Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

6390893468

CHEMISTRY **0620/32**

Paper 3 Theory (Core) **October/November 2016**

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 20.
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 **17** printed pages and **3** blank pages.

1 The diagram shows part of the Periodic Table.

							H										He
Li													C	N	O	F	Ne
Na												Al					Ar
K	Ca						Fe		Ni	Cu	Zn						
										Ag							

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

(a) Which element

(i) gives a lilac colour in a flame test,

..... [1]

(ii) is a pinkish-brown metal,

..... [1]

(iii) can exist in at least **two** different solid forms,

..... [1]

(iv) has a full outer electron shell containing **two** electrons,

..... [1]

(v) is extracted from hematite?

..... [1]

(b) Silver has two naturally occurring isotopes.

$^{107}_{47}Ag$ and $^{109}_{47}Ag$

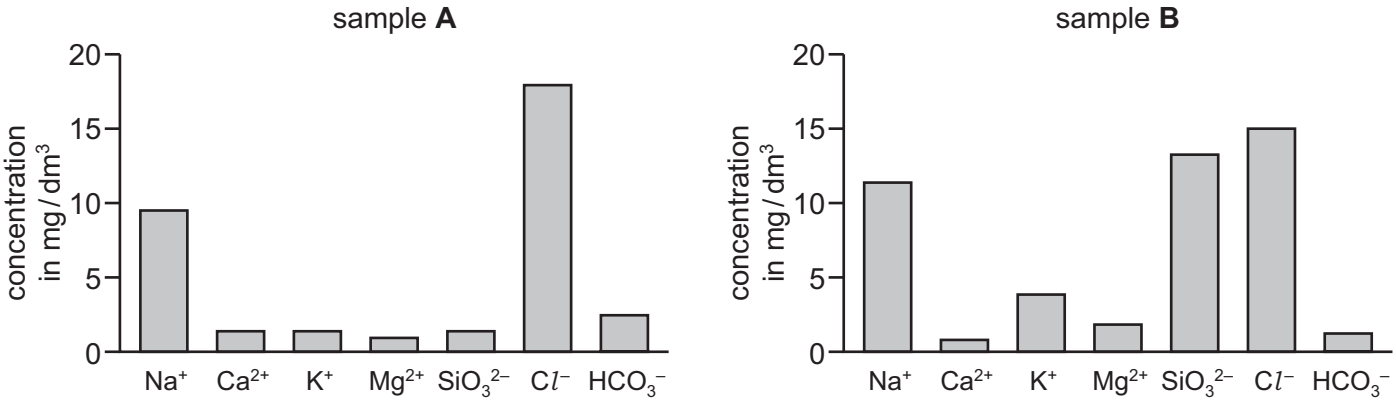
Complete the table to show the number of protons, electrons and neutrons in these **two** isotopes.

	$^{107}_{47}Ag$	$^{109}_{47}Ag$
number of protons		
number of electrons		
number of neutrons		

[3]

[Total: 8]

2 The bar charts compare the concentrations of ions in two samples of water, sample **A** and sample **B**.



(a) Use the information in the bar charts to answer the following questions.

(i) Describe **two** differences in the composition of sample **A** and sample **B**.

.....

.....

..... [2]

(ii) Which positive ion has the lowest concentration in sample **B**?

..... [1]

(iii) Calculate the mass of chloride ions present in 100 cm^3 of sample **B**.
Show all your working. [1 dm^3 = 1000 cm^3]

mass = ... mg [2]

(b) Describe a test for chloride ions.

test .....

result .....
[2]

(c) River water contains small particles of clay.
These particles show Brownian motion.

Which **one** of these statements best describes Brownian motion?
Tick **one** box.

the diffusion of gases	☐
the random movement of particles in a suspension	☐
the downward movement of particles in a suspension	☐

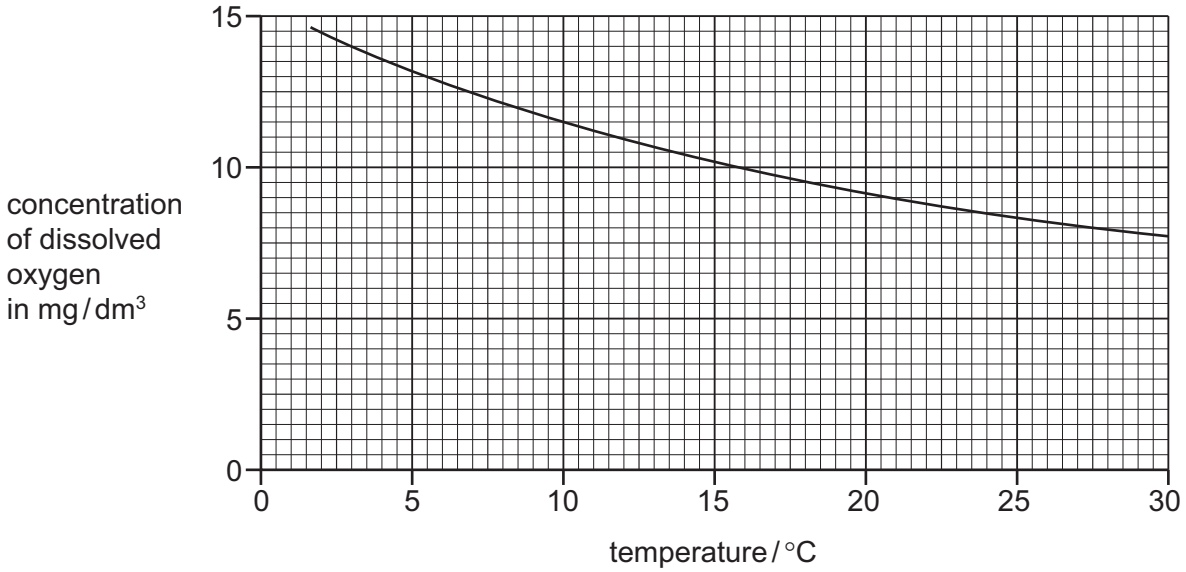
[1]

(d) Silicon in river water comes from silicate rocks. Some of these contain silicon(IV) oxide.

Explain why silicon(IV) oxide is an acidic oxide.

..... [1]

(e) River water contains dissolved oxygen.
The graph shows how the concentration of dissolved oxygen changes with temperature.



(i) Describe how the concentration of dissolved oxygen changes with temperature.

..... [1]

(ii) Determine the concentration of oxygen present in the water at 10 °C.

..... [1]

(iii) Suggest how the rate of corrosion of iron water pipes changes with temperature.
Explain your answer.

.....

..... [1]

(f) Describe how water is treated to make it suitable to drink.

.....

..... [2]

(g) Oxides of nitrogen are common pollutants in the air.

(i) State **one** source of oxides of nitrogen in the air.

..... [1]

(ii) State **one** adverse effect of oxides of nitrogen on health.

..... [1]

[Total: 16]

3 Iron is a metal.

(a) The equation for the reaction of iron with steam is shown.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

Which substance is reduced in this reaction?
Explain your answer.

.....

..... [2]

(b) Iron is extracted by heating iron ore with carbon in a blast furnace.

(i) What is the meaning of the term *ore*?

..... [1]

(ii) Air is blown into the blast furnace.

What is the purpose of this air?

..... [1]

(iii) The impurities in the iron ore are removed as slag.

Which **one** of the following is slag?
Tick **one** box.

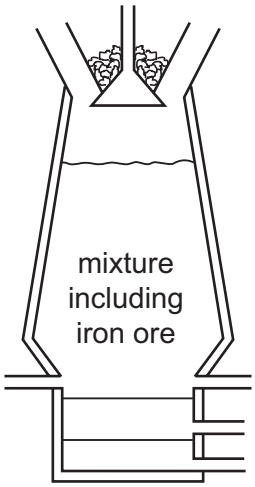
iron(II) oxide	☐
calcium silicate	☐
calcium carbonate	☐
coke	☐

[1]

[Turn over

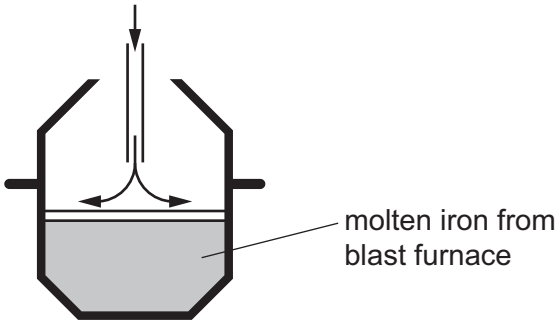
(iv) Slag is less dense than iron.
The diagram shows a blast furnace used to extract iron.

On the diagram, write the letter **S** to show where the slag is removed.



[1]

(c) Iron from the blast furnace contains impurities.
The diagram shows a converter used to make steel from iron.



Describe how iron is converted into steel.
In your answer

- describe the impurities present,
- describe how the impurities are removed,
- include a relevant word equation.

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

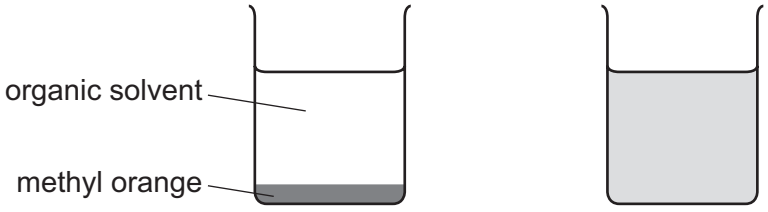
4 Methyl orange and methyl red are both dyes which can be used as indicators.

(a) The actual value for the melting point of methyl red is 180 °C.
A chemist prepares a sample of methyl red and finds that it melts over the range 173 °C to 177 °C.

Suggest why the melting point of this sample was different from the actual value.

..... [1]

(b) A concentrated solution of methyl orange was placed at the bottom of a beaker containing an organic solvent.
After 5 hours, the orange colour had spread throughout the solvent.



Use the kinetic particle model of matter to explain this observation.

.....

.....

.....

..... [3]

(c) Methyl orange is used as an indicator.

What colour is methyl orange when placed in dilute sulfuric acid?

..... [1]

(d) Sulfuric acid can be used to prepare copper(II) sulfate from copper(II) oxide.

(i) Complete the general word equation for this reaction.

metal oxide + acid → ..... + ...

[2]

(ii) Sulfuric acid is added to excess copper(II) oxide. The mixture is heated and the unreacted copper(II) oxide is removed.

Suggest how the unreacted copper(II) oxide is removed.

..... [1]

(iii) Put statements **A** to **E** about the preparation of pure dry crystals of copper(II) sulfate from copper(II) sulfate solution in the correct order.

A The crystals are filtered off.

B The heating is stopped when the point of crystallisation is reached.

C The mixture is left to form crystals.

D The crystals are dried with filter paper.

E The solution is heated gently.

correct order ☐ ☐ ☐ ☐ ☐

[2]

[Total: 10]

5 Cement is made by heating clay with limestone. Some of the limestone (calcium carbonate) breaks down to form calcium oxide and a gas which turns limewater milky.

(a) (i) Complete the chemical equation for this reaction.

$$CaCO_3 \rightarrow \text{.....} + \text{.....}$$

[2]

(ii) What type of chemical reaction is this?

..... [1]

(iii) Determine the relative formula mass of calcium carbonate. Show all your working.

[2]

(b) Concrete is a mixture of cement, sand, water and small stones.
Calcium carbonate is a compound, but concrete is a mixture.

State **two** differences between a compound and a mixture.

.....

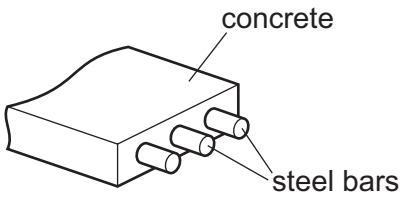
.....

.....

..... [2]

[Turn over

(c) Reinforced concrete contains steel bars within the concrete.



Some properties of concrete and steel are shown in the table.

	relative strength	relative expansion when heated	relative heat conductivity	cost
concrete	60	12	1.5	low
steel	250	12	60.0	high

Use the information in the table to suggest why concrete must be reinforced with steel when it is used to make bridges.

.....

..... [1]

(d) If reinforced concrete becomes cracked, liquids and gases can reach the steel bars. The steel bars rust.

Which **two** substances are needed for steel to rust?

..... and ..... [2]

[Total: 10]

6 Petroleum can be separated into useful hydrocarbon fractions by fractional distillation.

(a) (i) Explain the term *hydrocarbon fraction*.

hydrocarbon .....

fraction .....

.....
[2]

(ii) State **one** use for each of the following hydrocarbon fractions.

naphtha .....

kerosene .....
[2]

(b) Organic compounds can be grouped into different homologous series.

Explain the term *homologous series* by referring to alkenes.

.....

.....

.....

.....

.....

..... [4]

(c) The table shows some information about alkenes.

alkene	formula	density of liquid alkene in g / cm^3	melting point / °C	boiling point / °C
ethene	C_2H_4	0.568	–169	–104
propene	C_3H_6	0.610	–185	–47
butene	C_4H_8	0.626	–185	–6
pentene	C_5H_{10}	0.640	–165	+30
hexene	C_6H_{12}	0.673	–140	

(i) A student predicts that the density of the liquid alkenes increases as the number of carbon atoms increases.

Describe whether the data in the table support this prediction.

.....

..... [1]

(ii) Predict the boiling point of hexene.

..... [1]

(iii) Deduce the state of pentene at –60 °C.
Explain your answer.

.....

..... [2]

(d) Draw the structure of ethene. Show all of the atoms and all of the bonds.

[1]

(e) Alkenes are manufactured by cracking.
When tetradecane, $C_{14}H_{30}$, is cracked the products are ethene, an alkene with four carbon atoms and an alkane.

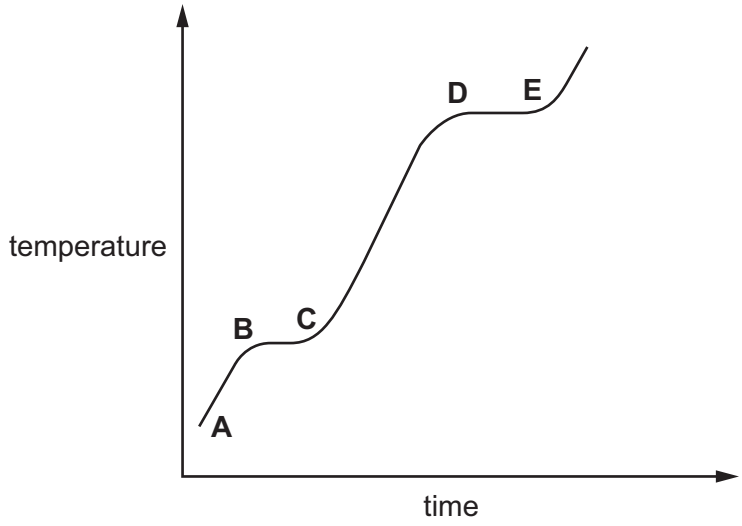
Complete the chemical equation for this reaction.

$$C_{14}H_{30} \rightarrow C_2H_4 + \text{.....} + \text{.....}$$

[2]

[Total: 15]

7 The graph shows how the temperature of sodium changes when it is heated at a constant rate in an atmosphere of argon.



(a) Suggest why the sodium is heated in argon and **not** in air.

..... [1]

(b) Which part of the graph above represents the boiling point of sodium?
Tick **one** box.

A–B ☐
B–C ☐
C–D ☐
D–E ☐

[1]

(c) (i) Describe **two** differences in the general properties of a liquid and a gas.

.....

.....

..... [2]

(ii) Describe the arrangement and motion of the particles in a liquid.

arrangement .....

motion .....

[2]

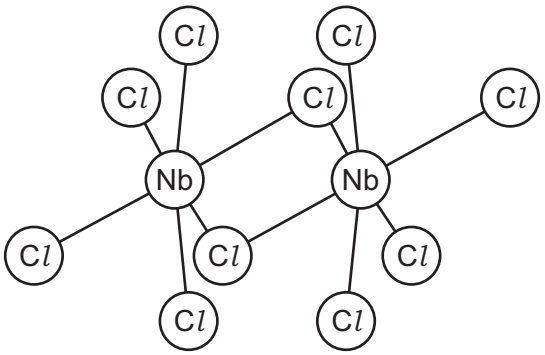
(d) Niobium is a transition element. Sodium is an element in Group I of the Periodic Table.

(i) Describe **two** properties of niobium which are different from sodium.

.....

..... [2]

(ii) The structure of niobium chloride is shown.



Determine the formula of niobium chloride.

..... [1]

(iii) Niobium chloride is a covalent molecule.

Predict **two** physical properties of niobium chloride.

.....

..... [2]

[Total: 11]

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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.).