

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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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.

- 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, Ca_3N_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.

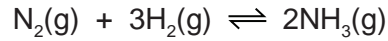
In terms of electron transfer, explain why calcium is the reducing agent.

.....

 [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 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, 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

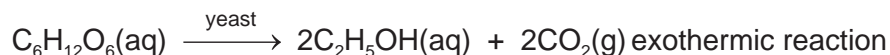
the value of x in this hydrate =

[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.

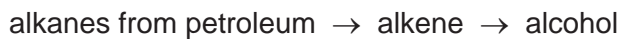
.....
 [2]

(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.



Describe the manufacture of ethanol from hexane, C₆H₁₄. Include in your description an equation and type of reaction for each step.

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

[Total: 17]

DATA SHEET
The Periodic Table of the Elements

I		Group										VII		0																									
II		III										IV		V	VI	VII	0																						
		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">1</td> <td style="width: 10%; text-align: center;">H</td> <td colspan="9"></td> </tr> <tr> <td colspan="2" style="text-align: center;">Hydrogen 1</td> <td colspan="10"></td> </tr> </table>										1	H										Hydrogen 1																
1	H																																						
Hydrogen 1																																							
7	Li											11	B	12	C	14	N	16	O	19	F	20	Ne																
Lithium 3												Boron 5		Carbon 6		Nitrogen 7		Oxygen 8		Fluorine 9		Neon 10																	
23	Na											27	Al	28	Si	31	P	32	S	35.5	Cl	40	Ar																
Sodium 11												Aluminium 13		Silicon 14		Phosphorus 15		Sulfur 16		Chlorine 17		Argon 18																	
39	K											70	Ga	73	Ge	75	As	79	Se	80	Br	84	Kr																
Potassium 19												Gallium 31		Germanium 32		Arsenic 33		Selenium 34		Bromine 35		Krypton 36																	
85	Rb											115	In	119	Sn	122	Sb	128	Te	127	I	131	Xe																
Rubidium 37												Indium 49		Tin 50		Antimony 51		Tellurium 52		Iodine 53		Xenon 54																	
133	Cs											204	Tl	207	Pb	209	Bi	208.4	Po	209	At	210	Rn																
Caesium 55												Thallium 81		Lead 82		Bismuth 83		Polonium 84		Astatine 85		Radon 86																	
87	Fr											226	Ra	227	Ac																								
Francium 87												Radium 88		Actinium 89																									
												140	Ce	141	Pr	144	Nd	150	Sm	152	Eu	157	Gd	162	Dy	165	Ho	167	Er	169	Tm	173	Yb	175	Lu				
												Cerium 58		Praseodymium 59		Neodymium 60		Samarium 62		Europium 63		Gadolinium 64		Dysprosium 66		Holmium 67		Erbium 68		Thulium 69		Ytterbium 70		Lutetium 71					
232	Th											238	U	238	Pu	238	Np	238	Am	238	Cm	238	Bk	238	Cf	238	Es	238	Fm	238	Md	238	No	238	Lr				
Thorium 90												Uranium 92		Plutonium 94		Neptunium 93		Americium 95		Curium 96		Berkelium 97		Californium 98		Einsteinium 99		Fermium 100		Mendelevium 101		Nobelium 102		Lawrencium 103					

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

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).