Paper Reference(s)

## 1522/5H    1530/3H

# Edexcel GCSE

### Science: Double Award A [1522]

Paper 5H

### Chemistry A [1530]

Paper 3H

# Higher Tier

Monday 14 June 2004 – Morning

Time: 1 hour 30 minutes

| **Materials required for examination** | **Items included with question papers** |
|---|---|
| Nil | Nil |

## Instructions to Candidates

In the boxes above, write your centre number, candidate number, the paper reference, your surname, initial(s) and signature.
The paper reference is shown above. If more than one paper reference is shown, you should write the one for which you have been entered.
Answer **ALL** questions in the spaces provided in this book.
Show all stages in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

## Information for Candidates

The marks for the various parts of questions are shown in round brackets: e.g. (**2**).
This paper has nine questions. There is one blank page.

## Advice to Candidates

This symbol shows where the quality of your written answer will also be assessed.

N 1 8 3 5 4 A

*Turn over*

# Edexcel
*Success through qualifications*

# THE PERIODIC TABLE

## Group

| Period | 1 | 2 | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | 4<br>**He**<br>Helium<br>2 |
| 2 | 7<br>**Li**<br>Lithium<br>3 | 9<br>**Be**<br>Beryllium<br>4 | | 11<br>**B**<br>Boron<br>5 | 12<br>**C**<br>Carbon<br>6 | 14<br>**N**<br>Nitrogen<br>7 | 16<br>**O**<br>Oxygen<br>8 | 19<br>**F**<br>Fluorine<br>9 | 20<br>**Ne**<br>Neon<br>10 |
| 3 | 23<br>**Na**<br>Sodium<br>11 | 24<br>**Mg**<br>Magnesium<br>12 | | 27<br>**Al**<br>Aluminium<br>13 | 28<br>**Si**<br>Silicon<br>14 | 31<br>**P**<br>Phosphorus<br>15 | 32<br>**S**<br>Sulphur<br>16 | 35.5<br>**Cl**<br>Chlorine<br>17 | 40<br>**Ar**<br>Argon<br>18 |

**H** Hydrogen

| 4 | 39<br>**K**<br>Potassium<br>19 | 40<br>**Ca**<br>Calcium<br>20 | 45<br>**Sc**<br>Scandium<br>21 | 48<br>**Ti**<br>Titanium<br>22 | 51<br>**V**<br>Vanadium<br>23 | 52<br>**Cr**<br>Chromium<br>24 | 55<br>**Mn**<br>Manganese<br>25 | 56<br>**Fe**<br>Iron<br>26 | 59<br>**Co**<br>Cobalt<br>27 | 59<br>**Ni**<br>Nickel<br>28 | 63.5<br>**Cu**<br>Copper<br>29 | 65<br>**Zn**<br>Zinc<br>30 | 70<br>**Ga**<br>Gallium<br>31 | 73<br>**Ge**<br>Germanium<br>32 | 75<br>**As**<br>Arsenic<br>33 | 79<br>**Se**<br>Selenium<br>34 | 80<br>**Br**<br>Bromine<br>35 | 84<br>**Kr**<br>Krypton<br>36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| 5 | 85<br>**Rb**<br>Rubidium<br>37 | 88<br>**Sr**<br>Strontium<br>38 | 89<br>**Y**<br>Yttrium<br>39 | 91<br>**Zr**<br>Zirconium<br>40 | 93<br>**Nb**<br>Niobium<br>41 | 96<br>**Mo**<br>Molybdenum<br>42 | 99<br>**Tc**<br>Technetium<br>43 | 101<br>**Ru**<br>Ruthenium<br>44 | 103<br>**Rh**<br>Rhodium<br>45 | 106<br>**Pd**<br>Palladium<br>46 | 108<br>**Ag**<br>Silver<br>47 | 112<br>**Cd**<br>Cadmium<br>48 | 115<br>**In**<br>Indium<br>49 | 119<br>**Sn**<br>Tin<br>50 | 122<br>**Sb**<br>Antimony<br>51 | 128<br>**Te**<br>Tellurium<br>52 | 127<br>**I**<br>Iodine<br>53 | 131<br>**Xe**<br>Xenon<br>54 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| 6 | 133<br>**Cs**<br>Caesium<br>55 | 137<br>**Ba**<br>Barium<br>56 | 139<br>**La**<br>Lanthanum<br>57 | 178<br>**Hf**<br>Hafnium<br>72 | 181<br>**Ta**<br>Tantalum<br>73 | 184<br>**W**<br>Tungsten<br>74 | 186<br>**Re**<br>Rhenium<br>75 | 190<br>**Os**<br>Osmium<br>76 | 192<br>**Ir**<br>Iridium<br>77 | 195<br>**Pt**<br>Platinum<br>78 | 197<br>**Au**<br>Gold<br>79 | 201<br>**Hg**<br>Mercury<br>80 | 204<br>**Tl**<br>Thallium<br>81 | 207<br>**Pb**<br>Lead<br>82 | 209<br>**Bi**<br>Bismuth<br>83 | 210<br>**Po**<br>Polonium<br>84 | 210<br>**At**<br>Astatine<br>85 | 222<br>**Rn**<br>Radon<br>86 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| 7 | 223<br>**Fr**<br>Francium<br>87 | 226<br>**Ra**<br>Radium<br>88 | 227<br>**Ac**<br>Actinium<br>89 |
|---|---|---|---|

## Key

| Relative atomic mass |
|---|
| **Symbol** |
| Name |
| Atomic number |

**1.** (a) Complete the table to show the relative mass, relative charge and position in an atom of an electron, neutron and proton.

| | relative mass | relative charge | position in an atom |
|---|---|---|---|
| electron | negligible | | orbiting the nucleus |
| neutron | 1 | | in the nucleus |
| proton | | +1 | |

(4)

(b) Use the periodic table to help you give the electronic structure of

a beryllium atom ..........................................................................................................

a magnesium atom ........................................................................................................

(3)

(c) Using evidence from part (b), explain why you would expect beryllium and magnesium to have similar chemical reactions.

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(1)

(d) An atom of fluorine has an atomic number of 9 and a mass number of 19.

(i) How many protons are in this atom?

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(1)

(ii) How many neutrons are in this atom?

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(1)

Q1

(Total 10 marks)

**TURN OVER FOR QUESTION 2**

3

**2.** (a) Titanium is a hard, lustrous, silvery metal. It is found in the central section of the periodic table.

What name is given to metals in this section of the periodic table?

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(1)

(b) Titanium is a lightweight metal which does not corrode. It is able to withstand extreme temperatures. It is as strong as steel and twice as strong as aluminium but much more expensive than these metals.

Suggest a commercial use for titanium.

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(1)

(c) Titanium powder burns in air to form titanium(IV) oxide, $TiO_2$.

Write the balanced equation for this reaction.

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(2)

(d) Titanium(IV) oxide, $TiO_2$, is formed by combination of titanium and oxygen atoms.

(i) In the formation of titanium(IV) oxide each titanium atom loses four electrons.

What is the formula of the titanium particle produced?

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(1)

(ii) In the formation of titanium(IV) oxide each oxygen atom gains two electrons.

What is the formula of the oxygen particle produced?

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(1)

(iii) The electronic structure of an oxygen atom is 2.6.

Write the electronic structure of the oxygen particle formed in titanium(IV) oxide.

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(1)

(iv) What type of bonding is present in titanium(IV) oxide?

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(1)

(Total 8 marks)

**3.** Environmental problems can be caused by our use of plastic.

Thousands of tonnes of plastic waste are thrown away each year. Plastic items are made from polymers. Chemists have found a way of breaking down some polymer molecules into the monomers from which they were made. Energy is used in this process.

(a) Name an item that is made from a plastic and state the property of the plastic that makes it suitable.

item ...................................................................................................................

property ...............................................................................................................

**(2)**

(b) What is a polymer?

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**(3)**

(c) There are advantages and disadvantages of breaking down polymers into monomers.

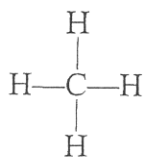(i) State **two** advantages of breaking down polymers into monomers.

1 ...............................................................................................................

2 ...............................................................................................................

**(2)**

(ii) State **one** disadvantage of breaking down polymers into monomers.

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**(1)**

**Q3**

**(Total 8 marks)**

**TURN OVER FOR QUESTION 4**

4. Consider the three molecules **X**, **Y** and **Z**.

$$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-H$$

$$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-Cl$$

$$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-H$$
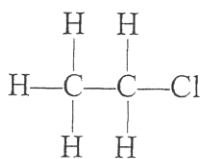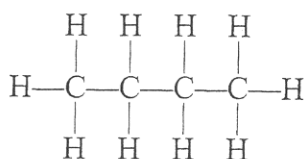
    **X**        **Y**         **Z**

(a) (i) Which of these molecules are hydrocarbons?

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(1)

(ii) Explain your answer.

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(1)

(b) Which molecule is the main constituent of natural gas?

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(1)

(c) Name molecule **Z**.

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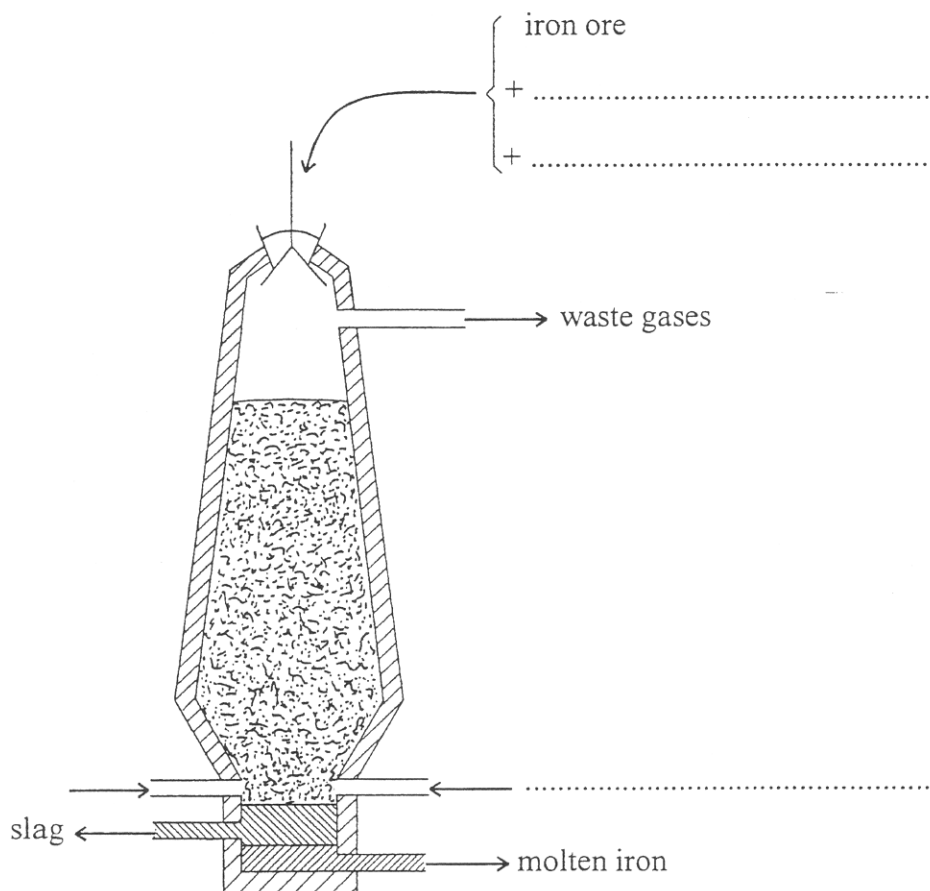
(1)   Q4

**(Total 4 marks)**

**5.** Metals are extracted from their ores by a process called reduction. The actual method depends on the reactivity of the metal.

(a) What is meant by **reduction**?

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(1)

(b) The diagram shows a blast furnace used for the extraction of iron from iron ore.

iron ore

+ .................................................

+ .................................................

→ waste gases

slag ←

→ molten iron

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(i) Complete the diagram giving the names of the other **three** raw materials.

(3)

(ii) Name the gas that reduces the iron ore.

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(1)

(iii) Give **one** use of slag.

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(1)

**QUESTION 5 CONTINUES ON NEXT PAGE**

7

**Turn over**

(c) The following diagram shows the cell in which aluminium is extracted from bauxite by electrolysis. Electricity is passed through a mixture of bauxite dissolved in molten cryolite.
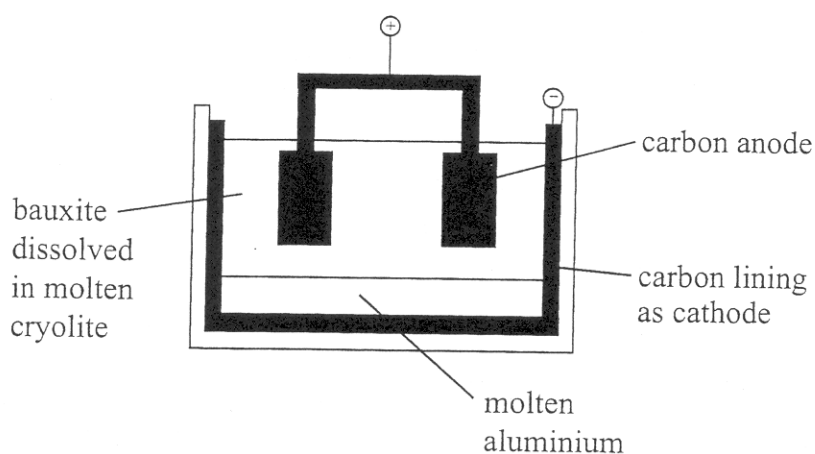
(i) A mixture of bauxite dissolved in molten cryolite rather than molten bauxite is used in the electrolysis cell.

Explain why.

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(2)

(ii) The anodes, which are made of carbon, have to be replaced each month.

Explain why.

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(3)

(d)  The approximate prices per tonne of aluminium and iron are

        aluminium          £800

        iron               £80

Explain why aluminium is more expensive than iron.

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(4)

Q5

**(Total 15 marks)**

**TURN OVER FOR QUESTION 6**

**6.** Hydrogen peroxide solution decomposes to form water and oxygen.

(a) An investigation is carried out to measure the rates of this reaction at 30 °C with a catalyst and without a catalyst.

Describe how you could carry out the investigation to measure the rate of reaction at 30 °C **without** the catalyst.

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(4)

(b) A catalyst can be described as 'a substance that speeds up a reaction **and** has not been used up at the end of the reaction'.

A black powder is a catalyst for this reaction.

Describe an experiment to prove that the black powder is a catalyst for the reaction.

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(3)

(c) (i) What is an enzyme?

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(1)

(ii) Give an example of an industrial process that uses an enzyme.

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(1)

(Total 9 marks)

7.  (a)  Draw a dot and cross diagram of a molecule of carbon dioxide.

Show the outer electrons only.

(3)

(b)  Name and describe the type of bonding that holds the atoms together in the carbon dioxide molecule.

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(2)

(c)  (i)  When propane, $C_3H_8$, is burnt completely in air, carbon dioxide is one of the products.

Write the balanced equation for the reaction.

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(3)

(ii)  Propane is used as a fuel in some room heaters.  There is a safety hazard if propane is burnt in a limited supply of air.

Explain this hazard.

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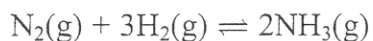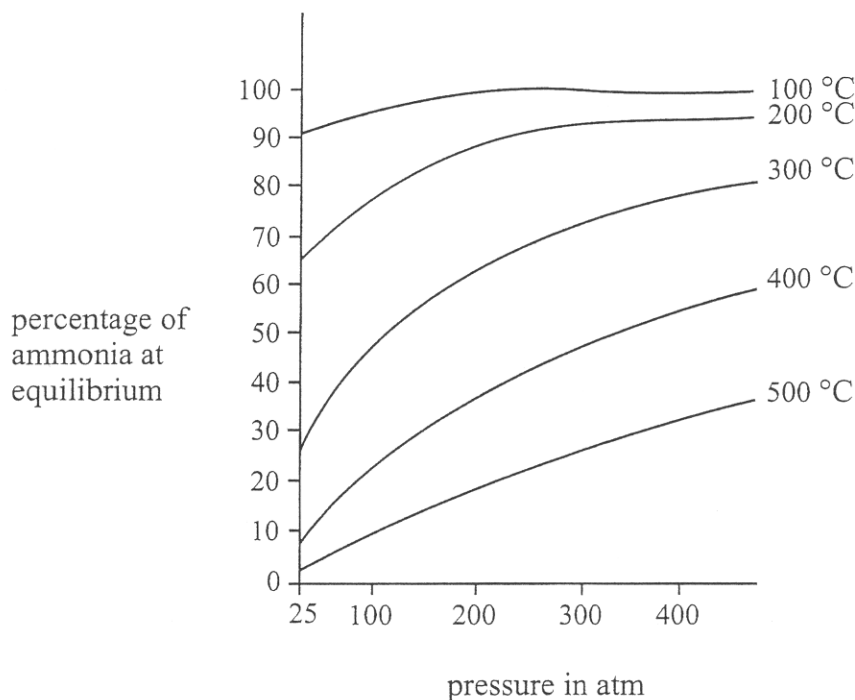
(2)

Q7

(Total 10 marks)

**TURN OVER FOR QUESTION 8**

**8.** Ammonia is made from nitrogen and hydrogen in the Haber process. The reaction is exothermic.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The graph shows the variation in the percentage of ammonia present at equilibrium with increasing pressure at various temperatures.



pressure in atm

(a) (i) Using the graph, state what happens at 300 °C to the percentage of ammonia present at equilibrium as the pressure is increased.

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(1)

(ii) Suggest a disadvantage of operating the process at high pressures.

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(1)

(b) Using the graph, state what happens at 250 atm to the percentage of ammonia present at equilibrium as the temperature is increased.
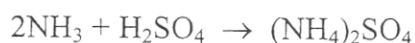
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(1)

(c) In terms of reacting particles, explain why the rate is faster at higher temperatures.

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**(3)**

(d) When ammonia is neutralised by sulphuric acid, the fertiliser ammonium sulphate, $(NH_4)_2SO_4$, is formed.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

(Relative atomic masses: $H = 1.0$; $N = 14$; $O = 16$; $S = 32$)

(i) Calculate the relative formula mass of ammonium sulphate.

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**(1)**

(ii) Calculate the maximum mass of ammonium sulphate that could be formed from 100 tonnes of ammonia.

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**(3)**

(e) Farmers carefully control the amount of fertiliser applied to the soil.

Suggest why.

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**(2)**

**(Total 12 marks)**

Q8

**9.** The table gives the boiling points of the noble gases.

| noble gas | atomic symbol | boiling point (°C) |
|---|---|---|
| helium | He | −269 |
| neon | Ne | −246 |
| argon | Ar | −186 |
| krypton | Kr | −152 |
| xenon | Xe | −107 |

(a) Describe how the boiling points of the noble gases vary with atomic number.

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(1)

(b) Neon has two isotopes.

| isotope | atomic number | mass number | percentage abundance |
|---|---|---|---|
| neon-20 | 10 | 20 | 90.9 |
| neon-22 | 10 | 22 | 9.1 |

(i) In terms of particles in the atoms, explain how the two isotopes differ.

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(1)

(ii) Using the data, calculate the relative atomic mass of neon.

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(2)

(c) Explain why the noble gases are unreactive.

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(2)

(d) Under certain conditions xenon can be made to react with fluorine to form a crystalline compound, xenon fluoride.

In the preparation of xenon fluoride, it was found that 26.2 g of xenon formed 49.0 g of xenon fluoride.

Calculate the empirical formula of xenon fluoride.

(Relative atomic masses: F = 19.0, Xe = 131)

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(4)

(e) Under different conditions another fluoride of xenon, $XeF_4$, also forms as a crystalline solid in equilibrium with its elements.

Write the balanced equation for this equilibrium, including state symbols.

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(4)

Q9

(Total 14 marks)

TOTAL FOR PAPER: 90 MARKS

END