

| | | |
|---------------|------------------|------|
| Centre Number | Candidate Number | Name |
|---------------|------------------|------|

CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE

0652/03

Paper 3

May/June 2003

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 on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
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.
A copy of the Periodic Table is printed on page 16.

For Examiner's Use

| | |
|--------------|--|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| Total | |

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

1 Fig. 1.1 shows the trends in some of the properties of the elements in Group V of the Periodic Table.

| | | | |
|------------|-----------|--------------|-------------|
| nitrogen | non-metal | acidic oxide | gas at 20°C |
| phosphorus | ↓ | ↓ | ↓ |
| arsenic | | | |
| antimony | | | |
| bismuth | | | |
| | | | |

Fig. 1.1

(a) (i) Describe the structure and bonding in nitrogen.

.....
.....

(ii) Explain how this structure relates to the properties shown above.

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

(b) Suggest, with a reason, the type of oxide you would expect arsenic to form.

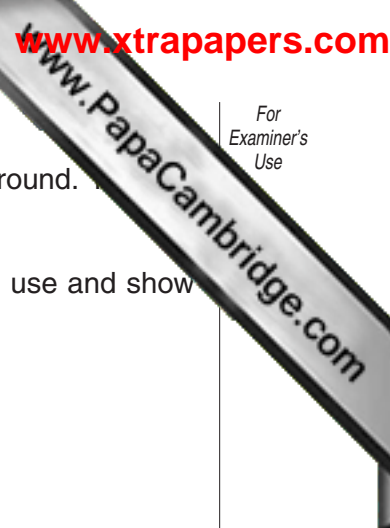
.....
.....[2]

(c) Antimony is a metallic element. Suggest why you would expect antimony to have a higher melting point than bismuth.

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

(d) Write down the formula that you would expect for a chloride of phosphorus.

.....[1]



2 A child throws a beach ball, of mass 0.075 kg, vertically upwards from the ground. It takes 0.3 s to accelerate from rest to 11 m/s.

(a) Calculate the acceleration of the ball. Write down the equation that you use and show all your working.

acceleration = [3]

(b) Calculate the maximum kinetic energy of the ball. Write down the equation that you use and show all your working.

maximum kinetic energy = [3]

(c) The ball reaches a vertical height of 2.7 m. Calculate the maximum gravitational potential energy of the ball. Write down the equation that you use and show all your working. [$g = 10 \text{ N/kg}$]

maximum gravitational potential energy = [3]

(d) (i) Explain what is meant by the term *efficiency*.

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

(ii) Discuss whether or not the energy conversion from kinetic to gravitational potential has been done efficiently.

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

3 Many substances need to be kept under carefully controlled conditions. Use your knowledge of the reactions of the substances involved to explain each of the following.

(a) Silver nitrate is stored in dark brown bottles.

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

(b) Sodium metal is stored immersed in liquid paraffin.

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

(c) Anhydrous copper(II) sulphate is stored in a desiccator.

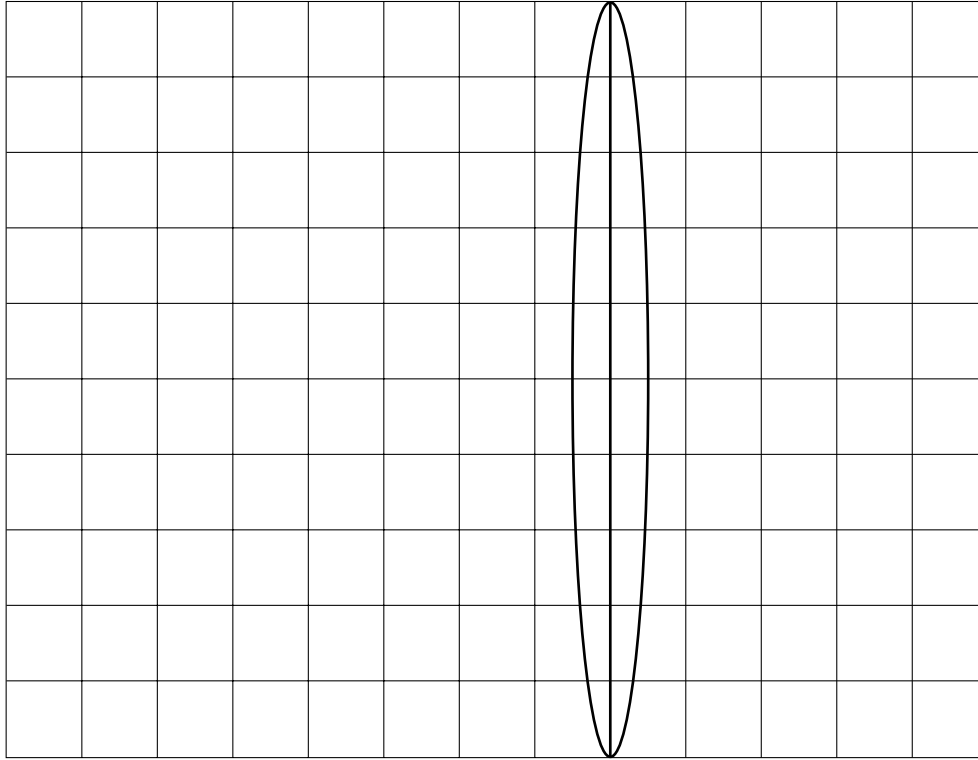
.....
.....
.....[2]

(d) Bromine should be kept cold and in a fume cupboard.

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

4 An object of height 2.0 cm is placed 3.0 cm to the left of a converging (convex) lens of length 5.0 cm.

(a) On the grid below draw a ray diagram to show the formation of the image by the lens. The central line shows the centre of the lens.



[3]

(b) Write down **three** properties of the image.

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

(c) Suggest a use for a lens forming an image in this way.

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

5 The two diagrams in Fig. 5.1 represent the structures of a pure metal and one of its alloys.

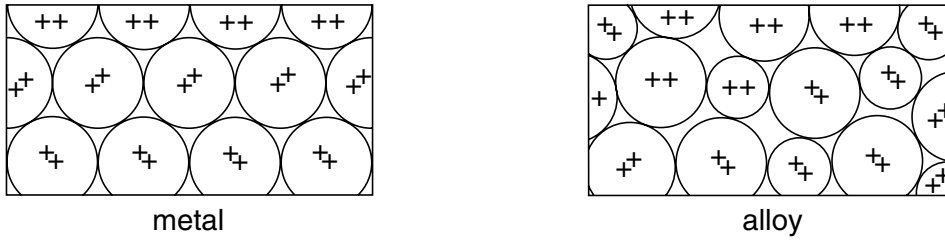


Fig. 5.1

(a) State what holds the positive metal ions together.

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

(b) By referring to the diagrams, explain why pure metals are more malleable than alloys.

.....
.....
.....
.....
.....
.....[4]

(c) Both the metals in the alloy belong to Group II in the Periodic Table. The smaller circles represent magnesium ions.

(i) Suggest what ions the larger circles represent. [1]

(ii) Describe **two** changes that you would expect to observe if a sample of the pure metal were placed in cold water.

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

6 Fig. 6.1 shows a coil of copper wire wound on a cardboard tube. The ends of the coil are connected to a cathode ray oscilloscope (c.r.o.) and a magnet is released so that it falls vertically down the tube.

Fig. 6.2 shows the trace seen on the c.r.o., along with its y-gain and time-base settings.

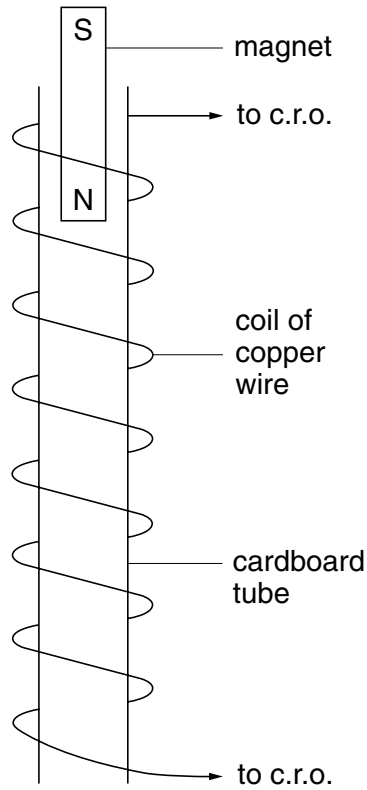


Fig. 6.1

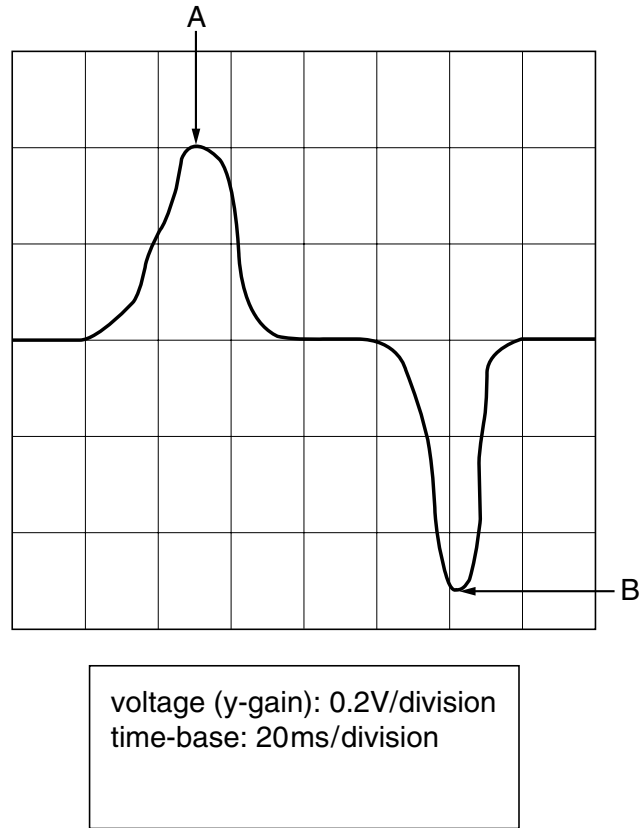


Fig. 6.2

(a) Write down the voltages at **A** and **B**.

voltage at **A** =V

voltage at **B** =V
[2]

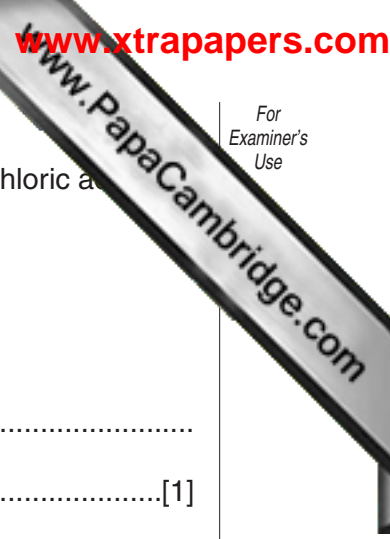
(b) Explain why these voltages are produced.

.....

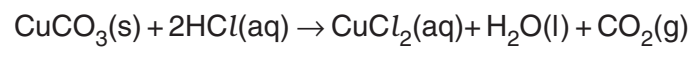
.....

.....

.....[2]



7 The equation for the reaction between copper(II) carbonate and dilute hydrochloric acid can be written as shown below.



(a) (i) What do you understand by the symbol (II) after the word copper?

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

(ii) Why is it **not** necessary to write this symbol after calcium in the name calcium carbonate?

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

(b) In an experiment copper(II) carbonate is added to 50 cm³ of hydrochloric acid of concentration 1 mol/dm³, until no more will react.

(i) Calculate the number of moles of HCl in the 50 cm³ of acid.

number of moles of HCl [1]

(ii) Calculate the number of moles of copper(II) carbonate that will react with this acid.

number of moles of copper(II) carbonate[1]

(iii) Calculate the relative formula mass, M_r , of copper(II) carbonate.
[A_r: C, 12; O, 16; Cu, 64]

M_r of copper(II) carbonate[2]

(iv) Calculate the mass of copper(II) carbonate that will react with this acid.

mass of copper(II) carbonate[2]

8 Fig. 8.1 shows a circuit with a high-resistance voltmeter being used to measure the e.m.f. of a cell.

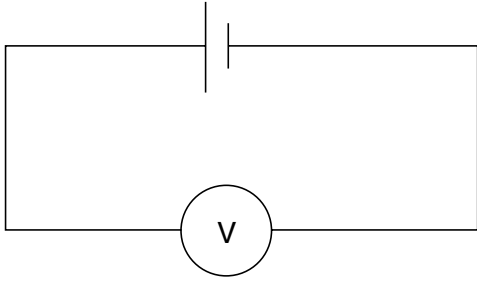


Fig. 8.1

(a) Explain the meaning of the term *e.m.f.*

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

(b) Explain why the voltmeter must have a high resistance if it is to measure an accurate value of the e.m.f.

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

(c) Fig. 8.2 shows a cell with an internal resistance of 2 Ω.

A voltmeter which has a resistance of 100 Ω is connected across the cell. The e.m.f. of the cell is 1.50 V.

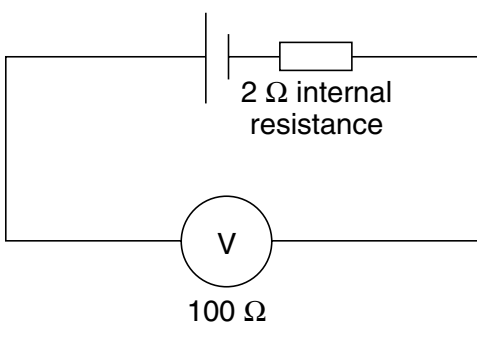


Fig. 8.2

11

(i) Calculate the current in the circuit.

current = [3]

(ii) Calculate the potential difference across the voltmeter.

potential difference = [2]

(iii) The potential difference in (ii) is **not** equal to the e.m.f. of the cell. Explain why this is the case and state what change you would make in order to give a value much closer to the e.m.f. of the cell.

.....

.....

.....

.....

.....

.....[3]

9 Ethene, C₂H₄, is the first member of the homologous series of alkenes.

(a) Draw a diagram to show the arrangement of the outer shell electrons in a molecule of ethene.

[2]

(b) In most homologous series the first member contains only one carbon atom. Explain why this is not the case with alkenes.

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

(c) Ethene and hydrogen can be produced from saturated hydrocarbons by cracking.

(i) Write an equation for the cracking of butane, C₄H₁₀, to produce ethene and hydrogen.

.....[2]

(ii) State **two** essential conditions for cracking to occur.

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

DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------------|----------------------------------|--------------------------------|-----------------------------|------------------------------|--------------------------------|------------------------------|--------------------------------|-------------------------------|------------------------------|-------------------------------|------------------------------------|----------------------------------|------------------------------------|---------------------------------|-----------------------------------|--------------------------------|---------------------------------|-------------------------------|-----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|------------------------------------|-------------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------------------|----------------------------------|------------------------------------|----------------------------------|-----------------------------------|----------------------------------|----------------------------------|-----------------------------------|------------------------------------|---------------------------------|------------------------------------|----------------------------------|-------------------------------------|-------------------------------------|------------------------------------|----------------------------------|------------------------------------|---------------------------------|----------------------------------|---------------------------------|------------------------------|-----------------------------------|------------------------------------|--------------------------------|--------------------------------|----------------------------------|---------------------------------|------------------------------------|---------------------------------|---------------------------------------|------------------------------------|-------------------------------------|-----------------------------------|-----------------------------------|-------------------------------------|----------------------------------|-------------------------------------|----------------------------------|---------------------------------|----------------------------------|------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|----------------------------------|---------------------------------|----------------------------------|-----------------------------------|-------------------------------|----------------------------------|-----------------------------------|-------------------------------|----------------------------------|-----------------------------------|-----------------------------------|--------------------------------|-----------------------------------|---------------------------------|-----------------------------------|----------------------------------|---------------------------------------|---------------------------------|------------------------------------|------------------------------------|------------------------------------|---------------------------------|------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|--|-------------------------------------|---------------------------------------|--|------------------------------------|---------------------------------------|------------------------------------|------------------------------------|---------------------------------------|---|--|--|-------------------------------------|--------------------------------------|--------------------------------------|--|---------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|-------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| I | II | III | IV | V | VI | VII | 0 | | | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | 1 H Hydrogen 1 | 5 B Boron 5 | 6 C Carbon 6 | 7 N Nitrogen 7 | 8 O Oxygen 8 | 9 F Fluorine 9 | 10 Ne Neon 10 | 11 B Boron 5 | 12 C Carbon 6 | 13 Al Aluminium 13 | 14 Si Silicon 14 | 15 P Phosphorus 15 | 16 S Sulphur 16 | 17 Cl Chlorine 17 | 18 Ar Argon 18 | 19 F Fluorine 9 | 20 Ne Neon 10 | 21 Sc Scandium 21 | 22 Ti Titanium 22 | 23 V Vanadium 23 | 24 Cr Chromium 24 | 25 Mn Manganese 25 | 26 Fe Iron 26 | 27 Co Cobalt 27 | 28 Ni Nickel 28 | 29 Cu Copper 29 | 30 Zn Zinc 30 | 31 Ga Gallium 31 | 32 Ge Germanium 32 | 33 As Arsenic 33 | 34 Se Selenium 34 | 35 Br Bromine 35 | 36 Kr Krypton 36 | 37 Rb Rubidium 37 | 38 Sr Strontium 38 | 39 Y Yttrium 39 | 40 Zr Zirconium 40 | 41 Nb Niobium 41 | 42 Mo Molybdenum 42 | 43 Tc Technetium 43 | 44 Ru Ruthenium 44 | 45 Rh Rhodium 45 | 46 Pd Palladium 46 | 47 Ag Silver 47 | 48 Cd Cadmium 48 | 49 In Indium 49 | 50 Sn Tin 50 | 51 Sb Antimony 51 | 52 Te Tellurium 52 | 53 I Iodine 53 | 54 Xe Xenon 54 | 55 Cs Caesium 55 | 56 Ba Barium 56 | 57 La Lanthanum 57 | 58 Ce Cerium 58 | 59 Pr Praseodymium 59 | 60 Nd Neodymium 60 | 61 Pm Promethium 61 | 62 Sm Samarium 62 | 63 Eu Europium 63 | 64 Gd Gadolinium 64 | 65 Tb Terbium 65 | 66 Dy Dysprosium 66 | 67 Ho Holmium 67 | 68 Er Erbium 68 | 69 Tm Thulium 69 | 70 Yb Ytterbium 70 | 71 Lu Lutetium 71 | 72 Hf Hafnium 72 | 73 Ta Tantalum 73 | 74 W Tungsten 74 | 75 Re Rhenium 75 | 76 Os Osmium 76 | 77 Ir Iridium 77 | 78 Pt Platinum 78 | 79 Au Gold 79 | 80 Hg Mercury 80 | 81 Tl Thallium 81 | 82 Pb Lead 82 | 83 Bi Bismuth 83 | 84 Po Polonium 84 | 85 At Astatine 85 | 86 Rn Radon 86 | 87 Fr Francium 87 | 88 Ra Radium 88 | 89 Ac Actinium 89 | 90 Th Thorium 90 | 91 Pa Protactinium 91 | 92 U Uranium 92 | 93 Np Neptunium 93 | 94 Pu Plutonium 94 | 95 Am Americium 95 | 96 Cm Curium 96 | 97 Bk Berkelium 97 | 98 Cf Californium 98 | 99 Es Einsteinium 99 | 100 Fm Fermium 100 | 101 Md Mendelevium 101 | 102 No Nobelium 102 | 103 Lr Lawrencium 103 | 104 Rf Rutherfordium 104 | 105 Db Dubnium 105 | 106 Sg Seaborgium 106 | 107 Bh Bohrium 107 | 108 Hs Hassium 108 | 109 Mt Meitnerium 109 | 110 Ds Darmstadtium 110 | 111 Rg Roentgenium 111 | 112 Cn Copernicium 112 | 113 Nh Nihonium 113 | 114 Fl Flerovium 114 | 115 Mc Moscovium 115 | 116 Lv Livermorium 116 | 117 Ts Tennessine 117 | 118 Og Oganesson 118 | 119 Uu Ununennium 119 | 120 Uub Unbibium 120 | 121 Uut Untrium 121 | 122 Uuq Unquadrium 122 | 123 Uuq Unquadrium 123 | 124 Uuq Unquadrium 124 | 125 Uuq Unquadrium 125 | 126 Uuq Unquadrium 126 | 127 Uuq Unquadrium 127 | 128 Uuq Unquadrium 128 | 129 Uuq Unquadrium 129 | 130 Uuq Unquadrium 130 | 131 Uuq Unquadrium 131 | 132 Uuq Unquadrium 132 | 133 Uuq Unquadrium 133 | 134 Uuq Unquadrium 134 | 135 Uuq Unquadrium 135 | 136 Uuq Unquadrium 136 | 137 Uuq Unquadrium 137 | 138 Uuq Unquadrium 138 | 139 Uuq Unquadrium 139 | 140 Uuq Unquadrium 140 | 141 Uuq Unquadrium 141 | 142 Uuq Unquadrium 142 | 143 Uuq Unquadrium 143 | 144 Uuq Unquadrium 144 | 145 Uuq Unquadrium 145 | 146 Uuq Unquadrium 146 | 147 Uuq Unquadrium 147 | 148 Uuq Unquadrium 148 | 149 Uuq Unquadrium 149 | 150 Uuq Unquadrium 150 | 151 Uuq Unquadrium 151 | 152 Uuq Unquadrium 152 | 153 Uuq Unquadrium 153 | 154 Uuq Unquadrium 154 | 155 Uuq Unquadrium 155 | 156 Uuq Unquadrium 156 | 157 Uuq Unquadrium 157 | 158 Uuq Unquadrium 158 | 159 Uuq Unquadrium 159 | 160 Uuq Unquadrium 160 | 161 Uuq Unquadrium 161 | 162 Uuq Unquadrium 162 | 163 Uuq Unquadrium 163 | 164 Uuq Unquadrium 164 | 165 Uuq Unquadrium 165 | 166 Uuq Unquadrium 166 | 167 Uuq Unquadrium 167 | 168 Uuq Unquadrium 168 | 169 Uuq Unquadrium 169 | 170 Uuq Unquadrium 170 | 171 Uuq Unquadrium 171 | 172 Uuq Unquadrium 172 | 173 Uuq Unquadrium 173 | 174 Uuq Unquadrium 174 | 175 Uuq Unquadrium 175 | 176 Uuq Unquadrium 176 | 177 Uuq Unquadrium 177 | 178 Uuq Unquadrium 178 | 179 Uuq Unquadrium 179 | 180 Uuq Unquadrium 180 | 181 Uuq Unquadrium 181 | 182 Uuq Unquadrium 182 | 183 Uuq Unquadrium 183 | 184 Uuq Unquadrium 184 | 185 Uuq Unquadrium 185 | 186 Uuq Unquadrium 186 | 187 Uuq Unquadrium 187 | 188 Uuq Unquadrium 188 | 189 Uuq Unquadrium 189 | 190 Uuq Unquadrium 190 | 191 Uuq Unquadrium 191 | 192 Uuq Unquadrium 192 | 193 Uuq Unquadrium 193 | 194 Uuq Unquadrium 194 | 195 Uuq Unquadrium 195 | 196 Uuq Unquadrium 196 | 197 Uuq Unquadrium 197 | 198 Uuq Unquadrium 198 | 199 Uuq Unquadrium 199 | 200 Uuq Unquadrium 200 | 201 Uuq Unquadrium 201 | 202 Uuq Unquadrium 202 | 203 Uuq Unquadrium 203 | 204 Uuq Unquadrium 204 | 205 Uuq Unquadrium 205 | 206 Uuq Unquadrium 206 | 207 Uuq Unquadrium 207 | 208 Uuq Unquadrium 208 | 209 Uuq Unquadrium 209 | 210 Uuq Unquadrium 210 | 211 Uuq Unquadrium 211 | 212 Uuq Unquadrium 212 | 213 Uuq Unquadrium 213 | 214 Uuq Unquadrium 214 | 215 Uuq Unquadrium 215 | 216 Uuq Unquadrium 216 | 217 Uuq Unquadrium 217 | 218 Uuq Unquadrium 218 | 219 Uuq Unquadrium 219 | 220 Uuq Unquadrium 220 | 221 Uuq Unquadrium 221 | 222 Uuq Unquadrium 222 | 223 Uuq Unquadrium 223 | 224 Uuq Unquadrium 224 | 225 Uuq Unquadrium 225 | 226 Uuq Unquadrium 226 | 227 Uuq Unquadrium 227 | 228 Uuq Unquadrium 228 | 229 Uuq Unquadrium 229 | 230 Uuq Unquadrium 230 | 231 Uuq Unquadrium 231 | 232 Uuq Unquadrium 232 | 233 Uuq Unquadrium 233 | 234 Uuq Unquadrium 234 | 235 Uuq Unquadrium 235 | 236 Uuq Unquadrium 236 | 237 Uuq Unquadrium 237 | 238 Uuq Unquadrium 238 | 239 Uuq Unquadrium 239 | 240 Uuq Unquadrium 240 | 241 Uuq Unquadrium 241 | 242 Uuq Unquadrium 242 | 243 Uuq Unquadrium 243 | 244 Uuq Unquadrium 244 | 245 Uuq Unquadrium 245 | 246 Uuq Unquadrium 246 | 247 Uuq Unquadrium 247 | 248 Uuq Unquadrium 248 | 249 Uuq Unquadrium 249 | 250 Uuq Unquadrium 250 | 251 Uuq Unquadrium 251 | 252 Uuq Unquadrium 252 | 253 Uuq Unquadrium 253 | 254 Uuq Unquadrium 254 | 255 Uuq Unquadrium 255 | 256 Uuq Unquadrium 256 | 257 Uuq Unquadrium 257 | 258 Uuq Unquadrium 258 | 259 Uuq Unquadrium 259 | 260 Uuq Unquadrium 260 | 261 Uuq Unquadrium 261 | 262 Uuq Unquadrium 262 | 263 Uuq Unquadrium 263 | 264 Uuq Unquadrium 264 | 265 Uuq Unquadrium 265 | 266 Uuq Unquadrium 266 | 267 Uuq Unquadrium 267 | 268 Uuq Unquadrium 268 | 269 Uuq Unquadrium 269 | 270 Uuq Unquadrium 270 | 271 Uuq Unquadrium 271 | 272 Uuq Unquadrium 272 | 273 Uuq Unquadrium 273 | 274 Uuq Unquadrium 274 | 275 Uuq Unquadrium 275 | 276 Uuq Unquadrium 276 | 277 Uuq Unquadrium 277 | 278 Uuq Unquadrium 278 | 279 Uuq Unquadrium 279 | 280 Uuq Unquadrium 280 | 281 Uuq Unquadrium 281 | 282 Uuq Unquadrium 282 | 283 Uuq Unquadrium 283 | 284 Uuq Unquadrium 284 | 285 Uuq Unquadrium 285 | 286 Uuq Unquadrium 286 | 287 Uuq Unquadrium 287 | 288 Uuq Unquadrium 288 | 289 Uuq Unquadrium 289 | 290 Uuq Unquadrium 290 | 291 Uuq Unquadrium 291 | 292 Uuq Unquadrium 292 | 293 Uuq Unquadrium 293 | 294 Uuq Unquadrium 294 | 295 Uuq Unquadrium 295 | 296 Uuq Unquadrium 296 | 297 Uuq Unquadrium 297 | 298 Uuq Unquadrium 298 | 299 Uuq Unquadrium 299 | 300 Uuq Unquadrium 300 |

8-71 Lanthanoid series
90-103 Actinoid series

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

