Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4493/02

S16-4493-02

CHEMISTRY

CHEMISTRY 3
HIGHER TIER

A.M. THURSDAY, 19 May 2016

1 hour

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

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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***(a)* and **8**.

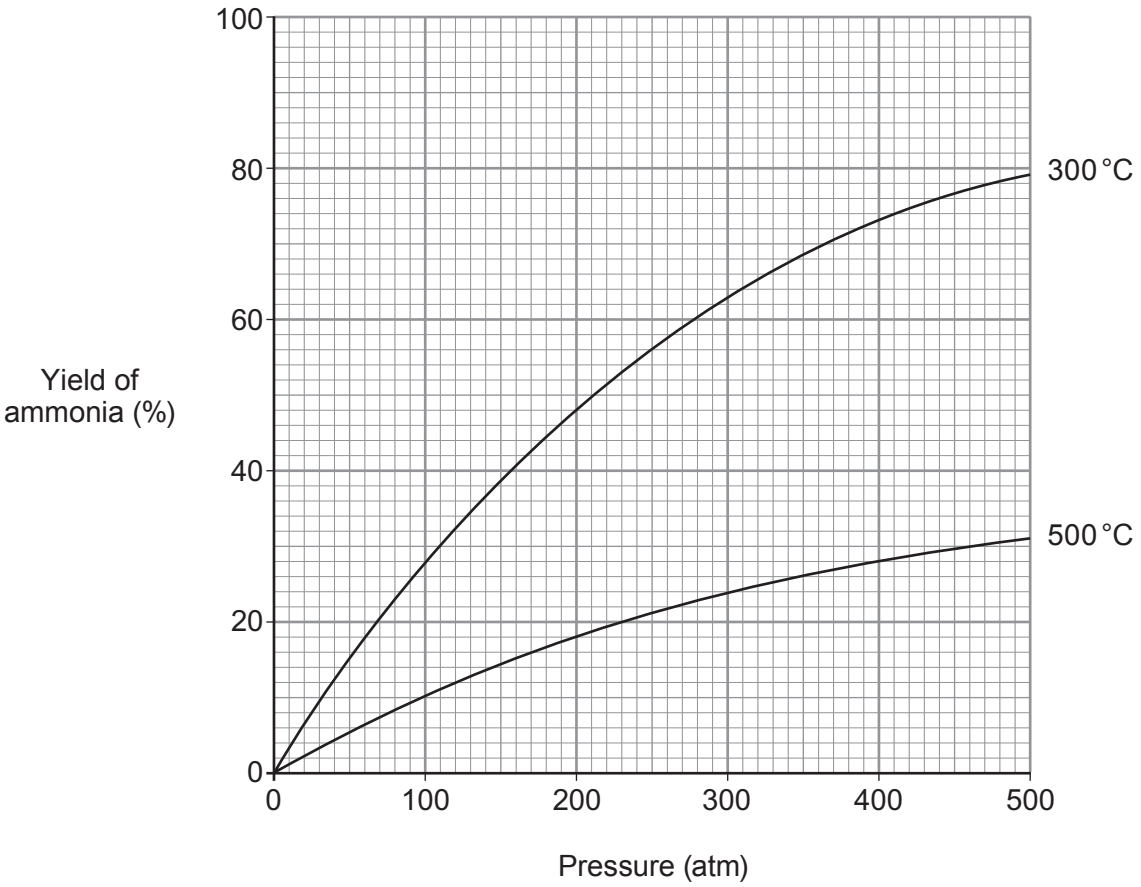
The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

Examiner only

Answer **all** *questions.*

1. In the Haber process, nitrogen reacts with hydrogen to give ammonia.

The following graphs show the effect of changing pressure on the yield of ammonia at 300 °C and 500 °C.



The table shows the percentage yield of ammonia at various pressures at 400 °C.

Pressure (atm)	0	100	200	300	400	500
Yield of ammonia (%)	0	22	37	44	49	51

(a) Plot the points on the grid above and draw a suitable line. [2]

(b) Using the graphs, state the temperature and pressure which produce the highest yield of ammonia. [1]

..... °C and ..... atm

Examiner only

(c) State what conclusions can be drawn from the graphs. [2]

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(d) (i) Complete and balance the following equation for the production of ammonia. [2]

N_2 + ☐ H_2 $\rightleftharpoons$ ☐ .....

(ii) State the meaning of $\rightleftharpoons$ in the equation in part (i). [1]

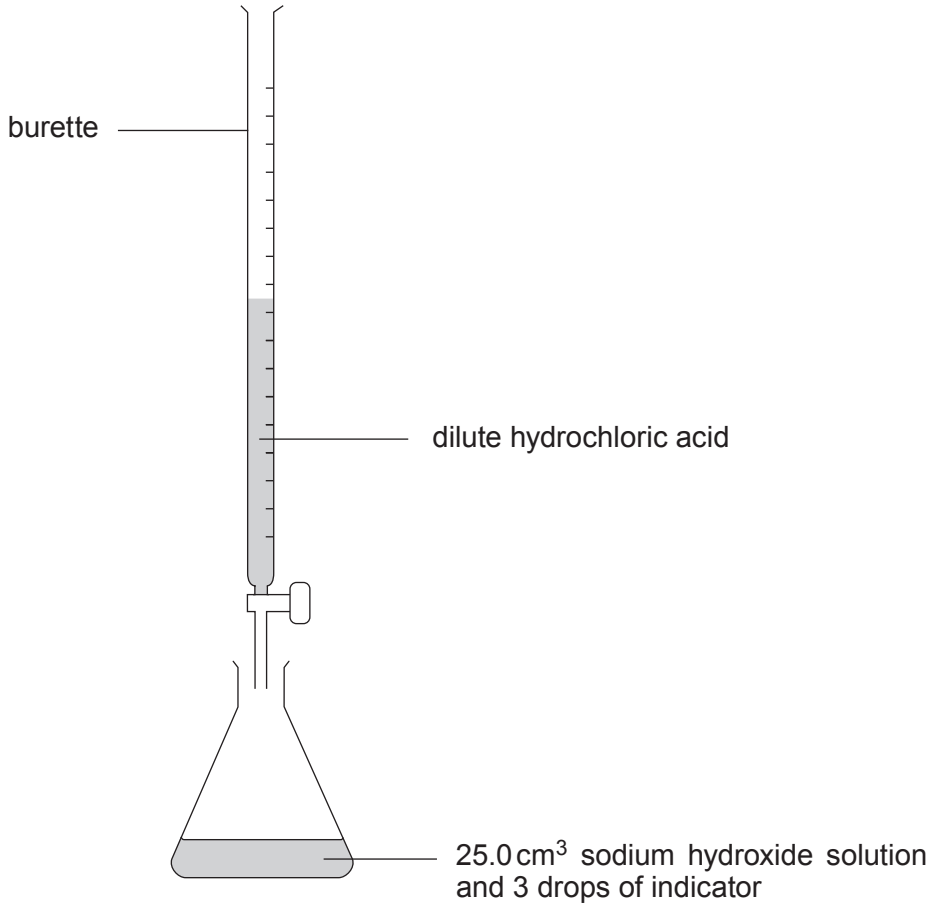
.....

8

2. The diagram shows the apparatus that was used to find the volume of hydrochloric acid needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

The balanced equation for the reaction between sodium hydroxide and hydrochloric acid is as follows.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$



The acid was added slowly from the burette. The volume of acid needed to change the indicator colour was recorded.

The titration was carried out four times and the volume of acid added each time was recorded in the table below.

Run	1	2	3	4
Volume of hydrochloric acid (cm^3)	33.5	29.5	29.6	29.4

Examiner only

(a) State why an indicator was used in this experiment. [1]

.....

(b) State whether the acid or the alkali is the more concentrated. Give a reason for your answer. [1]

.....

.....

(c) (i) Calculate the mean volume of hydrochloric acid needed to neutralise 25.0 cm^3 of the sodium hydroxide solution. [1]

Mean = ... cm^3

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(ii) Using all the information provided and your mean volume, describe how a pure sample of sodium chloride crystals could be made. [4]

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7

Examiner only

3. *(a)* You have been given three gases, **A**, **B** and **C**. The gases are carbon dioxide, hydrogen and oxygen, but not necessarily in that order.

Describe the tests for carbon dioxide, hydrogen and oxygen and plan a method to identify gases **A**, **B** and **C without** using all three tests. [6 QWC]

(b) When a mixture of sodium hydroxide solution and ammonium chloride is heated a gas is given off.

(i) Name the gas. ..... [1]

(ii) Describe a test you could carry out to identify the gas. [2]

9

Examiner only

4. When samples of calcium carbonate and copper(II) carbonate are heated they undergo thermal decomposition.

(a) Describe **one** similarity and **one** difference in the reactions that take place when these two carbonates thermally decompose. [2]

.....

.....

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(b) Give the balanced **symbol** equation for the reaction that takes place when calcium carbonate is heated. [2]

..... ⟶ ..... + ...

(c) If the two carbonates were replaced with sodium carbonate, what would be the difference when this was heated? Give a reason for this difference. [2]

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6

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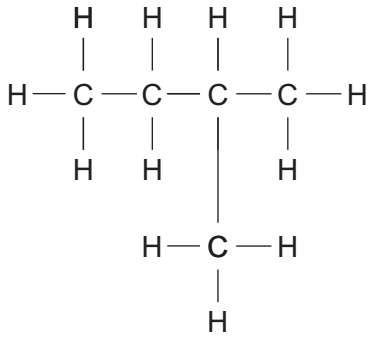
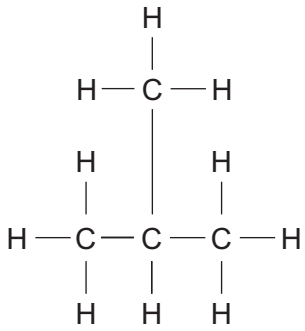
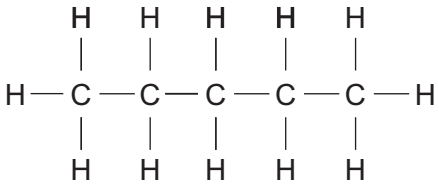
5. **A**-**F** are the structural formulae for some organic compounds.



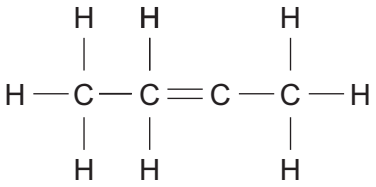
A



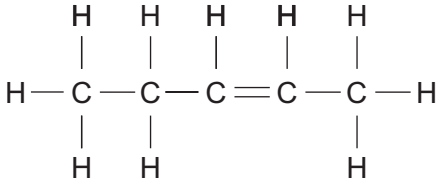
B



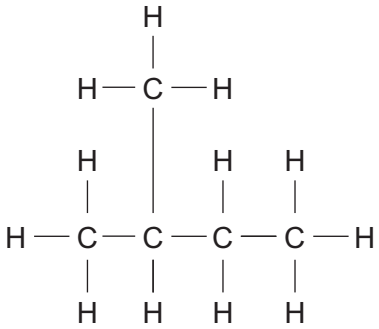
C



D



E



F

(a) Give the letters of the two structural formulae that are **identical**. [1]

..... and .....

(b) State which structural formula is **incorrect**. Give a reason for your answer. [2]

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Examiner only

(c) Draw the structural formula of the isomer of C_5H_{12} **not** shown opposite. [1]

(d) Describe a chemical test to distinguish between compounds **C** and **E**. [3]

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(e) Infrared spectroscopy is a method used to identify bonds present in organic compounds.

The table below shows the wavenumber range at which some bonds absorb infrared light.

Bond	Wavenumber (cm^{-1})
O—H	3700-3200
C—H	3200-2800
C=O	1800-1650
C=C	1700-1600
C—O	1250-1000

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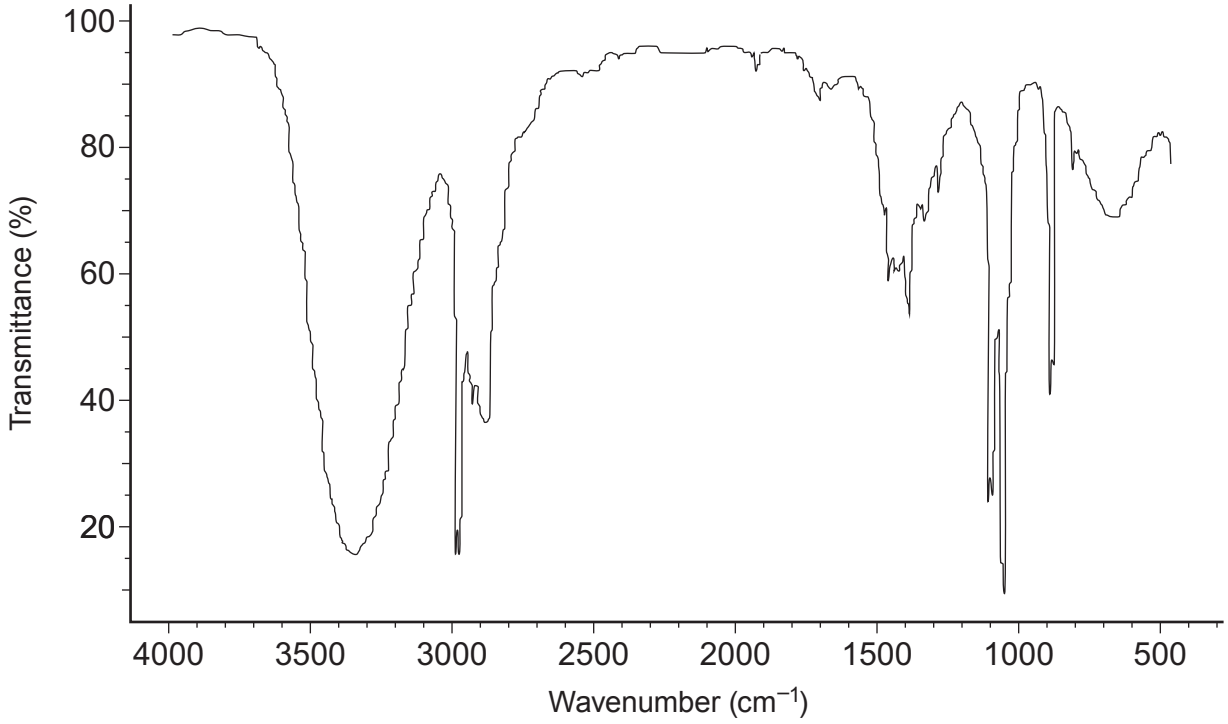
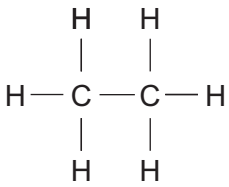
Compound **X** gave the following infrared spectrum.

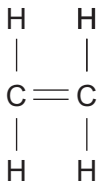


State which of the following compounds **X** could be. Give **two** reasons for your choice.

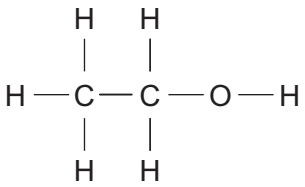
[3]



ethane



ethene



ethanol

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10

Examiner only

6. A solution is suspected to be iron(II) sulfate, $FeSO_4$.

(a) (i) Describe how sodium hydroxide solution could be used to show the presence of iron(II) ions. [2]

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(ii) Give the balanced **ionic** equation for the reaction that takes place. [3]

..... + ... ⟶ .....

(b) Describe how you could test for the presence of sulfate ions in iron(II) sulfate. [2]

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7

Examiner only

7. The concentration of sodium hydroxide solution can be determined by titration.

25.0 cm^3 of 0.10 mol/dm^3 sulfuric acid were placed in a conical flask and titrated with sodium hydroxide solution. It was found that 21.5 cm^3 of sodium hydroxide were required to neutralise the acid.

The equation for the reaction between sodium hydroxide and sulfuric acid is as shown.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

(a) Calculate the number of moles of sulfuric acid in 25.0 cm^3 of 0.10 mol/dm^3 solution. [2]

Number of moles of sulfuric acid = ... mol

(b) Calculate the number of moles of sodium hydroxide in 21.5 cm^3 of solution. [1]

Number of moles of sodium hydroxide = ... mol

(c) Calculate the concentration of the sodium hydroxide solution. [2]

Concentration of sodium hydroxide = ... mol/dm^3

(d) A reaction between the same solutions of sodium hydroxide and sulfuric acid can produce a different salt called sodium hydrogensulfate as shown in the following equation.

$$NaOH + H_2SO_4 \longrightarrow NaHSO_4 + H_2O$$

State the volume of sodium hydroxide solution needed to react with 25.0 cm^3 of 0.10 mol/dm^3 sulfuric acid to give sodium hydrogensulfate. Give your reasoning. [2]

Volume = ... cm^3

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Examiner only

8. Describe how sulfur is converted into sulfuric acid in the contact process. Include equations in your account. [6 QWC]

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6

END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	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^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key: