

CANDIDATE  
NAME

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**CHEMISTRY**

**0620/32**

Paper 3 (Extended)

**May/June 2015**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**MODIFIED LANGUAGE**

**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 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 Certificate.

This document consists of **11** printed pages and **1** blank page.

- 1 Complete the following table which gives the number of protons, electrons and neutrons in each of the five particles.

particle	number of protons	number of electrons	number of neutrons
.....	19	19	20
${}^{56}_{26}\text{Fe}$	.....	.....	.....
.....	3	2	4
${}^{70}_{31}\text{Ga}^{3+}$	.....	.....	.....
.....	34	36	45

[Total: 8]

- 2 The table shows the melting points, boiling points and electrical properties of five substances, A to E.

substance	melting point /°C	boiling point /°C	electrical conductivity of solid	electrical conductivity of liquid
A	-7	59	poor	poor
B	1083	2567	good	good
C	755	1387	poor	good
D	43	181	poor	poor
E	1607	2227	poor	poor

Choose a substance from the table above to match each of the following descriptions. A substance may be used once, more than once or not at all. Justify each choice with evidence from the table.

One has been completed as an example.

This substance is covalent and is a solid at room temperature (25 °C). .....**D**.....

evidence *Its melting point is above room temperature. It has a low melting point and it does not conduct as a liquid, so it is covalent.*

(a) This substance has a giant covalent structure. ....

evidence ..... [3]

(b) This substance is a metal. ....

evidence ..... [2]

(c) This substance is a liquid at room temperature (25 °C). ....

evidence ..... [3]

(d) This substance is an ionic solid. ....

evidence ..... [3]

[Total: 11]

3 Calcium reacts with nitrogen to form the ionic compound calcium nitride,  $\text{Ca}_3\text{N}_2$ .

(a) Draw a diagram, based on the correct formula, which shows the charges on the ions and the arrangement of the electrons around the negative ion.

Use o to represent an electron from a calcium atom.  
Use x to represent an electron from a nitrogen atom.

[3]

(b) In the lattice of calcium nitride, the ratio of calcium ions to nitride ions is 3 : 2.

(i) What is meant by the term *lattice*?

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

(ii) In terms of ionic charges, explain why the ratio of ions is 3 : 2.

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

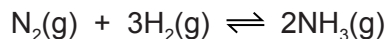
(c) The reaction between calcium and nitrogen to form calcium nitride is a redox reaction.

In terms of electron transfer, explain why calcium is the reducing agent.

.....  
.....  
.....  
..... [3]

[Total: 10]

4 Ammonia is made by the Haber process.



The forward reaction is exothermic.

Typical reaction conditions are:

- finely divided iron catalyst,
- temperature 450 °C,
- pressure 200 atmospheres.

(a) Explain why the catalyst is used as a very fine powder and larger pieces of iron are not used.

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

(b) Using the above conditions, the equilibrium mixture contains about 15% ammonia.

State two changes to the reaction conditions which would increase the percentage of ammonia at equilibrium.

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

(c) Suggest why the changes you have described in (b) are **not** used in practice.

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

[Total: 6]

5 Three common methods of preparing salts are shown below.

method **A** adding an excess of an insoluble base or carbonate or metal to a dilute acid and removing excess by filtration

method **B** using a burette and indicator

method **C** mixing two solutions to obtain the salt by precipitation

For each of the following salt preparations, choose a method, **A**, **B** or **C**. Name any additional reagent which is needed and complete the equation.

(a) the soluble salt, nickel chloride, from the insoluble compound nickel carbonate

method .....

reagent .....

word equation .....

[3]

(b) the insoluble salt, lead(II) bromide, from aqueous lead(II) nitrate

method .....

reagent .....

ionic equation ..... + .....  $\rightarrow$   $\text{PbBr}_2$

[3]

(c) the soluble salt, lithium sulfate, from the soluble base lithium hydroxide

method .....

reagent .....

equation .....

[4]

[Total: 10]

6 The Atacama desert in Chile has deposits of the salt sodium nitrate. Very large amounts of this salt were exported to Europe for use as a fertiliser. After the introduction of the Haber process in 1913, this trade rapidly diminished.

(a) (i) Explain why the introduction of the Haber process reduced the demand for sodium nitrate.

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

(ii) Suggest why surface deposits of sodium nitrate only occur in areas with very low rainfall such as desert areas.

..... [1]

(iii) The desert has smaller surface deposits of potassium nitrate.

Suggest why potassium nitrate is a better fertiliser than the sodium salt.

..... [1]

(b) All nitrates decompose when heated. The extent to which a nitrate decomposes is determined by the metal in the salt.

(i) Sodium nitrate decomposes to form sodium nitrite,  $\text{NaNO}_2$ .

Write the equation for decomposition of sodium nitrate.

..... [2]

(ii) Sodium nitrite is a reducing agent.

What would be observed if an excess of sodium nitrite solution was added to a solution of acidified potassium manganate(VII)?

..... [2]

(iii) Copper(II) nitrate decomposes to form copper(II) oxide, nitrogen dioxide and oxygen.

What is the relationship between the extent of decomposition and the reactivity of the metal in the nitrate?

.....  
 ..... [1]

(c) The equation for the decomposition of copper(II) nitrate is given below.



(i) Predict what you would observe when copper(II) nitrate is heated.

.....  
 .....  
 ..... [3]

(ii) Copper(II) nitrate forms a series of hydrates with the formula  $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ .  
 All these hydrates decompose to form copper(II) oxide.  
 1 mole of  $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$  forms 1 mole of CuO.

What is meant by 1 mole of a substance?

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

(iii) 7.26 g of a hydrate,  $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ , formed 2.4 g copper(II) oxide.

number of moles of CuO formed = .....

number of moles of  $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$  in 7.26 g = .....

mass of 1 mole of  $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$  = .....g

mass of 1 mole of  $\text{Cu}(\text{NO}_3)_2$  is 188 g

the value of x in this hydrate = .....

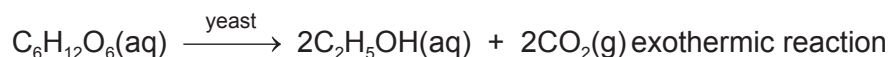
[4]

[Total: 18]



7 Alcohols can be made by fermentation or from petroleum.

(a) Ethanol can be made by the fermentation of glucose.



Yeast are living single-cell fungi which ferment glucose by anaerobic respiration. This reaction is catalysed by enzymes from the yeast.

(i) What is meant by the term *respiration*?

.....  
 .....  
 ..... [3]

(ii) *Anaerobic* means in the absence of oxygen.

Name the products formed from respiration in the **presence** of oxygen.

..... [1]

(iii) What are enzymes?

..... [1]

(iv) Suggest a method of measuring the rate of this reaction.

.....  
 ..... [1]

(b) The following observations were noted.

- When a small amount of yeast was added to the aqueous glucose the reaction started and the solution went slightly cloudy.
- The reaction rate increased and the solution became cloudier and warmer.
- After a while, the reaction rate decreased and eventually stopped, leaving a 14% solution of ethanol in water.

(i) Why did the reaction rate increase?

..... [1]

(ii) Suggest an explanation for the increase in cloudiness of the solution.

..... [1]

(iii) Give **two** reasons why the fermentation stopped.

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

(c) One use of ethanol is in alcoholic drinks.

Give **two** other uses of ethanol.

..... [2]

(d) Alcohols can be made from petroleum by the following sequence of reactions.

alkanes from petroleum → alkene → alcohol

Describe the manufacture of ethanol from hexane, C<sub>6</sub>H<sub>14</sub>. Include in your description an equation and type of reaction for each step.

.....  
.....  
.....  
..... [5]

[Total: 17]



**DATA SHEET**  
**The Periodic Table of the Elements**

Group		I	II	III	IV	V	VI	VII	0							
		1 <b>H</b> Hydrogen 1							2 <b>He</b> Helium 2							
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4				11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18				
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12			27 <b>Fe</b> Iron 26	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36			
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	55 <b>Mn</b> Manganese 25	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36		
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54		
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>Rn</b> Radon 86		
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	89 <b>Ac</b> Actinium														
		140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71		
		232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Pa</b> Protactinium 91	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	

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

Key

a	<b>X</b>
b	

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

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