3051/3

BGCSE

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 3 3051/3

Wednesday **8 JUNE 2005** 12.30 – 2.00 P.M.

Additional materials:
Answer booklet
Graph paper

MINISTRY OF EDUCATION
NATIONAL EXAMINATIONS

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INSTRUCTIONS AND INFORMATION TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your school number, candidate number, surname and initials at the top of this page as well as at the top of all lined paper submitted.

Answer **ALL** the questions in **Section A** in the spaces provided on the question paper and any **TWO** questions from **Section B** on the lined paper provided.

Equations and diagrams should be given wherever they are helpful.

Essential working must be shown.

The intended marks for each question or part question are given in brackets [ ].

Relative atomic masses are given in the Periodic Table of elements provided.

ADDITIONAL INFORMATION

s.t.p. (t = 0 °C, p = 760 mm Hg)
The volume of one mole of gas at room temperature and pressure (r.t.p.) is 24,000 cm^3.

FOR EXAMINER'S USE	
Section A	
1	
2	
3	
4	
Section B	
5	
6	
7	
TOTAL	

This question paper consists of 12 printed pages and 4 blank pages.

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The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Sulphur 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

Section A

Answer all four questions in this section.

1. This recipe is for banana nut bread. Nutritional values indicate 6.6 g of sugar (sucrose) per serving. The recipe serves 12.

½ cup butter	1 teaspoon baking soda
1½ cups sugar	1 cup mashed bananas
2 eggs	1½ teaspoons vanilla
1½ teaspoons salt	1½ cups chopped pecans
1½ cups flour	

(a) (i) Baking soda, $NaHCO_3$, is used to make the bread rise. It decomposes when it is heated.

$$2\,NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

Calculate the volume of carbon dioxide produced by one teaspoon (5 g) of baking soda at r.p.t. [A_r: C,12; H, 1; O, 16; Na; 23].

[3]

(ii) Name the ingredient in the recipe which can be replaced by potassium chloride.

_____ [1]

(iii) Potassium ions are abundant in bananas.

State the oxidation number of the potassium ion.

_____ [1]

(b) In one serving of banana nut bread there will be 6.6 g of sucrose. When digested, sucrose will turn to glucose, then glucose is used for energy production in the body.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow 2\,C_6H_{12}O_6$$
sucrose glucose

Calculate the mass of glucose produced from 6.6 g of sucrose.

[2]

(c) The overall equation for energy production from glucose is given.

$$C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O \quad \Delta H = -2800\ kJ$$

Use the mass of glucose in your answer to (b) to find

(i) the mass of water produced from this mass of glucose,

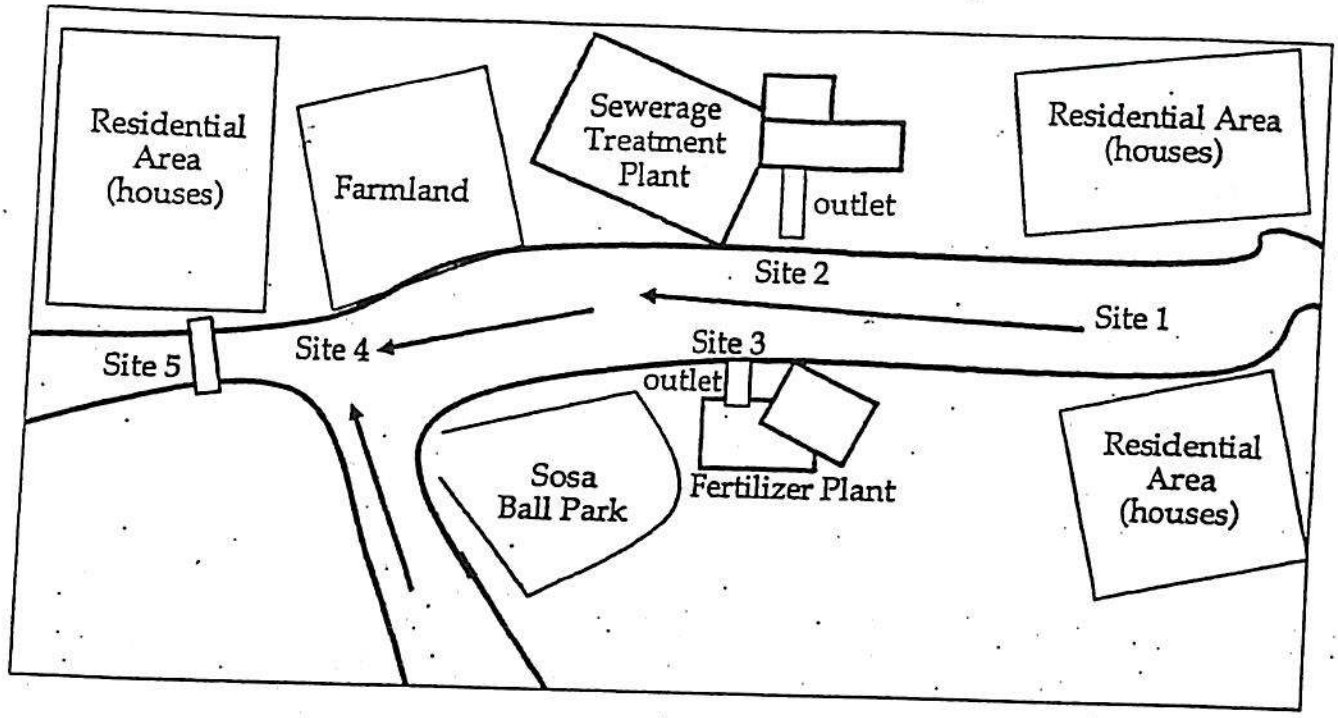
[1]

(ii) the amount of heat energy produced, in kilojoules.

[2]

Total marks [10]

2. The diagram shows a polluted river flowing through a part of a town.



(a) Briefly explain how you would recognize a river polluted by phosphates.

_____

_____ [1]

(b) Chemistry students carried out a number of tests at the different sites.

Test Results

Site	phosphates mg/L	dissolved oxygen mg/L
1	10.0	10.0
2	22.0	4.0
3	25.0	3.5
4	28.0	2.2
5	27.0	8.0

(i) Plot two bar graphs to represent the results of the water testing. The x-axis is same in both graphs. Use a scale marked in 5 mg/L units on the y-axis.

[4]

Identify the site which shows the largest change in

(ii) phosphate concentration;

_____

(iii) dissolved oxygen concentration.

_____

(iv) Use the information given to identify the source which is the greatest contributor to the phosphate pollution.

_____ [3]

(c) State where phosphates enter the river and give the source of the phosphates.

_____

_____ [1]

(d) Name another pollutant which may enter the river at site 4.

_____ [1]

Total marks [10]

3. Electroplating is the coating of an object with a thin layer of metal in an electrolytic cell.

(a) (i) Before plastic automobile bumpers, name the transition metal that was used to electroplate the old iron bumpers.

_____ [1]

(ii) Give two reasons for the electroplating of bumpers.

_____

_____

_____

_____ [2]

(b) (i) Sketch an electrolytic cell to coat an iron ring with silver. Use silver nitrate as an electrolyte. The anode is made of silver. Label the cathode and anode.

[4]

(ii) Write symbolic equations for the reactions at the anode and cathode.

Cathode _____

Anode _____ [2]

(c) Give one industrial application of electrolysis other than electroplating.

_____ [1]

Total marks [10]

4. Methanol may be used to produce gasoline. A special catalyst (ZSM-5) may be used to assist the reactions.

The reactions are:

Stage 1 methanol → water + dimethyl ether $(CH_3)_2O$
Stage 2 $(CH_3)_2O$ → ethene + water
Stage 3 ethene → hydrocarbons of C_6 to C_{12}

(a) Write the chemical formulae of the organic compounds methanol and ethane.

Methanol

ethane [2]

(b) Give a name for the type of reaction that takes place in **stage 3.**

_____ [1]

(c) Draw the structural diagram of a molecule having **six** carbon atoms that could be formed in **stage 3.**

[1]

(d) Ethanoic acid is a weak acid. Two substances that can react with it are some metals and alcohols.

Explain the term **weak acid.**

_____ [1]

(e) Write a balanced chemical reaction for ethanoic acid with

(i) **magnesium,** [2]

(ii) **methanol.** [2]

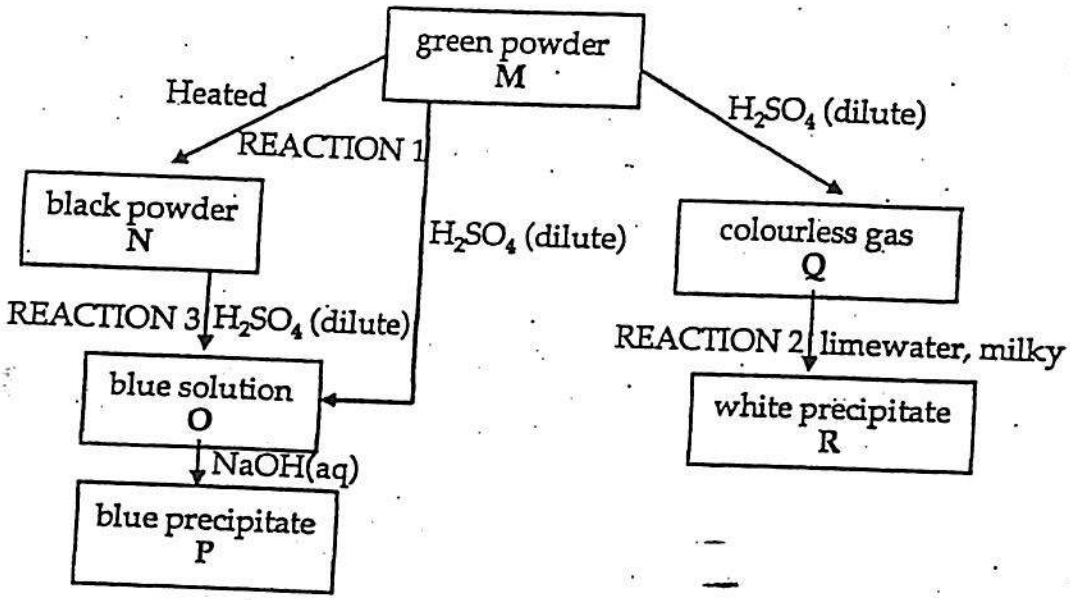
(iii) Name the type of compound formed in **(e)(ii).**

_____ [1]

Section B

Answer any two questions.

5. The diagram represents a number of chemical reactions.



(a) Name the substances **M, N, O, P, Q** and **R**. [6]

(b) Using the reagents named write balanced equations for

(i) REACTION 1

(ii) REACTION 2

(iii) REACTION 3 [6]

(c) The blue solution, **O**, was electrolysed using graphite rods. A brownish-pink solid was deposited at the cathode.

(i) Name the solid deposited at the cathode.

(ii) Write the ionic half reaction that takes place at the cathode.

(iii) Name the gaseous product formed at the anode. [4]

(d) Using information in (c)(ii) calculate the mass of solid produced if 4 moles of electrons were transferred. [2]

(e) An ore of copper contains copper carbonate. If electricity is not available for the electrolysis process, suggest how metallic copper could be obtained from its ore. [2]

Total marks [20]

6. A hydrocarbon **X** contains 82.76% of carbon by mass and has a relative molecular mass of 58. The hydrocarbon **X** slowly reacts with chlorine in the presence of diffused sunlight.

(a) (i) Find the percentage of hydrogen in the compound.

(ii) Determine the empirical formula of **X**.

(iii) Determine the molecular formula of **X**. [6]

(b) (i) Define the term isomer. [2]

(ii) Draw and name the structural formula of **X** and draw one other isomer that has this formula. [3]

(c) State **two** pieces of evidence, from the formula, that are used to classify **X** into a specific homologous series and state the M_r of the next member of this homologous series. [2]

(d) (i) Write an equation for the reaction of hydrocarbon **X** with chlorine in diffused sunlight. [2]

(ii) Name this type of reaction. [1]

(e) (i) Describe the flame that is seen when this hydrocarbon burns in a limited supply of oxygen. [1]

(ii) Name the toxic gas formed in the conditions described in (i). [1]

(iii) Find the volume of oxygen which will be used up when one mole of hydrocarbon **X** burns in excess oxygen. [2]

Total marks [20]

7. A student took a lump of dirty limestone with a mass of 1.0 g and reacted it with an excess of hydrochloric acid. The carbon dioxide gas produced by the reaction was collected and its volume measured at regular intervals at r.p.t.

The experiment was repeated using 1.0 g of small pieces of dirty limestone.

The experiment was repeated a third time using 1.0 g of finely powdered dirty limestone.

The student's data is recorded as shown.

time/min	0	1	2	3	4	5	6	7	8	9	10	11	12
expt A/cm^3	0	11	22	33	43.5	53.5	63	71	77.5	79.5	80	80	80
expt B/cm^3	0	18.5	37.5	54.5	67.5	74.5	78.5	80	80	80	80	80	80

(a) Draw and label graphs for experiment A and experiment B using the same axes. [8]

(b) On the same graph draw a curve for the expected results when the student uses 1.0 g of finely powdered dirty limestone. Label this graph C. [2]

(c) (i) Write a balanced equation for the reaction that occurs in all three experiments. [2]

(ii) Calculate the number of moles present in 1 g of pure carbonate, $CaCO_3$. [2]

(iii) Use your equation in (c)(i) to find the number of moles of calcium in 1 g of the pure limestone.

Determine the volume of CO_2 produced from the pure sample at r.t.p. [2]

(iv) Calculate the number of moles of carbon dioxide present in the maximum volume of carbon dioxide given off in experiment A from 1 g of dirty limestone. [1]

(v) Find the percentage of calcium carbonate in the limestone. [2]

(d) Use your knowledge of the kinetic theory to explain why dry ice takes energy from its surroundings when it becomes a gas. [1]

Total marks [20]

End]