Surname	Centre Number	Candidate Number
Other Names		0



GCSE

4493/02



CHEMISTRY

CHEMISTRY 3 HIGHER TIER

A.M. THURSDAY, 14 May 2015

1 hour

For Examiner's use only				
Question	Maximum Mark	Mark Awarded		
1.	10			
2.	8			
3.	6			
4.	6			
5.	6			
6.	8			
7.	5			
8.	5			
9.	6			
Total	60			

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page. Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) used in your answers to questions **3** and **9**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

Answer all questions.

(i) Write t	he balanced	l symbol ed	uation whicl	h represent	s this reaction	on.	[3
		+		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		-	
	aph below stature between			age yield of	f sulfur trioxi	ide change	s wi
	100						
	80						
Percentage yield of sulfur	60						
trioxide	40-						
	20						
	0						
	300	400	500	600	700	800	
			Temperatu	re (°C)			
	e graph to fi 50°C to 450		ase in perce	ntage yield	if the tempe	rature is re	duce [2
			Incr	ease in per	rcentage yie	ld =	(
	olecule of so ale of oleum			one molecu	ıle of sulfurio	acid to for	m on
\\/rita	a balanced s	was ballagu	ation for this	roaction			[2

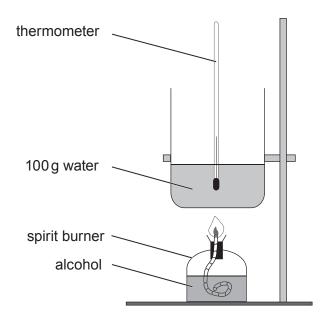
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(b)	State what you would observe when a few drops of concentrated sulfuric acid are added to a beaker containing a small amount of sugar. Name the product left in the beaker. [3]	Examiner only
		10

2. Methanol, ethanol, propanol and butanol belong to the alcohol family.

An experiment was carried out to discover which alcohol gives out the most energy when burned. The diagram below shows the apparatus used.



1g of each alcohol was used to heat 100g of water. The results are shown below.

Alcohol	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change (°C)	Energy given out (J/g)
methanol	18	31	13	5460
ethanol	20	45	25	10 500
propanol	19	48	29	12 180
butanol	20	50	30	

(a)	The energy given out	by e	each alcohol can	be	calcı	ulat	ed using the formula:
	energy given out	=	mass of water	×	4.2	×	temperature change
	Calculate the energy given out in burning 1 g of butanol.						

[2]

Energy given out = J/g

- (b) Apart from using 1 g of each alcohol and 100 g of water, give **one** other step that should be taken to ensure a fair test. [1]
- (c) The theoretical values for the energy given out by each alcohol are given in the table below.

Alcohol	Theoretical value for energy given out (J/g)
methanol	22700
ethanol	29700
propanol	33600
butanol	36 100

Compare the experimental and theoretical values and give the **main** reason for the difference between them. [3]

(d)	Some people are opposed to the large-scale use of bioethanol as a fuel. Describe br why someone could take this view.	iefly [2]

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4. Fire fighters use their understanding of the fire triangle to put out fires. Every year thousands of acres of moorland are destroyed by fire. Fire fighters use several different methods to put out this type of fire.



Suggest **three** *different* methods that could be used to put out moorland fires. Each method should refer to a different part of the fire triangle. State how **each** method is effective. [6]

Method 1
Method 2
Method 3

[2]

5. (a) The table below shows the first five members of the alkane family.

Alkane	Molecular formula
methane	CH ₄
ethane	C ₂ H ₆
propane	C ₃ H ₈
butane	C ₄ H ₁₀
pentane	C ₅ H ₁₂

(i) Give the molecular formula for the alkane which contains 18 hydrogen atoms. [1]

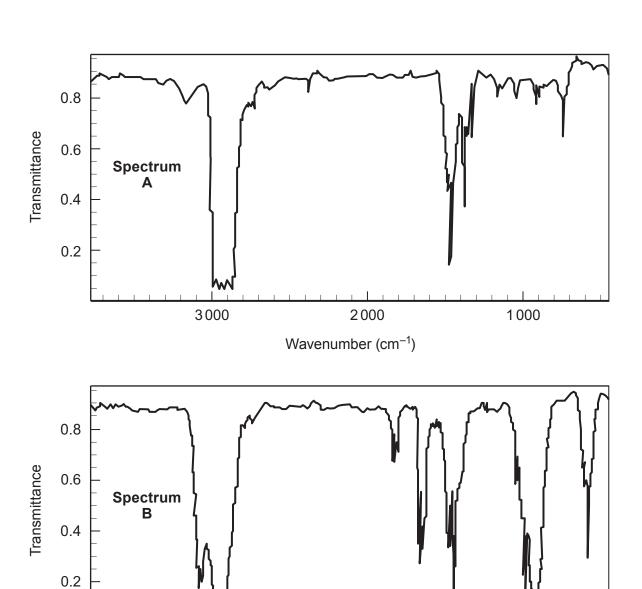
(ii) C₅H₁₂ has three isomers. The diagram below shows one of these isomers.Draw the other two isomers.

Isomer 2

Isomer 3

(b)	(i)	The first two members of the alkene family are ethene, C_2H_4 , and propene, C_3H_6 . Give the general formula for the alkene family.	₃ . [1]	•
	(ii)	Draw the structural formula for propene.	[1]	

(c) Study the infrared spectra of propane and propene below. Using the information in the table opposite, identify the spectrum of propene and give a reason for your answer. [1]



2000

1000

Examiner only

Bond	Wavenumber/cm ⁻¹
C—C	1620 to 1670
C=O	1650 to 1750
С—Н	2800 to 3100
0—Н	2500 to 3550

Spectrum	 			
Reason	 	 	 	

6. (a) Ammonia is made industrially from nitrogen and hydrogen by the Haber process.

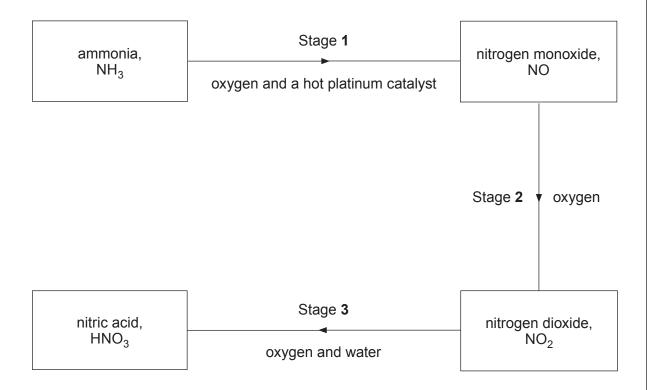
The table below shows the yield of ammonia under different pressure and temperature conditions.

		Te	emperature (°0	C)	
Pressure (atmospheres)	100	200	300	400	500
		Yiel	d of ammonia	(%)	
10	88.2	50.7	14.7	3.9	1.2
50	94.5	75.0	39.5	15.3	5.6
100	96.7	81.7	52.5	25.2	10.6
200	98.4	89.0	66.7	40.0	18.3
400	99.4	94.6	79.7	55.4	31.9
1000	99.9	98.3	92.6	79.8	57.5

(i)	Using only the data in the table suggest the conditions that should be chosen for the process.	or [1]
	Pressure atmospheres Temperature°C	
(ii)	Give the disadvantage of using a low temperature in the process and state how th problem is overcome.	iis 2]
(iii)	The actual pressure used in the process is 200 atmospheres. Apart from safe issues, suggest a disadvantage of using a higher pressure.	ty [1]

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(b) Ammonia is used to form nitric acid in a three-stage reaction.



- (i) Once the reaction in stage **1** has started there is sufficient heat to maintain the reaction. Give the term used to describe a reaction that produces heat. [1]
- (ii) Balance the symbol equation below that represents the reaction taking place in stage 3. [1]

(iii) Write a balanced symbol equation for the reaction that occurs when nitric acid is added to copper(II) carbonate. [2]

7. (a) A pupil used the following tests to identify unknown compounds A, B, C and D.

add sodium hydroxide solution and warm mixture, test gas given off with damp litmus paper

add dilute hydrochloric acid, bubble gas given off into limewater

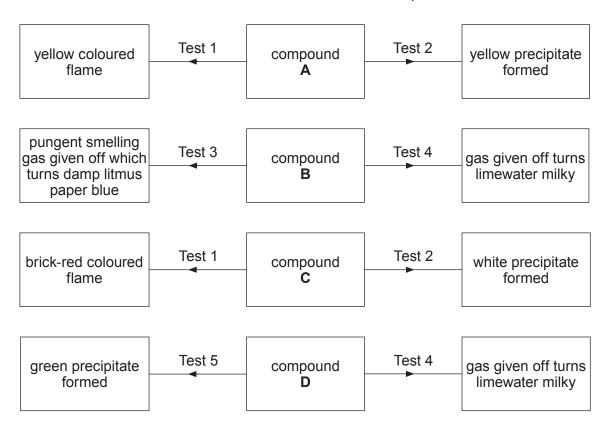
add silver nitrate solution

add sodium hydroxide solution

flame test

These are described as tests 1 to 5 but not necessarily in this order.

The flow charts show the results obtained for each compound.



Deduce which test is which and hence give the names of compounds A, B, C and D. [4]

- Α
- В
- C
- D
- (b) Describe the test for sulfate ions in solution. Include the result for your test.

[1]

 An analytical chemist was asked to check the amount of vitamin C in a tablet. Vitamin C tablets contain ascorbic acid, C₆H₈O₆, and a starch "filler" which holds them together.

Ascorbic acid reacts with sodium hydroxide solution according to the equation below:

$$C_6H_8O_6$$
 + NaOH \longrightarrow Na $C_6H_7O_6$ + H_2O



To determine how much vitamin C is present, a tablet was dissolved in water and titrated with sodium hydroxide solution of concentration 0.10 mol/dm³. The endpoint was determined using the indicator phenolphthalein. The procedure was repeated three times and the mean value of sodium hydroxide solution needed to neutralise a vitamin C tablet was found to be 17.5 cm³.

(a) Calculate the number of moles of sodium hydroxide in 17.5 cm³ of the 0.10 mol/dm³ solution. [2]

Number of moles = mol

(b) Calculate the relative molecular mass, M_r , of ascorbic acid, $C_6H_8O_6$. [1]

$$A_{r}(H) = 1$$
 $A_{r}(O) = 16$ $A_{r}(C) = 12$

*M*_r =

(c) The label on the bottle states that each tablet contains 300 mg (0.3 g) of vitamin C. Using your answers to parts (a) and (b) show whether this statement is correct. [2]

9.	Sodium chloride is made when sodium hydroxide solution reacts with dilute hydrochloric acid.	'
	NaOH + HCl → NaCl + H ₂ O	
	Describe a laboratory method for making crystals of pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid. [6 QWC]	
	Diagrams may be used as part of your answer.	
		_
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FORMULAE FOR SOME COMMON IONS

POSITIV	E IONS	NEGATIV	VE IONS
Name	Formula	Name	Formula
Aluminium	Al ³⁺	Bromide	Br ⁻
Ammonium	$\mathrm{NH_4}^+$	Carbonate	CO ₃ ²⁻
Barium	Ba ²⁺	Chloride	CI
Calcium	Ca ²⁺	Fluoride	F ⁻
Copper(II)	Cu ²⁺	Hydroxide	OH ⁻
Hydrogen	H⁺	lodide	I ⁻
Iron(II)	Fe ²⁺	Nitrate	NO ₃ -
Iron(III)	Fe ³⁺	Oxide	O ²⁻
Lithium	Li⁺	Sulfate	SO ₄ ²⁻
Magnesium	Mg ²⁺		•
Nickel	Ni ²⁺		
Potassium	K ⁺		
Silver	Ag^{t}		
Sodium	Na ⁺		
Zinc	Zn ²⁺		

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PERIODIC TABLE OF ELEMENTS

_	7					Gro	dno.					က	4	2	9	^	0
								Ţ									⁴ He
								Hydrogen									Helium
7 Li	⁹ ₄ Be											11 B	12 C	N 41 7	16 8	19 F 9	²⁰ ₁₀ Ne
Lithium	Beryllium											Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon
23 Na	24 Mg											27 AI	28 Si	31 P	32 S	35 CI	40 Ar
Sodium	Magnesium											Aluminium	Silicon	Phosphorus	Sulfur	Chlorine	Argon
39 K	40 Ca	45 SC	48 Ti	51 V 23 V	52 Cr	55 Mn	⁵⁶ Fe	⁵⁹ Co	59 Ni	64 29 Cu	65 Zn	70 Ga	73 Ge	75 AS	79 Se	80 Br	84 Kr 36 Kr
Potassium	Calcium	Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
86 Rb	88 38 S r	89 ★	91 Zr	93 Nb	⁹⁶ Mo	99 TC	101 44 Ru	103 Rh	106 Pd 46 Pd	108 Ag	112 Cd	115 In	119 Sn 50 Sn	122 Sb	128 Te 52	127 53	¹³¹ Xe ₅₄ Xe
Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	lodine	Xenon
133 Cs 55	137 Ba 56	¹³⁹ La	179 Hf	¹⁸¹ Ta	184 W	¹⁸⁶ Re	190 OS	192 r 77	195 Pt	197 79 190	201 Hg	204 TI	²⁰⁷ Pb	209 Bi	²¹⁰ Po	²¹⁰ At	²²² Rn
Caesium	Barium	Lanthanum	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon
223 Fr 87	226 Ra 88	²²⁷ ₈₉ Ac															
Francium	Radium	Actinium			Key:												

Element Symbol

×

⋖

Mass number

Z Name

Atomic number

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