Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certif cate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY

0620/32

Paper 3 (Extended)

October/November 2015

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 f uid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 12.
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 Certif cate.

This document consists of **12** printed pages.

CAMBRIDGE
International Examinations

1 Use your copy of the Periodic Table to help you answer some of these questions.

(a) Predict the formulae of the following compounds.

(i) nitrogen f uoride ..... NF_3 .....

N 3 F 1

(ii) phosphorus sulf de ..... P_2S_3 .....

P 3 S 2

[2]

(b) Deduce the formulae of the following ions.

(i) selenide ..... Se^{2-} .....

Se is in grp 6 of the periodic table .So it will have 6 valence electrons. So it will accept 2 electrons when forming an ion

(ii) gallium ..... Ga^{3+} .....

Ga is in the group 3 of the periodic table.So it will want to lose 3 electrons when forming an ion

[2]

(c) Use the following ions to determine the formulae of the compounds.

ions OH^- Cr^{3+} Ba^{2+} SO_4^{2-}

Cr 3 SO_4 2

compounds

(i) chromium(III) sulfate ..... $Cr_2(SO_4)_3$ .....

Ba 2 OH 1

(ii) barium hydroxide ..... $Ba(OH)_2$ .....

[2]

[Total: 6]

2 **(a)** Polluted air contains two oxides of carbon and two oxides of nitrogen. A major source of these pollutants is motor vehicles.

(i) Describe how carbon dioxide and carbon monoxide are formed in motor vehicle engines.

When fuel in a vehicle burns , then it produces CO_2 in case of complete combustion and

CO in case of incomplete combustion. In this was CO_2 and CO are formed in motor

vehicle engines

..... [3]

(ii) State **one** adverse effect of each of these gases.

CO2 causes global warming

CO is a poisonous gas and may result in health poisoning like tissue damnage or worse cases death ..... [2]

(iii) Nitrogen monoxide, NO, is released by motor vehicle exhausts.

Explain how nitrogen monoxide is formed in motor vehicle engines.

Nitrogen and oxygen combine at high temperature in the car engine to produce NO

..... [2]

(iv) When nitrogen monoxide is released into the atmosphere, nitrogen dioxide, NO_2, is formed.

Suggest an explanation why this happens.

NO combines with more oxygen in the atmosphere to form NO_2 ..... [1]

(b) Predict the possible adverse effect on the environment when this non-metal oxide, NO_2, reacts with water and oxygen.

.1.It lowers the pH of the rivers and lakes and kills the aquatic animals.

2. It causes acid rain ..... [2]

(c) How are the amounts of carbon monoxide and nitrogen monoxide emitted by modern motor vehicles reduced? Include an equation in your answer.

The amount of carbon monoxide and nitrogen oxide emitted by vehicles is reduced by

fitting catalytic convertors.

Equation: $2NO + 2CO \rightarrow 2CO_2 + N_2$ ..... [3]

[Total: 13]

3 Two of the main uses of zinc are for galvanising and for making alloys.

One of the main ores of zinc is zinc blende, ZnS. There are two stages in the extraction of zinc from this ore.

(a) Stage 1 Zinc oxide is made from zinc blende.

Describe how this is done and write a word equation for the reaction.

Method:zinc blende is roasted heated in air. In this way zinc oxide is formed from zinc blende
.....

.....

Equatio: zinc sulfide + oxygen → zinc oxide + sulfur dioxide;
..... [2]

(b) Stage 2 Zinc oxide is reduced to zinc.

Write a word equation for the reduction of zinc oxide by coke.

zinc oxide + carbon → zinc + carbon dioxide / monoxide;
..... [1]

(c) The zinc produced by this process is impure. It can be purif ed by electrolysis using a method which is similar to the purif cation of copper. Under the conditions used in the process, zinc is the product at the negative electrode (cathode).

Complete the following description of this purif cation.

The electrolyte is aqueous zinc sulfate ..... . [1]

The negative electrode (cathode) is made of pure zinc ..... . [1]

The positive electrode (anode) is impure zinc.

The equation for the reaction at the cathode is $Zn^{2+} + 2e^- \rightarrow Zn$; ..... . [1]

The equation for the reaction at the anode is $Zn \rightarrow Zn^{2+} + 2e^-$; ..... . [1]

Explain why the concentration of the electrolyte does **not** change.

Zinc ions get removed from the solution .At the same time zinc ions are replaced back
.....

into the solution. This hapopens at the same rate
..... [2]

(d) Brass is an alloy which contains zinc.

(i) Name the other metal in brass.

Copper

..... [1]

(ii) Suggest **two** reasons why an alloy such as brass is preferred to either of its constituent metals.

Only 2 points needed

1. It is stronger and harder

.....

2. It has ibetter appearance. 3. It offers more resistance to corrosion

..... [2]

(e) In an experiment to investigate the rate of rusting of steel, three pieces of steel were used. One piece of steel was completely coated with copper, one piece completely coated with zinc and the third piece was left uncoated. All three pieces were left exposed to the atmosphere.

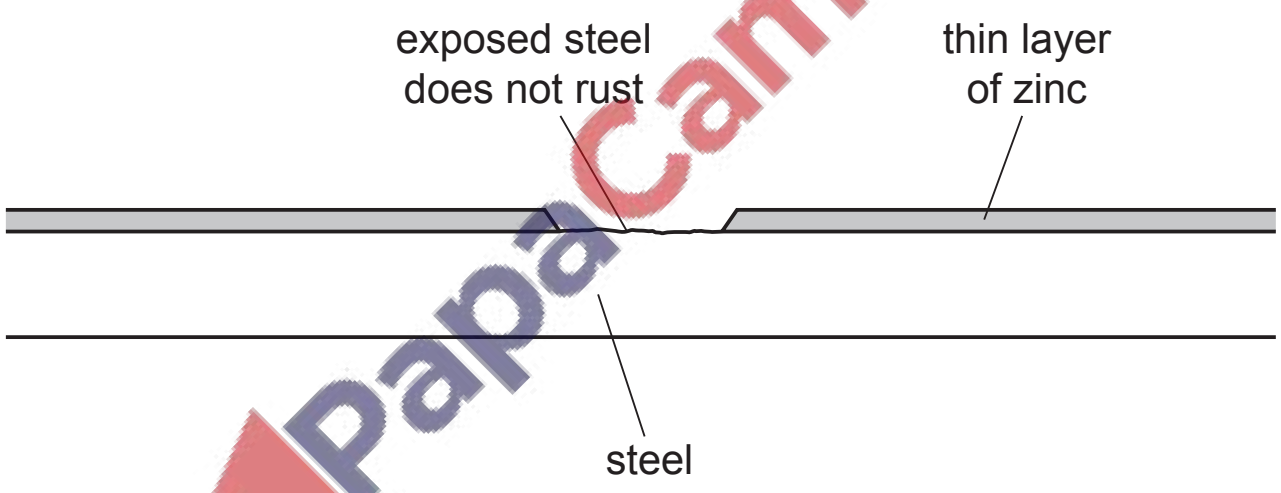
(i) Explain why the uncoated piece started to rust.

This is because the iron in the steel gets exposed to oxygen and water.

.....

..... [1]

(ii) The coating on both of the other two pieces was scratched, exposing the steel.



The piece of steel coated with zinc still did not rust but the copper-coated piece of steel rusted very rapidly.

Explain these observations in terms of the formation of ions and the transfer of electrons.

Zn more reactive than Fe .Therefore Zn loses more readily and forms (+ve) ions in preference to Fe

.....

.....

Fe is more reactive than Cu; Fe loses electrons more readily and forms (+ve) ions in preference to Cu

.....

.....

..... [4]

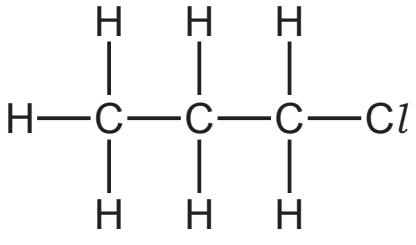
[Total: 17]

4 **(a)** Propane reacts with chlorine to form a mixture of chloropropanes. This is a photochemical reaction.

(i) What is meant by the phrase *photochemical reaction*?

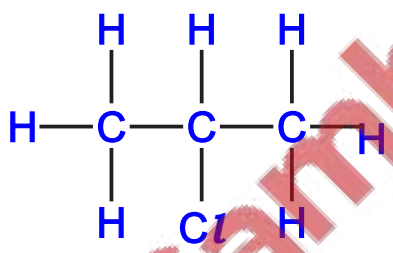
A photochemical reaction is a reaction whose rate is influenced by light or a reaction which occurs in presence of light. [1]

(ii) The products of this reaction include two isomers, one of which has the following structural formula.



Draw the structural formula of the other isomer.

$CH_3CHClCH_3$;



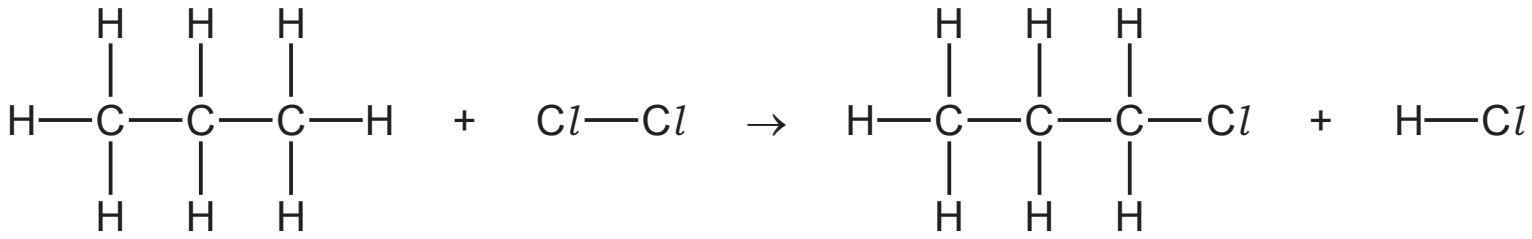
[1]

(iii) Explain why these two different compounds are isomers.

Both these structures have the same molecular formula but different structural formula [2]

(b) Bond breaking is an endothermic change and bond forming is an exothermic change.

Bond energy is the amount of energy in kJ/mol needed to break one mole of the specified bond.



Use the following bond energies to determine whether this reaction is exothermic or endothermic. You must show your reasoning.

bond	bond energies in kJ/mol
C–C*l*	338
C–H	412
C*l*–C*l*	242
H–C*l*	431
C–C	348

Bond breaking

8 (H-C) bonds are broken= 8 x 412= 3296 kJ/mol

2(C-C) bonds = 2X 348 = 696 kJ/mol

1 (Cl-Cl)bond = 1 X 242 = 242 kJ/mol

Total energy supplied = 4234 kJ/mol

Bond making

7 (H-C) bonds formed= 7 X 412 =3448 kJ/mol

2(c-c) bonds = 2X 348 = 696 kJ/mol

1 (C-Cl) bond =1X338 =338 kJ/mol

1 (H-Cl) bond 1X 431 = 431kJ/mol

Total energy released = 4349 kJ/mol

[3]

Ans: Energy released is more than energy supplied

(c) (i) Chloropropane can be hydrolysed to propanol, $CH_3CH_2CH_2OH$, by sodium hydroxide.

Write the equation for this reaction.

$CH_3CH_2CH_2Cl + NaOH \rightarrow CH_3CH_2CH_2Cl + NaCl$ [2]

(ii) Propanol can be dehydrated. It loses a water molecule to form a hydrocarbon.

Give the name and structural formula of this hydrocarbon.

name propene;

structural formula

$CH_2{=}CHCH_3$

[2]

(iii) Propanol is oxidised to a carboxylic acid by acidif ed potassium manganate(VII).

Deduce the name of this acid.

propanoic acid [1]

(d) Propanol reacts with methanoic acid to form the ester propyl methanoate.

$$CH_3CH_2CH_2OH + HCOOH \rightarrow HCOOCH_2CH_2CH_3 + H_2O$$

4.0 g of methanoic acid was reacted with 6.0 g of propanol.

(i) Calculate the M_r of methanoic acid = 46 [1]

(ii) Calculate the M_r of propanol = 60 [1]

(iii) Determine which one is the limiting reagent. Show your reasoning.

moles of $CH_3CH_2CH_2OH$ = 0.1;

moles of HCOOH = 0.087 (0.09)

and limiting reagent is methanoic acid; [2]

(iv) Calculate the maximum yield in grams of propyl methanoate, M_r = 88.

88 × (mol of limiting reagent in 4(d)(iii)); [1]

expected answer: 88 × 0.087 = 7.65 g;

[Total: 17]

5 Iron is extracted from its ore, hematite, in a blast furnace.

Substances added to the furnace are:

- iron ore, hematite, containing impurities such as silica, SiO_2
- air
- coke, C
- limestone, $CaCO_3$

Substances formed in the blast furnace are:

- molten iron
- molten slag
- waste gases such as carbon dioxide

(a) State the **two** functions of the coke used in the blast furnace.

1.It is a source of heat energy

.....

2. It is used as a reducing agent [2]

(b) Write an equation for the conversion of hematite, Fe_2O_3, to iron.

(b Fe2O3 + 3CO → 2Fe + 3CO2 species [2]

(c) Explain how the silica impurity is removed and separated from the molten iron.

Silica reacts with limestone to form slag. •The molten slag forms a layer above the more dense molten iron and they can be both separately, and regularly, drained away.

[3]

(d) The molten iron from the furnace is impure.
It contains impurities which include the element carbon.

Explain how the carbon is removed. Include an equation in your answer.

Oxygen is blown over the molten iron.carbon reacts with oxygen and carondioxide is formed . carbondioxide being a gas escapes.
Reaction:C + O2 → CO2
This is how carbon is removed from molten iron

[3]

[Total: 10]

6 The table below shows the elements in the third period of the Periodic Table, the number of electrons in their outer energy level, their oxidation state in their common compounds and their melting points.

element	Na	Mg	A*l*	Si	P	S	C*l*	Ar
number of outer electrons	1	2	3	4	5	6	7	8
oxidation state	+1	+2	+3	+4/–4	–3	–2	–1	0
melting point/°C	98	650	660	1414	317	115	–101	–189

(a) Describe and explain the variation in oxidation state across the period.

The number of e- gained or lost is equal to the numerical value of oxidation state.

1) Electrons are lost from Na to Si
2) Electrons are gained from Si to Cl
3) Si either gains or loses electrons.
4) Argon neither gains nor loses electrons

(b) The first three elements, Na, Mg and A*l*, are metals.

Describe the structure of a typical metal.

Metals are made of metallic ions which are positively charged.These metallic ions are arranged in a lattice.Also present in the lattice are a sea of electrons,also known as the delocalised electrons.

[3]

(c) Explain why Na, Mg and A*l* are good conductors of electricity.

Na, Mg and Al are good conductors because they have free electrons

[1]

(d) Which element exists as diatomic molecules of the type X_2?

Chlorine [2

(e) Silicon has a similar structure to diamond.

Explain why silicon has the highest melting point in the period.

Silicon is a macromolecule with strong covalent bonds. So it has the highest melting point in the group

[2]

(f) Sodium chloride is a crystalline solid with a high melting point. It dissolves in water to give a neutral solution. Phosphorus trichloride is a liquid at room temperature. It reacts with water to form an acidic solution.

•

•

Suggest an explanation for these differences in properties.

NaCl is an ionic compound and PCl_3 is a covalent compound.NaCl has strong ionic bonds but intermolecular forces are weak. SO it dissoves in water. PCl_3 is a liquid at room temperature because it has wek Vanderwals forces between its molecules.

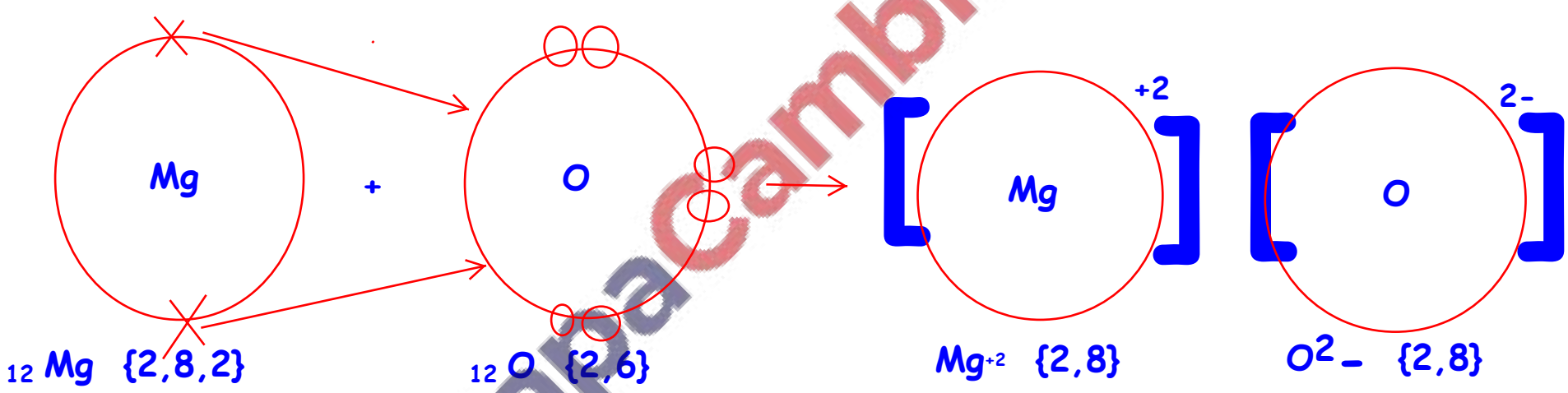
[3]

(g) Describe how you could show that magnesium oxide is a basic oxide and not an amphoteric oxide.

Magnesium oxide with neutralise acidic oxide. If MgO is amphoteric then it will also react with a base to neutralise it. [2

But MgO is not amphoteric , hence it will not react with a base or alkali or basic oxide.

(h) Draw a dot-and-cross diagram showing the bonding in magnesium oxide. Show outer electrons only.



[3]

[Total: 17]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	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	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	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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a
X
b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

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