Paper Reference(s)

5018H/1H   5038H/1H

Edexcel GCSE

Additional Science (5018H)

Chemistry (5038H)

C2 – Topics 5 to 8

Higher Tier

Tuesday 9 November 2010 – Afternoon

Time: 30 minutes

Materials required for examination	**Items included with question papers**
Calculator	Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature, and complete the paper reference.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use black ink.
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 individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 5 questions in this question paper. The total mark for this paper is 30.
There are 16 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.

Turn over

edexcel
advancing learning, changing lives

The Periodic Table of the Elements

1	2												3	4	5	6	7	0
							1 **H** hydrogen 1											4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4												11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12												27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30		70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48		115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80		204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111								

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated.

The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.
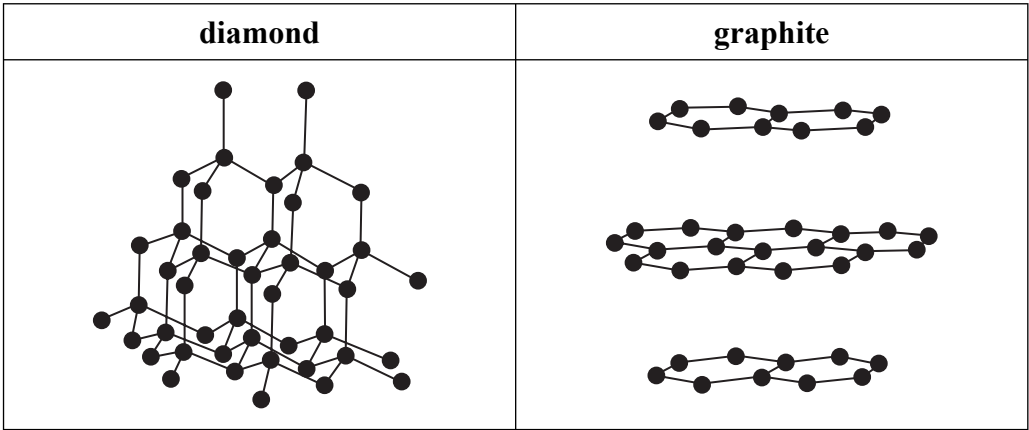
The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

BLANK PAGE

1. The diagrams show parts of the structures of diamond and of graphite, which are two forms of the element carbon.

diamond	graphite

(a) Each bond in diamond is formed by a shared pair of electrons.

   (i) What is the name of this type of bond?

   ....

   (1)

   (ii) How many of these bonds does each carbon atom in diamond form?

   ....

   (1)

   (iii) Why is a large amount of energy needed to convert solid diamond into a gas?

   ....

   ....

   (1)

(b) Graphite can be used as a lubricant.
   Explain, in terms of its structure, why graphite is a lubricant.

   ....

   ....

   ....

   (2)

(c) Recently, two other forms of carbon have been discovered.
One is Buckminsterfullerene, a type of fullerene.

(i) Name another recently discovered form of carbon.

....

(1)

(ii) A molecule of Buckminsterfullerene has the formula C_{60}.
Calculate the relative formula mass of this molecule.
(Relative atomic mass: C = 12)
Show your working.

....

....

Answer = ...

(1)

(d) Information on the Internet gives the formulae of three different oxides of carbon.
They are CO, CO_2 and C_3O_2.
An oxide of carbon was found to contain 12 g of carbon and 16 g of oxygen.
What is the formula of this oxide of carbon?
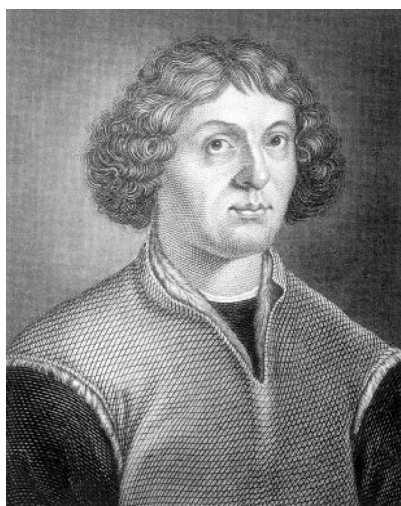(Relative atomic masses: C = 12, O = 16)

....

(1)

Q1

(Total 8 marks)

2. In July 2009, the element with atomic number 112 was named copernicium.
The element was named after Nicolaus Copernicus, a Polish astronomer.

Nicolaus Copernicus

The symbol for an atom of copernicium is Cp.

(a) The atomic number of copernicium is 112.

   (i) How many protons are there in an atom of copernicium?

   ....

(1)

   (ii) Some atoms of copernicium have a mass number of 277.
How many neutrons are in the nucleus of one of these atoms?

   ....

(1)

   (iii) By July 2009, four isotopes of copernicium were known.
How do atoms of these isotopes of copernicium differ from each other?

   ....

   ....

(1)

(b) As only a few atoms of copernicium have been made, its chemical and physical properties are unknown.

However, copernicium is expected to form an ionic fluoride.

This compound will contain copernicium ions, Cp^{2+}, and fluoride ions, F^-.

(i) Write the formula of copernicium fluoride.

....

(1)

(ii) Describe how copernicium atoms, Cp, and fluorine atoms, F, form copernicium ions, Cp^{2+}, and fluoride ions, F^-.

....

....

....

(2)

Q2

(Total 6 marks)

3. Titanium is a silver-grey metal.
It is in much demand because it is strong and resistant to corrosion, and has a relatively low density.
The melting point of titanium is 1670 °C.
Like other metals, titanium is a good conductor of electric current.

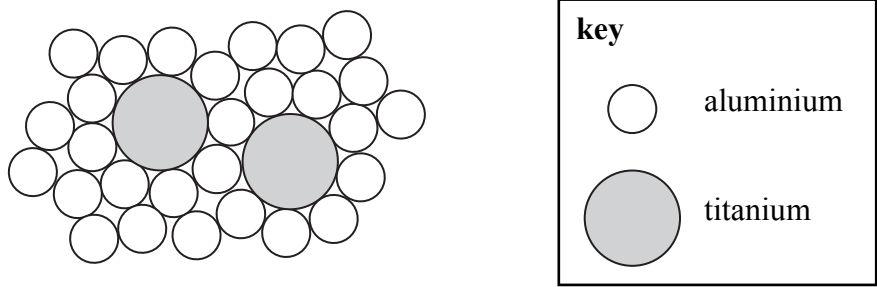(a) Explain why metals are good conductors of electric current.

....

....

....

(2)

(b) Titanium can be mixed with many other metals, such as aluminium, to make alloys.
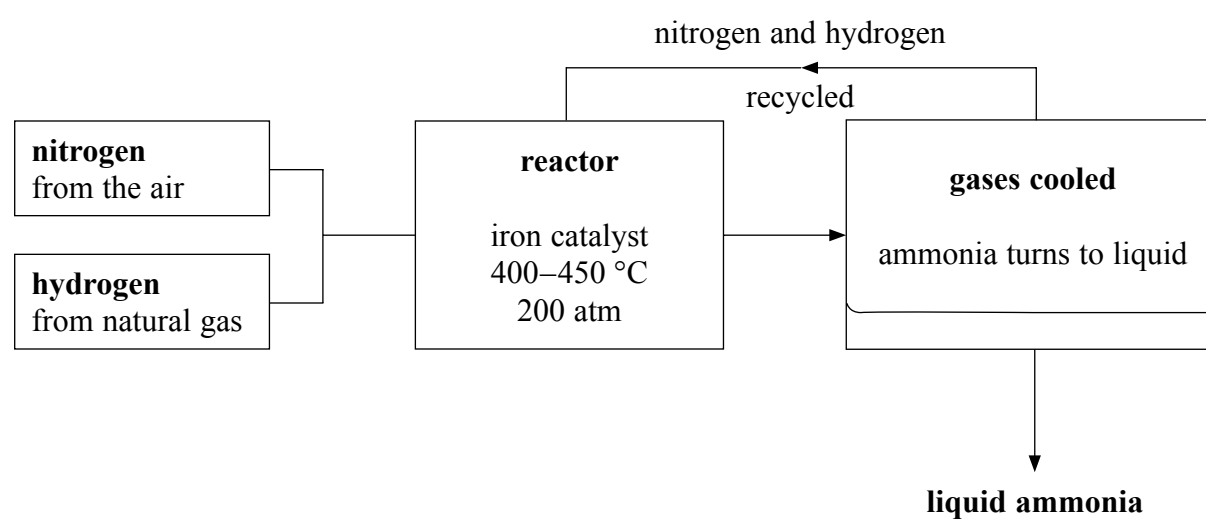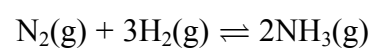Explain how alloying titanium with aluminium can make aluminium stronger.

key

○ aluminium

⬤ titanium

....

....

....

(2)

(c) When heated, titanium combines with oxygen to form titanium(IV) oxide, TiO_2.

$$Ti \ + \ O_2 \ \rightarrow \ TiO_2$$

Calculate the maximum mass of titanium(IV) oxide that could be produced if 9.6 g of titanium were reacted with excess oxygen.
(Relative atomic masses: O = 16, Ti = 48)

....

....

....

....

....

....

answer = ... g

(2)

Q3

(Total 6 marks)

4. In the Haber process, nitrogen and hydrogen are reacted to form ammonia. A diagram for the process is shown below.

nitrogen and hydrogen

recycled

| **nitrogen** from the air | **reactor** iron catalyst 400–450 °C 200 atm | **gases cooled** ammonia turns to liquid |
| **hydrogen** from natural gas | | |

liquid ammonia

The equation for the reaction is

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

(a) Explain the meaning of the symbol $\rightleftharpoons$

....

....

(1)

(b) The mixture of gases leaving the reactor contains nitrogen and hydrogen. Explain why this nitrogen and hydrogen is recycled.

....

....

(1)

H37750A01016

(c) The graph shows the percentage of ammonia in equilibrium mixtures at different temperatures and at a pressure of 400 atm.

percentage of ammonia in equilibrium mixture
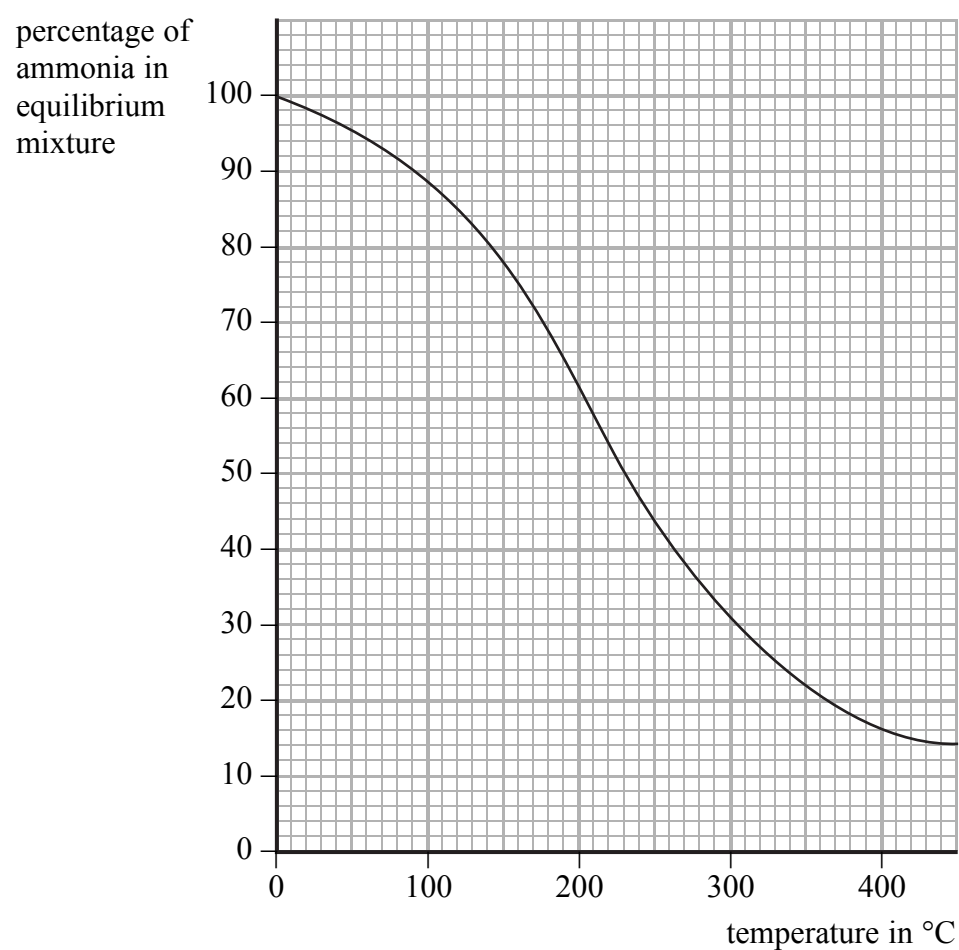
(i) Write down the temperature needed to produce 20% of ammonia in the equilibrium mixture at a pressure of 400 atm.

temperature ....°C

(1)

(ii) What happens to the percentage of ammonia in the equilibrium mixtures as the temperature decreases?
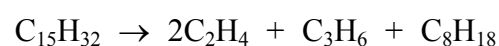
....

....

(1)

(Total 4 marks)

Turn over

5. In the petroleum industry, fractions are obtained by the fractional distillation of crude oil. Ethene is formed when some of these fractions are cracked.

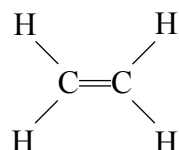One possible reaction in the cracking process is

$$C_{15}H_{32} \rightarrow 2C_2H_4 + C_3H_6 + C_8H_{18}$$

(a) Two of the products shown are ethene and octane, C_8H_{18}.
Give the name of the other product of this reaction.

....

(1)
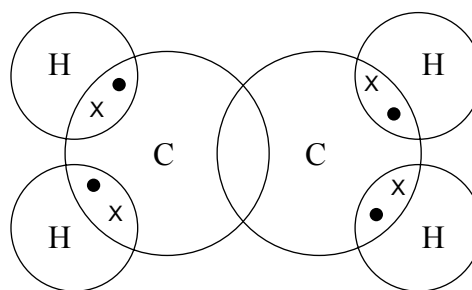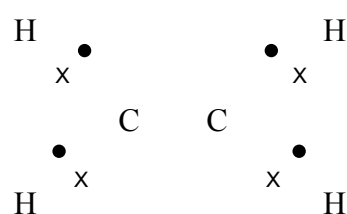
(b) Some fractions containing large molecules are cracked.
Explain why it is useful to crack these fractions.

....

....

....

....

(2)

(c) The structure of an ethene molecule can be shown as

Complete **either** of the two dot and cross diagrams below to show the electrons in the bonds between the carbon atoms in an ethene molecule.
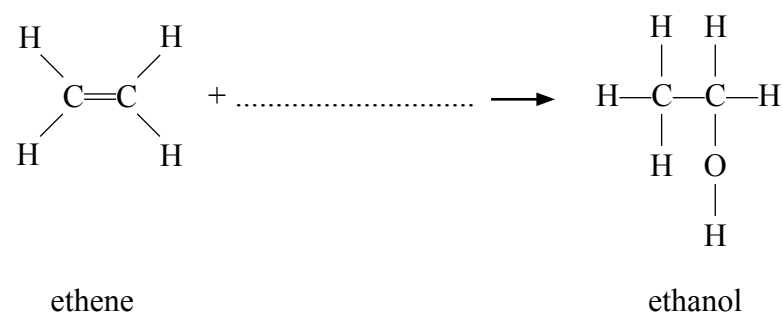

(1)

(d) Some of the ethene, C_2H_4, is converted into ethanol, C_2H_5OH.

$$
\begin{array}{ccccc}
\text{H} & & \text{H} & & \\
& \diagdown & & & \\
& \text{C} = \text{C} & + \text{.............................} & \longrightarrow & \\
& \diagup & & & \\
\text{H} & & \text{H} & & \\
\end{array}
$$

ethene   ethanol

(i) Give the name of the substance that reacts with ethene to form ethanol in this reaction.

....

(1)

(ii) In one factory, 1.00 tonne of ethene produces 1.48 tonnes of ethanol.
Calculations from the equation show that 1.00 tonne of ethene should produce 1.64 tonnes of ethanol.
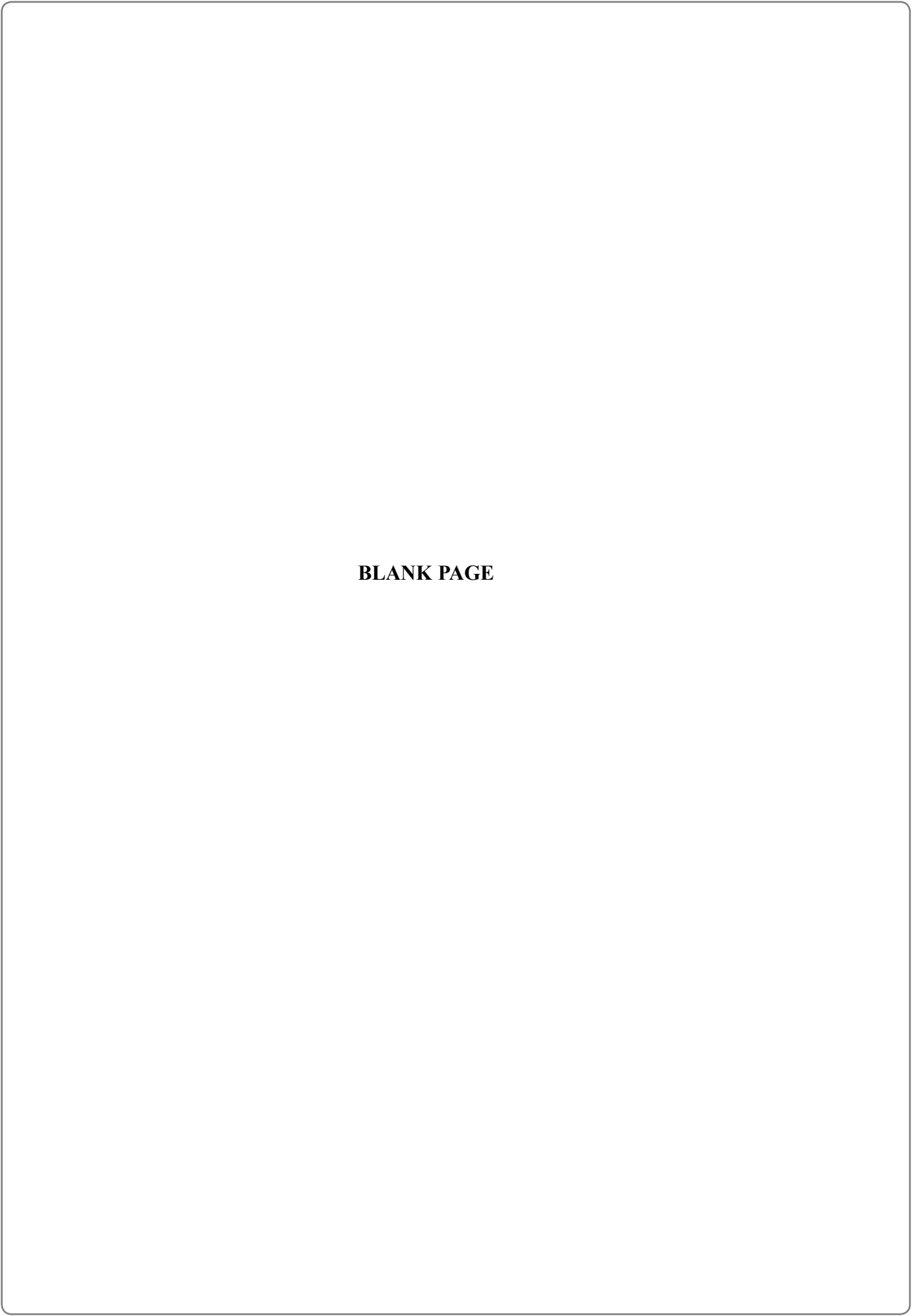Calculate the percentage yield of this reaction.

....

....

....

answer = ... %

(1)   **Q5**

(Total 6 marks)

TOTAL FOR PAPER: 30 MARKS

END

BLANK PAGE

BLANK PAGE

BLANK PAGE