O

JURONGVILLE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2023
Secondary 4 Express

STUDENT NAME			
CLASS		INDEX NUMBER	

CHEMISTRY

6092/01

Paper 1 Multiple Choice

28 August 2023

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number in the spaces at the top of this page.

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 Multiple Choice Answer Sheet.

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 15.
The use of an approved scientific calculator is expected, where appropriate.

DO NOT OPEN THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

For Examiner's Use
40

Setter: Mdm Ethel Chng

This document consists of **15** printed pages.

1 A gas is released at point Q in the apparatus shown.

Which gas changes the colour of the damp Universal Indicator paper most quickly?

A chlorine

B hydrogen

C hydrogen chloride

D oxygen

2 The reaction between aqueous sodium thiosulfate and hydrochloric acid forms a pale yellow precipitate.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

A student follows the rate of this reaction by measuring the time taken for a cross to disappear.

Besides a white tile marked with a cross, what other apparatus would be needed in the student's experiment?

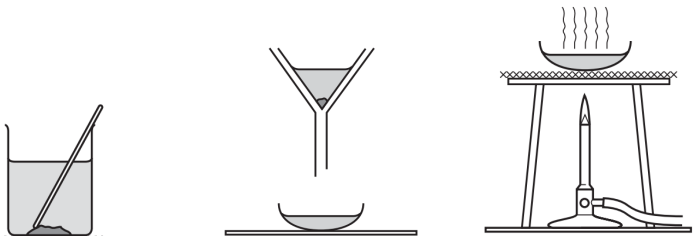
A burette, pipette, stopwatch, thermometer

B conical flask, electronic balance, stopwatch

C conical flask, measuring cylinder, stopwatch

D gas syringe, measuring cylinder, stopwatch

3 The diagram shows the steps for separating a mixture.



Which mixture **cannot** be separated into its components by these steps?

A charcoal and sugar

B copper(II) sulfate and iron

C magnesium nitrate and potassium carbonate

D marble chips and sodium chloride

4 Which observation is **not** possible for a solid element?

A It dissolves in water.

B It melts at a fixed temperature.

C When heated in air, it forms an oxide.

D When it is electrolysed in its molten state, two products are formed.

5 An unknown solid was added to dilute hydrochloric acid. Effervescence was observed and the gas formed a white precipitate in limewater.

Addition of aqueous sodium hydroxide to the resulting mixture produced a white precipitate. Upon addition of more aqueous sodium hydroxide, the white precipitate remained insoluble.

What could the unknown solid be?

A $CaCO_3$ **B** $NaHCO_3$ **C** $Pb(OH)_2$ **D** $ZnCO_3$

6 Chromium has four stable isotopes and forms ions of variable oxidation states.

A particle formed from its most abundant isotope can be written as $^{52}_{24}Cr^{3+}$.

Which statements are correct about the particle shown?

1 It has 27 electrons.

2 It has 28 neutrons.

3 It has 24 protons.

4 It has same number of electron shells as $^{53}_{24}Cr$.

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

7 Two elements, X and Y, are in the same period of the Periodic Table.

Each atom of X contributes 2 electrons to its 'sea of electrons', while each atom of Y shares 1 electron with another atom of Y.

Which statements describe the compound formed by X and Y?

1 It conducts electricity when dissolved in water.

2 It exists as a solid at room temperature.

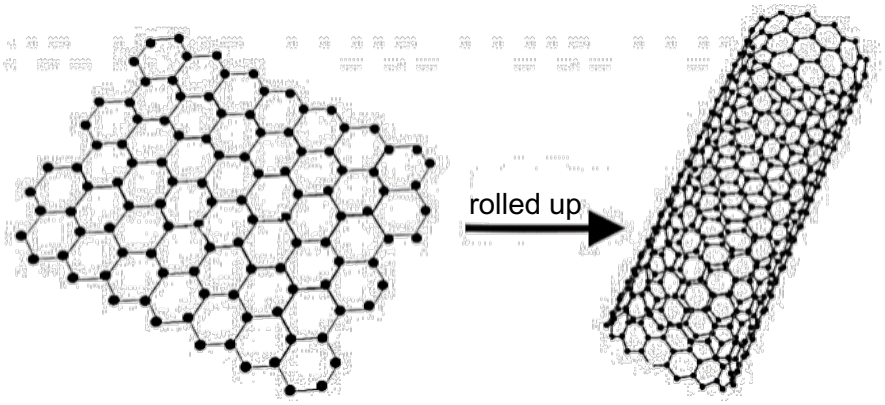
3 It has a crystal lattice structure similar to that of sodium chloride.

4 Its elements can be obtained by electrolysis of its aqueous solution.

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

8 Allotropes of carbon include graphenes and carbon nanotubes.

By rolling up a graphene sheet into a tube, a carbon nanotube is formed.



graphene sheet carbon nanotube

Which statement is **not** true of a carbon nanotube?

A It acts as a lubricant.

B It conducts electricity.

C It has a high melting point.

D It is insoluble in water.

9 The following substances all contain covalent bonds.

1 carbon tetrafluoride

2 ethene

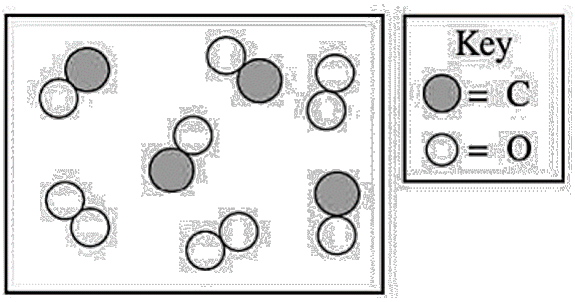
3 oxygen

4 propanol

Which substances contain only single covalent bonds?

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

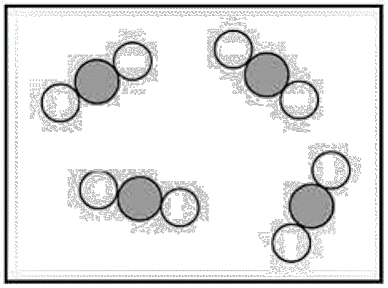
10 A mixture of carbon monoxide and oxygen is placed in a reaction vessel.



A reaction occurs, forming carbon dioxide.

Which diagram represents the gaseous reaction mixture in the vessel after the reaction is complete?

A



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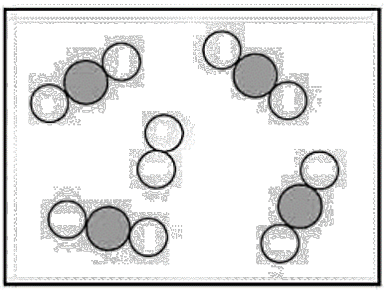

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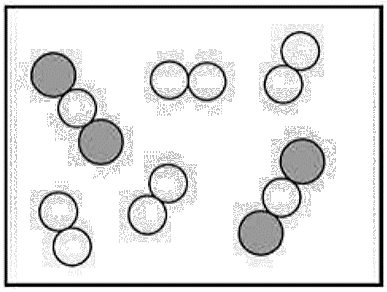

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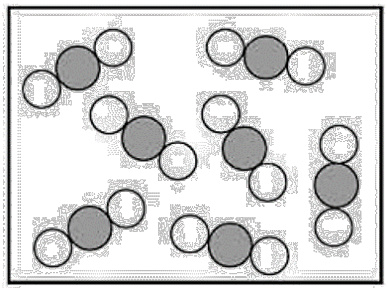


11 Which element contains the greatest number of atoms in 1 g?

A argon **B** chlorine **C** magnesium **D** oxygen

12 Phosphorus pentachloride reacts with water to form phosphoric acid and hydrochloric acid.

$$PCl_5(s) + 4H_2O(l) \rightarrow H_3PO_4(aq) + 5HCl(aq)$$

When 130 g of an impure sample of phosphorus pentachloride is reacted with an excess of water, 3 moles of hydrochloric acid are formed.

What is the percentage purity of phosphorus pentachloride in the impure sample?

A 32.1% **B** 46.2% **C** 76.9% **D** 96.2 %

13 Ammonium nitrate fertiliser is manufactured from ammonia by a two-stage process.

stage 1	$NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$
stage 2	$HNO_3 + NH_3 \rightarrow NH_4NO_3$

What is the maximum mass of fertiliser that can be made if only 17 tonnes of ammonia is available?

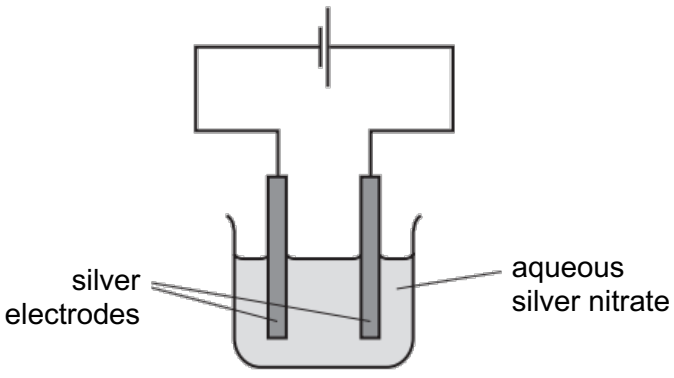
A 34 tonnes **B** 40 tonnes **C** 80 tonnes **D** 97 tonnes

14 Dilute aqueous copper(II) bromide and concentrated aqueous potassium bromide are electrolysed using inert electrodes in separate experiments.

Which row shows the products of their experiments?

	dilute aqueous copper(II) bromide		concentrated aqueous potassium bromide	
	negative electrode	positive electrode	negative electrode	positive electrode
A	bromine	copper	bromine	potassium
B	copper	oxygen	hydrogen	bromine
C	hydrogen	bromine	potassium	oxygen
D	oxygen	hydrogen	oxygen	hydrogen

15 The diagram shows the electrolysis of aqueous silver nitrate using silver electrodes.



Which statement is correct?

A Molten silver is deposited at the negative electrode.

B No gas is evolved at both electrodes.

C Oxygen is produced at the positive electrode.

D The mass of one electrode remains unchanged.

16 In separate experiments, a cell is made to supply electrical energy.

The table shows the results when rods of three metals, R, S and T are placed with a more reactive metal magnesium.

rod 1	rod 2	voltmeter reading / V
magnesium	R	1.10
magnesium	S	2.72
magnesium	T	0.78

What is the correct order of reactivity for these metals?

	least reactive ⟶ most reactive			
A	R	S	T	Mg
B	R	T	S	Mg
C	S	R	T	Mg
D	T	R	S	Mg

17 The table shows the bond energies of some covalent bonds.

bond	bond energy in kJ/mol
C*l* – C*l*	242
H – C*l*	431
H – H	436

HC*l*(g) can be made from H_2(g) and Cl_2(g) following these steps.

1 $Cl_2(g) \rightarrow 2Cl(g)$

2 $H_2(g) + Cl(g) \rightarrow HCl(g) + H(g)$

3 $H(g) + Cl_2(g) \rightarrow HCl(g) + Cl(g)$

4 $H(g) + Cl(g) \rightarrow HCl(g)$

Which steps have a positive value of enthalpy change?

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

18 Copper does not react with dilute acids, however it reacts with concentrated nitric acid to form copper(II) nitrate, nitrogen dioxide gas and water.

$$Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$$

In one student's experiment, this reaction proceeded at a much slower rate than it did in the other students' experiments.

Which statement could explain the slower reaction rate?

A The concentration of acid used was 4.0 mol/dm^3 instead of 20 mol/dm^3.

B The mass of metal used was 2 g instead of 1 g.

C The metal pieces were much smaller.

D The reaction mixture was heated as the acid was added.

19 Disproportionation is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

A $2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$

B $Cu_2O + H_2SO_4 \rightarrow Cu + CuSO_4 + H_2O$

C $2KClO_3 \rightarrow 2KCl + 3O_2$

D $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

20 Which pair of reactants gives a neutral solution when they are mixed together in equal number of moles?

A hydrochloric acid and calcium hydroxide

B nitric acid and calcium hydroxide

C nitric acid and potassium hydroxide

D sulfuric acid and sodium hydroxide

21 In which reaction is sodium hydroxide **not** behaving as an alkali?

A $NaOH + NH_4NO_3 \rightarrow NaNO_3 + H_2O + NH_3$

B $2NaOH + 2Al + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

C $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

D $3NaOH + FeCl_3 \rightarrow 3NaCl + Fe(OH)_3$

22 Quicklime is used to treat flue gas from a factory.

Which substance is removed by quicklime?

A ammonia

B nitrogen

C oxygen

D sulfur dioxide

23 The ionic equation for a reaction is shown.

$$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$$

How does this reaction take place most readily?

A adding excess barium carbonate to sulfuric acid

B adding excess barium oxide to sulfuric acid

C mixing barium hydroxide with calcium sulfate

D mixing barium nitrate solution with sodium sulfate solution

24 A student wants to prepare these three salts: ammonium sulfate, lead(II) nitrate, and zinc carbonate.

Which statement describes the methods for preparing these salts?

A All three salts require different preparation methods.

B All three salts require the same preparation method.

C Only one of the salts does not require precipitation method.

D Only one of the salts does not require titration method.

25 Why is iron used in the Haber process?

A It increases the yield of ammonia.

B It lowers the activation energy of the forward reaction.

C It makes the manufacture of ammonia exothermic.

D It prevents the backward reaction from occurring.

26 Livermorium, an element discovered in 2000, has an atomic number of 116.

What is the formula of the product obtained when livermorium reacts with hydrogen gas?

A HLv **B** H_2Lv **C** Lv_2H **D** Lv_2H_3

27 Which statement about the Group VII elements is correct?

A All their vapours are coloured.

B Bromine has less oxidising power than iodine.

C Only astatine is a black solid at room temperature.

D Reaction occurs between aqueous sodium chloride and bromine.

28 The table shows some properties of four metals.

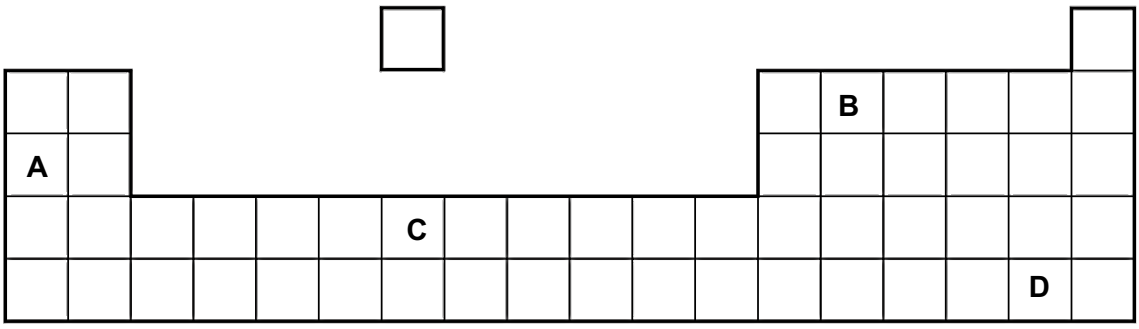
Which metal is an alkali metal?

metal	density in g/cm^3	melting point / °C
A	1.74	649
B	8.90	1495
C	7.28	232
D	0.97	98

29 The diagram shows part of the Periodic Table.

Which letter identifies the element described below?

- It is a silvery solid added to make steel harder and more corrosion resistant.
- It reacts with dilute hydrochloric acid to form a pink solution.



30 Which statement explains why metals are often used in the form of alloys?

A Alloys conduct electricity by the movement of electrons and ions.

B Alloys have a much lower density compared to metals.

C Alloys melt at higher temperatures.

D Alloys react less readily with oxygen in the air.

31 Beryllium does not react with cold water, but it reacts with hydrochloric acid.

It cannot be extracted from its ore by heating with carbon.

Where is beryllium placed in the reactivity series?

magnesium

A

zinc

B

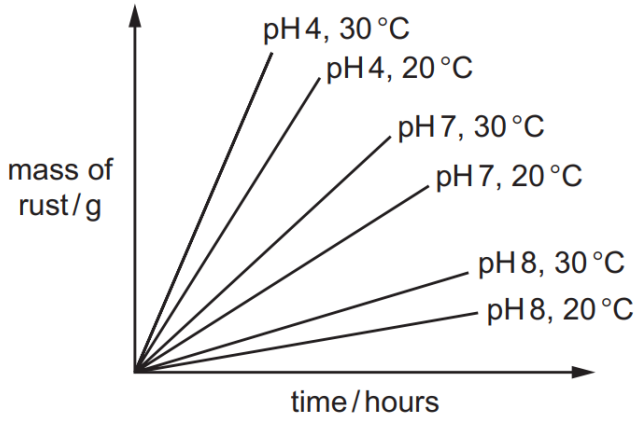
iron

C

copper

D

32 The graph shows the rate of rusting at different pH values and temperatures.



How do higher pH and temperature values affect the rate of rusting?

	higher pH	higher temperature
A	faster rusting	faster rusting
B	faster rusting	slower rusting
C	slower rusting	faster rusting
D	slower rusting	slower rusting

33 Which reaction takes place in the blast furnace to produce a substance to manufacture iron?

A $C + O_2 \rightarrow CO_2$

B $CaCO_3 \rightarrow CaO + CO_2$

C $CaO + SiO_2 \rightarrow CaSiO_3$

D $CO_2 + C \rightarrow 2CO$

34 Why are catalytic converters fitted to car exhaust systems?

A to reduce emissions of carbon dioxide

B to reduce emissions of oxides of nitrogen

C to remove soot or smoke

D to use catalysts for energy production

35 Petroleum can be separated into fractions using fractional distillation.

Which row is correct?

	fraction	use
A	bitumen	making polishes
B	kerosene	bottled gas for heating
C	naphtha	making chemicals
D	petroleum gas	fuel for aircraft

36 Which statement about fuels is **not** correct?

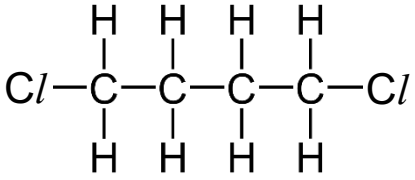
A Burning of fuels can be endothermic or exothermic.

B Ethanol is a less volatile fuel than petrol.

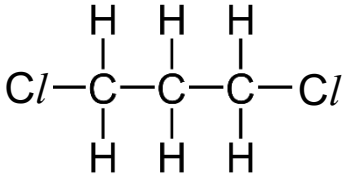
C Hydrogen is used as a fuel although it is difficult to store.

D Natural gas is a cleaner fuel than diesel oil.

37 The structures of two compounds are shown.



compound 1



compound 2

Which statement identifies the compound with the higher boiling point and provides the correct explanation for the higher boiling point?

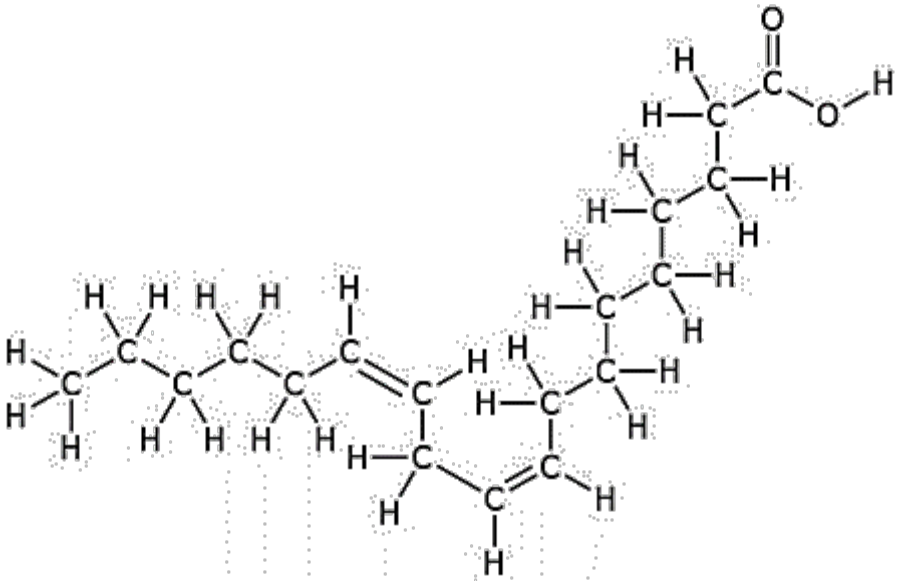
A Compound 1, as it has stronger covalent bonds than compound 2.

B Compound 1, as it has stronger intermolecular forces of attraction than compound 2.

C Compound 2, as it has stronger covalent bonds than compound 1.

D Compound 2, as it has stronger intermolecular forces of attraction than compound 1.

38 The structure of a compound is shown.



Which statements describe the compound?

1 It decolourises acidified potassium manganate(VII).

2 It decolourises bromine water.

3 It reacts with magnesium.

4 It reacts with magnesium carbonate.

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

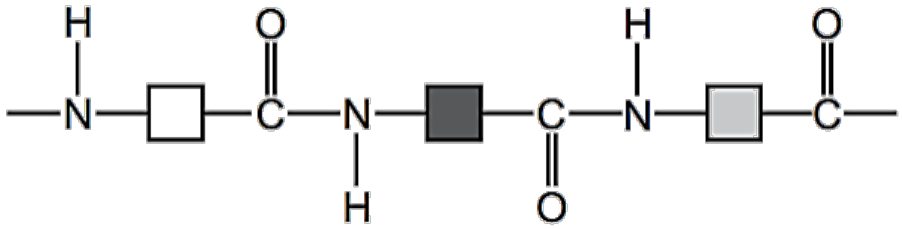
39 The formula of an ester is $CH_3CH_2CH_2COOCH_2CH_2CH_3$.

Which carboxylic acid and alcohol react together to make the ester?

	acid	alcohol
A	butanoic acid	butanol
B	butanoic acid	propanol
C	propanoic acid	butanol
D	propanoic acid	propanol

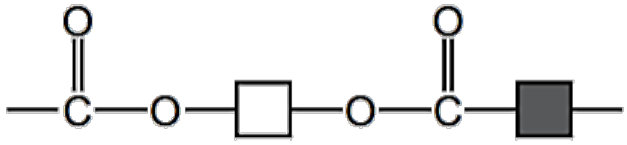
40 Which structure represents Terylene?

A

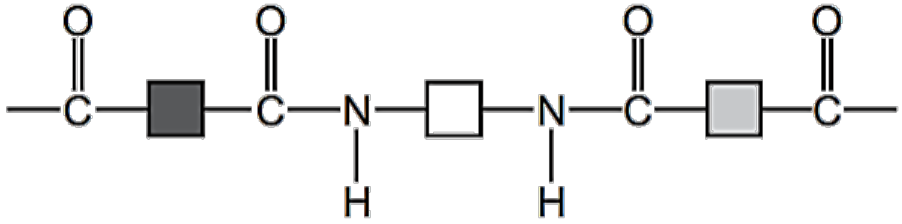


B

C



D



End of Paper

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							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 226	89 – 103 actinoids	104 Rf Rutherfordium -	105 Db Dubnium -	106 Sg Seaborgium -	107 Bh Bohrium -	108 Hs Hassium -	109 Mt Meitnerium -	110 Ds Damstadtium -	111 Rg Roentgenium -	112 Cn Copernicium -		114 Fl Flerovium -		116 Lv Livermorium -		

Key

proton (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.)