**Q1.**

(a)     A particle of ammonia is represented by the formula NH3 or as:



(i)      How many different elements are there in a particle of ammonia?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     Draw a ring around the correct answer to complete the sentence.

|  |  |
| --- | --- |
| A particle of ammonia is called | an atom.an ion.a molecule. |

**(1)**

(iii)    Complete the dot and cross bonding diagram for ammonia.

Show **only** electrons in the outer energy level of each atom.



**(2)**

(b)     Ammonia gas reacts with hydrogen chloride gas to produce a white solid.

The formula of the white solid is NH4Cl

(i)      Complete the equation by adding the correct state symbols.

NH3(g)  +  HCl(\_\_\_\_)    NH4Cl(\_\_\_\_)

**(1)**

(ii)     The white solid has the formula NH4Cl

Complete the name of the white solid.

Ammonium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     Concentrated ammonia solution gives off ammonia gas.

Concentrated hydrochloric acid gives off hydrogen chloride gas.

Apparatus was set up as shown in **Diagram 1**.

**Diagram 1**

|  |  |  |
| --- | --- | --- |
| Cotton wool soakedin concentratedhydrochloric acid |   | Cotton wool soakedin concentratedammonia solution |



(i)      Concentrated hydrochloric acid is corrosive.

Give **one** safety precaution you should take when using concentrated hydrochloric acid.

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**(1)**

(ii)     After 3 minutes a white solid was seen in the glass tube, as shown in **Diagram 2**.

**Diagram 2**

|  |  |  |
| --- | --- | --- |
| Cotton wool soakedin concentratedhydrochloric acid |   | Cotton wool soakedin concentratedammonia solution |



White solid formed here

Suggest why the white solid is seen nearer the concentrated hydrochloric acid than the concentrated ammonia.

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**(1)**

(iii)    The experiment was repeated at a higher temperature.

Explain why the white solid was produced in less than 3 minutes.

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**(2)**

**(Total 10 marks)**

**Q2.**

This question is about calcium.

(a)     What type of compound is calcium oxide?

Tick **one** box.

|  |  |
| --- | --- |
| An acid |  |
| A base |  |
| A carbonate |  |
| A salt |  |

**(1)**

(b)     Ionic compounds, such as calcium oxide, have high melting points.

Complete the sentences. Use words from the box.

|  |
| --- |
| **bonds          forces          ions          layers** |

Calcium oxide has a giant ionic lattice in which there are strong electrostatic

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of attraction in all directions.

**(1)**

(c)     The figure below shows the electronic structure of an oxygen atom and a calcium atom.



Describe how the calcium atom and the oxygen atom forms calcium oxide.

You should give the charge on each ion formed.

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**(4)**

**(Total 6 marks)**

**Q3.**

This question is about sodium chloride and iodine.

(a)     Describe the structure and bonding in sodium chloride.

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**(4)**

(b)     When sodium chloride solution is electrolysed, one product is chlorine.

Name the **two** other products from the electrolysis of sodium chloride solution.

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**(2)**

(c)     Many people do not have enough iodine in their diet.

Sodium chloride is added to many types of food. Some scientists recommend that sodium chloride should have a compound of iodine added.

Give **one** ethical reason why a compound of iodine should **not** be added to sodium chloride used in food.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(1)**

(d)     The bonding in iodine is similar to the bonding in chlorine.

(i)      Complete the diagram below to show the bonding in iodine.

Show the outer electrons only.



**(2)**

(ii)     Explain why iodine has a low melting point.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(3)**

(iii)    Explain, in terms of particles, why liquid iodine does not conduct electricity.

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**(2)**

**(Total 14 marks)**

**Q4.**

Carbon atoms are used to make nanotubes.



© Denis Nikolenko/Hemera/Thinkstock

Carbon atoms in a nanotube are bonded like a single layer of graphite.

The figure below shows the structure of a single layer of graphite.



© Evgeny Sergeev/iStock/Thinkstock

(a)     Suggest why carbon nanotubes are used as lubricants.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(b)     Explain why graphite can conduct electricity.

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**(2)**

**(Total 4 marks)**

Mark schemes

**Q1.**

(a)     (i)      two

**1**

(ii)     a molecule

**1**

(iii)    one pair of electrons between nitrogen and each of 3 hydrogens

**1**

rest correct

*second mark dependent on first*

**1**

(b)     (i)      (g) (s)

**1**

(ii)     chloride

*ignore formulae*

**1**

(c)     (i)      any **one** from:

•        wear goggles

•        wear gloves

•        do not breathe in fumes

•        wipe up spills immediately

•        work in a fume cupboard

**1**

(ii)     (particles of) ammonia move faster than (particles of) hydrogen chloride

*allow diffuses faster*

*allow hydrochloric acid*

**1**

(iii)    particles / molecules have more energy

*do* ***not*** *accept atoms / ions*

**1**

so they move faster

*ignore references to rate of reaction*

**1**

**[10]**

**Q2.**

(a)     A base

**1**

(b)     forces

**1**

(c)     calcium loses electrons and oxygen gains electrons

*max 3 for incorrect reference to atom / ion or to oxygen / oxide*

**1**

two electrons are transferred

**1**

calcium has a 2+ charge

**1**

oxide has a 2– charge

**1**

**[6]**

**Q3.**

(a)     lattice / giant structure

*max* ***3*** *if incorrect structure or bonding or particles*

**1**

ionic **or** (contains) ions

**1**

Na+ **and** Cl-

*accept in words or dot and cross diagram: must include type and magnitude of charge for each ion*

**1**

electrostatic attraction

*allow attraction between opposite charges*

**1**

(b)     hydrogen

*allow H2*

**1**

sodium hydroxide

*allow NaOH*

**1**

(c)     any **one** from, eg:

•        people should have the right to choose

•        insufficient evidence of effect on individuals

•        individuals may need different amounts.

*allow too much could be harmful*

*ignore religious reasons*

*ignore cost*

*ignore reference to allergies*

**1**

(d)     (i)      one bonding pair of electrons

*accept dot, cross or e or − or any combination, eg
*

**1**

6 unbonded electrons on each atom

**1**

(ii)     simple molecules

*max* ***2*** *if incorrect structure or bonding or particles*

*accept small molecules*

*accept simple / small molecular structure*

**1**

with intermolecular forces

*accept forces between molecules*

*must be no contradictory particles*

**1**

which are weak **or** which require little energy to overcome − must be linked to second marking point

*reference to weak covalent bonds negates second and third marking points*

**1**

(iii)    iodine has no delocalised / free / mobile electrons or ions

**1**

so cannot carry charge

*if no mark awarded iodine molecules have no charge gains* ***1*** *mark*

**1**

**[14]**

**Q4.**

(a)     nanotubes can slide (over each other)

*allow nanotubes can roll (over each other)*

**1**

because no (covalent) bonds between the nanotubes

*accept weak forces between the nanotubes* ***or*** *weak intermolecular forces*

*allow layers for nanotubes throughout*

**1**

(b)     delocalised electrons

*accept free electrons*

**1**

*so (delocalised) electrons* can move through the graphite

*accept so (delocalised) electrons can carry charge through the graphite*

**1**

**[4]**