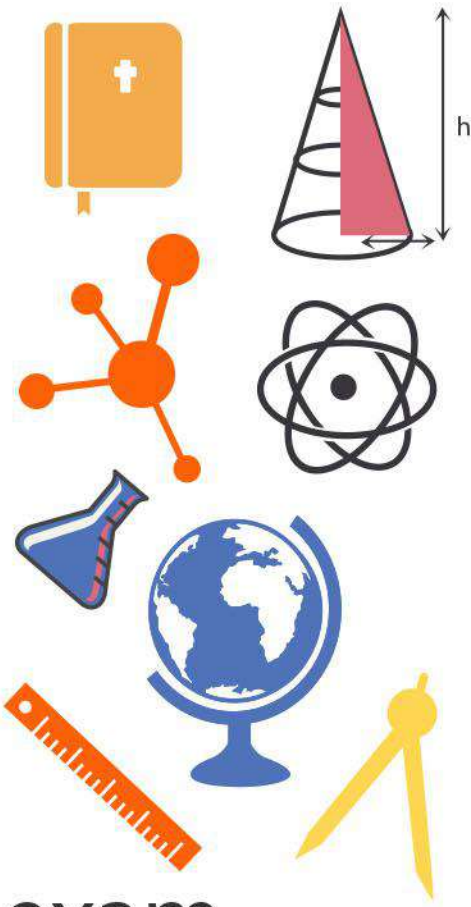

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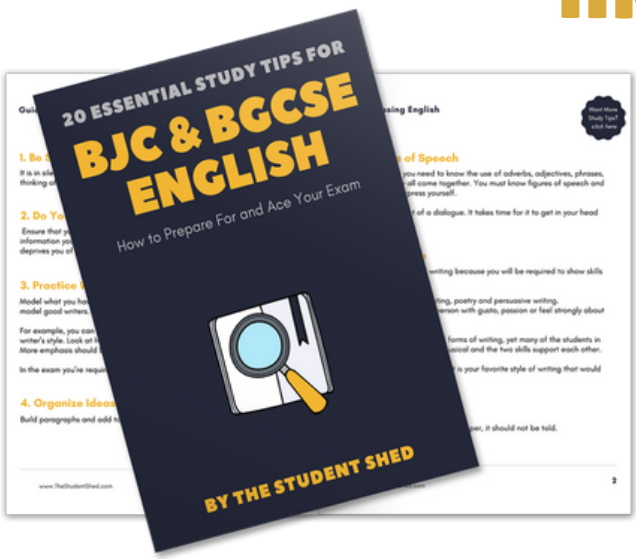

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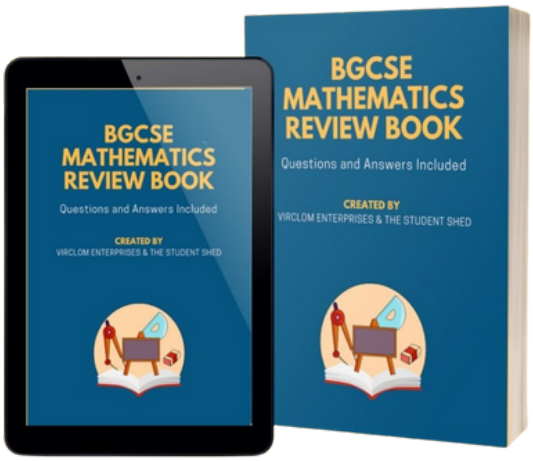

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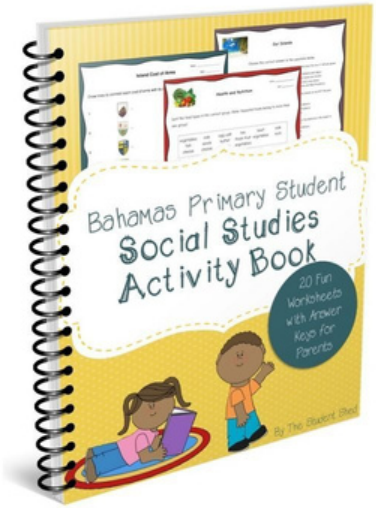

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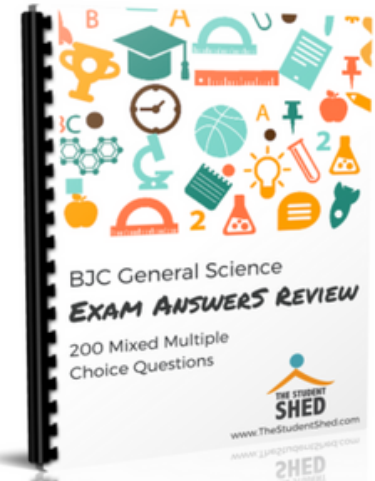

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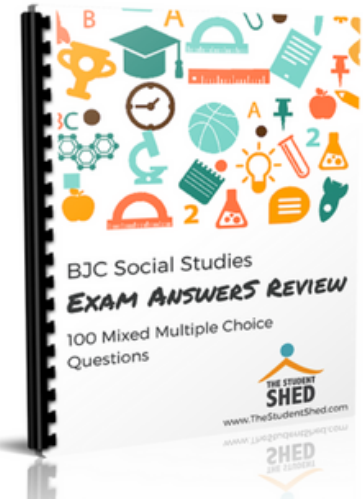

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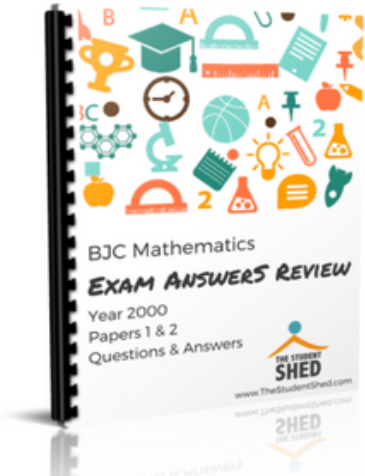

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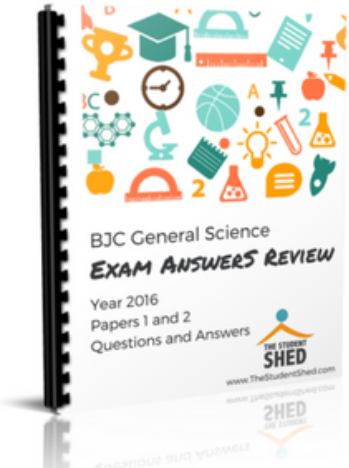

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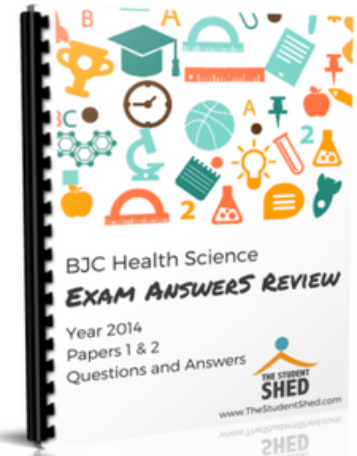

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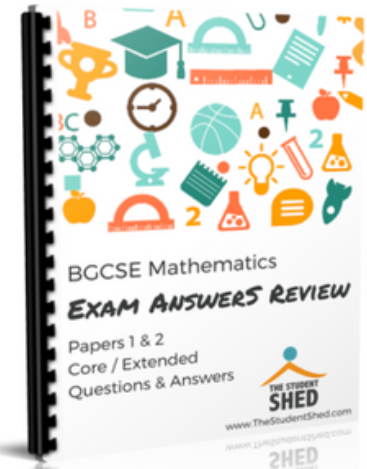

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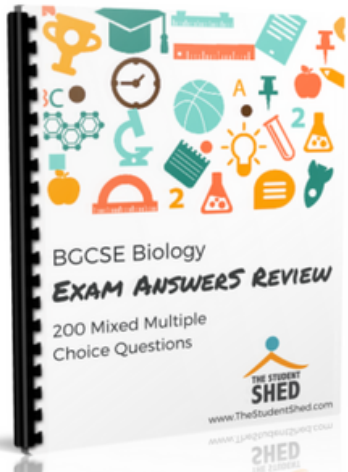

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3051/1 **BGCSE**

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CHEMISTRY

PAPER 1 3051/1

Wednesday 18 MAY 2016 12:00 NOON–1:15 P.M.

Additional materials:
None

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Write your school number, candidate number, surname and initials in the spaces provided above.

Answer **ALL** the questions on this paper.

For each question in this paper, **four** suggested answers A, B, C and D are given.

Circle the letter of the response which you consider to be correct.

Attempt **ALL** the questions. Marks will **NOT** be deducted for wrong answers. Your total score on this test will be the number of correct answers given.

Relative atomic masses are given in the Periodic Table of elements provided on page 2.

The volume of one mole of gas at room temperature and pressure (r.t.p.) is 24 000 cm^3 and at standard temperature and pressure (s.t.p.) is 22 400 cm^3.

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TOTAL MARKS	

This question paper consists of _14_ printed pages and _2_ blank pages.

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 ium	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 dium	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 ssium	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 idium	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 esium	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 ncium	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

-71 Lanthanoid series
-103 Actinoid series

a
X
b

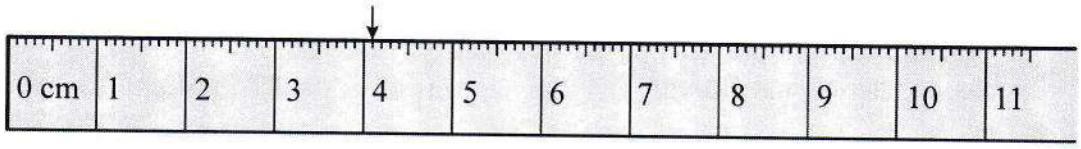
a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

1. What is the name of a group of chemicals that speed up a chemical reaction?

A catalysts
B galvanizers
C oxidising agents
D reducing agents

2. The diagram represents a scale found on a centimetre rule.

What is the value indicated by the arrow?



A 0.41 cm
B 0.42 cm
C 4.10 cm
D 4.20 cm

3. The reading on a thermometer indicates the temperature of a boiling liquid is 101°C.

Which liquid could the thermometer have been placed in?

	liquid	**purity**
A	ethanol	pure
B	methane	pure
C	propane	impure
D	water	impure

4. A sample of water is heated from −10°C to 110°C in a 15 minute period.

How many single states of matter and how many mixed states of matter will the water undergo?

	single states	**mixed states**
A	2	5
B	2	3
C	3	2
D	3	0

5. How is the number of neutrons determined for any atom?

A adding the number of protons to the mass number
B doubling the atomic number
C equals the number of electrons
D subtracting the number of protons from the mass number

6. Where on the Periodic Table would the element with the electronic configuration 2, 8, 3 be found?

A Group II
B Group VIII/0
C Period 3
D Second Period and Group III

7. In the Bohr model of an atom, how many orbits are needed to hold silicon's 14 electrons?

A 1
B 2
C 3
D 4

8. Carbon dioxide molecules with slightly different masses have been found.

Which factor accounts for this mass variation?

A allotropes
B isomers
C isotopes
D states of matter

9. What is the **total number** of electrons found in a water molecule?

A 2
B 8
C 10
D 18

The list below contains the names of the four different types of chemical bonds. Use this information to answer questions **10** to **12**. The choices may be used once, more than once or not at all.

A covalent
B dative
C ionic
D metallic

Which type of bond is formed when

10. hydrogen and oxygen bond to form water; A. B C D

11. the lattice structure of NaC*l* is formed; A. B C D

12. ammonia bonds with a fourth hydrogen to form the ammonium ion? A B C D

13. What is the amount in moles, of NaOH, found in 32 g of NaOH?

A 0.80 moles
B 1.25 moles
C 40 moles
D 1 280 moles

14. What is the relative molecular mass of H_2SO_4?

A 3
B 7
C 48
D 98

15. Which element can be found in the form of a diamond?

A carbon
B krypton
C potassium
D silver

16. What is the molecular formula of a compound with the structural formula $CH_3CH_2CH_3$?

A CH
B $3C_8H$
C C_3H_8
D $(CH_3)_2CH_2$

17. How many moles of oxygen gas are needed to balance the combustion reaction of one mole of butane?

$$C_4H_{10} + \underline{X}O_2 \longrightarrow 4CO_2 + 5H_2O$$

A ½
B 5
C 6½
D 9

18. What is the molecular formula of a hydrocarbon with an empirical formula of CH_3 and an M_r of 30?

A CH_3
B C_2H_6
C C_3H_8
D C_4H_{10}

19. Hydrogen bromide gas dissolves in a liquid and ionises to produce hydrogen ions as the only positive ions in a liquid.

Which liquid causes hydrogen bromide gas to ionise?

A acetone
B methylbenzene
C toluene
D water

20. Which statement about an acid is **true**?

A forms water with an alkali
B pH is >7
C forms negatively charged hydronium ions in water
D is a non-electrolyte

21. When copper reacts with hot concentrated sulfuric acid it produces copper sulfate.

Which other products are formed?

A hydrogen gas only
B water only
C water and sulfur dioxide gas
D water and hydrogen gas

22. Which salt remains when a solution of H_2SO_4 is titrated with a solution of $Ca(OH)_2$?

A calcium hydroxide
B calcium oxide
C calcium sulfate
D calcium sulfite

23. The table shows the colours that Universal Indicator becomes when added to four different solutions.

Which row in the table correctly matches the colour of the indicator and the solution?

	name of solution	**colour of Universal Indicator**
A	nitric acid	blue
B	potassium nitrate	green
C	sodium hydroxide	yellow
D	ammonia solution	red

24. Which ion is indicated by a blue-green colour in a firework display?

A Cu^{2+}
B Ba^{2+}
C Na^{+}
D Ca^{2+}

Use the list of gases to answer questions **25**, **26** and **27**. The choices can be used once, more than once or not at all.

A ammonia
B hydrogen chloride
C sulfur dioxide
D chlorine

Which gas

25. turns moist red litmus blue; A B C D

26. forms dense white fumes with ammonia gas; A B C D

27. turns moist blue litmus red and then bleaches it? A B C D

28. What is the name of the process by which electricity is used to bring about a chemical change?

A corrosion
B electrolysis
C oxidation
D voltage

29. Which change occurs to the ion at the anode during electrolysis?

A reduction
B oxidation
C gains electrons
D gains mass

30. This reaction is part of the contact process.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

What happens if the amount of SO_2 is increased?

A O_2 increases and SO_3 increases
B O_2 decreases and SO_3 decreases
C O_2 increases and SO_3 decreases
D O_2 decreases and SO_3 increases

31. What is a change in concentration of either a reactant or product over a period of time called?

A reaction rate
B reactant concentration
C product concentration
D state change

32. Zinc is less reactive than magnesium.

What is the reactivity relationship between zinc and magnesium?

A Magnesium can displace zinc ions from zinc compounds.
B Zinc can displace magnesium from magnesium compounds.
C Magnesium is lower than zinc in the reactivity series.
D Zinc is a stronger reducing agent than magnesium.

33. Which of these statements does **not** describe what happens during a redox oxidation?

A a decrease in oxidation number
B a loss of protons
C a gain of oxygen
D a loss of hydrogen by a covalent molecule

Use the table to answer questions **34** and **35**.

The table shows the products formed at the anode and the cathode during electrolysis.

	compound electrolysed	**product at carbon anode**	**product at carbon cathode**
A	molten lead bromide	bromine	lead
B	potassium nitrate solution	oxygen	hydrogen
C	concentrated sodium chloride solution	oxygen	hydrogen
D	copper sulfate solution	oxygen	copper

Which row in the table shows an

34. incorrect product at one of the electrodes; A B C D

35. electrolysed compound which did not produce hydroxide ions? A B C D

36. Magnesium metal is made by the electrolysis of molten $MgCl_2$. One of the half-reactions is shown.

$$Mg^{2+} + 2e^- \longrightarrow Mg$$

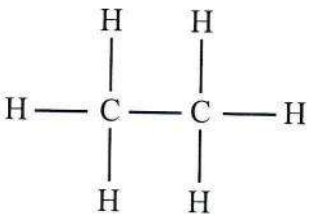
Which statement about the electrolysis of molten $MgCl_2$ is correct?

A magnesium is made at the cathode.
B magnesium ions are oxidised.
C chloride ions are reduced at the anode.
D chloride ions gain electrons during the process.

37. Which pollution problem can be caused by the ammonia, NH_3 produced by burning fossil fuels?

A acid rain
B eutrophication
C global warming
D depletion of the ozone layer

38. The diagram shows the structural formula of ethane.



The electronic configuration of C is 2, 4 and H is 1.

How many covalently bonded electrons surround each carbon atom in the above structure?

A 2
B 4
C 6
D 8

39. What is the correct order of the following hydrocarbons in terms of increasing boiling points?

propane C_3H_8 methane CH_4 and ethane C_2H_6

A methane, propane, ethane
B ethane, methane, propane
C methane, ethane, propane
D ethane, propane, methane

40. Which name is given to a series of compounds that differ from each other by a fixed repeating unit?

A heterogeneous series
B homologous series
C homogeneous series
D hydrocarbon series

41. Dilute acetic acid, commonly known as vinegar, is the second smallest carboxylic acid.

Which choice correctly matches the correct formula and name for this acid?

	acid name	**formula**
A	ethanoic	CH_3COOH
B	hydrochloric	HCl
C	methanoic	CHOOH
D	methanoic	CHO_2H

42. Which pair shows two elements which are liquids at room temperature and pressure?

A bromine and mercury
B chlorine and water
C fluorine and silver
D oxygen and zinc

43. Which element in the Periodic Table has an allotrope that is capable of conducting electricity?

A carbon
B chlorine
C oxygen
D sulfur

Questions **44** and **45** are about the refining of petroleum.

44. Which method is used to obtain lubricating oil from crude oil?

A centrifugation
B chromatography
C filtration
D fractional distillation

45. Lubricating oils undergoes additional processing to obtain larger amounts of the more valuable hydrocarbons.

What is the name of this process?

A cracking
B esterification
C hydrolysis
D polymerisation

46. Which compound is an unsaturated hydrocarbon?

A ethane
B ethene
C ethanoic acid
D ethyl methanoate

47. Blanco Bleach is a Bahamian company.

Which element is needed in large quantities by Blanco to make bleach?

A bromine
B chlorine
C fluorine
D iodine

48. Carbon dioxide emissions have steadily increased since the start of the industrial age. As a result, the carbon dioxide in the Earth's air has increased by approximately 20%.

What are the effects of this change?

A acid rain
B global warming
C both of the above
D none of the above

49. Which ore is aluminum metal extracted from?

A aragonite
B bauxite
C galena
D haematite

50. Iron is extracted from its ore using a blast furnace.

Which form of iron is extracted from the blast furnace?

A impure pig iron
B pure liquid iron
C solid iron nuggets
D stainless steel iron

3051/2

BGCSE

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 2 3051/2

Wednesday 18 MAY 2016 1:30 P.M.–3:00 P.M.

Additional materials:
None

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Answer **ALL** the questions on this paper.

Read each question carefully and make sure you know what you have been asked to do before starting your answer.

The instruction **NAME . . .** requires an answer in words **NOT** chemical symbols.

Show **ALL** your working when answering numerical questions. Lines are provided on the question paper for your answers. You should write your answers on these lines only.

A copy of the Periodic Table is provided on page 2.

The mark for each part question is given in brackets [ ].

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

This question paper consists of 16 printed pages and 4 blank pages.

The Periodic Table of the Elements

Group

	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
	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
	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
	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
	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
	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
	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

71 Lanthanoid series
03 Actinoid series

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

1. This question is about the Periodic Table.

(a) What is the Periodic Table?

_____ [1]

(b) State how the Modern Periodic Table is arranged.

_____ [1]

(c) Name the least reactive group of elements in the Periodic Table.

_____ [1]

(d) Name the series of elements to which Mn belongs.

_____ [1]

(e) Name the element that is in Period 3 Group II.

_____ [1]

(f) Name the element that has cation X^{3+} and electronic configuration 2,8.

_____ [1]

(g) State the name of the element with the symbol Sb.

_____ [1]

(h) State the charge on one ion of sodium.

_____ [1]

(i) Name the grey/purple solid halogen.

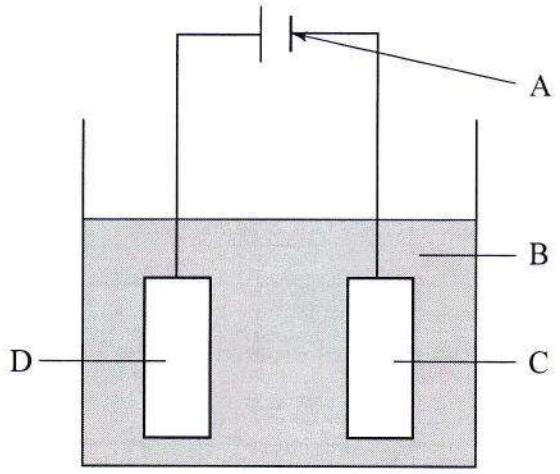
_____ [1]

(j) Name a non-metal that occupies 78% of the air.

_____ [1]

TOTAL MARKS [10]

2. The diagram shows an electrolytic cell.



(a) (i) Use the letters above to identify the part(s) of the cell that may be made of carbon.

_____ [1]

(ii) Name the allotrope of carbon used to make the parts mentioned in (a)(i).

_____ [1]

(iii) In an electrolysis cell, name the place where oxidation and reduction reactions occur.

oxidation _____

reduction _____ [2]

(b) Describe in terms of electrons, the meaning of **redox** reactions.

_____

_____ [2]

(c) Aluminium can be extracted by electrolysis from its ore, Bauxite. During the electrolysis oxygen is produced. The anode reacts with this oxygen, as shown in the equation.

$$C + O_2 \longrightarrow CO_2$$

(i) State the oxidation number of each carbon in the following.

C _____

CO_2 _____ [1]

(ii) State which element is oxidised and which is reduced in the equation.

oxidised _____

reduced _____ [1]

(iii) State why aluminium cannot be extracted from its ore by reduction with carbon.

_____ [1]

(d) Iron is extracted from its ore by a reaction with carbon.

State the name of the ore.

_____ [1]

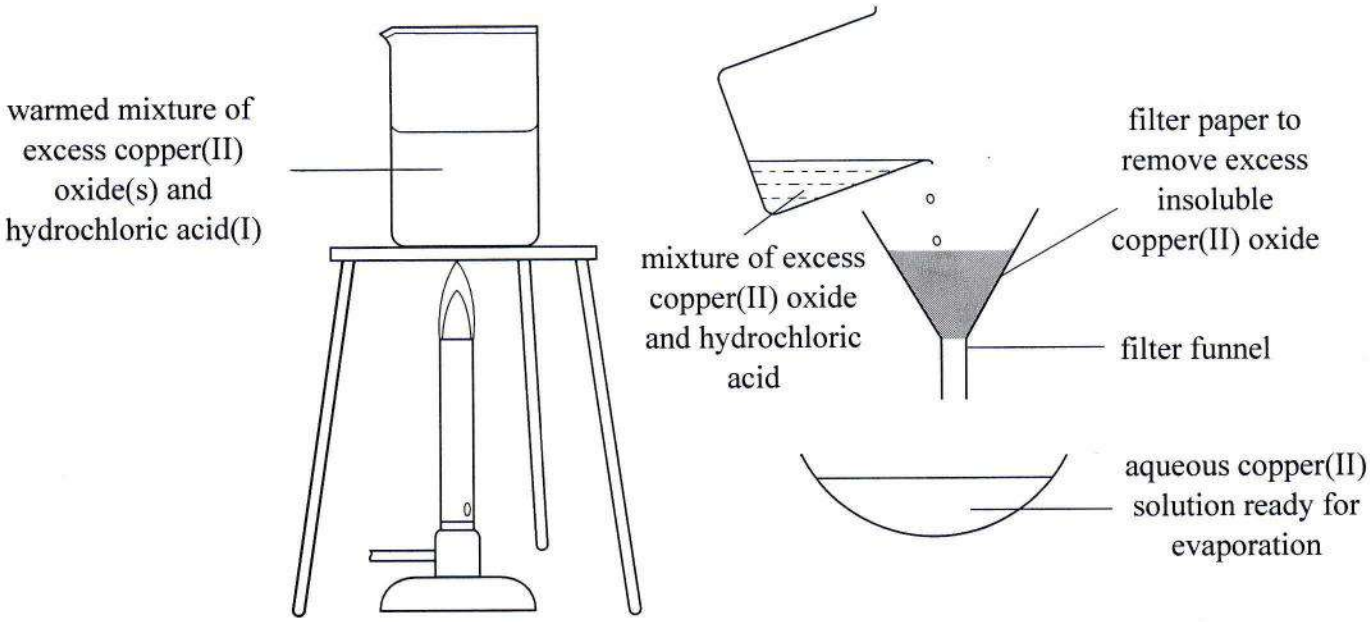
TOTAL MARKS [10]

3. (a) Litmus turns red in acid and blue in alkali.

Write the formulae of the ions in an acid and an alkali that cause litmus to have these colours.

acid _____ alkali _____ [2]

(b) The diagrams show the method of preparing a solid sample of a soluble salt, copper(II), using a base, copper(II) oxide, and an acid, hydrochloric acid.



stage 1 **stage 2**

(i) Explain why excess copper(II) oxide is added to hydrochloric acid in **stage 1**.

_____ [1]

(ii) State the pH of the copper(II) chloride solution in **stage 2**.

_____ [1]

(iii) After **stage 2**, the copper(II) chloride solution is heated.

Explain the reason for heating the copper(II) chloride solution.

_____ [1]

(iv) Balance the chemical equation for the reaction between CuO and HCl(aq).

___ CuO(s) + ___ HCl(aq) $\longrightarrow$ $CuCl_2$(aq) + ___ H_2O(l) [1]

(c) Coal, crude oil and natural gas contain small amounts of sulfur, which produces a colourless, toxic gas when burned in oxygen gas. The gas dissolves in rainwater and produces acid rain.

The chemical equation for this reaction is shown.

$$SO_2(g) + H_2O(l) \longrightarrow H_2SO_3(aq)$$

(i) Write a word equation for this chemical equation.

_____ [1]

(ii) Calculate the relative molecular mass of the product.

[1]

(iii) Determine the amount, in moles, in 41 grams of H_2SO_3

[1]

(iv) One way of reducing acid rain is to generate electricity without using fossil fuels. Instead, we can use renewable energy sources.

Name **ONE** renewable energy source.

_____ [1]

TOTAL MARKS [10]

4. Scientists have discovered many subatomic particles. The three most important for chemistry are the proton, neutron and electron.

(a) (i) Fill in the blanks to complete the table for these three named particles.

particle	mass (amu)	charge
proton		
neutron		
electron		

[3]

(ii) State why an atom is electrically neutral.

_____ [1]

(iii) The table gives values for the subatomic particles in **atoms**. Complete the table, using the Periodic Table on page 2.

symbol	number of protons	number of neutrons	number of electrons
	1	0	1
Na		12	11
Fe	26		26
P^{3-}	15	31	

[4]

(iv) Write the electronic configuration for Na.

_____ [1]

(b) Carbon-12, carbon-13 and carbon-14 are all isotopes of the solid carbon.
State how these isotopes are **different** and **similar**.

different _____

similar _____ [1]

TOTAL MARKS [10]

5. The industrial preparation of ammonia involves combining nitrogen and hydrogen at a high temperature and very high pressure in the presence of a catalyst.

(a) Name the process by which ammonia is manufactured.

_____ [1]

(b) Name the catalyst used in the process.

_____ [1]

(c) The overall chemical equation for the reaction is shown.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Calculate the amount, in moles, of hydrogen required to react with nitrogen to produce 13 moles of ammonia, using the equation.

[1]

(d) Explain why only partial conversion occurs in the manufacture of ammonia.

_____ [1]

(e) State what happens to the unreacted nitrogen and hydrogen gases.

_____ [1]

(f) A mixture of hydrogen, nitrogen and ammonia has a total volume of 48 dm^3 at room temperature and pressure. The ammonia makes up 45% of this mixture.

What is the amount, in moles, of ammonia in the mixture?

[2]

(g) Give the chemical name for a fertiliser, made by reacting ammonia with sulfuric acid.

_____ [1]

(h) Using outer electrons only, draw the covalent bonding diagram of a molecule of ammonia, NH_3.

[2]

TOTAL MARKS [10]

6. The table shows data collected and recorded from various metals reacting with aqueous hydrochloric acid.

metal	maximum temperature recorded (°C)
aluminium	85
copper	21
iron	35
lead	23
magnesium	95
zinc	55

(a) (i) Arrange the metals from the least to the most reactive.

_____ least reactive

_____

_____

_____

_____

_____ most reactive [1]

(ii) Write a word equation for magnesium reacting with aqueous hydrochloric acid.

_____ + _____ → _____ + _____ [2]

(iii) State the test and positive results for the gas produced in (ii).

test _____

positive results _____ [2]

(b) Use your knowledge of the reactivity series and metals to explain the following observations.

(i) Initially aluminium did not react with the hydrochloric acid but after a time it reacted vigorously.

_____ [1]

(ii) Copper pots do not react with lemon juice but aluminium and iron pots do.

_____ [1]

(iii) A student wanted to put a piece of potassium metal into the hydrochloric acid solution.

Explain why the teacher did not allow the student to do this.

_____ [1]

(c) Metals are economically important.

Explain the following observations based on the economic importance of metals.

(i) Manufacturers of pots use aluminium or steel instead of copper to make the vast majority of pots.

_____ [1]

(ii) There are finite amounts of metals.

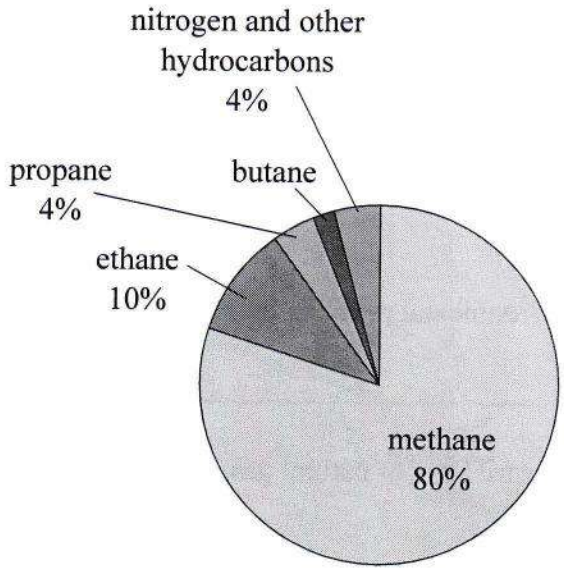
State a method that can be used to preserve these metals for future generations.

_____ [1]

TOTAL MARKS [10]

7. The pie chart shows the various hydrocarbons that are found in natural gas.

Per cent (%)



(i) Give the name of the homologues series the hydrocarbons in the pie chart belong to and its general formula.

homologues series _____

general formula _____ [2]

(ii) Calculate the relative molecular mass of butane.

[1]

(iii) Draw the structural formula of butane.

[2]

(iv) Write the word equation for the complete combustion of butane.

_____ [2]

(v) Arrange the named hydrocarbons butane, ethane, methane and propane from the highest to the lowest boiling points.

highest boiling point

_____

_____

_____

_____

lowest boiling point [1]

(vi) State **ONE** environmental problem burning natural gas can cause.

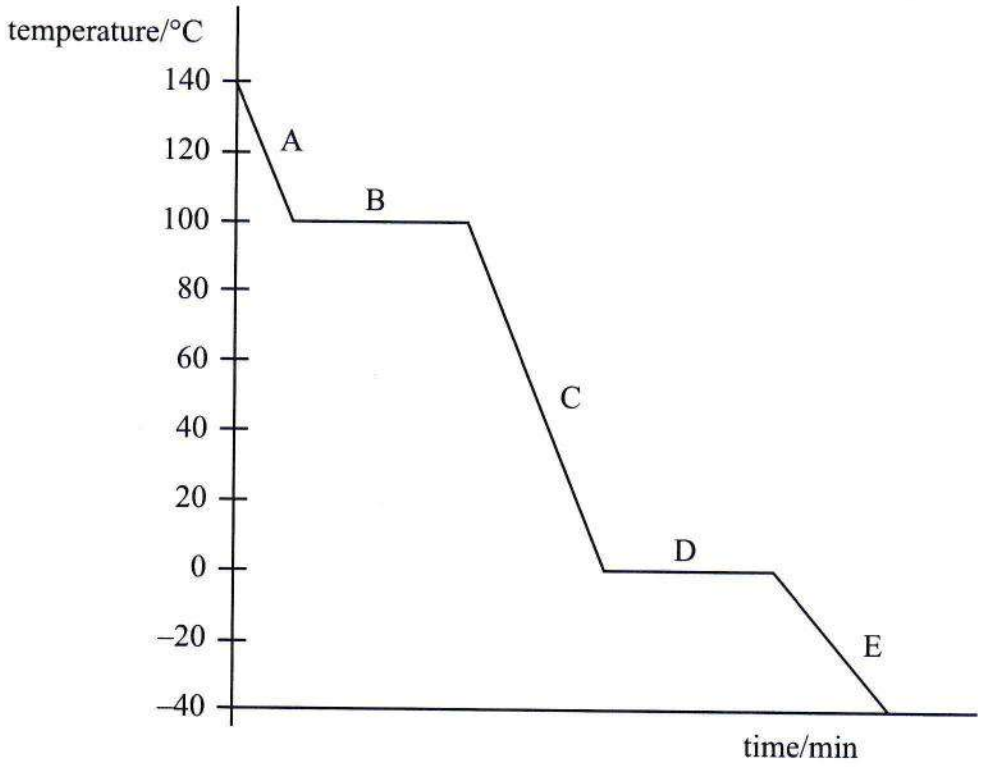
_____ [1]

(vii) State **ONE** industrial use of natural gas.

_____ [1]

TOTAL MARKS [10]

8. The cooling curve shows the relationship between temperature and time for a pure substance as it cools. The identity of the pure substance can be determined from the data shown by the graph. Sections of the graph are labelled with the letters A, B, C, D and E.



(a) (i) Give the name of the pure substance that produced this cooling curve.

_____ [1]

(ii) How many states of matter are shown by the cooling curve?

_____ [1]

(b) Give the name of the process when the pure substance changes from:

(i) A to B;

_____ [1]

(ii) E to D.

_____ [1]

(c) State how the addition of salt affects the numerical value of the substance's boiling point.

_____ [1]

(d) Name the bonding that holds the atoms to each other in the molecules.

_____ [1]

(e) Draw the particle packing for the appearance of the pure substance at section **E** of the graph.

[1]

(f) Briefly explain how the particle packing changes as it goes from **E** to **C**.

_____

_____ [1]

(g) Solid white crystals of ammonium chloride turn into a colourless gas when they are heated. The white crystals reappear when the gas is cooled.

(i) Name the change from solid to gas.

_____

(ii) Give the common name for solid CO_2 that can undergo this same change.

_____ [2]

TOTAL MARKS [10]

3051/3

BGCSE

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 3 3051/3

Monday 30 MAY 2016 12:00 noon–1:30 P.M.

Additional materials:
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 this question booklet and any **TWO** questions from **Section B** on the lined paper provided at the back of this question booklet.

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 printed on page 2.

For Examiner's Use	
Section A	
1	
2	
3	
4	
Section B	
5	
6	
7	
TOTAL	

ADDITIONAL INFORMATION

s.t.p. ($t = 0\,°C$, $p = 760\,mmHg$)

The volume of one mole of gas at room temperature and pressure (r.t.p.) is $24\,000\,cm^3$.

This question paper consists of 14 printed pages, 4 lined pages and 2 blank pages.

The Periodic Table of the Elements

Group

	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
m	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
a m	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
um	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
o um	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
s um	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
um	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

'1 Lanthanoid series
03 Actinoid series

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

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SCIENCE GRAPH PAPER

MINISTRY OF EDUCATION
BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

AB7

School No.	Candidate No.		Level:	For Examiner's Use
Subject Number & Title:			Paper:	
Surname & Initials:			Section:	
Signature:		Date:	Qu. No.	

Section A

1. A titration experiment was performed by adding 23.5 cm^3 of hydrochloric acid from a burette to neutralise 20 cm^3 potassium hydroxide solution in a conical flask. The concentration of the acid was 0.03 mol/dm^3.

(a) Explain why a burette, rather than a measuring cylinder was used in the titration.

_____

_____ [1]

(b) Phenolphthalein was the indicator used in the experiment.

State the colour of the indicator at the endpoint of the titration.

_____ [1]

(c) (i) Write a chemically balanced equation for the neutralisation reaction between hydrochloric acid and potassium hydroxide.

_____ [1]

(ii) Calculate the amount, in moles, of hydrochloric acid that completely neutralised the potassium hydroxide in the titration.

[2]

(iii) Calculate the concentration of potassium hydroxide, using your answers to (c)(i) and (ii).

[2]

(d) Hydrochloric acid is a strong acid which ionises completely in solution.

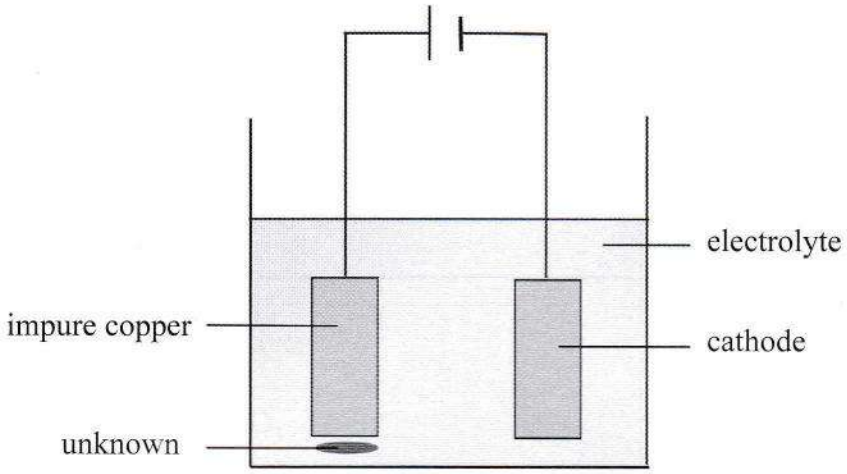
Write an ionic equation to show that a solution of hydrochloric acid is a strong acid that ionises completely in solution. Include state symbols in your equation.

_____ [2]

(e) State the range of values on the pH scale that indicate acids.

_____ [1]

2. The diagram shows a schematic sketch of an electrolysis cell.



(a) Explain the term *electrolysis*.

_____

_____ [2]

(b) The electrolyte in the purification of copper is copper(II) sulfate.

(i) State the materials that the anode and cathode are each made of.

anode _____

cathode _____ [2]

(ii) State the half-equation at the anode and at the cathode in the purification of copper.

anode reaction _____

cathode reaction _____ [2]

(iii) Describe what happens to the colour of the electrolyte as the reaction proceeds.

_____

_____

_____ [2]

(iv) Modern aluminium frying pans are anodised.

Name the substance which is used to cover and protect aluminium.

_____ [1]

(v) Name the type of substance found in the unknown.

_____ [1]

TOTAL MARKS [10]

3. Two important metals are aluminium and iron.

(a) Complete the table. [2]

metal	ore	extraction process
aluminium	**name:** _____ **formula:** _____	electrolysis
iron	**name:** hematite **formula:** Fe_2O_3	_____

(b) (i) Calculate the mass of hematite needed to produce 168 g of iron metal, using the equation.

$$Fe_2O_3(s) + 3CO(g) \longrightarrow 2Fe(l) + 3CO_2(g)$$

[2]

(ii) State the oxidation states of iron in each of the substances.

$Fe_2O_3(s)$ _____

$Fe(l)$ _____ [2]

(c) Write the ionic half-equation for the reaction at the cathode in the extraction of aluminium by electrolysis.

_____ [2]

(d) Iron and aluminium form many alloys.

(i) Define the term *alloy*.

_____ [1]

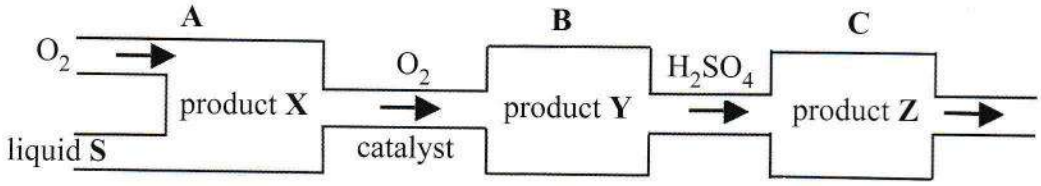
(ii) State **ONE** advantage of using an alloy of aluminium compared to aluminium metal.

_____ [1]

TOTAL MARKS [10]

4. Manufacture of sulfuric acid is of great economic importance.

A schematic diagram for the manufacture of sulfuric acid is shown.



(a) (i) Write chemically balanced equation for the formation of product **X** in part **A**.

_____ [2]

(ii) Name the catalyst used in part **B**.

_____ [1]

(iii) Explain why product **Y** is dissolved in concentrated sulfuric acid in part **C**, rather than water.

_____

_____ [1]

(b) The formation of product **Y** in part **B** is a reversible reaction.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad \Delta H = -197 \text{ kJ/mol}$$

Explain the effect of the actions on the equilibrium yield of sulfur trioxide, according to Le Chatelier's Principle.

(i) adding more oxygen is added

_____

_____ [2]

(ii) decreasing the pressure

_____

_____ [2]

(iii) There was a leakage of sulfur trioxide from part **B** and 120 g of sulfur trioxide escaped.

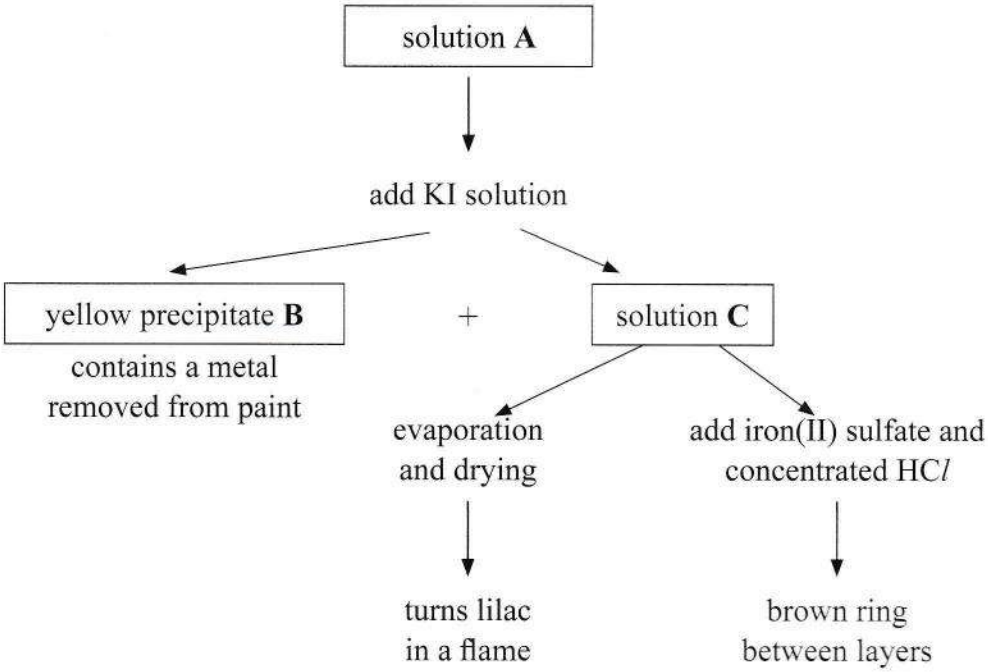
Determine the volume this mass of sulfur trioxide gas would occupy measured at room temperature and pressure.

[2]

TOTAL MARKS [10]

SECTION B

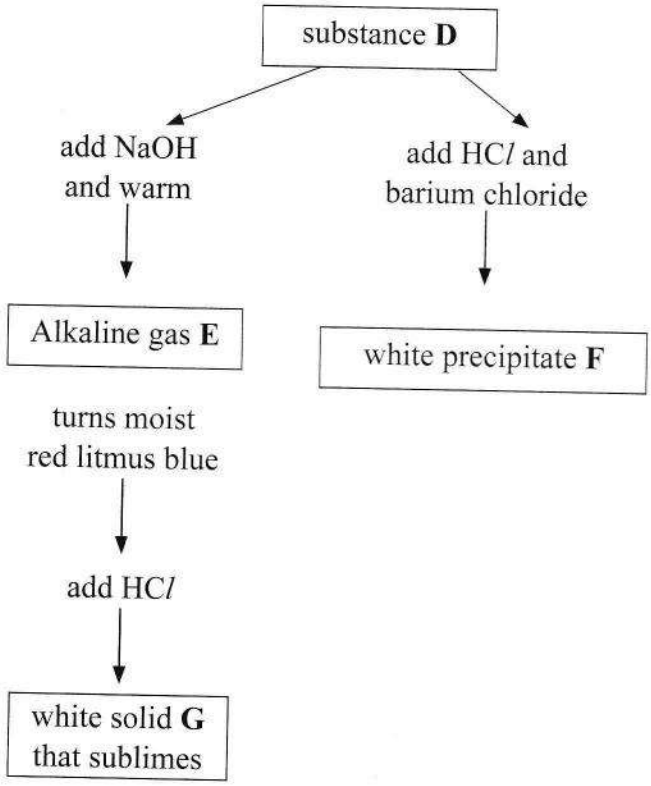
5. Use the information in the chart to answer the questions.



(a) (i) Identify solution **A**, yellow precipitate **B** and solution **C**. [3]

(ii) Write the complete balanced equation for the reaction between solutions **A** and **KI**. [2]

(b) Two tests were performed on unknown substance **D**. Use the information in the chart to answer the questions.



(i) Identify substance **D**, gas **E**, white precipitate **F** and the white solid **G**. [4]

(ii) Write a complete balanced equation for the reaction between phosphoric acid and gas **E**. [2]

(c) Fertilisers are important chemical compounds. However the sale of large quantities of fertilisers containing nitrates is prohibited.

(i) Explain why fertilisers, like ammonium nitrate, are closely monitored. [1]

(ii) Two fertilisers that contain nitrogen are ammonium sulfate and ammonium phosphate.

Determine which of the two fertilisers has the higher percentage of nitrogen. [2]

(iii) State the role of nitrogen in plants. [1]

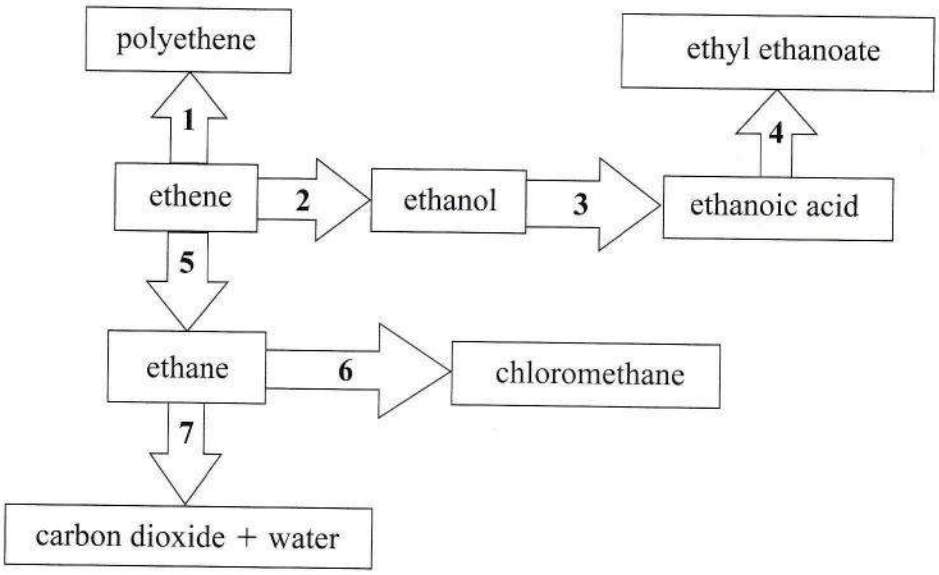
(iv) Determine the mass of nitrogen in 10 g of the best fertiliser, based on your answer to (c)(ii). [1]

(d) (i) Name one ion that causes eutrophication. [1]

(ii) Describe the process of eutrophication. [3]

TOTAL MARKS [20]

6. The diagram shows a series of organic reactions that change ethene into other organic compounds.



(a) (i) State the type of chemical reactions that occur in each of the stages, **1** to **7**, indicated by the arrows. [7]

(ii) Write balanced chemical equations for reaction **5** and for reaction **6**. [4]

(iii) The diagram shows a compound.

```
H   H
C = C
H   H
```

Copy and draw **TWO** successive links in the polymer chain with this compound. [2]

(iv) State the name of the monomer and polymer shown. [2]

(v) Give **ONE** use for the polymer in (a)(iii). [1]

(b) An organic compound is composed of 54.5% carbon, 36.4% oxygen and an unknown percentage of hydrogen. There are no other atoms in the compound. The molecular formula of the compound is 88.

Calculate its empirical and molecular formulae. [4]

TOTAL MARKS [20]

7. An experiment was carried out to investigate the effect of acid on limestone (calcium carbonate). A conical flask containing dilute nitric acid was placed on a balance. Lumps of calcium carbonate were added to the dilute nitric acid and a loose cotton wool plug was quickly placed in the neck of the conical flask.

The chemical reaction between calcium carbonate and dilute nitric acid produced calcium nitrate, water and carbon dioxide gas which escape into the air. The conical flask and its contents were weighed at regular intervals and the results were recorded in a table.

time/minutes	0	1	2	3	4	5	6	7	8	9	10	11	12
mass of flask and contents/g	96	82.5	74	66.5	60	54	49	46	44	43	42	42	42

(a) Plot these results on a graph. [6]

(b) (i) Use the graph to determine the decrease in the mass in the first 30 s. [1]

(ii) Explain why there is a decrease in the mass of the flask and its contents as time proceeds. [1]

(c) State the purpose of placing the cotton wool in the neck of the flask. [1]

(d) Write a balanced equation for the reaction. [2]

(e) (i) Calculate the mass of carbon dioxide released into the air when all of the calcium carbonate was completely reacted with the dilute nitric acid in the experiment. [1]

(ii) Calculate the volume of carbon dioxide that escaped into the air at r.t.p., using your answer in (e)(i). [2]

(f) When concentrated nitric acid, HNO_3, was spilled on a roll of copper wire, nitrogen dioxide, NO_2, $Cu(NO_3)_2$, and water were formed. Nitrogen dioxide is a reddish brown toxic gas and the building was evacuated.

(i) Explain why the reaction of nitric acid with copper wire is more dangerous than if the acid had fallen onto the same mass of copper bars. Use particle theory to support your explanation. [2]

(ii) Explain how the toxic gas was able to fill the lab quickly. Use particle theory to support your explanation. [1]

(iii) Balanced the chemical equation for the reaction between concentrated nitric acid and copper.

$$HNO_3 + Cu \longrightarrow Cu(NO_3)_2 + H_2O + NO_2$$ [1]

(iv) Calculate the volume of nitrogen dioxide produced at room temperature and pressure, when 320 g of copper completely reacts with concentrated nitric acid. [2]

TOTAL MARKS [20]

Question .....
Write on both sides of the paper

Question …….
Write on both sides of the paper

Question .....
Write on both sides of the paper

Question …….
Write on both sides of the paper