



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**CHEMISTRY**

**0620/21**

Paper 2

**May/June 2012**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

A copy of the Periodic Table is printed on page 16.

At the end of the examination, fasten all your work securely together.

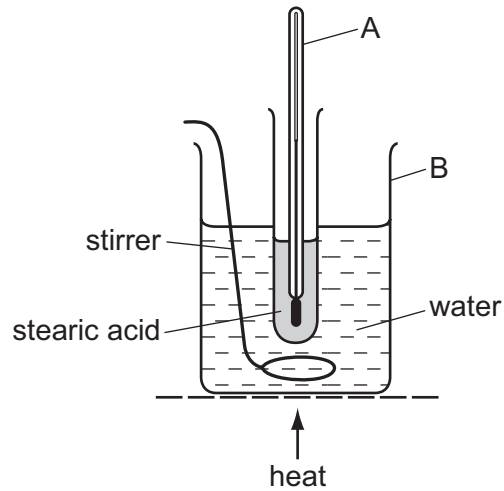
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
<b>Total</b>	

This document consists of **15** printed pages and **1** blank page.



- 1 Stearic acid is a solid at room temperature.  
The diagram below shows the apparatus used for finding the melting point of stearic acid.  
The apparatus was heated at a steady rate and the temperature recorded every minute.



- (a) State the name of the piece of apparatus labelled

A, .....

B. .... [2]

- (b) (i) Suggest why the water needs to be kept stirred during this experiment.

.....

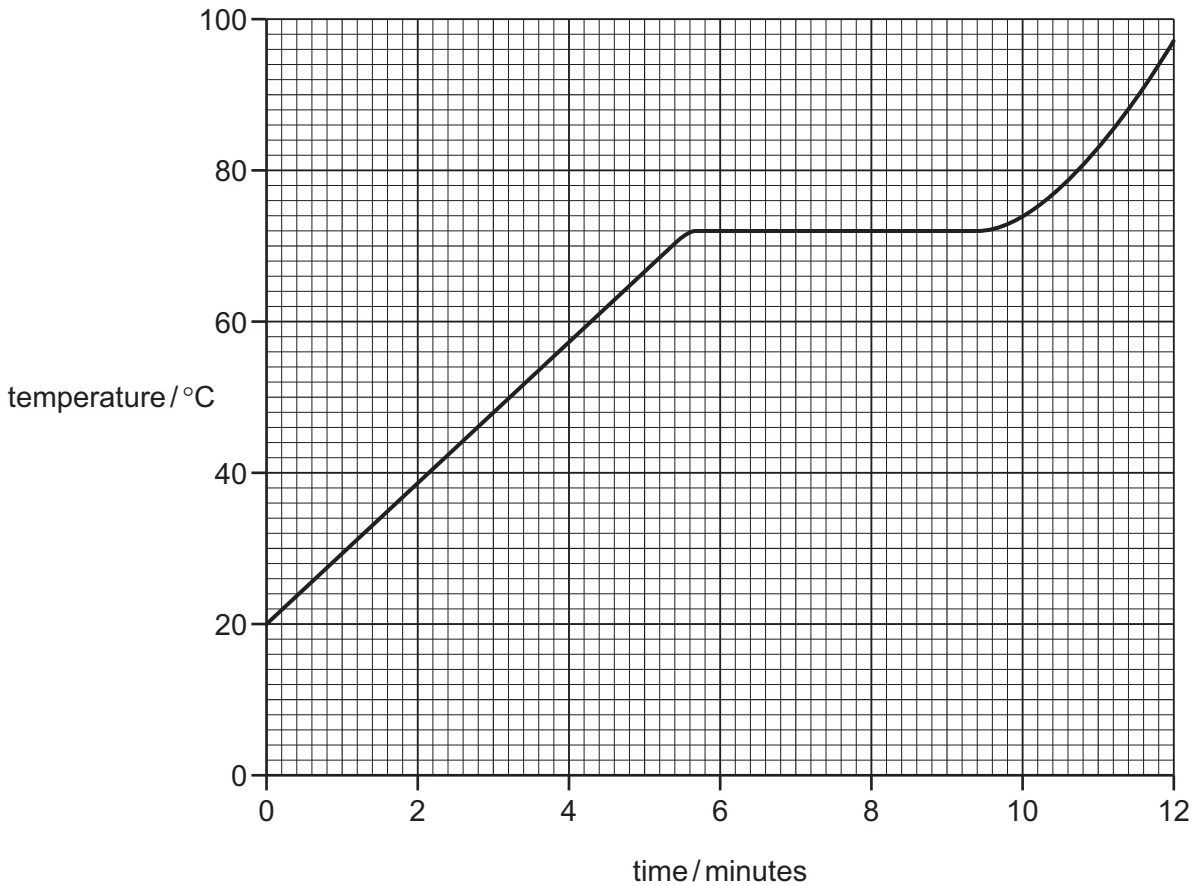
..... [1]

- (ii) Describe a chemical test for water.

test .....

result ..... [2]

(c) A graph of temperature of stearic acid against time of heating is shown below.



(i) What was the temperature of the stearic acid after 3 minutes heating?

..... [1]

(ii) Use the information on the graph to determine the melting point of stearic acid.

..... [1]

(d) Describe the arrangement and motion of the particles in liquid stearic acid.

arrangement .....

motion ..... [2]

(e) A sample of stearic acid contained 1% of another compound with a higher relative molecular mass.

(i) Which one of the following statements about this sample of stearic acid is correct?  
Tick **one** box.

Its density is exactly the same as that of pure stearic acid.

Its boiling point is the same as that of pure stearic acid.

Its melting point is different from pure stearic acid.

Its melting point is the same as that of pure stearic acid.

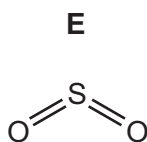
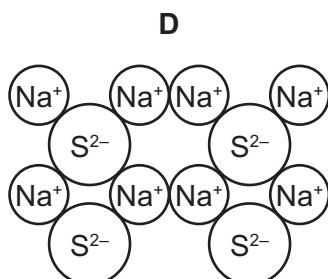
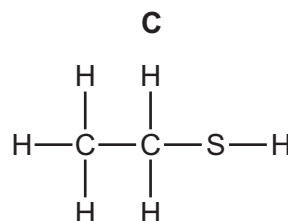
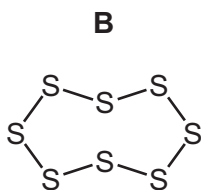
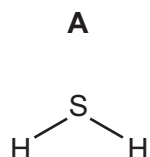
[1]

(ii) Describe **one** area of everyday life where the purity of substances is important.

..... [1]

[Total: 11]

2 The diagram below shows the structure of some substances, **A**, **B**, **C**, **D** and **E**.



(a) (i) Which **one** of these substances, **A**, **B**, **C**, **D** or **E**, is an element?

..... [1]

(ii) What do you understand by the term *element*?

..... [1]

(b) Calculate the relative molecular mass of **E**.

[1]

(c) Write the simplest formula for **D**.

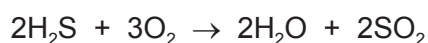
..... [1]

(d) Which substance, **A**, **B**, **C**, **D** or **E**, conducts electricity when it is molten?  
Explain your answer.

.....

..... [2]

(e) The equation for the combustion of substance **A** is shown below.



What type of chemical reaction is this?  
Put a ring around the correct answer.

**decomposition**      **neutralisation**      **oxidation**      **reversible**

[1]

[Total: 7]

3 Hydrochloric acid and ethanoic acid are both acidic in nature.

(a) Which **one** of the following is a pH value for an acidic solution.  
Put a ring around the correct answer.

**pH 3**

**pH 7**

**pH 9**

**pH 13**

[1]

(b) Describe how you would use litmus to test if a solution is acidic.

.....  
.....  
..... [3]

(c) Acids react with metal carbonates.

(i) Write a word equation for the reaction of calcium carbonate with hydrochloric acid.

[3]

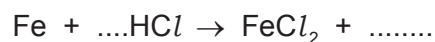
(ii) Calcium carbonate can be used to treat acidic soil.  
State **one** other use of calcium carbonate.

..... [1]

(iii) Name **one** other compound that can be used to treat acidic soil.

..... [1]

(d) Hydrochloric acid reacts with iron to form iron(II) chloride and hydrogen.  
Complete the equation for this reaction.



[2]

(e) (i) Complete the table below to show:

- the molecular formula for ethanoic acid
- the full structural formula for ethanol.

	ethanoic acid	ethanol
full structural formula	$  \begin{array}{c}  \text{H} \\    \\  \text{H}-\text{C}-\text{C} \\    \quad // \\  \text{H} \quad \text{O} \\  \quad \quad \backslash \\  \quad \quad \text{O}-\text{H}  \end{array}  $	
molecular formula		$\text{C}_2\text{H}_6\text{O}$

[2]

(ii) Ethanol can be manufactured by the catalytic addition of steam to ethene. Complete the equation for this reaction.



[1]

[Total: 14]

- 4 Fractional distillation is used to separate petroleum into different fractions. Each fraction has a particular use.

- (a) Match the fractions on the left with their uses on the right.  
The first one has been done for you.

gas oil	heating
bitumen	fuel for ships
lubricating fraction	surfacing roads
refinery gases	waxes and polishes
naphtha	making chemicals

[4]

- (b) Petroleum fractions contain hydrocarbons.  
What do you understand by the term *hydrocarbon*?

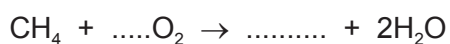
..... [1]

- (c) Methane, CH<sub>4</sub>, is a hydrocarbon.

- (i) Draw the structure of methane, showing all atoms and bonds.

[1]

- (ii) Complete the following equation for the burning of methane in excess oxygen.



[2]



- (iii) Methane belongs to a homologous series called the alkanes.  
What do you understand by the term *homologous series*?

.....

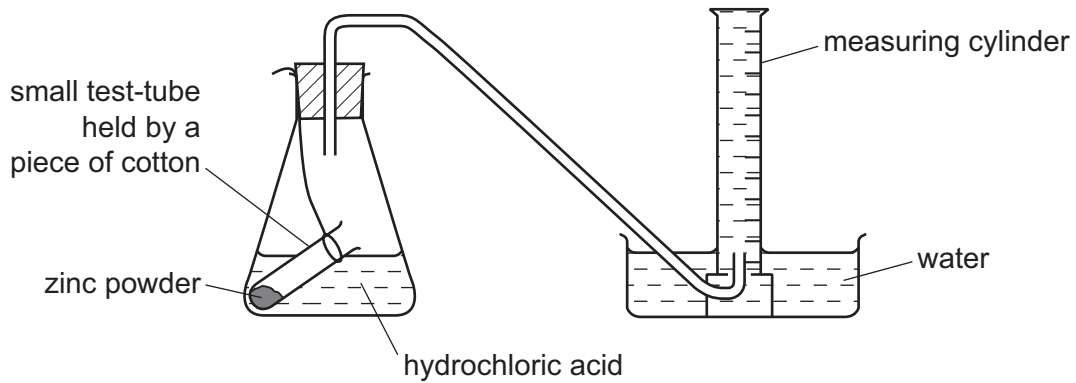
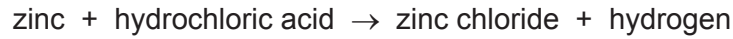
..... [2]

- (iv) Name the second member of the alkane homologous series.

..... [1]

[Total: 11]

- 5 A student investigated the reaction between zinc and hydrochloric acid using the apparatus shown below. The zinc was in excess.



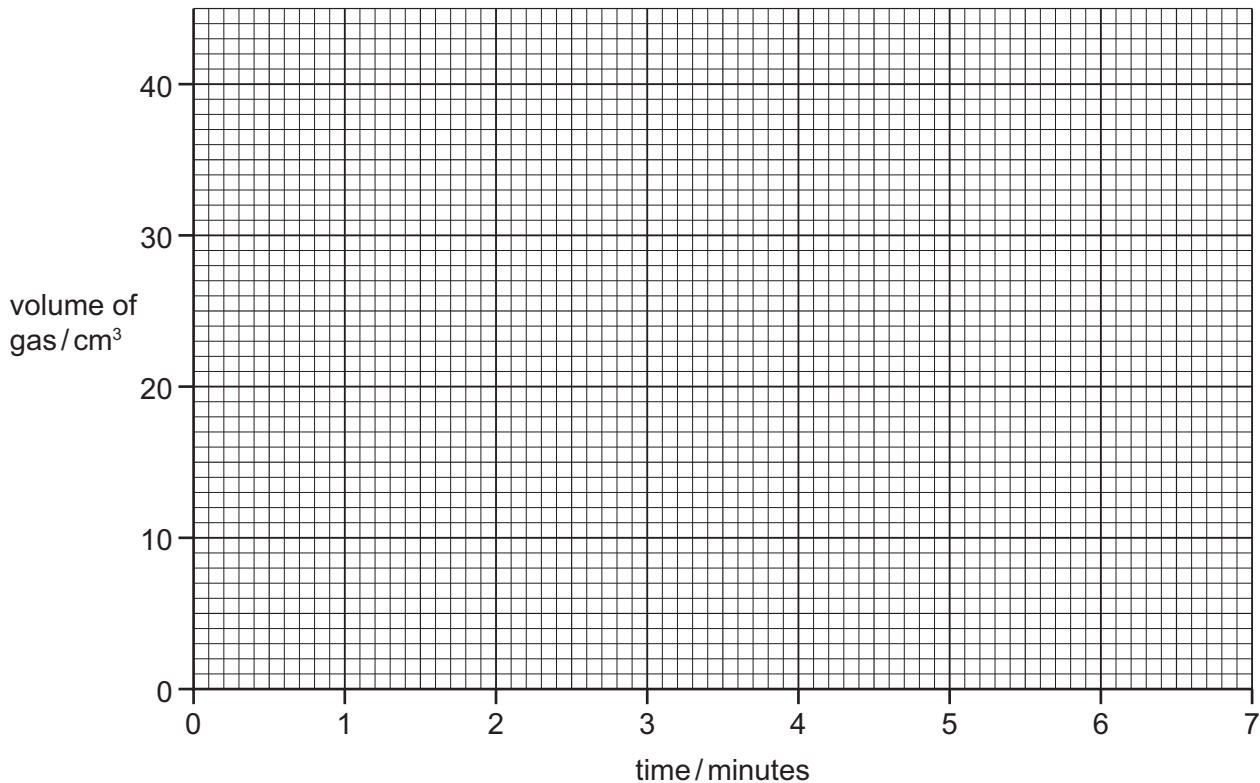
- (a) What should the student do to start the reaction?

..... [1]

- (b) The student measured the volume of gas in the measuring cylinder at minute intervals. The results are shown in the table.

time / minutes	0	1	2	3	4	5	6	7
volume of gas / cm <sup>3</sup>	0	15	23	30	33	35	35	35

- (i) Plot the results on the grid below and draw the best curve through the points.



[3]

(ii) Explain why the volume of gas stays the same after 5 minutes.

.....  
..... [2]

(c) Complete the following sentences about this reaction using words or phrases from the list below.

- |                      |                       |                  |
|----------------------|-----------------------|------------------|
| <b>concentration</b> | <b>decreases</b>      | <b>increases</b> |
| <b>speed</b>         | <b>stays the same</b> | <b>volume</b>    |

When the ..... of hydrochloric acid is increased, the volume of gas given off in the first two minutes ..... Decreasing the temperature of the reaction mixture ..... the ..... of the reaction. [4]

(d) When the reaction is complete, the flask contains a mixture of zinc and aqueous zinc chloride. Describe how you can obtain pure dry crystals of zinc chloride from this reaction mixture.

.....  
.....  
.....  
..... [3]

[Total: 13]

6 Lithium, sodium and potassium are in Group I of the Periodic Table.

(a) The equation for the reaction of lithium with water is



(i) Write a word equation for this reaction.

..... [2]

(ii) Sodium reacts with water in a similar way to lithium.  
Write a symbol equation for the reaction of sodium with water.

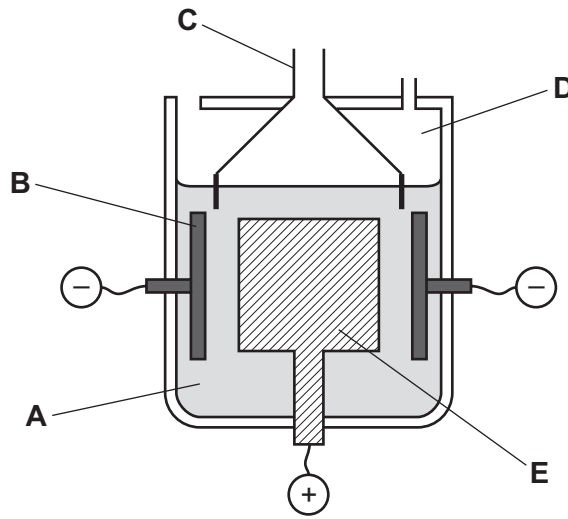
[1]

(b) Describe the reactions of lithium, sodium and potassium with water.  
In your description, write about:

- the difference in the reactivity of the metals
- the observations you would make when these metals react with water.

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

(c) The diagram below shows an electrolysis cell used to manufacture sodium from molten sodium chloride.



(i) Which letter in the diagram above represents  
the anode? .....

the electrolyte? ..... [2]

(ii) State the name of the product formed  
at the positive electrode, .....

at the negative electrode. .... [2]

(iii) Which one of the following substances is most likely to be used for the anode?  
Put a ring around the correct answer.

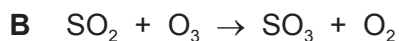
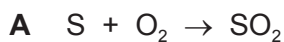
- graphite      iodine      magnesium      sodium**
- [1]

(d) Lithium, sodium and potassium are metals with a low density.  
State **two** other physical properties of these metals.

1. ....
2. .... [2]

[Total: 15]

- 7 (a) The equations **A** and **B** below show two reactions which lead to the formation of acid rain.



- (i) Write a word equation for reaction **A**.

..... [2]

- (ii) Which two of the following statements about reaction **B** are correct?  
Tick **two** boxes.

SO<sub>2</sub> is oxidised to SO<sub>3</sub>

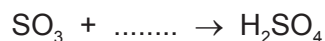
SO<sub>2</sub> is reduced to SO<sub>3</sub>

O<sub>3</sub> is reduced to O<sub>2</sub>

O<sub>3</sub> is oxidised to O<sub>2</sub>

[2]

- (iii) Complete the equation to show how an aqueous solution of sulfuric acid, H<sub>2</sub>SO<sub>4</sub>, is formed from SO<sub>3</sub>.



[1]

- (b) Describe and explain the effect of sulfuric acid on buildings made from limestone (calcium carbonate).

.....  
 .....  
 .....  
 ..... [3]

- (c) State **one** effect of acid rain other than on buildings.

..... [1]

[Total: 9]



**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																																																																		
I	II	III	IV	V	VI	VII	0																																																													
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>N</b> Nitrogen 7	15 <b>O</b> Oxygen 8	16 <b>F</b> Fluorine 9	17 <b>Ne</b> Neon 10	18 <b>Ar</b> Argon 18	19 <b>K</b> Potassium 19	20 <b>Ca</b> Calcium 20	21 <b>Sc</b> Scandium 21	22 <b>Ti</b> Titanium 22	23 <b>V</b> Vanadium 23	24 <b>Cr</b> Chromium 24	25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38	39 <b>Y</b> Yttrium 39	40 <b>Zr</b> Zirconium 40	41 <b>Nb</b> Niobium 41	42 <b>Mo</b> Molybdenum 42	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	72 <b>Hf</b> Hafnium 72	73 <b>Ta</b> Tantalum 73	74 <b>W</b> Tungsten 74	75 <b>Re</b> Rhenium 75	76 <b>Os</b> Osmium 76	77 <b>Ir</b> Iridium 77	78 <b>Pt</b> Platinum 78	79 <b>Au</b> Gold 79	80 <b>Hg</b> Mercury 80	81 <b>Tl</b> Thallium 81	82 <b>Pb</b> Lead 82	83 <b>Bi</b> Bismuth 83	84 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	†
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	131 <b>Xe</b> Xenon 54	137 <b>Cs</b> Caesium 55	139 <b>La</b> Lanthanum 57	141 <b>Ce</b> Cerium 58	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	92 <b>Pa</b> Protactinium 91	93 <b>Np</b> Neptunium 93	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103																											

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

Key

a	<b>X</b>
b	

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

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

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