Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/23**

Paper 2 Multiple Choice (Extended) **May/June 2016**

45 Minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

* 0 8 7 2 6 4 5 5 7 6 *

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

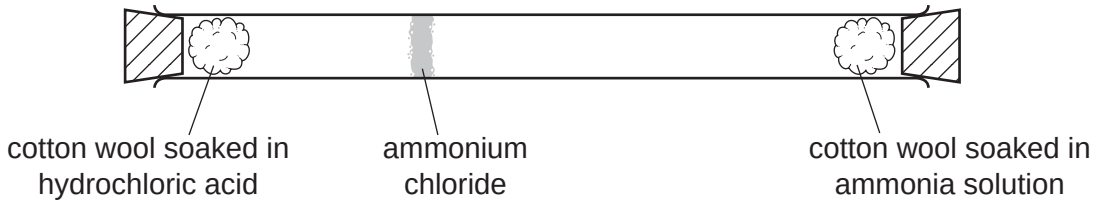
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 20.
Electronic calculators may be used.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **17** printed pages and **3** blank pages.

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1 The diagram shows an experiment to demonstrate diffusion.



Which statement explains why the ring of ammonium chloride appears as shown?

A Ammonia solution only produces a gas which moves until it meets the hydrochloric acid.

B Both solutions produce a gas, but ammonia moves quicker than hydrogen chloride because it is lighter.

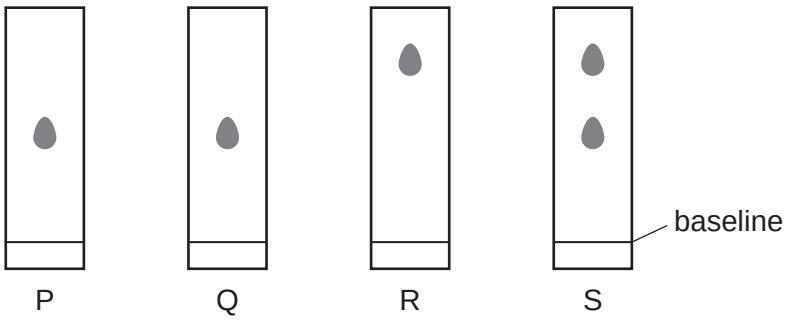
C Hydrochloric acid produces hydrogen chloride which stays at one end of the tube until the ammonia reaches it.

D The two solutions run along the tube until they meet.

2 Chromatography experiments are carried out on four substances, P, Q, R and S.

The same solvent is used in each experiment.

The resulting chromatograms are shown below.



Which statement is **not** correct?

A P and Q are pure substances.

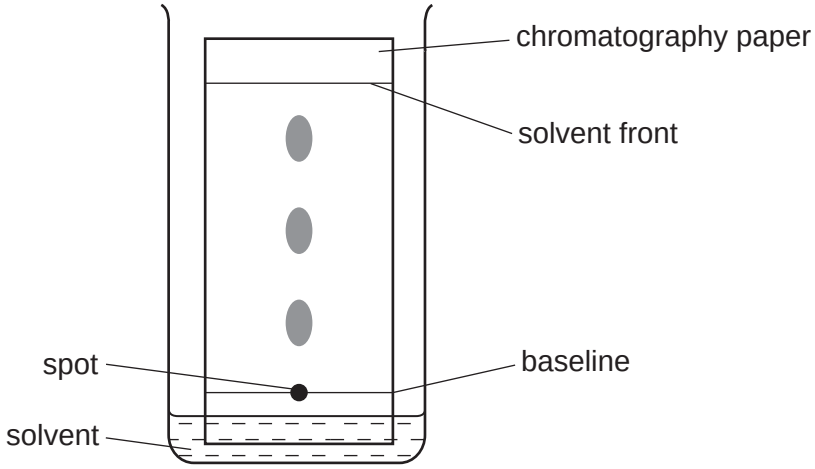
B P and R are different substances.

C R and S are pure substances.

D S is a mixture of substances.

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3 The diagram shows the apparatus used to separate the different components of a mixture by chromatography.



Which statement about this experiment is correct?

A A locating agent is used to find the position of the solvent front.

B The components to be separated must be soluble in the solvent.

C The baseline on which the spot of the mixture is placed is drawn in ink.

D The R_f value is calculated by $\frac{\text{the distance travelled by the solvent front}}{\text{the distance travelled by the component}}$

4 Which statements about isotopes of the same element are correct?

1 They are atoms which have the same chemical properties because they have the same number of electrons in their outer shell.

2 They are atoms which have the same number of electrons and neutrons but different numbers of protons.

3 They are atoms which have the same number of electrons and protons but different numbers of neutrons.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

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5 The table shows the electronic structure of four atoms.

atom	electronic structure
W	2,8,1
X	2,8,4
Y	2,8,7
Z	2,8,8

Which two atoms combine to form a covalent compound?

A W and X **B** W and Y **C** X and Y **D** X and Z

6 Which statement describes the attractive forces between molecules (intermolecular forces)?

A They are strong covalent bonds which hold molecules together.

B They are strong ionic bonds which hold molecules together.

C They are weak forces formed between covalently-bonded molecules.

D They are weak forces which hold ions together in a lattice.

7 Which substance exists as a lattice of positive ions in a 'sea of electrons'?

A liquid potassium chloride

B solid graphite

C solid magnesium

D solid silicon(IV) oxide

8 Analysis of a compound formed between magnesium and nitrogen showed it contained 14.4 g of magnesium and 5.6 g of nitrogen.

What is the empirical formula of the compound?

A Mg_2N_3 **B** Mg_3N_2 **C** Mg_4N_6 **D** Mg_6N_4

9 An excess of zinc is added to 100 cm^3 of 1.0 mol / dm^3 hydrochloric acid.

The equation for the reaction is:

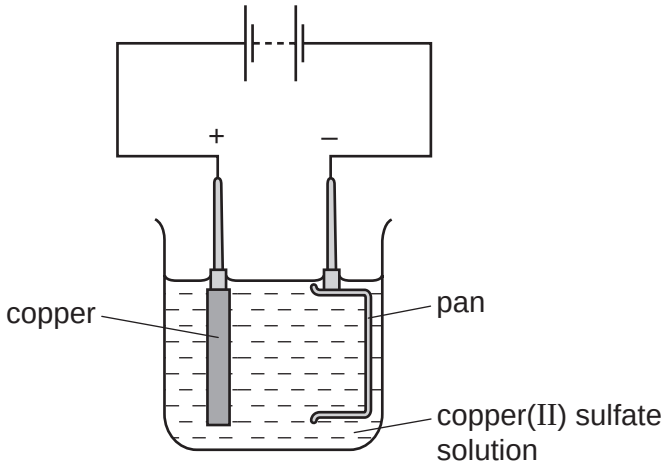
$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

What is the maximum volume of hydrogen evolved at room temperature and pressure?

A 1.2 dm^3 **B** 2.0 dm^3 **C** 2.4 dm^3 **D** 24 dm^3

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10 The diagram shows a method used to copper-plate a pan



Which equation represents the reaction at the cathode?

A $Cu^{2+} + 2e^- \rightarrow Cu$

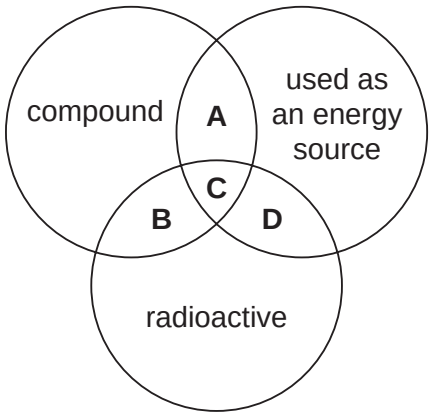
B $2H^+ + 2e^- \rightarrow H_2$

C $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

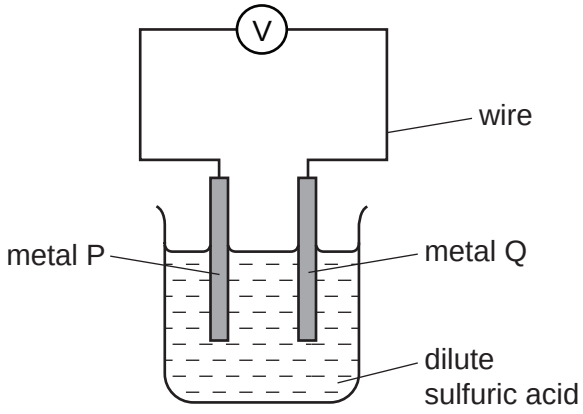
D $2O^{2-} \rightarrow O_2 + 4e^-$

11 The diagram shows some properties that substances may have.

To which labelled part of the diagram does ^{235}U belong?



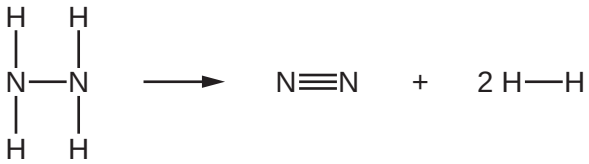
12 The diagram shows a simple cell.



Which pair of metals produces the largest voltage?

	metal P	metal Q
A	iron	copper
B	magnesium	copper
C	magnesium	zinc
D	zinc	copper

13 Hydrazine, N_2H_4, decomposes as shown.



The energy change for this reaction is –95 kJ / mol.

The table shows some bond energies involved.

bond	bond energy in kJ / mol
N≡N	945
N–H	391
H–H	436

What is the bond energy of the N–N bond?

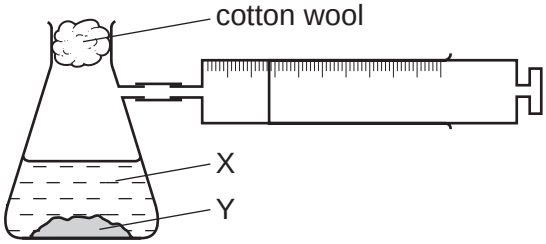
A 158 kJ / mol **B** 315 kJ / mol **C** 348 kJ / mol **D** 895 kJ / mol

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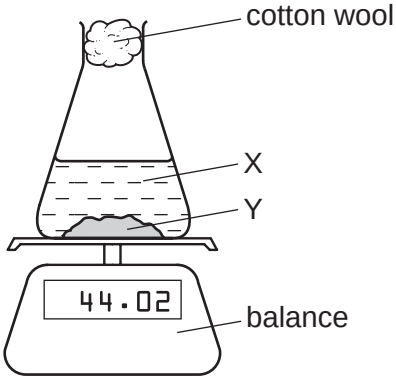
14 A liquid X reacts with solid Y to form a gas.

Which two diagrams show suitable methods for investigating the rate (speed) of the reaction?

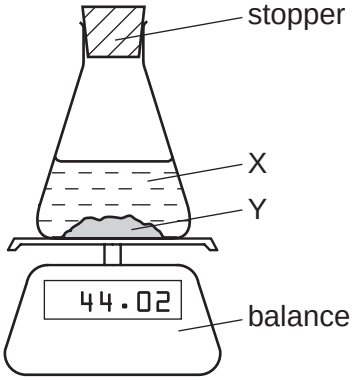
1



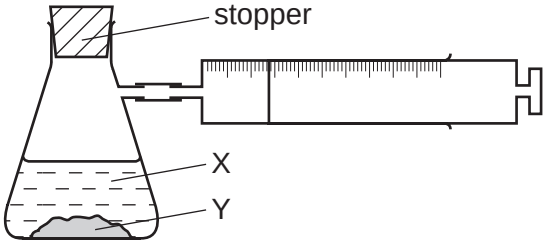
2



3



4



A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

15 Which row explains why increasing temperature increases the rate of reaction?

	particles collide more often	particles collide with more energy
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

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16 Methanol is manufactured by reacting carbon monoxide and hydrogen together in the presence of an aluminium oxide catalyst.

The equation for the reaction is shown.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The reaction is a reversible reaction.

The forward reaction is exothermic.

Which change in conditions increases the yield of methanol?

A decreasing the concentration of the carbon monoxide

B increasing the pressure

C increasing the rate of the reaction

D increasing the temperature

17 Which equation represents a reduction reaction?

A $Fe^{2+} + e^- \rightarrow Fe^{3+}$

B $Fe^{2+} \rightarrow Fe^{3+} + e^-$

C $Fe^{3+} + e^- \rightarrow Fe^{2+}$

D $Fe^{3+} \rightarrow Fe^{2+} + e^-$

18 Which statements are properties of an acid?

1 reacts with ammonium sulfate to form ammonia

2 turns red litmus blue

	1	2
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

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19 Which row describes whether an amphoteric oxide reacts with acids and bases?

	reacts with acids	reacts with bases
A	no	no
B	no	yes
C	yes	no
D	yes	yes

20 Barium sulfate is an insoluble salt.

It can be made by reacting copper(II) sulfate solution with barium nitrate solution.

$$CuSO_4(aq) + Ba(NO_3)_2(aq) \rightarrow Cu(NO_3)_2(aq) + BaSO_4(s)$$

What is the correct order of steps to obtain a pure, dry sample of barium sulfate from the reaction mixture?

	step 1	step 2	step 3
A	filter	evaporate the filtrate to dryness	leave the solid formed to cool
B	filter	evaporate the filtrate to the point of crystallisation	leave the filtrate to cool
C	filter	leave the residue in a warm place to dry	wash the residue with water
D	filter	wash the residue with water	leave the residue in a warm place to dry

21 Where in the Periodic Table is the metallic character of the elements greatest?

	left or right side of a period	at the top or bottom of a group
A	left	bottom
B	left	top
C	right	bottom
D	right	top

22 Which statement about the elements in Group I is correct?

A Hydrogen is evolved when they react with water.

B Ions of Group I elements have a –1 charge.

C Sodium is more reactive than potassium.

D Solid sodium is a poor electrical conductor.

23 Osmium is a transition element.

Which row gives the expected properties of osmium?

	melting point	density	compounds formed
A	high	high	coloured
B	high	high	white
C	high	low	white
D	low	high	coloured

24 Two statements about noble gases are given.

1 Noble gases are reactive, monatomic gases.

2 Noble gases all have full outer shells of electrons.

Which is correct?

A Both statements are correct and statement 2 explains statement 1.

B Both statements are correct but statement 2 does not explain statement 1.

C Statement 1 is correct but statement 2 is incorrect.

D Statement 2 is correct but statement 1 is incorrect.

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25 Some properties of substance X are listed.

- It conducts electricity when molten.
- It has a high melting point.
- It burns in oxygen and the product dissolves in water to give a solution with pH 11.

What is X?

A a covalent compound

B a macromolecule

C a metal

D an ionic compound

26 Four metals P, Q, R and S are added to separate aqueous solutions of their ions.

The results are shown.

metal	P^{2+}	Q^{2+}	R^{2+}	S^{2+}
P	✗	✗	✓	✓
Q	✓	✗	✓	✓
R	✗	✗	✗	✗
S	✗	✗	✓	✗

key

✓ = reaction occurs

✗ = reaction does not occur

What is the order of reactivity of the metals, most reactive first?

A $Q \rightarrow P \rightarrow S \rightarrow R$

B $Q \rightarrow S \rightarrow P \rightarrow R$

C $R \rightarrow P \rightarrow S \rightarrow Q$

D $R \rightarrow S \rightarrow P \rightarrow Q$

27 Copper is a transition element used to make saucepans.

Which property is **not** correct for copper?

A good conductor of heat

B insoluble in water

C low melting point

D malleable (can be hammered into shape)

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28 Aluminium is extracted by electrolysis of a mixture of aluminium oxide and cryolite.

Which statement is **not** correct?

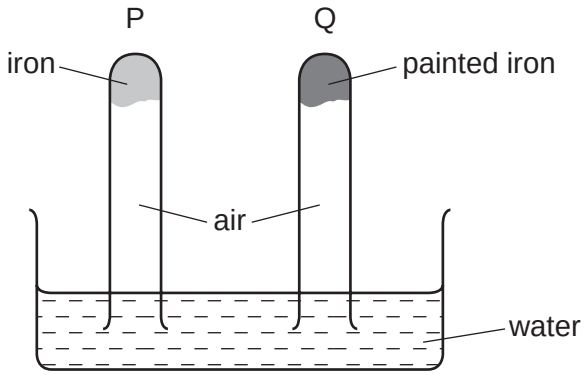
A The electrodes are made from graphite.

B The formula for aluminium oxide is Al_2O_3.

C The purpose of the cryolite is to lower the melting point of the mixture.

D The reaction taking place at the anode is $Al^{3+} + 3e^- \rightarrow Al$.

29 The diagram shows an experiment to investigate how paint affects the rusting of iron.

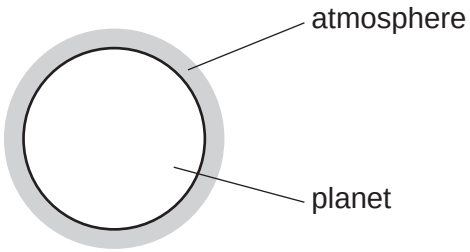


What happens to the water level in tubes P and Q?

	tube P	tube Q
A	falls	rises
B	no change	rises
C	rises	falls
D	rises	no change

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30 A new planet has been discovered and its atmosphere has been analysed.



The table shows the composition of its atmosphere.

gas	percentage by volume
carbon dioxide	4
nitrogen	72
oxygen	24

Which gases are present in the atmosphere of the planet in a higher percentage than they are in the Earth's atmosphere?

A carbon dioxide and oxygen

B carbon dioxide only

C nitrogen and oxygen

D nitrogen only

31 Catalytic converters are used to remove some gaseous pollutants from car exhaust fumes.

Which gas is removed from the fumes by oxidation?

A carbon dioxide

B carbon monoxide

C nitrogen

D nitrogen oxide

32 Ammonia is produced by the Haber process.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g).$$

Which statement about the Haber process is **not** correct?

A An iron catalyst is used to increase the rate of reaction.

B The reaction is carried out at high temperature to increase the rate of reaction.

C The reaction is carried out at low pressure to increase the yield of ammonia.

D The reaction is reversible.

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[Turn over

33 One step in the manufacture of sulfuric acid is the oxidation of sulfur dioxide to sulfur trioxide.

Which conditions are used for this step?

	temperature / °C	pressure / atmospheres	catalyst
A	450	1.5	iron
B	450	1.5	vanadium(V) oxide
C	450	200	iron
D	450	200	vanadium(V) oxide

34 Which process is used to make lime (calcium oxide) from limestone (calcium carbonate)?

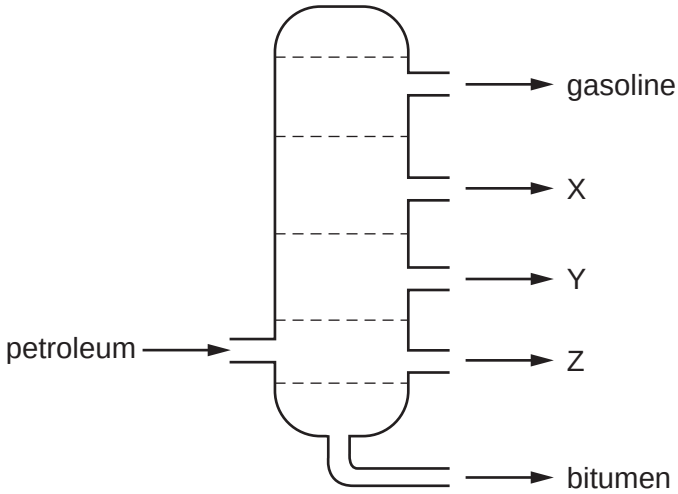
A chromatography

B electrolysis

C fractional distillation

D thermal decomposition

35 The diagram shows the separation of petroleum into fractions.



What could X, Y and Z represent?

	X	Y	Z
A	diesel oil	lubricating fraction	paraffin
B	lubricating fraction	diesel oil	paraffin
C	paraffin	lubricating fraction	diesel oil
D	paraffin	diesel oil	lubricating fraction

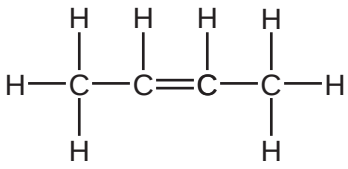
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36 Which compound does **not** belong to the same homologous series as the other three compounds?

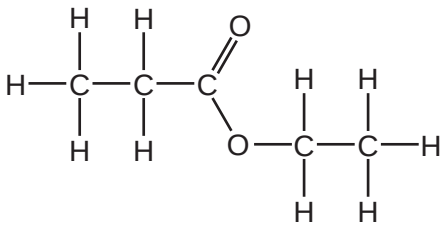
A CH_3OH **B** C_2H_5COOH **C** C_2H_5OH **D** $C_7H_{15}OH$

37 The structure of an alkene and the structure of an ester are shown.

P



Q



What are the names of P and Q?

	P	Q
A	but-1-ene	ethyl propanoate
B	but-1-ene	propyl ethanoate
C	but-2-ene	ethyl propanoate
D	but-2-ene	propyl ethanoate

38 What is an advantage of producing ethanol by fermentation of sugar compared to the catalytic addition of steam to ethene?

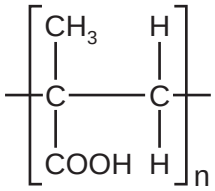
A The alcohol produced is purer.

B The process is faster.

C The process uses high temperature.

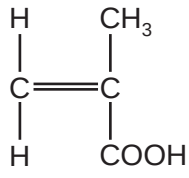
D The process uses renewable raw materials.

39 A polymer has the formula shown.

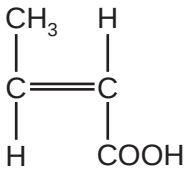


From which monomers can it be formed?

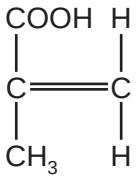
R



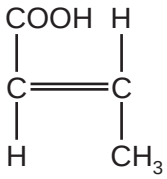
S



T



U



A R and S **B** R and T **C** S and U **D** T and U

40 Which row shows a natural polymer with the same linkages as a synthetic polymer?

	natural polymer	synthetic polymer
A	complex carbohydrate	nylon
B	complex carbohydrate	*Terylene*
C	protein	nylon
D	protein	*Terylene*

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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