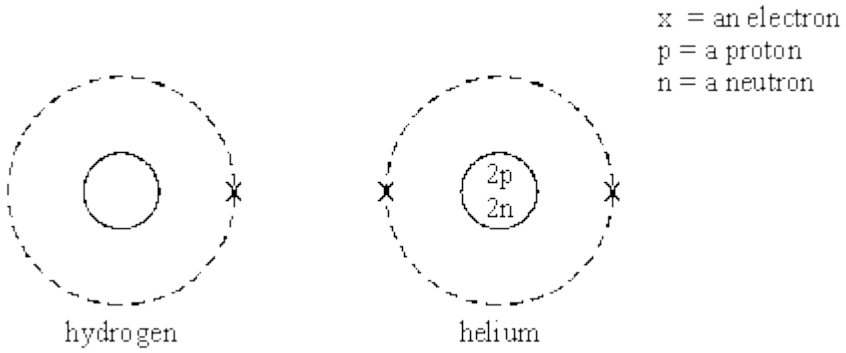
(3)

(Total 7 marks)

Q13.

(a) The diagrams represent the atomic structures of two gases, hydrogen and helium.

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Hydrogen gas is made up of diatomic molecules (molecules with two atoms).
Helium gas exists as single atoms.

(i) How is a molecule of hydrogen formed from two hydrogen atoms?
(You may use a diagram as part of your answer)

_____

_____

_____

(2)

(ii) Why does helium exist only as single atoms?

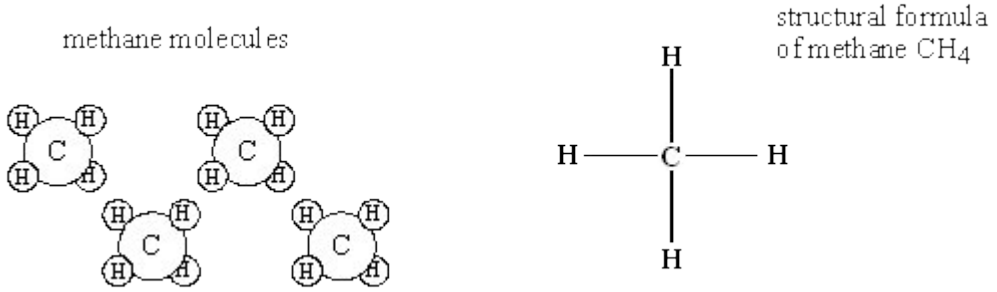
_____

_____

_____

(2)

(b) Hydrogen combines with carbon to form methane.
Each molecule contains four hydrogen atoms strongly bonded to a carbon atom.



Explain why methane has a low boiling point.

_____

_____

_____

_____

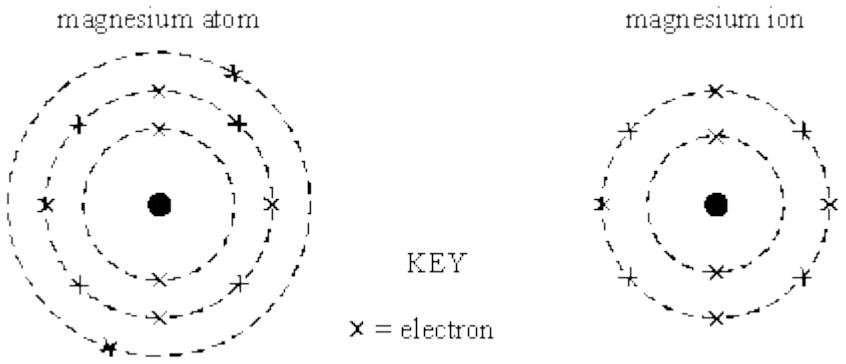
(2)

(Total 6 marks)

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Q14.

(a) The diagrams below show the electronic structure of a magnesium atom and a magnesium ion.



What is the charge on the magnesium ion? _____

(2)

(b) Calcium bromide has the formula $CaBr_2$.

What does this tell you about the ions in this compound?

_____

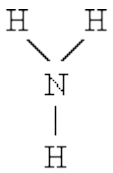
_____

(2)

(Total 4 marks)

Q15.

The diagram shows one molecule of the compound ammonia.



Write down everything that the diagram tells you about each molecule of ammonia.

_____

_____

_____

_____

_____

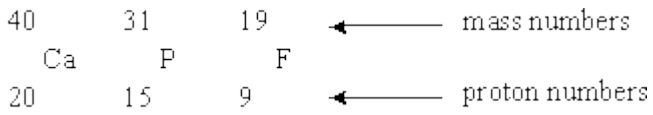
_____

(Total 4 marks)

Q16.

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Atoms of calcium, phosphorus and fluorine are represented below, each with its mass number and proton number.



(a) Use this information to complete the table.

	CALCIUM	PHOSPHORUS	FLUORINE
Number of protons in the nucleus	20		9
Number of neutrons in the nucleus	20	16	
Number of electrons		15	9

(3)

(b) Calcium and fluorine atoms can combine to form the compound calcium fluoride, CaF_2.

The fluoride ion is represented by F^-.

(i) Explain how the fluorine atom forms a fluoride ion.

_____

_____

(2)

(ii) How is the calcium ion represented?

_____

(2)

(c) Phosphorus and fluorine form a covalent compound, phosphorus trifluoride.

Complete the sentences below which are about this compound.

Phosphorus trifluoride is made up of phosphorus and fluorine _____

These are joined together by sharing pairs of _____ to form

phosphorus trifluoride _____ .

(3)

(d) (i) Sodium chloride, an ionic compound, has a high melting point whereas paraffin wax, a molecular compound, melts easily.

Explain why.

_____

_____

_____

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_____

(2)

(ii) Molten ionic compounds conduct electricity but molecular compounds are non-conductors, even when liquid.

Explain why.

_____

_____

_____

(2)

(Total 14 marks)

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