



1.

Millions of years ago the Earth formed as a giant ball of molten rock. The outer surface cooled forming a thin, solid outer crust. Volcanic activity on the surface produced an atmosphere containing the compounds carbon dioxide, ammonia, methane and water vapour.

Describe the bonding in any **one** of these compounds. You must include electronic structures in your explanation.

(Total 4 marks)

2.

Glass is made from silicon dioxide.



© Velirina/iStock/Thinkstock

- (a) Silicon dioxide has a very high melting point.

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

(1)

- (b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

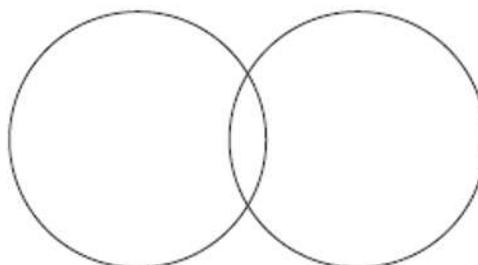
- (i) Sodium oxide contains Na^+ ions and O^{2-} ions.

Give the formula of sodium oxide.

(1)

- (ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).



www.ibworldwideacademy.com

(2)

(c) Glass can be coloured using tiny particles of gold. Gold is a metal.



Describe the structure of a metal.

(3)
(Total 7 marks)



3. The picture shows a wooden bowl.
The pieces of wood used for this bowl were dyed different colours.



By Bertramz (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

The artist who made the bowl explained why he dissolved the coloured dyes in methanol.

I use different coloured dyes dissolved in methanol.
I use methanol because with dyes dissolved in water the wood needs to be soaked for a longer time.
The bowl dries more quickly if I use methanol instead of water.

- (a) The artist uses methanol instead of water.

Give **two** reasons why.

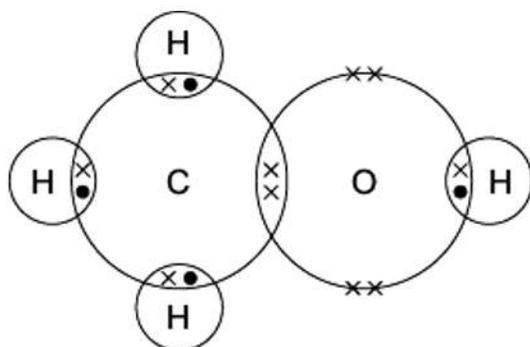
1. _____

2. _____

(2)



(b) The diagram shows how the atoms are bonded in methanol.



Draw a ring around:

(i) the formula of methanol



(1)

(ii) the type of bonding in methanol.

covalent

ionic

metallic

(1)

(c) Methanol has a low boiling point.

Tick (✓) the reason why.

Reason why	Tick (✓)
It has a giant covalent structure.	
It is made of small molecules.	
It has a giant metallic structure.	

(1)

(Total 5 marks)

(b) A problem with lead compounds is that they slowly react with hydrogen sulfide in the air. This produces lead sulfide which is black.



(i) Hydrogen sulfide has the formula H_2S . The bonding in a molecule of hydrogen sulfide can be represented as:

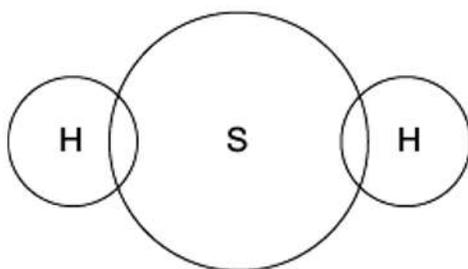


Complete the diagram below to show the arrangement of the outer electrons of the hydrogen and sulfur atoms in hydrogen sulfide.

Use dots (●) and crosses (x) to represent the electrons.

You need only show the outer shell electrons.

(Atomic numbers: H = 1; S = 16.)



(1)

(ii) Hydrogen sulfide has a low boiling point.

Explain why.

(2)

(iii) Lead white is also used in paint. The white colour slowly darkens when lead sulfide is produced.

The painting can be restored with hydrogen peroxide. This converts the black lead sulfide into white lead sulfate.

Balance the equation for the reaction between lead sulfide and hydrogen peroxide (H_2O_2).

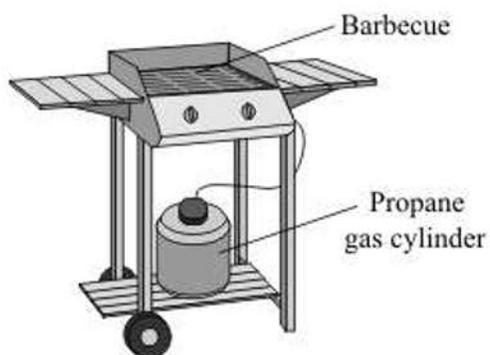


(1)

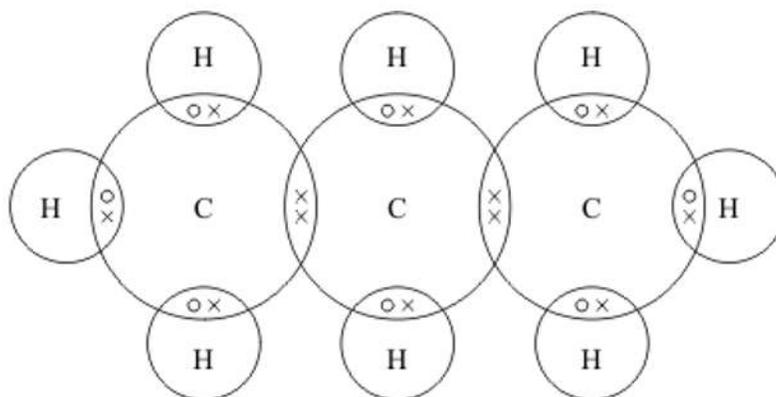
(Total 8 marks)

5.

This barbecue burns propane gas.



The diagram represents a propane molecule.



(a) What is the formula of propane?

(1)

(b) (i) Draw a ring around the name of the particle represented by the symbols \circ and \times in the diagram.

electron neutron proton

(1)

(ii) Draw a ring around the type of bonding that holds the atoms together in a propane molecule.

covalent ionic metallic

(1)

- (c) Under high pressure in the cylinder propane is a liquid.
Liquid propane evaporates easily to form a gas when the tap on the cylinder is opened.



Draw a ring around the correct answer in each box to explain why propane evaporates easily.

Propane has a

high
low

 boiling point because it consists of

large
small

 molecules.

(1)

(Total 4 marks)