Candidate Name	Centre Number					Candidate Number				
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GCSE

SCIENCE (Double Award)

UNIT 5: (Double Award) CHEMISTRY 2
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**6**	
4.	**6**	
5.	**6**	
6.	**8**	
7.	**8**	
8.	**5**	
9.	**6**	
Total	**60**	

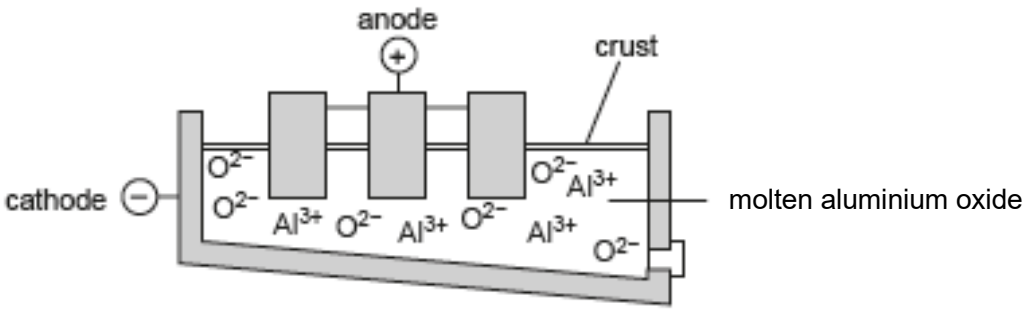
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **9** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. (a) Aluminium is obtained by the electrolysis of molten aluminium oxide.



(i) The electrode equation for the formation of aluminium is as shown below.

$$Al^{3+} + 3e^{-} \longrightarrow Al$$

State at which electrode aluminium is formed. Give a reason for your answer. [2]

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(ii) Write a balanced symbol equation for the overall reaction taking place. [3]

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(iii) Explain how the extraction of aluminium may contribute to global warming. [2]

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(b) Aluminium is a good electrical conductor and is therefore used to make overhead power cables.

Give a **different** property of aluminium and **one** use which relies on this property. [1]

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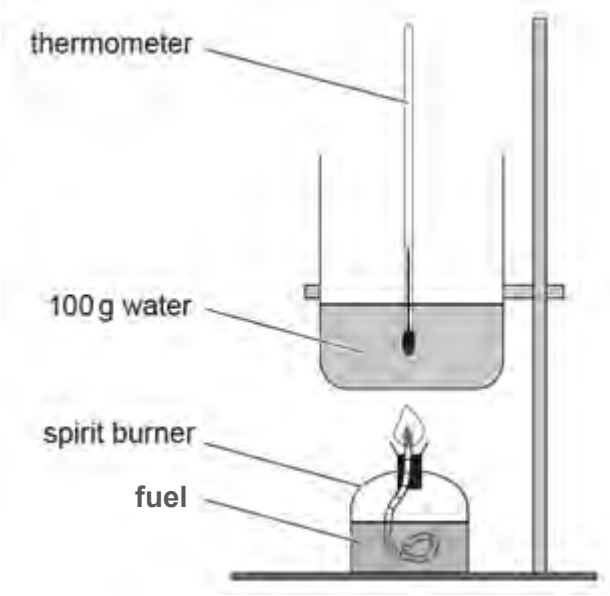
8

2. Methanol, ethanol, propanol and butanol can be used as fuels. An experiment was carried out to find out which alcohol gives out the most energy when burned. The diagram below shows the apparatus used.



1 g of each fuel was used to heat 100 g of water. The results are shown below.

Fuel	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change (°C)	Energy given out (J/g)
methanol	18	31	13	5460
ethanol	20	45	25	10 500
propanol	19	48	29	12 180
butanol	20	50	30	

(a) The energy given out by each fuel can be calculated using the formula:

energy given out = mass of water × 4.2 × temperature change

Use this formula to calculate the energy given out per gram of butanol burned. [2]

Energy given out = ……..J/g

(b) Apart from using 1 g of each fuel and 100 g of water, give **two** *other* ways the experiment could be made a fair test. [2]

1. ……

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2. ……

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(c) The theoretical values for the energy given out by each alcohol are given in the table below.

Fuel	Theoretical energy given out values (J/g)
methanol	22 700
ethanol	29 700
propanol	33 600
butanol	36 100

(i) Give **one** similarity and **one** difference between the experimental and theoretical values. [2]

Similarity ……

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Difference ……

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(ii) Give the **main** reason for the difference between the experimental and theoretical values. [1]

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7

3. Organic substances are arranged in families of compounds with similar properties.

The table below shows the first three members of two families of hydrocarbon compounds – alkanes and alkenes.

Alkanes	Alkenes
methane, CH_4	ethene, C_2H_4
ethane, C_2H_6	propene, C_3H_6
propane, C_3H_8	butene, C_4H_8

(a) Decane contains 10 carbon atoms. Give the molecular formula of decane. [1]

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(b) Isomers are compounds which have the same molecular formula but different structural formulae.

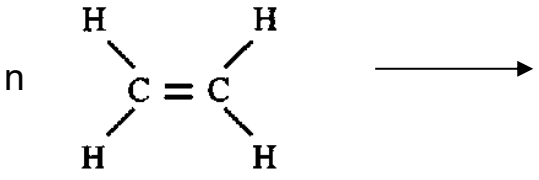
Butene has two isomers. Draw the two isomers of butene. [2]

Isomer 1

Isomer 2

(c) Ethene can undergo addition polymerisation to make polythene.

Complete the equation for this reaction and explain what is meant by the term addition polymerisation. [3]



ethene

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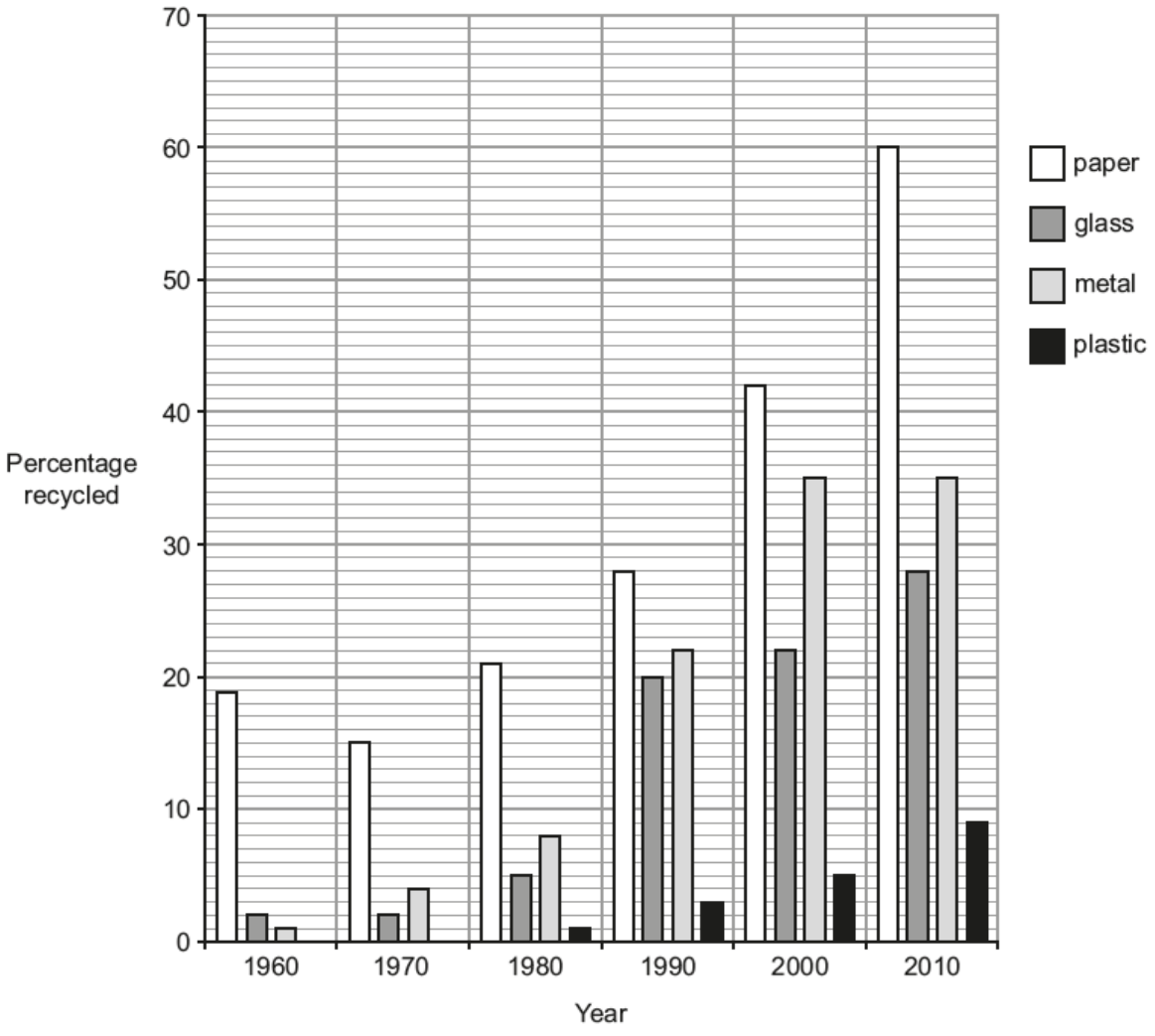
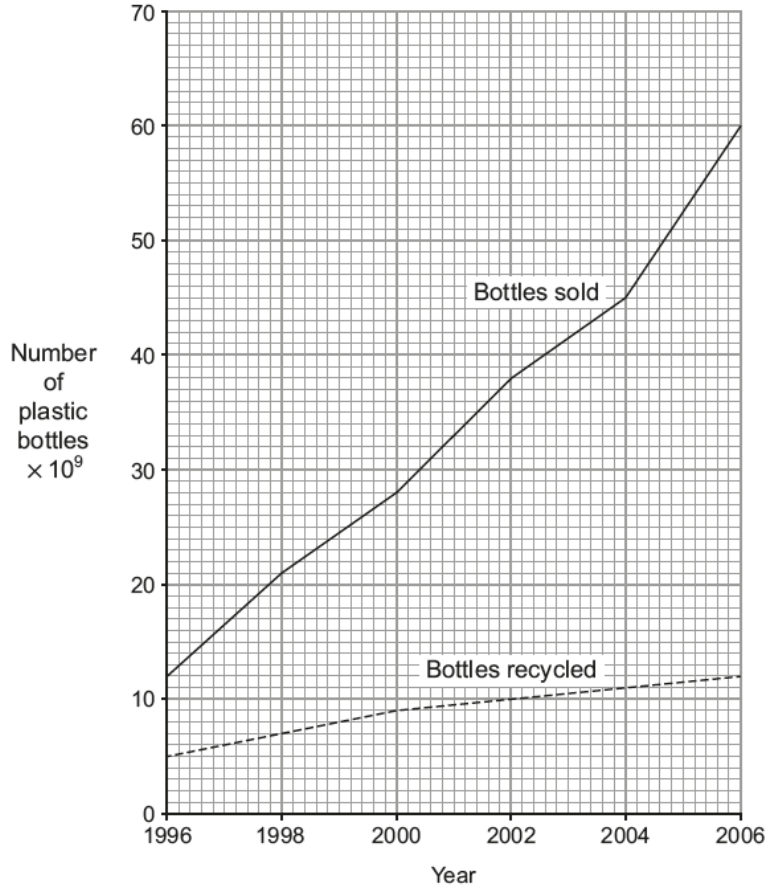
4. Plastic bottles can be found as litter almost anywhere on Earth. Plastics are cheap to produce and most drinks are now sold in plastic bottles. There is continuing discussion and debate over whether the recycling of plastic bottles is economically viable.

Graph 1 shows how the percentage of common materials recycled changed between 1960 and 2010.



Graph 1

Graph 2 shows the number of plastic bottles produced and recycled between 1996 and 2006.



Graph 2

(a) Determine which of paper and plastic has the greater percentage increase in recycling between 2000 and 2010. Show your working. [2]

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(b) Calculate the total number of un-recycled plastic bottles between 2004 and 2006, estimating a value for the number in 2005. [2]

Number of un-recycled plastic bottles = ……

(c) Discuss why recycling plastic bottles does not save money. [2]

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5. (a) Describe how you would prepare a sample of dry copper(II) sulfate crystals from sulfuric acid. Explain each stage of your procedure. [4]

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(b) Write a balanced **symbol** equation for your chosen reaction. [2]

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6. Tetrachloromethane and calcium chloride contain different types of bonding.

Element	Electronic structure
carbon	(2.4)
calcium	(2.8.8.2)
chlorine	(2.8.7)

(a) (i) Explain the bonding in calcium chloride using dot and cross diagrams. [2]

(ii) State and explain **two** expected properties of calcium chloride which supports the presence of ionic bonding. [4]

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(b) Show the bonding in tetrachloromethane using a dot and cross diagram. [2]

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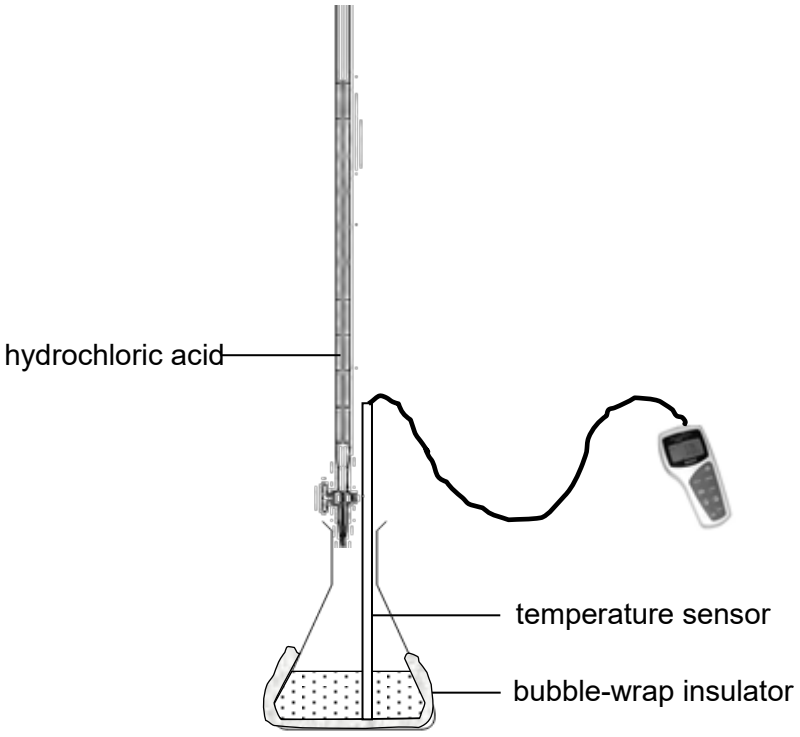
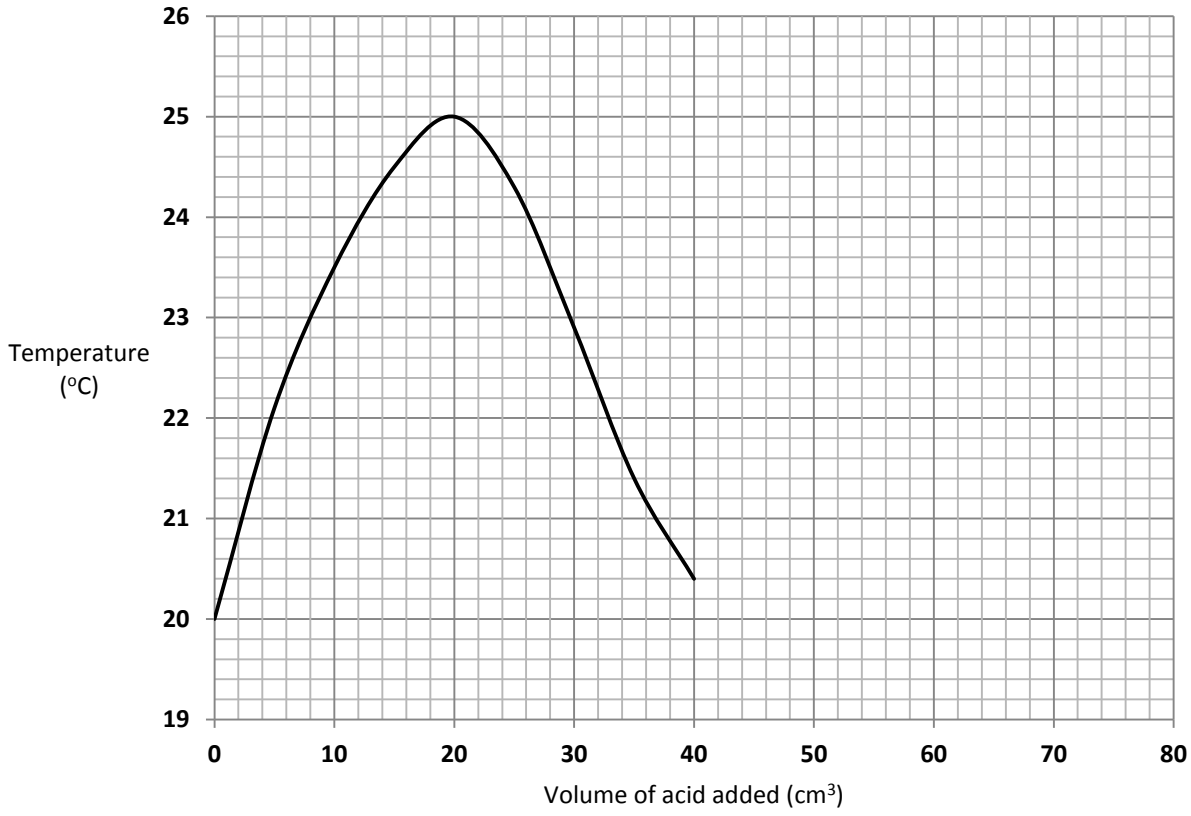
7. 25 cm^3 of sodium hydroxide solution was added to a bubble-wrap insulated conical flask. 40 cm^3 of dilute hydrochloric acid were added 5 cm^3 at a time and the temperature was recorded using a temperature sensor.



The following graph shows the temperature change observed as the acid was added.



(a) If the experiment were repeated with all 20 cm^3 of acid added at once, how would you expect the maximum temperature recorded to be different? Explain your answer. [2]

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(b) Sketch the graph you would expect if the experiment were repeated using hydrochloric acid of **half** the original concentration. Explain the differences between your sketch and the original graph. [4]

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(c) The equation for this reaction is

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Write the **ionic** equation that summarises the reaction between any acid and alkali. Include state symbols. [2]

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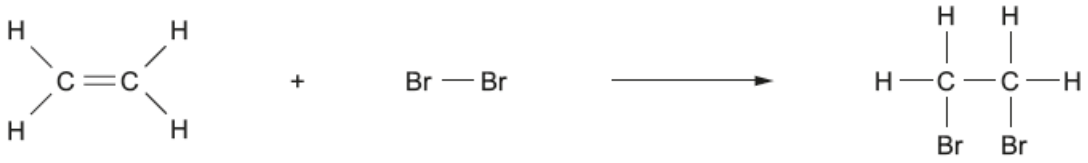
8. The equation below shows the reaction between ethene and bromine.



The bond energies relevant to the reaction are shown in the table.

Bond	Bond energy (kJ)
Br—Br	193
C—H	413
C—Br	276

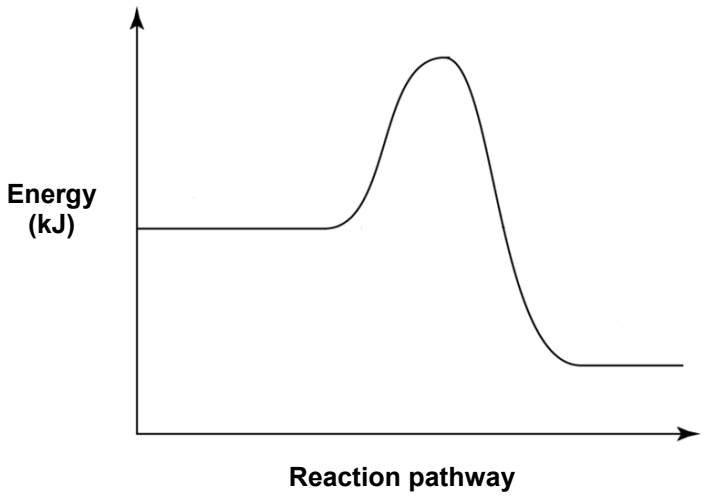
(a) The **total** energy needed to break the bonds in the reactants is 2459 kJ.
Calculate the energy needed to break a C=C bond. [2]

Energy needed = …… kJ

(b) The **total** energy released when bonds in the products are formed is 2551 kJ.
Calculate the energy released in forming a C—C bond.
[2]

Energy released = ……kJ

(c) On the reaction profile below use arrows (↕) to show the activation energy and the overall energy change. Label the activation energy, **A**, and the overall energy change, **B**. [1]



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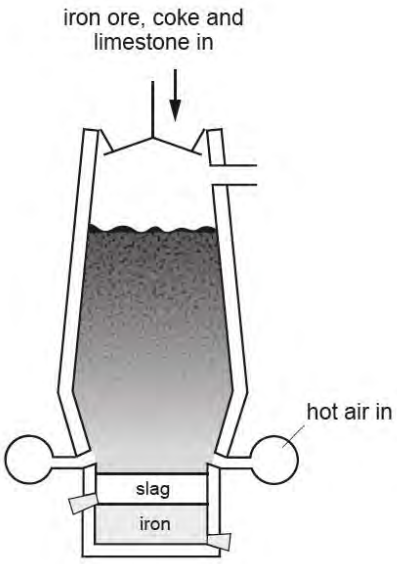
9. The diagram below shows the blast furnace used to extract iron from its ore in plants such as that in Port Talbot.



Explain, using chemical equations, the industrial extraction of iron. [6 QER]

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END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2											3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key: