Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

5730339853

CHEMISTRY **0620/33**

Paper 3 Theory (Core) **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

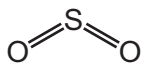
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

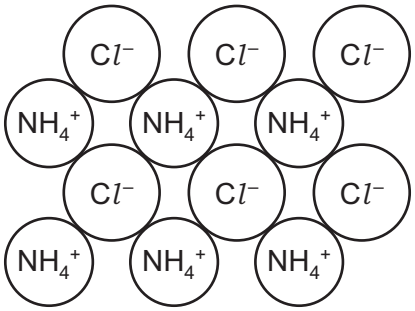
This document consists of **13** printed pages and **3** blank pages.

1 The diagram shows the structures of five substances, **A**, **B**, **C**, **D** and **E**.

A

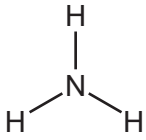


B

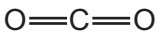


C

D



E



Answer the following questions using only the structures in the diagram.
Each structure may be used once, more than once or not at all.

(a) Which structure, **A**, **B**, **C**, **D** or **E**,

(i) is a compound which is used as a fertiliser, ... [1]

(ii) is a diatomic molecule, ... [1]

(iii) contains chloride ions, ... [1]

(iv) is a gas which turns damp red litmus paper blue, ... [1]

(v) is an element? ..... [1]

(b) Structure **A** is sulfur dioxide.
Sulfur dioxide is an atmospheric pollutant.

(i) State **one** source of sulfur dioxide.

..... [1]

(ii) Give **one** adverse effect of sulfur dioxide on health.

..... [1]

(c) An isotope of nitrogen is represented by the symbol $^{15}_{7}N$.

Deduce the number of protons, neutrons and electrons in this isotope of nitrogen.

number of protons .....

number of neutrons .....

number of electrons .....

[3]

[Total: 10]

2 The atmosphere of the planet Venus contains 96.4% carbon dioxide, 3.5% nitrogen and small amounts of other gases.

(a) Describe how Venus' atmosphere differs from the Earth's atmosphere.
Give **three** differences.

1 .....

.....

2 .....

.....

3 .....

.....
[3]

(b) Describe a test for carbon dioxide.

test .....

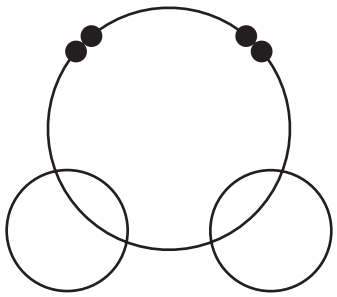
result .....
[2]

(c) Venus' atmosphere also contains small amounts of water and argon.

(i) Water is a covalent compound.

Complete the diagram to show
- the arrangement of electrons in a molecule of water,
- the symbols of the atoms present.

Show outer shell electrons only.



[2]

(ii) The melting point of argon is –189 °C.
The boiling point of argon is –186 °C.

What is the physical state of argon at –200 °C?
Explain your answer.

.....

..... [2]

(iii) Argon is unreactive.

Explain why argon is unreactive in terms of its electronic structure.

.....

..... [1]

(d) Clouds of sulfuric acid are present in Venus' atmosphere.
Sulfuric acid reacts with magnesium carbonate.

$$H_2SO_4 + MgCO_3 \rightarrow MgSO_4 + CO_2 + H_2O$$

(i) Write the word equation for this reaction.

..... [2]

(ii) Calculate the relative molecular mass of sulfuric acid, H_2SO_4.
Use your Periodic Table to help you.

relative molecular mass = ... [2]

(e) Sulfur dioxide is found in the atmospheres of both Venus and the Earth.

(i) State **one** use of sulfur dioxide.

..... [1]

(ii) Sulfur dioxide dissolves in water to form an acidic solution.

Which **one** of the following pH values is acidic?
Put a circle around the correct answer.

pH 2 pH 7 pH 9 pH 14

[1]

[Total: 16]

3 The list shows some of the compounds used to manufacture ink.

calcium carbonate

ethanoic acid

iron(II) sulfate

potassium dichromate(VI)

sodium sulfate

sulfuric acid

(a) Which compound is present in limestone?

..... [1]

(b) Hydrated iron(II) sulfate is heated gently.

$$FeSO_4.7H_2O \rightarrow FeSO_4 + 7H_2O$$

(i) Describe what you would see when a test-tube containing a small amount of hydrated iron(II) sulfate is heated gently.

..... [1]

(ii) Describe a test for aqueous iron(II) ions.

test .....

result .....

[2]

(c) Iron(II) sulfate can be prepared by reacting an excess of iron with dilute sulfuric acid.

(i) Complete the chemical equation for this reaction.

$$Fe + H_2SO_4 \rightarrow FeSO_4 + ...$$

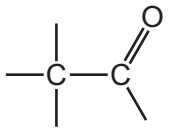
[1]

(ii) Describe how you could remove the excess iron from the mixture formed.

..... [1]

[Turn over

(d) (i) Complete the structure of ethanoic acid to show all of the atoms and all of the bonds.



[2]

(ii) Give **one** observation when aqueous ethanoic acid reacts with magnesium.

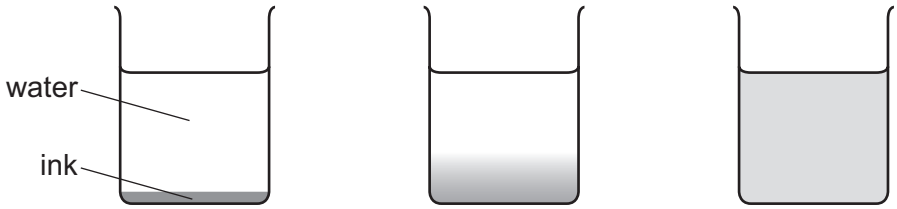
..... [1]

(e) Black ink contains a mixture of different coloured dyes.

Draw a labelled diagram of the apparatus used to separate these different coloured dyes by chromatography.

[3]

(f) Blue ink was placed at the bottom of a beaker containing water.
After 2 days, a blue colour had spread throughout the beaker.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

[Total: 15]

4 The table shows the properties of four substances.

substance	boiling point	electrical conductivity of solid	electrical conductivity when molten	density in g / cm^3
aluminium	high	conducts	conducts	2.70
diamond				3.51
potassium bromide	high	does not conduct	conducts	2.75
sulfur	low	does not conduct		2.07

(a) Complete the table to show the electrical conductivity of solid diamond and molten sulfur. [2]

(b) Give **one** piece of evidence from the table that shows that sulfur is a simple covalent substance.

..... [1]

(c) What information in the table shows that potassium bromide is an ionic compound?

.....

..... [2]

(d) (i) State **one** property of aluminium given in the table which makes it suitable for making aircraft.

..... [1]

(ii) Aluminium oxide is obtained from the ore bauxite.

What method is used to extract aluminium from aluminium oxide?

..... [1]

(e) Molten potassium bromide can be electrolysed.

Predict the products of this electrolysis at

the positive electrode (anode), ...

the negative electrode (cathode). .....
[2]

[Turn over

(f) (i) Which **two** statements describe the structure and bonding in diamond?
Tick **two** boxes.

Diamond has ionic bonds.	☐
Diamond has a giant structure.	☐
Diamond is a simple molecule.	☐
Diamond has covalent bonds.	☐

[1]

(ii) Give **one** use of diamond.

..... [1]

[Total: 11]

5 Lead is extracted from an ore which contains lead(II) sulfide.

(a) The ore is first heated in air.

Balance the chemical equation for this reaction.

$$2PbS + ...O_2 \rightarrow 2PbO + ...SO_2$$

[2]

(b) The lead(II) oxide produced is then reduced with carbon.

$$PbO + C \rightarrow Pb + CO$$

(i) How does this equation show that the lead(II) oxide is reduced?

..... [1]

(ii) Lead is a metal in Group IV.
Iron is a transition element.

Give **two** physical properties that are typical of transition elements.

1 .....

2 .....

[2]

(c) State the conditions needed for iron to rust.

..... [2]

(d) Iron from the blast furnace is converted into steel using oxygen and basic oxides.

(i) What is the purpose of the oxygen?

..... [1]

(ii) Which **one** of these oxides is a basic oxide?
Put a circle around the correct answer.

carbon dioxide **nitrogen dioxide** **potassium oxide** **sulfur trioxide**

Explain your answer.

.....

[2]

[Turn over

(e) Steel is an alloy.

What is meant by the term *alloy*?

.....

..... [2]

(f) **(i)** Give **one** common use of mild steel.

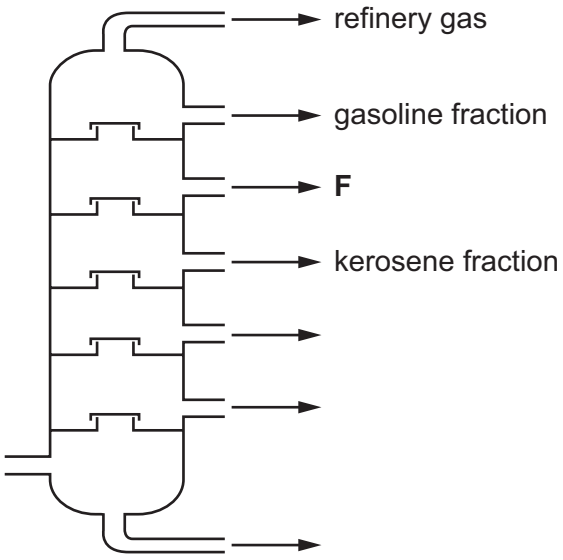
..... [1]

(ii) Give **one** common use of stainless steel.

..... [1]

[Total: 14]

6 The diagram shows a fractionating column used for the fractional distillation of petroleum.



(a) On the diagram, write
- the letter **X** to show where the temperature in the fractionating column is highest,
- the letter **B** to show where bitumen is removed from the fractionating column.

[2]

(b) Give the name of the fraction labelled **F** in the diagram.

..... [1]

(c) Refinery gas contains methane, ethane and propane.

(i) Draw the structure of a molecule of ethane showing all of the atoms and all of the bonds.

[1]

(ii) Methane can be converted to hydrogen by reaction with steam.

Balance the chemical equation for this reaction.

$$CH_4 + H_2O \rightarrow CO + ...H_2$$

[1]

(iii) This reaction is endothermic.

What is meant by the term *endothermic*?

..... [1]

[Turn over

(d) Some petroleum fractions are cracked to form different hydrocarbons.

Describe the process of cracking.

In your answer
- explain what is meant by the term *cracking*,
- state the conditions needed to crack hydrocarbons.

.....

.....

.....

.....

.....

.....

..... [4]

(e) The table shows some properties of four alkanes.

alkane	number of carbon atoms in one molecule	boiling point / °C
methane	1	–164
ethane	2	–88
propane	3	
butane	4	0

(i) How does the boiling point change as the number of carbon atoms in one molecule increases?

..... [1]

(ii) Predict the boiling point of propane.

..... [1]

(iii) Describe the arrangement and separation of the molecules in liquid butane.

arrangement .....

separation .....
[2]

[Total: 14]

BLANK PAGE

BLANK PAGE

BLANK PAGE

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).