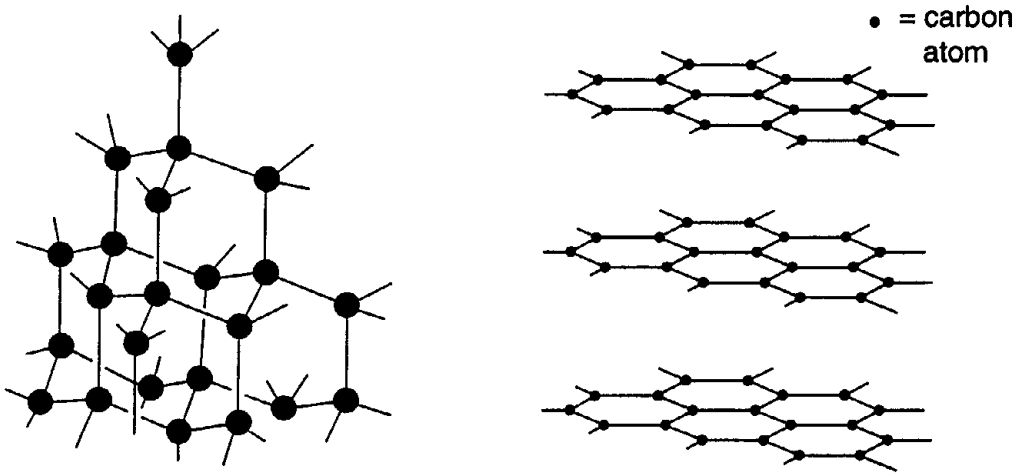
Core 1

Diamond and graphite are each forms of the element carbon. Their structures are shown below.



diamond graphite

(a) Explain the meaning of the term *element*.

.....[1]

(b) In the diamond structure, how many bonds does each carbon atom make with other carbon atoms?

.....[1]

(c) Diamond is a giant structure. Explain what is meant by the term *giant structure*.

.....

.....[1]

(d) Diamond is used in tools for cutting and drilling rocks.

(i) Suggest a property of diamond that makes it suitable for these jobs.

.....

(ii) Explain your answer by referring to the bonding in diamond.

.....

.....

(iii) Silicon carbide, SiC, has a structure like that of diamond.
Use your knowledge of the Periodic Table to suggest why silicon carbide has a similar structure to diamond.

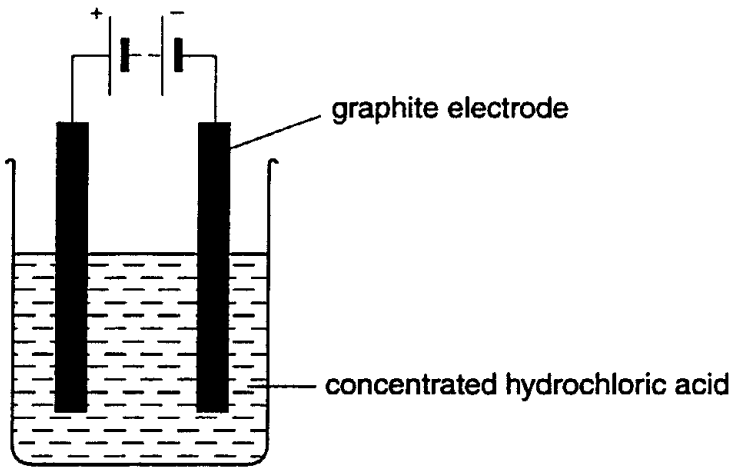
.....[4]

(e) Graphite is used as a lubricant.
By referring to its structure, explain why graphite is used as a lubricant.

.....

.....[2]

(f) Graphite electrodes can be used in the electrolysis of concentrated hydrochloric acid.



(i) Suggest one property of graphite that makes it a suitable material to use for an electrode.

.....

(ii) Name the product formed during this electrolysis at

the positive electrode, ...

the negative electrode. .....

[3]

(e) The table shows some properties of lactose, sulphur and potassium nitrate.

property	lactose	sulphur	potassium nitrate
state at room temperature	solid	solid	solid
solubility in water	soluble	insoluble	soluble
electrical conductivity of a solution in water	does not conduct	no solution formed	conducts
structure	molecular	molecular	ionic giant structure

(i) Suggest how you can separate a solid mixture of lactose and sulphur.

.....

.....

.....[2]

(ii) Suggest why a solution of potassium nitrate in water conducts electricity.

.....

.....[2]

(iii) Suggest why a solution of lactose in water does not conduct electricity.

.....[1]

(f) Copper(II) chloride is used in some fireworks to make blue sparks.

Describe a test for

(i) copper(II) ions,

Test .....

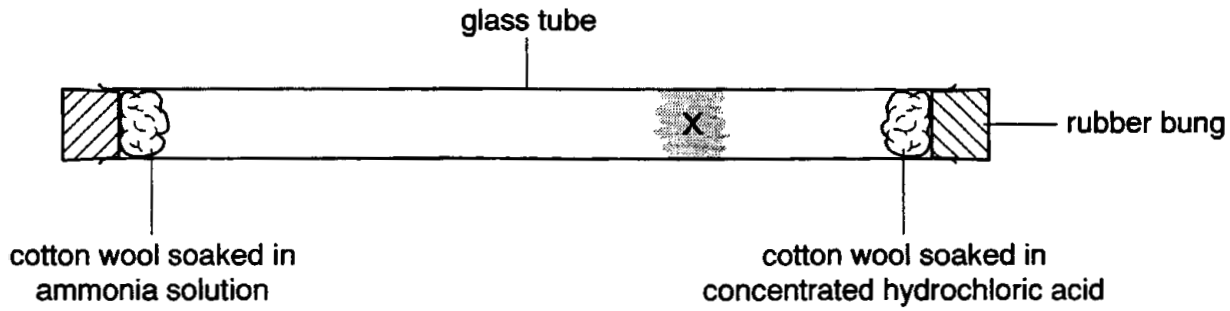
Result .....[3]

(ii) chloride ions.

Test .....

Result .....[3]

A student set up the apparatus shown.



After two minutes, a white solid was seen at point X, where fumes of hydrogen chloride and ammonia had reacted.

(a) State the name of the white solid formed at point X.

.....[1]

(b) Use ideas about particles to explain these observations.

.....

.....

.....

.....[3]

(c) Hydrogen chloride, HC*l*, has a single covalent bond.

Draw a diagram to show how the electrons are arranged in a molecule of hydrogen chloride. Only the outer electron shells need be shown.

(d) Hydrogen chloride reacts with zinc.

Complete the equation for this reaction.

$$\ldots\ HCl + Zn \rightarrow ZnCl_2 + \ldots$$ [2]

Extension 1

The element scandium, proton (atomic) number, $Z = 21$, was discovered by L Nilson in Sweden in 1879.

(a) It forms only one ion which has the formula $^{45}_{21}Sc^{3+}$.

(i) How many electrons, protons and neutrons are there in this ion?

number of electrons .....

number of protons .....

number of neutrons .....

(ii) Predict the electron distribution of this ion.

.....

[4]

Extension 2

The two non-metals, sulphur and selenium, are in Group VI.

(a) Sulphuric acid is made from sulphur. This acid is used to make detergents called sulphonates. A hydrocarbon is made to react with oleum (fuming sulphuric acid) to form sulphonic acids. These form salts called sulphonates.

(i) Complete the word equations for some reactions of a sulphonic acid.

magnesium + sulphonic acid ⟶ magnesium sulphonate + ...

sodium carbonate + sulphonic acid ⟶ ..... + ... + water.

....

(ii) Sulphonate ions are of the type RSO_3^-, where R is an organic group.
What is the formula of magnesium sulphonate?

.....

(iii) How is oleum made in the Contact Process?

.....

.....

(iv) How is oleum changed into concentrated sulphuric acid?

.....

[7]

(b) Insoluble and soluble sulphates can each be made from dilute sulphuric acid. Describe how a pure sample of the insoluble salt, lead(II) sulphate, can be made.

.....

.....

.....

.....[4]

(c) Predict two **chemical** properties of the non-metal selenium.

.....

.....[2]

(d) Selenium is used to make a device that can change light energy into electrical energy.

(i) Name the process used in green plants to change light energy into chemical energy.

.....

(ii) Explain how a liquid fuel can be obtained from plant material.

.....

.....

[3]

Core 1

a substance containing only one type of atom / substance which can not be broken down to a simpler substance

b 4

c idea of many bonds / many atoms joined together (almost) indefinitely

d(i) hard

(ii) strong bonds
between atoms

(iii) C and Si are in the same group in Periodic Table / C and Si have same number of electrons in outer shell

e layers of atoms
weak forces between layers / layers slide over each other

f(i) inert / conducts electricity

(ii) positive – chlorine
negative – hydrogen

Core 2

a(i) dissolve lactose / add water
filter

(ii) (potassium nitrate) is ionic structure / contains ions
ions free to move

(iii) does not contain ions / it is a molecular structure

f(i) add ammonia
white precipitate formed
precipitate dissolves in excess ammonia / goes deeper blue

(ii) add silver nitrate(solution)
white precipitate
and either acidify compound with nitric acid or precipitate soluble in excess ammonia

Core 3

a ammonium chloride

b any three of
evaporation of ammonia / hydrogen chloride from the solutions / cotton wool
diffusion
explanation of what diffusion is e.g. continuous movement of molecules
when the gas particles react they form a solid / in solid the particles are not moving /
white solid has particles which are not moving

c 7 electrons in outer shell of chlorine and 1 in outer shell of hydrogen
pair of electrons shared between the two toms
symbols for Cl and H

d 2 (HCl)
H_2

Extension 1

a(i) 18e
21p
24n

(ii) 2.8.8

Extension 2

a(i) hydrogen
sodium sulphonate
carbon dioxide

(ii) $Mg(RSO_3)_2$

(iii) sulphur trioxide
(iv) add water

b lead nitrate and sulphuric acid
solution
filter
wash or dry

c any two from these
acidic oxide
covalent chloride or covalent bonds
accepts electrons
oxidising agent
ion Se^{2-}
valency 2
forms oxide $SeO_2$and / or SeO_3
forms selenides

d(i) photosynthesis

(ii) alcohol or ethanol
fermentation