



Rewarding Learning

General Certificate of Secondary Education
2019

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 2

Higher Tier



[GCM22]

GCM22

WEDNESDAY 12 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **3(e)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

11831



20GCM2201

1 Iron is extracted from its ore in the Blast Furnace. The extraction involves redox reactions.

(a) (i) Name the ore from which iron is extracted in the Blast Furnace.

_____ [1]

(ii) Explain what is meant by the term redox.

_____ [1]

(b) (i) Name the reducing agent in the Blast Furnace and write balanced symbol equations to show the formation of this compound.

Name: _____

Equations:

_____ [6]

(ii) Write a balanced symbol equation for the reduction of iron ore in the Blast Furnace.

_____ [3]



(c) Copper may be extracted from low grade ores in soil by phytomining. The first stage of this process involves plants absorbing copper(II) ions from the soil.

(i) Explain how a solution of copper(II) ions is produced from the plants.

[2]

(ii) In the next stage of the process, scrap iron is added to the solution of copper(II) ions and a displacement reaction occurs. Explain why iron can displace copper from the solution.

[1]

(iii) Write a half equation for the formation of copper from copper(II) ions.

[3]

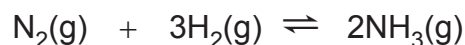
(iv) State one advantage of phytomining over traditional mining methods.

[1]

[Turn over



- 2** Ammonia is manufactured in the Haber Process. An iron catalyst is used in this process to increase the rate of the reaction.
The balanced symbol equation for the reversible reaction in the Haber Process is:



- (a)** Explain how a catalyst increases the rate of a chemical reaction.

[2]

- (b)** The temperature and pressure used in the Haber Process are 450 °C and 200 atm. The reaction establishes a dynamic equilibrium.

- (i)** What is meant by the term dynamic equilibrium?

[2]



(ii) State and explain the effect of increasing the temperature on the **rate** of this reaction.

Effect: _____

Explanation:

[4]

(iii) Use Le Châtelier's Principle to state and explain the effect of increasing the pressure on the **yield** of ammonia at constant temperature.

Effect: _____

Explanation:

[3]

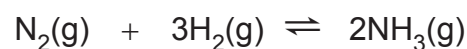
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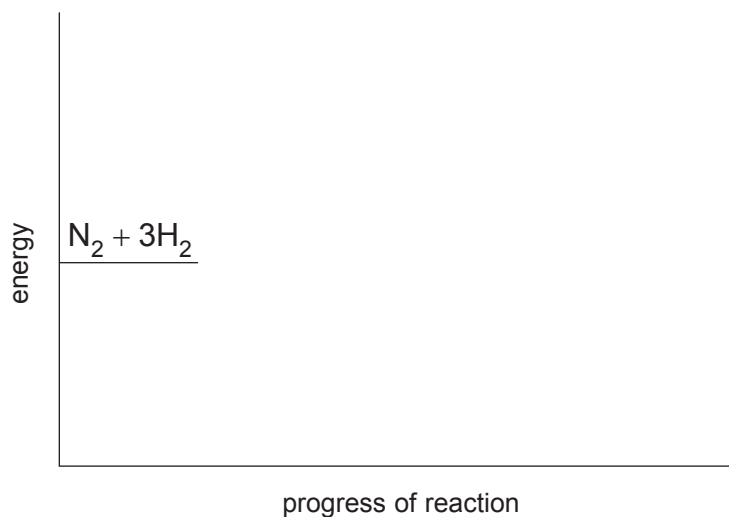
(c) In the Haber Process the forward reaction is exothermic.



(i) Explain, in terms of bonds, why this reaction is exothermic.

[3]

(ii) Complete and label the reaction profile diagram for the Haber Process. Include the energy level for the products and the energy change for the reaction.



[2]



(iii) Use the balanced symbol equation for the Haber Process and the bond energies given in the table below to calculate the energy change for the forward reaction.

Bond	Bond Energy/kJ
$\text{N}\equiv\text{N}$	916
$\text{H}-\text{H}$	436
$\text{N}-\text{H}$	386

Energy change = _____ kJ [4]



3 Alkenes are unsaturated hydrocarbons which are used to make polymers and other chemicals.

(a) (i) State the meaning of the term hydrocarbon.

_____ [1]

(ii) Write the general formula of the alkenes.

_____ [1]

(b) But-1-ene and but-2-ene are alkenes.

(i) Draw the structural formulae of but-1-ene and but-2-ene.

but-1-ene

but-2-ene

[2]



(ii) Write a balanced symbol equation for the complete combustion of but-1-ene.

_____ [3]

(c) Propene, another alkene, may be produced from the cracking of the hydrocarbon C_7H_{16} . One other product is formed in this reaction.

(i) Write a balanced symbol equation for the cracking of C_7H_{16} .

_____ [2]

(ii) Name the other product formed in this reaction.

_____ [1]

(iii) Suggest why high temperatures are required for cracking reactions.

_____ [1]

[Turn over

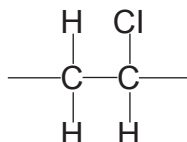


(d) Alkenes can undergo polymerisation to form polymers.

(i) State the type of polymerisation which alkenes undergo.

_____ [1]

(ii) An alkene produces the polymer with the repeating unit shown below.



Name the alkene from which this polymer is formed.

_____ [1]

(iii) Write an equation for the polymerisation of ethene.

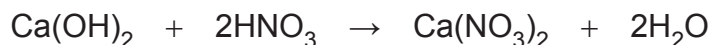
[3]



4 Calcium nitrate is used as a component in fertilisers and in explosives.

- (a) Calcium nitrate may be formed from the reaction of nitric acid with calcium hydroxide solution. In a titration 25.0 cm^3 portions of calcium hydroxide solution were titrated against nitric acid of concentration 0.75 mol/dm^3 . The average titre was determined to be 24.0 cm^3 .

The balanced symbol equation for the reaction is:



- (i) Calculate the concentration of the calcium hydroxide solution in mol/dm^3 .

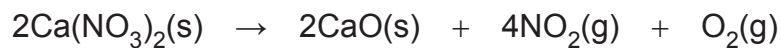
Concentration = _____ mol/dm^3 [3]

- (ii) Calculate the concentration of the calcium hydroxide solution in g/dm^3 .

Concentration = _____ g/dm^3 [1]



(b) Calcium nitrate decomposes on heating according to the following equation:



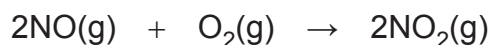
Calculate the total volume of gas (NO_2 and O_2), in dm^3 , produced at 20°C and 1 atm pressure when 32.8 kg of calcium nitrate are heated to constant mass.

Total volume of gas = _____ dm^3 [4]

[Turn over



- (c) Nitrogen dioxide gas, NO_2 , is an air pollutant that causes health problems especially in the respiratory system. It forms in the atmosphere when nitrogen monoxide gas, NO , reacts with oxygen gas according to the following equation:



- (i) State Avogadro's Law.

[2]

- (ii) Using Avogadro's Law, calculate the volume of NO_2 produced, in dm^3 , when 160 dm^3 of oxygen gas react completely with nitrogen monoxide.

Volume of $\text{NO}_2 =$ _____ dm^3 [1]





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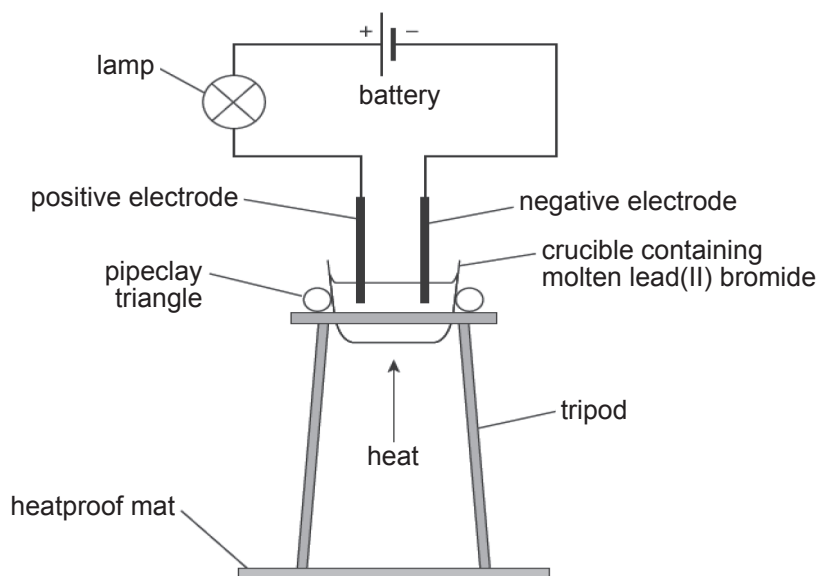
20GCM2215

5 Molten lead(II) bromide undergoes electrolysis.

(a) What is meant by the term electrolysis?

[1]

(b) The apparatus below is used to carry out the electrolysis of molten lead(II) bromide.



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(i) Name the material used to make the electrodes in this electrolysis.

[1]

(ii) State two reasons why this material is used to make the electrodes.

1. _____

2. _____

[2]



(iii) Suggest why this electrolysis experiment needs to be carried out in a fume cupboard.

_____ [1]

(iv) What name is given to the positive electrode?

_____ [1]

(c) Complete the table to give details of the electrolysis of molten lead(II) bromide.

	Negative electrode	Positive electrode
Observations at the electrode	silvery grey liquid formed	
Name of electrolysis product		
Half equation for the reaction at the electrode		

[10]

[Turn over



6 Oxygen gas may be prepared in the laboratory from the decomposition of hydrogen peroxide solution.

(a) (i) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

_____ [3]

(ii) Write the formula of the catalyst used in this reaction.

_____ [1]

(iii) Describe the chemical test for oxygen gas and state the result for a positive test.

_____ [2]



(b) Oxygen reacts with both metals and non-metals to form oxides. Complete the following table giving information about the reaction of oxygen gas with the elements magnesium and sulfur.

	Magnesium	Sulfur
Observations during reaction with oxygen		
Appearance of product after reaction with oxygen		
Nature of oxide formed (acidic or basic)		

[7]

THIS IS THE END OF THE QUESTION PAPER



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Question Number	Marks
1	
2	
3	
4	
5	
6	

Total Marks	
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Examiner Number

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20GCM2220

SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH ₄ ⁺
Chromium(III)	Cr ³⁺
Copper(II)	Cu ²⁺
Iron(II)	Fe ²⁺
Iron(III)	Fe ³⁺
Lead(II)	Pb ²⁺
Silver	Ag ⁺
Zinc	Zn ²⁺

Negative ions

Name	Symbol
Butanoate	C ₃ H ₇ COO ⁻
Carbonate	CO ₃ ²⁻
Dichromate	Cr ₂ O ₇ ²⁻
Ethanoate	CH ₃ COO ⁻
Hydrogencarbonate	HCO ₃ ⁻
Hydroxide	OH ⁻
Methanoate	HCOO ⁻
Nitrate	NO ₃ ⁻
Propanoate	C ₂ H ₅ COO ⁻
Sulfate	SO ₄ ²⁻
Sulfite	SO ₃ ²⁻

Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble
Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

gcse examinations

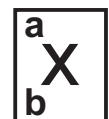
chemistry

THE PERIODIC TABLE OF ELEMENTS

Group

												1 H Hydrogen 1						4 He Helium 2	
		1	2											3	4	5	6	7	0
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	64 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	210 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	285 Cn Copernicium 112								

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series



a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103