Index Number	Class	Name

CHIJ ST JOSEPH'S CONVENT
PRELIMINARY EXAMINATIONS

NA **NA**

SCIENCE (CHEMISTRY) **5105/04**
Paper 4 Chemistry **5107/04**

Secondary 4 Normal (Academic) Thursday, 27 July 2023
Paper 3 and 4: 1 hour and 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your index number, class and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working
Do not use staples, paper clips highlighters, glue or correction fluid.

Paper 4:
Answer **all** questions in Section A and any **two** questions in Section B.
The use of an approved scientific calculator is expected, where appropriate.
In calculation, you should show all the steps in your working, giving your answer at each stage.

You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on page 14.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
Paper 3	/ 20
Paper 4	/ 30
TOTAL	/ 50

Section A (14 marks)

Answer **all** questions in the spaces provided.

1 Substances may be described as containing

A a pure element,
B a pure compound,
C a mixture of elements,
D a mixture of compounds.

Complete the table by writing the letter corresponding to the most appropriate description for each of the substances listed.

The first one has been completed for you.

substance	description
carbon dioxide	**B**
water	
bitumen	
steel	

[2]

[Total: 2]

2 Magnesium chloride can be used as a mineral supplement to prevent and treat low amounts of magnesium in the blood.

(a) State the formula of magnesium chloride.

…….. [1]

(b) Describe, in terms of electrons, how a chlorine atom becomes a chloride ion.

……..

…….. [1]

(c) Magnesium chloride has a high melting point.
Explain this using the structure and bonding found in magnesium chloride.

……..

……..

……..

…….. [2]

[Total: 4]

3 Some gases found in air pollute the environment.

(a) Complete the table to show one major source of the atmospheric pollutant in the table.

Table 3.1

atmospheric pollutant	source
carbon dioxide	combustion of fossil fuels
sulfur dioxide	

[1]

(b) Sulfur dioxide dissolves in raindrops to produce 'acid rain'.

(i) Write a word equation to show the conversion of the sulfur dioxide in a raindrop into a compound that causes acid rain.

…… [1]

(ii) The Eiffel Tower is made of iron.
State the effect that acid rain would have on the Eiffel Tower.

…… [1]

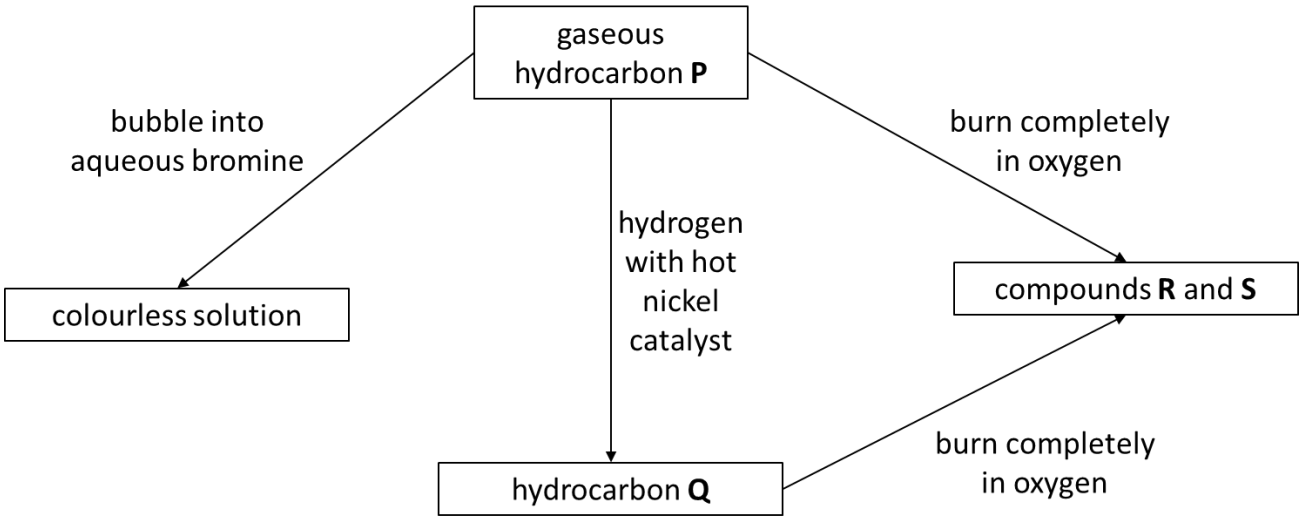
(c) One of the gases in Table 3.1 has been wrongly classified as an atmospheric pollutant. Name the gas and explain why it is not an atmospheric pollutant.

……..

…….. [1]

[Total: 4]

4 The diagram below shows some reactions involving compounds **P**, **Q**, **R** and **S**.



(a) By looking at the reaction with aqueous bromine, state which homologous series hydrocarbon **P** belongs to.

…….. [1]

(b) **(i)** Hydrocarbon **Q** has 2 carbon atoms.
Draw the full structural formula of hydrocarbon **Q**.

[1]

(ii) Hence, predict the observation when hydrocarbon **Q** is added to aqueous bromine.

…… [1]

(c) Identify compounds **R** and **S**.

…….. [1]

[Total: 4]

Section B (16 marks)

Answer any **two** questions from this section in the spaces provided.

5 (a) Tartrazine, $C_{16}H_9N_4Na_3O_9S_2$, is an orange colouring that can be added to food and drinks.
Orangine is an orange squash, which is often used to make orange flavoured drinks.

A label from a bottle of Orangine is shown.

ORANGINE

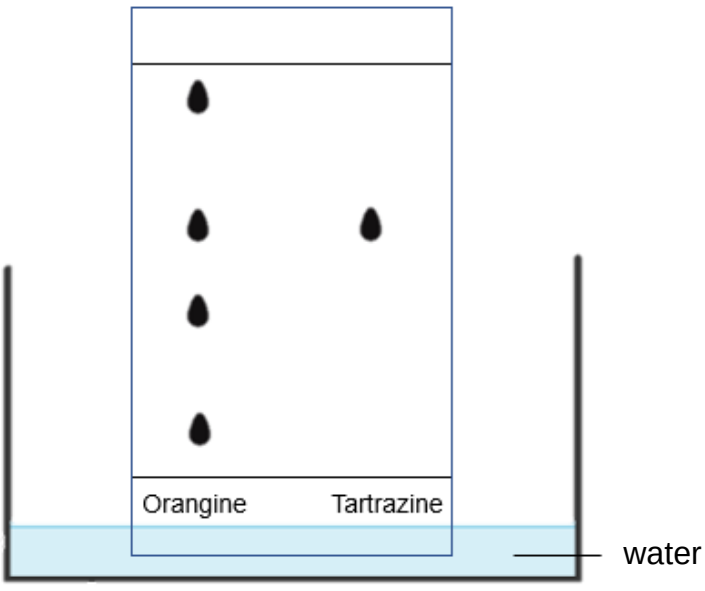
Rich in Vitamin C
Contains no tartrazine

Dilute by mixing 1 part of squash with 4 parts water

Orangine is tested for tartrazine by a food inspector.
The following procedure is used.

- A more concentrated solution of Orangine is made.
- A pencil line is drawn on a piece of filter paper.
- A drop of the concentrated Orangine and a drop of tartrazine solution are placed at different points on the pencil line.
- The filter paper is placed in a beaker of water and left for one hour.

The results of the test are as shown:



(i) State whether Orangine is a mixture of compounds or is a single compound. Give a reason for your answer.

……

…… [1]

(ii) Name the procedure used by the food inspector to test the Orangine.

…… [1]

(iii) What would happen if the water in the beaker was higher than the pencil line?

……

…… [1]

(iv) Is the label from the bottle of Orangine accurate? Explain your answer.

……

…… [1]

(v) How much Orangine drink is made when 75 cm^3 of Orangine squash is diluted with water?
Use the information from the label.

volume = …… cm^3 [1]

(vi) Calculate the relative molecular mass of Tartrazine, $C_{16}H_9N_4Na_3O_9S_2$.
[relative atomic masses, A_r: C, 12; H, 1; N, 14; Na, 23; O, 16; S, 32]

relative molecular mass = …… [1]

(b) Tartrazine has a melting point of 300 °C.

Describe the arrangement and movement of the particles of tartrazine at 30 °C.

Arrangement:

……

……

Movement:

……

…… [2]

[Total: 8]

6 A farmer wants to grow peas in a field.
The farmer tested the soil and finds it has a pH of 6.0.
Peas require soil that is slightly alkaline.

(a) (i) Is the soil in the field suitable for peas to grow? Explain.

……

…… [1]

(ii) The farmer added some calcium hydroxide to make the soil suitable for growing peas.

Explain, in terms of the chemistry involved, the effect calcium hydroxide has on the soil.

……

…… [1]

Ammonium sulfate, $(NH_4)_2SO_4$, is a common fertiliser that can also be added to soil to improve crop yield.

On warming, 0.5 g of ammonium sulfate reacts with excess aqueous sodium hydroxide to produce a salt, water, and ammonia gas.

(b) (i) Construct a balanced chemical equation for the above reaction.

…… [2]

(ii) Calculate the relative molecular mass of ammonium sulfate, $(NH_4)_2SO_4$.
[relative atomic masses, A_r: N, 14; H, 1; S, 32; O, 16]

relative molecular mass = …… [1]

(iii) Calculate the number of moles in 0.5 g of ammonium sulfate.

number of moles = …… mol [1]

(c) Aqueous sodium hydroxide also reacts with aqueous nitric acid to form salt **R** and water.

The salt solution formed was found to be contaminated with some sand particles.

Describe how you could obtain a pure, dry sample of **R** from the mixture.

……..

……..

……..

……..

…….. [2]

[Total: 8]

7 Metals have many uses in everyday life, such as being used to make vehicles and buildings.

(a) The table below shows some common metals and their electronic structures.

element	symbol	electronic structure
lithium	Li	2. 1
magnesium	Mg	2. 8. 2
calcium	Ca	2. 8. 8. 2

By referring to the Periodic Table, deduce a relationship between the electronic structure of an element and the period that it is found.

…….....

……..... [1]

(b) An experiment was conducted by placing lithium into a beaker of water. A gas **Y** was one of the products from the reaction.

(i) Name gas **Y** produced and describe a positive test to identify the gas.

name ……..…….

positive test ……..

……... [2]

(ii) A few drops of universal indicator is placed into the beaker. Describe the colour change that occurs.

……...

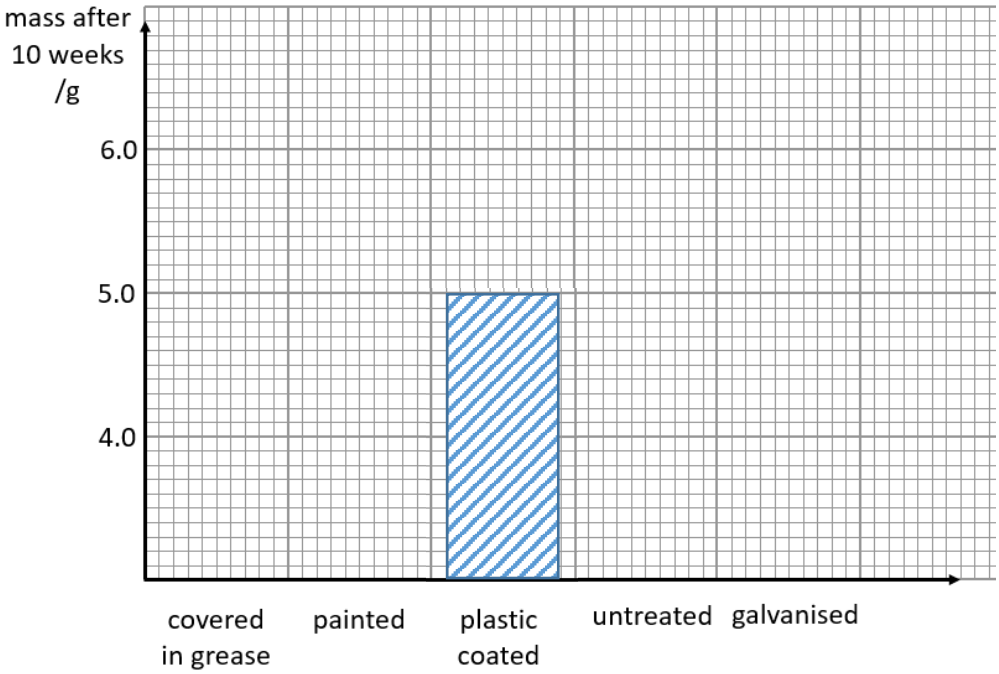
……... [1]

(b) An experiment was set up to investigate the rusting of iron. Five identical nails, each weighing 5 g, were used. Each nail was treated differently. The nails were left outside in the air for ten weeks, and then reweighed.

The results are shown in the table.

nail	treatment	mass at start / g	mass after ten weeks / g
P	covered in grease	5.0	5.2
Q	painted	5.0	5.3
R	plastic coated	5.0	5.0
S	untreated	5.0	6.3
T	galvanised	5.0	5.1

(i) Complete the bar chart to show the results



[1]

(ii) Explain why the masses of nails **R** and **S** were different after ten weeks.

……...

……... [1]

(iii) Calculate the number of moles in 5.0 g of iron.

number of moles = …… mol [1]

(iv) Iron is in high demand because it is used to make different structures and vehicles.

Why is it important that iron is recycled?

……...

……... [1]

[Total: 8]

End of Paper

The Periodic Table of 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		Key atomic number atomic symbol name relative atomic mass									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 –		

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.)