



Immanuel College

Specimen paper for entry into Year 12

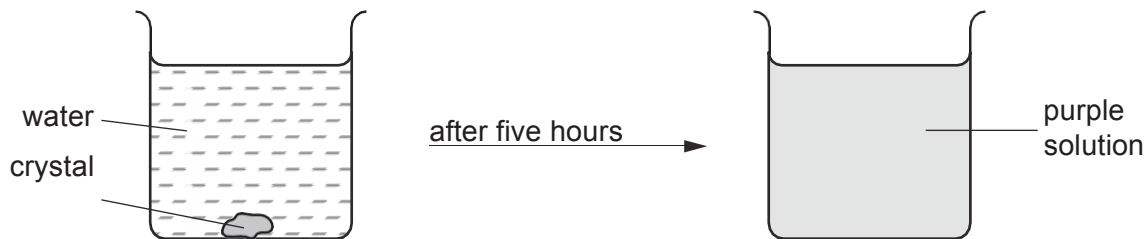
Chemistry

Time allowed: 1 hour

Total Marks: 45

Answer ALL questions

1 The diagram shows the result of dropping a purple crystal into water.



Which processes take place in this experiment?

	chemical reaction	diffusing	dissolving
A	✓	✓	✓
B	✓	✗	✓
C	✗	✗	✓
D	✗	✓	✓

(1 mark)

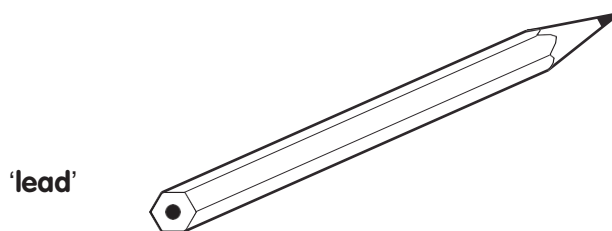
2 Alcohol and water are completely miscible. This means when mixed together they form only one liquid layer.

Which method is used to separate alcohol from water?

- A crystallisation
- B filtration
- C fractional distillation
- D precipitation

(1 mark)

3 The 'lead' in a pencil is made of a mixture of graphite and clay.



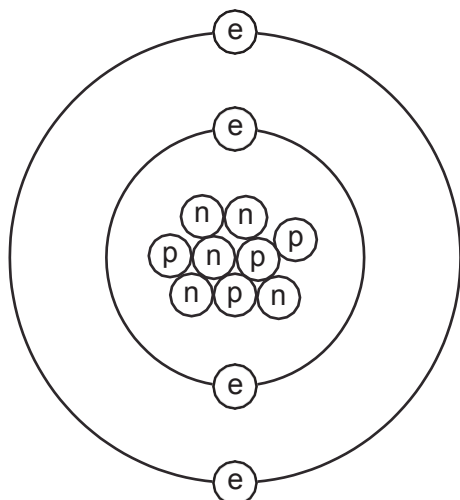
When the percentage of graphite is increased, the pencil slides across the paper more easily.

Which statement explains this observation?

- A Graphite has a high melting point.
- B Graphite is a form of carbon.
- C Graphite is a lubricant.
- D Graphite is a non-metal.

(1 mark)

4 The diagram shows the atomic structure of an element X.



key:

p proton

e electron

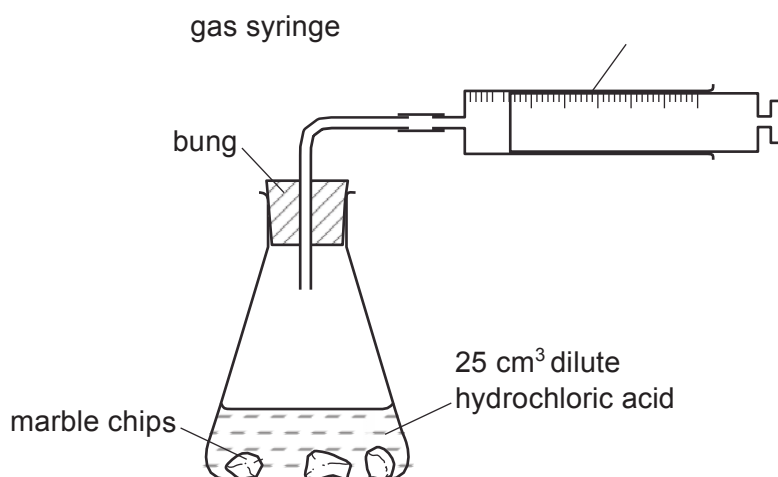
n neutron

What is X?

- A aluminium
- B beryllium
- C boron
- D fluorine

(1 mark)

5 A student uses the apparatus shown in the diagram below to measure the volume of carbon dioxide gas made when different masses of marble chips are added to 25 cm³ of dilute hydrochloric acid.



(1 mark)

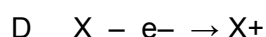
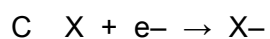
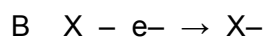
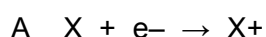
Which other items of apparatus are needed?

- D funnel and balance
- E funnel and stopwatch
- F measuring cylinder and balance
- G measuring cylinder and stopwatch

(1 mark)

6 Element X is in Group I of the Periodic Table. X reacts with element Y to form an ionic compound.

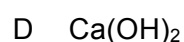
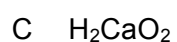
Which equation shows the process that takes place when X forms ions?



(1 mark)

7 A compound contains one atom of calcium, two atoms of hydrogen and two atoms of oxygen.

What is the correct chemical formula of the compound?



(1 mark)

8 What is the relative formula mass, M_r , of CaCO_3 ?

A 50

B 68

C 100

D 204

(1 mark)

9 Which gas is not found in clean air?

A carbon dioxide

B carbon monoxide

C nitrogen

D oxygen

(1 mark)

10 Which statement about petroleum is not correct?

A It can be separated into useful substances by fractional distillation.

B It consists mainly of hydrocarbons.

C It is found underground in many parts of the world.

D Its main use is for making lubricants and polishes.

(1 mark)

11 Which equation shows an oxidation reaction?

- A $C + O_2 \rightarrow CO_2$
- B $CaCO_3 \rightarrow CaO + CO_2$
- C $CaO + 2HCl \rightarrow CaCl_2 + H_2O$
- D $N_2O_4 \rightarrow 2NO_2$

(1 mark)

12 Which statements about alkalis are correct?

- 1 When reacted with an acid, the pH of the alkali increases.
- 2 When tested with litmus, the litmus turns blue.
- 3 When warmed with an ammonium salt, ammonia gas is given off.

- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

(1 mark)

13 Which statement about the Periodic Table is correct?

- A Elements in the same period have the same number of outer electrons.
- B The elements on the left are usually gases.
- C The most metallic elements are on the left.
- D The relative atomic mass of the elements increases from right to left.
- E Copper and hydrogen can each be formed by electrolysis.

(1 mark)

At which electrodes are these elements formed?

	copper	hydrogen
A	anode	anode
B	anode	cathode
C	cathode	anode
D	cathode	cathode

(1 mark)

14 Four steel paper clips are treated as described before being placed in a beaker of water.

Which paper clip rusts most quickly?

- A coated with grease
- B dipped in paint and allowed to dry
- C electroplated with zinc
- D washed with soap and rinsed

(1 mark)

15 Which statements about ethanol are correct?

- 1 It can be made by fermentation.
- 2 It is an unsaturated compound.
- 3 It burns in air and can be used as a fuel.

- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

(1 mark)

16 Hydrochloric acid is used to clean metals.

The acid reacts with the oxide layer on the surface of the metal, forming a salt and water. Which word describes the metal oxide?

- A alloy
- B base
- C element
- D indicator

(1 mark)

17 Which properties of the element titanium, Ti, can be predicted from its position in the Periodic Table?

	can be used as a catalyst	conducts electricity when solid	has low density	forms coloured compounds
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✓
D	✗	✓	✓	✓

(1 mark)

18 In the outline of the Periodic Table below, some elements are shown as numbers.

3																	
5	6																

Which two numbers are metals in the same group?

- A 1 and 2 B 1 and 7 C 3 and 5 D 5 and 6

(1 mark)

19 W, X, Y and Z are four metals.

Some properties of these metals are listed below.

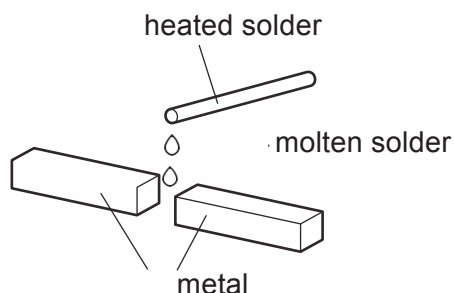
- 1 Only W and Z can be extracted by reduction of their oxides with carbon.
- 2 Only X will react with cold water.
- 3 Only Z can be found 'native' (not combined with any other element).

What is the correct order of these metals in the reactivity series (most reactive first)?

- A X, W, Y, Z B X, Y, W, Z C Z, W, Y, X D Z, Y, W, X

(1 mark)

20 Solder is an alloy of lead and tin. It is used for joining pieces of metal.



Which statement about solder is correct?

- A It can be represented by a chemical formula.
- B It contains a mixture of lead and tin.
- C It contains lead and tin chemically combined.
- D It has a higher melting point than lead or tin.

(1 mark)

21 A The symbol for an atom of one isotope of hydrogen is ${}^3_1\text{H}$

(i) State the number of protons, neutrons and electrons present in one atom of this isotope.

Number of protons

Number of neutrons

Number of electrons

(2 marks)

(ii) What is meant by the term isotopes?

.....
.....
.....

(2 marks)

B Bromine has two naturally-occurring isotopes with mass numbers 79 and 81.

A sample of bromine contained the two isotopes in the following proportions:

bromine-79 = 50.7% and bromine-81 = 49.3%

Use this information to calculate the relative atomic mass of bromine.

Give your answer to two decimal places.

.....

(2 marks)

(Total for Question = 6 marks)

- 22 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process. The overall equation for the Solvay Process is
- $$2\text{NaCl} + \text{CaCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CaCl}_2$$

Calculate the maximum mass of sodium carbonate that could be formed by reacting 40 kg of calcium carbonate with an excess of sodium chloride solution.

(Relative formula masses: $\text{CaCO}_3 = 100$; $\text{Na}_2\text{CO}_3 = 106$)

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(2 marks)

- 23 Nitrogen and oxygen are present in the air.
Another gas present in air is carbon dioxide, CO_2 .
There are covalent bonds between the atoms in a molecule of carbon dioxide.
(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.
Show outer electrons only.



(2 marks)

24 This question is about elements in Group 7 of the Periodic Table.

(a) Complete the table to show the physical state at room temperature of fluorine and astatine, and the colour of liquid bromine.

Element	Colour	Physical state at room temperature
fluorine	pale yellow	
chlorine	pale green	gas
bromine		liquid
iodine	dark grey	solid
astatine	black	

(2 marks)

(b) Chlorine reacts with hydrogen to form hydrogen chloride.

A piece of magnesium ribbon is added to hydrogen chloride in three separate experiments under different conditions.

The table below shows the observations made under these different conditions.

Experiment	Conditions	Observations
1	Hydrogen chloride gas	No visible change
2	Hydrogen chloride dissolved in water	The magnesium ribbon gets smaller and bubbles are seen
3	Hydrogen chloride dissolved in methylbenzene	No visible change

(i) Write the formulae of two ions formed in the solution produced in experiment 2.

Positive ion

Negative ion

(2 marks)

(ii) Identify the gas formed in experiment 2 and give a test for it.

gas

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test

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.....

(2 marks)

(iii) Silver nitrate solution and dilute nitric acid are added to the solution produced in experiment 2.

State what is observed and name the substance responsible for this observation.

observation

.....
.....

substance responsible

.....
.....

(2 marks)

(iv) Explain why there is no reaction in experiment 3.

.....
.....

(1 mark)

(Total for question = 9 marks)

25 Sodium (Na) and sodium chloride (NaCl) both have lattice structures. Their melting points are shown in the table.

	Melting point in °C	Type of lattice structure
sodium	98	giant metallic
sodium chloride	801	

(a) Complete the table by stating the type of lattice structure in sodium chloride.

(1 mark)

(b) Explain why sodium and sodium chloride have different melting points.

In your answer you should refer to:

- the types of particle
- the types of forces between the particles in each substance

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(5 marks)

(Total for question = 6 marks)

The Periodic Table of the Elements

	1	2	3	4	5	6	7	0									
	7 Li lithium 3	9 Be beryllium 4	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> 1 H hydrogen 1 </div>					19 F fluorine 9	4 He helium 2								
	23 Na sodium 11	24 Mg magnesium 12	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> relative atomic mass atomic symbol name atomic (proton) number </div>					16 O oxygen 8	20 Ne neon 10								
	39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
	85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
	133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated					

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.