Marks 4

- Complete the following table by filling in the compound name or formula as required.

Name	Formula
copper(II) sulfate	$CuSO_4$
sodium nitrate	$NaNO_3$
magnesium chloride	**$MgCl_2$**
iron(III) oxide	**Fe_2O_3**

Marks
2

- Complete the following table by filling in the compound name or formula as required.

Name	Formula
lead(II) chloride	**$PbCl_2$**
dinitrogen trioxide	**N_2O_3**
sodium sulphate	Na_2SO_4
sulfur hexafluoride	SF_6

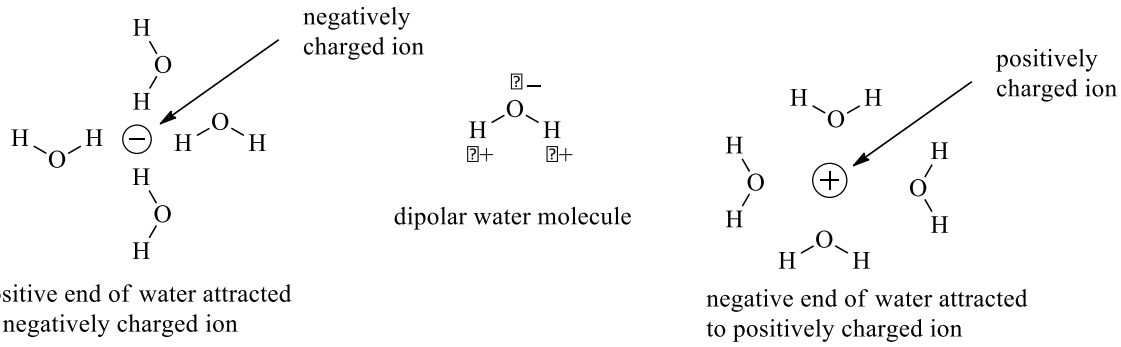
Marks
2

- Complete the following table.

Name	Formula
calcium nitride	**Ca_3N_2**
carbon tetrabromide	**CBr_4**
iron(III) oxide	Fe_2O_3
sulfuric acid	**H_2SO_4**

Marks 3

- Depict the arrangement of water molecules around an ion. Explain why many ionic compounds are soluble in water.



Water is a dipolar molecule. The positive ends (H) can directly interact with negative ions, while the negative end (O) can directly interact with positive ions. These interactions (called hydration enthalpy) are often sufficient to overcome the lattice enthalpy (the energy required to break up the ionic solid into its constituent ions).

Marks 2

- Complete the following table.

Name	Formula
ammonia	NH_3
phosphorus trichloride	**PCl_3**
potassium hydrogencarbonate	$KHCO_3$
calcium phosphate	**$Ca_3(PO_4)_2$**

Marks 4

- Complete the following table.

Formula	Systematic name
$CaBr_2$	**calcium bromide**
$KHCO_3$	potassium hydrogencarbonate
$KMnO_4$	**potassium permanganate**
$Fe(NO_3)_3$	**iron(III) nitrate**

• Account for why solid metals can conduct an electric current, but solid ionic compounds cannot.	**Marks 3**

The crystal structure of a metal consists of a lattice of positively charged nuclei surrounded by a "sea of electrons". These electrons are free to move under the influence of an electric field so can conduct the current.

An ionic solid consists of a lattice of positive and negative ions, packed together to minimise repulsion and maximise attraction. The atomic nuclei are fixed in place and all the electrons are localised around them so they are unable to conduct the current (They can conduct current when molten as the ions are then free to move.)

2

- Give the formula and name of the binary compound formed from the following elements.

	Formula	Name
lithium and oxygen	**Li_2O**	**lithium oxide**
calcium and hydrogen	**CaH_2**	**calcium hydride**

- Ionising radiation is defined as radiation that has energy greater than 1.93×10^{-18} J per photon. Using this criterion, determine whether UV light of $\nu = 1.00 \times 10^{16}$ Hz would be ionising.

Marks 2

The energy of electromagnetic radiation with frequency ν is given by:

$$E = h\nu$$

where $h = 6.626 \times 10^{-34}$ J s (Planck's constant).

For UV light of $\nu = 1.00 \times 10^{16}$ Hz,

$$E = (6.626 \times 10^{-34}\ \text{J s})\ (1.00 \times 10^{16}\ \text{s}^{-1}) = \underline{6.63 \times 10^{-18}\ \text{J}}$$

This energy is greater than 1.93×10^{-18} J so the radiation is ionizing

- The atoms in both iodine and diamond are joined by covalent bonds. However, iodine is a soft, low-melting point solid while diamond is very hard and has an extremely high melting point. Account for these differences in properties.

2

Iodine consists of discrete I_2 molecules. The intermolecular forces between these I_2 units are weak dispersion forces, so the solid is soft with a low melting point. (The strength of the I-I bond is essentially irrelevant.) Diamond consists of a giant 3-dimensional array of carbon atoms in a tetrahedral arrangement. Each atom is covalently bonded to its neighbour to give one giant molecule (covalent network solid). The C-C covalent bond is very strong, so diamond is hard with a high melting point.

- Give the formula and name of a binary ionic compound formed from the following elements.

Marks 6

	Formula	Name
magnesium and oxygen	**MgO**	**magnesium oxide**
barium and bromine	**$BaBr_2$**	**barium bromide**
sodium and nitrogen	**Na_3N**	**sodium nitride**
potassium and oxygen	**K_2O**	**potassium oxide**

- Explain why some ionic compounds are soluble in water and usually insoluble in hydrocarbon solvents such as kerosene.

2

When an ionic solid dissolves, the strong ionic bonds between the constituent ions need to be broken (lattice enthalpy). In water, strong bonds are formed between the ions and the highly polar water molecules to give aquated ionic species. The energy released in this process (enthalpy of solvation) is sufficient to overcome the lattice enthalpy and the solid dissolves. In kerosene, there is little attraction between the ions and the non-polar solvent. The solvation enthalpy is very small in this case, certainly not large enough to overcome the lattice enthalpy, and so dissolution does not occur.