NAME		REG. NO.		CLASS	

SERANGOON GARDEN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018

SUBJECT: SCIENCE(CHEMISTRY) 5105/3; 5107/3
LEVEL: SECONDARY 4 NORMAL(ACADEMIC)
DATE: 14 AUGUST 2018 (TUESDAY)
TIME: 0815 – 0930 HOURS
DURATION: 1 HOUR 15 MINUTES (PAPERS 3 AND 4)

READ THESE INSTRUCTIONS FIRST

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

There are **twenty** 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.

Answers to Paper 3 and Paper 4 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no more than **30 minutes** on **Paper 3**.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
Any rough working should be done in this paper.
A copy of the Periodic Table is printed on page 10.
The use of an approved scientific calculator is expected, where appropriate.

_____ _____
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20

This question paper consists of 9 printed pages and 1 blank page.

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1 In an experiment, a student needs to measure 29.7 cm^3 of sodium nitrate solution.

Which piece of apparatus would help him to measure this volume most accurately?

A beaker
B burette
C measuring cylinder
D pipette

2 Aspirin is often used to treat pain, fever, and inflammation.

What is the best method to test whether a sample of aspirin is pure?

A Check whether it melts at a single temperature.
B Filter its solution and check whether the solution can pass through the filter paper.
C Heat it to see whether it melts.
D Test whether it is soluble in water.

3 The table below shows the melting points and boiling points of four pure substances.

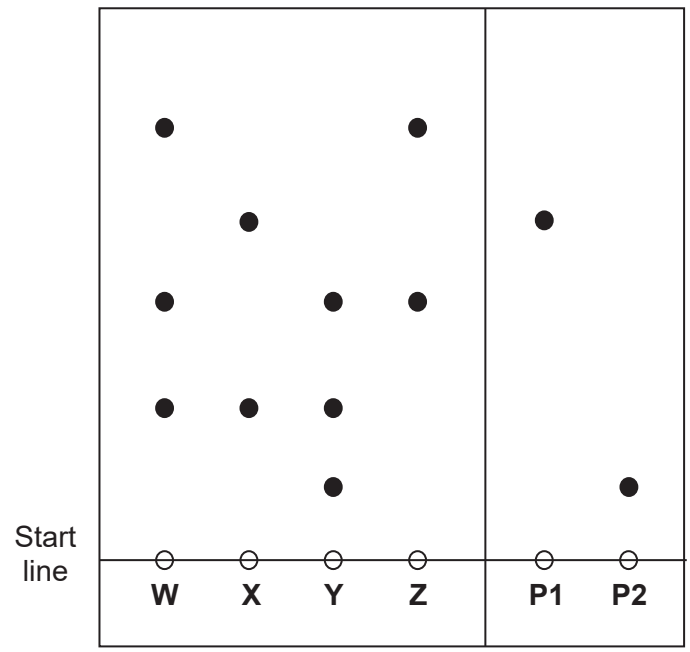
Which substance is a solid at room temperature?

	melting point / °C	**boiling point / °C**
A	-100	-35
B	-7	58
C	6	215
D	44	280

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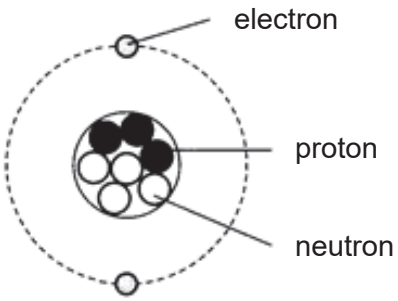
4 The chromatogram below shows the substances contained in four different cups of bubble tea labelled **W**, **X**, **Y** and **Z**. Substances **P1** and **P2** are plasticisers which are harmful.



Which cups of bubble tea are safe for consumption?

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

5 The diagram shows the structure of a particle.



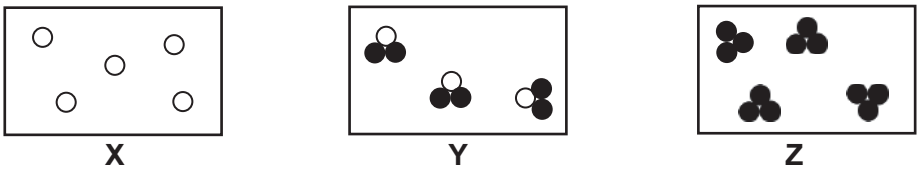
Which option describes the above structure accurately?

A a negative ion
B a positive ion
C an atom
D an isotope

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6 The diagrams show the arrangement of particles in three substances, **X**, **Y** and **Z**.
● and ○ represent atoms of different elements.



Which row correctly describes these three substances?

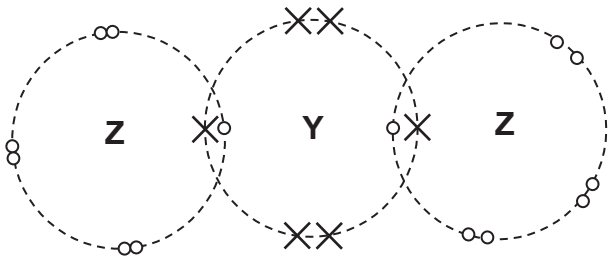
	X	Y	Z
A	compound	element	mixture
B	element	compound	compound
C	element	compound	element
D	element	mixture	element

7 The atoms of element **Y** have the electronic configuration 2.8.6.

Which statement about element **Y** is correct?

A It forms an ionic compound with potassium.
B It only reacts with non-metals.
C It forms an ion of charge +2.
D In an atom of **Y**, there are 6 protons in the valence shell.

8 The diagram shows the electron arrangement in a molecule of compound $\mathbf{YZ_2}$.



Which elements could **Y** and **Z** be?

	Y	Z
A	calcium	chlorine
B	carbon	oxygen
C	oxygen	chlorine
D	sulfur	oxygen

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9 Ethanoic acid is an active ingredient in vinegar. Its chemical formula is CH_3COOH.

How many elements is it made up of?

A 3
B 6
C 8
D 60

10 Which of the following is a property of all acidic solutions?

A They react with bases.
B They react with copper to give hydrogen.
C They are solids at room temperature.
D Their aqueous solutions have a pH greater than 7.

11 A student was asked to prepare a sample of zinc nitrate. He added a solid to dilute nitric acid. The experiment failed.

Which solid did he choose?

A zinc carbonate
B zinc chloride
C zinc metal
D zinc oxide

12 Why are lithium and fluorine placed in the same period of the Periodic Table?

A Lithium and fluorine combine together to form a compound of formula LiF.
B Lithium is a reactive metal and fluorine is a reactive non-metal.
C The atoms of both elements have eight electrons in their outer electron shell.
D The atoms of both elements have only two electron shells containing electrons.

13 Helium is the second most abundant element in the world. It is very unreactive and is used to provide an inert protective atmosphere for making fibre optics and semiconductors.

Which of the following explains why helium is a chemically unreactive gas?

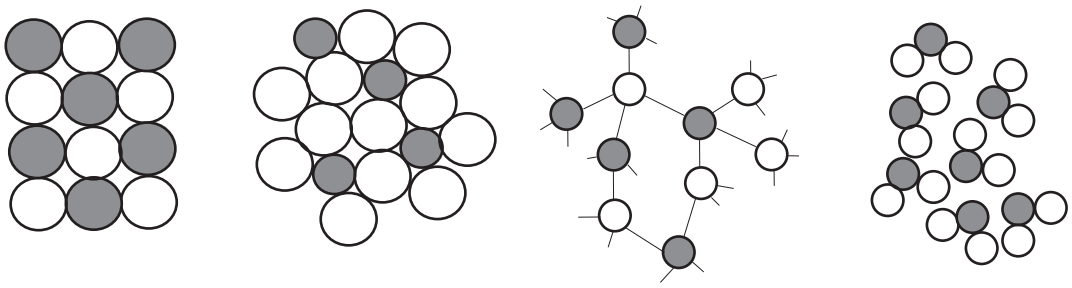
A Its outermost electron shell is completely filled.
B It has the same number of protons and electrons.
C There are eight electrons in the valence shell.
D There is an equal number of protons and neutrons in the nucleus.

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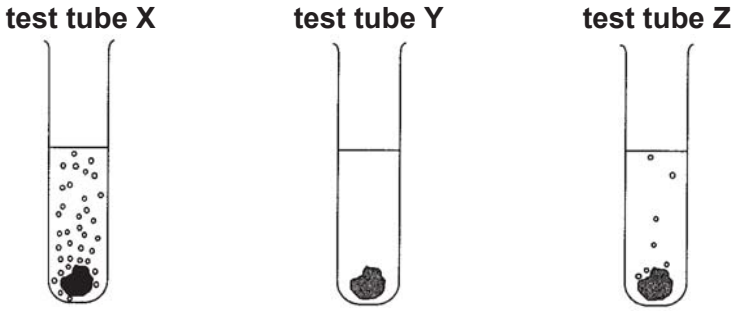
14 Stainless steel is commonly used for food processing equipment as it has excellent resistance to stains or rust.

Which of the following most likely shows the arrangement of atoms in stainless steel?



A **B** **C** **D**

15 The results of placing three metals separately in dilute hydrochloric acid are shown in the diagram below.



What could the metals in the three test tubes be?

	test tube X	**test tube Y**	**test tube Z**
A	zinc	copper	magnesium
B	copper	magnesium	iron
C	magnesium	copper	iron
D	magnesium	zinc	iron

16 Which metal(s) can be extracted by heating an ore containing its oxide with carbon?

	calcium	magnesium	lead	sodium
A	✓	✓	✓	✓
B	✓	✓	✓	×
C	×	×	✓	×
D	×	×	×	×

Key
✓ = reacts
× = does not react

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17 Which statement(s) about why metals should be recycled is/are correct?

1 There is a finite supply of metals.
2 Recycling metals produces more waste products compared to extraction of metals from their ores.
3 Recycling metals reduces the amount of space used up in landfill sites.
4 It is cheaper to recycle certain metals than to extract them from their ores.

A 1 and 4
B 2 and 3
C 1, 3 and 4
D All of the above

18 Which property/properties of the alkanes do(es) **not** increase as their relative molecular masses increase?

I boiling point
II flammability
III viscosity

A **I** only
B **II** only
C **I** and **II**
D All of the above

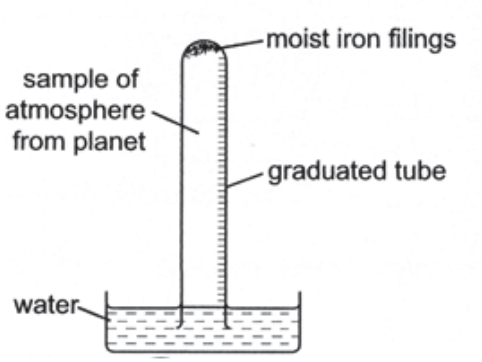
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19 The air taken from a newly discovered planet contains the following gases.

gas	concentration (%)
carbon dioxide	20
hydrogen	40
ammonia	10
oxygen	30

The apparatus below was set up with a 100 cm^3 sample of the air taken from the planet in the graduated tube. The volume of the sample was measured at regular time intervals until no further change in volume took place.

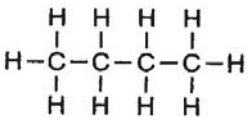


What volume of the sample would remain?

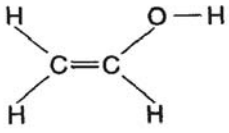
A 20 cm^3
B 30 cm^3
C 70 cm^3
D 80 cm^3

20 Which diagram represents an unsaturated hydrocarbon?

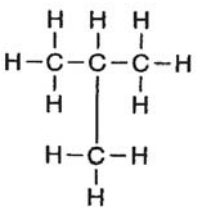
A



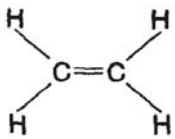
B



C



D



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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 proton (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.).

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DATE: 14 AUGUST 2018 (TUESDAY)
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DURATION: 1 HOUR 15 MINUTES (PAPERS 3 AND 4)

READ THESE INSTRUCTIONS FIRST

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

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 calculations, 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 13.

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.

_____ _____
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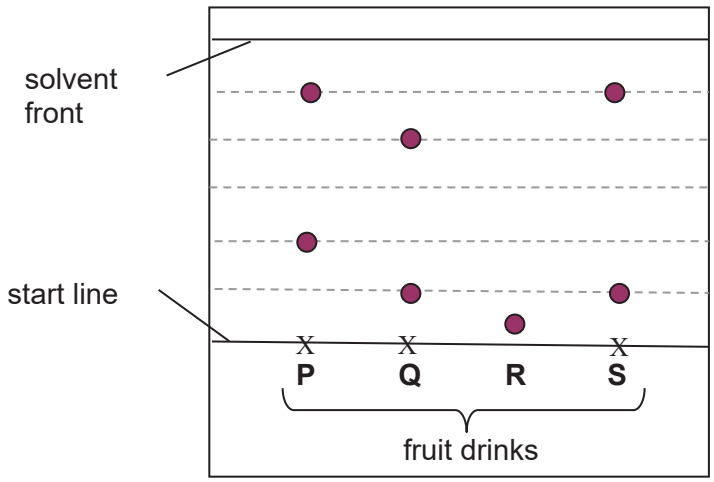
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Section A

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

1 The diagram shows the chromatogram obtained with water-soluble dyes used in fruit drinks labelled **P**, **Q**, **R** and **S**.



(a) Name a suitable solvent to produce this chromatogram. [1]

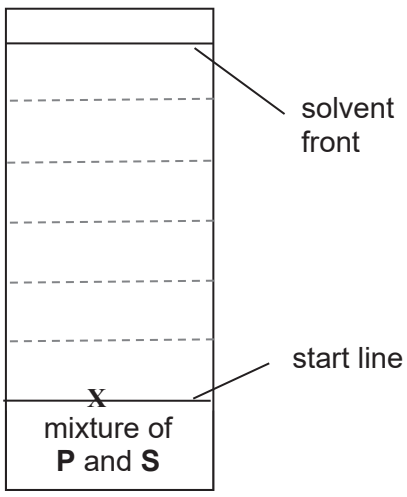
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(b) Identify the drink(s) that is/are mixture(s). Explain your answer. [1]

……

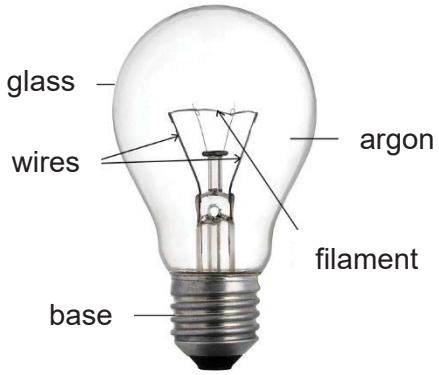
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(c) In another experiment, drinks **P** and **S** were mixed together and chromatography was carried out using the same solvent. Draw on the diagram below the chromatogram you would expect to obtain. [1]



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2 The diagram shows a light bulb. The wires and the filament are housed in a glass bulb, which is filled with an inert gas, such as argon.



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(a) Describe using the Kinetic Particle Theory, how argon fills the interior of the light bulb. [1]

……

……

(b) The most common isotope of argon in the air has the chemical symbol $^{40}_{18}Ar$.

(i) Determine the number of electrons and neutrons in one atom of this isotope. [1]

number of electrons = ……..

number of neutrons = ……..

(ii) Suggest the chemical symbol for another isotope of argon. [1]

……..……..……..

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3 The table shows information about some gases.

gas	formula	relative molecular mass, M_r	pH of aqueous solution of the gas
ammonia	NH_3		12
carbon dioxide	CO_2	44	6
sulfur dioxide		64	4
oxygen	O_2	32	7

[relative atomic masses, A_r: C, 12; H, 1; N, 14; O, 16; S, 32]

(a) Complete the table by filling in the blank spaces. [2]

(b) Which gas(es) will turn moist blue litmus paper red? [1]

……..……..

(c) Draw the 'dot-and-cross' diagram of an oxygen molecule. Show only the outer electrons. [1]

(d) Calculate the number of moles of carbon dioxide molecules present in 33 g of carbon dioxide. Show your working clearly.

number of moles = …… [1]

(e) State one major natural source for sulfur dioxide. [1]

……..……..

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4 The diagram shows the Third Series Singapore coins.



Credits to https://www.channelnewsasia.com/news/singapore/feedback-wanted-on-proposed-limits-on-using-coins-for-payments-8575854

Explain why steel is used to make the core of the coins, instead of pure nickel or copper. [2]

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Section B

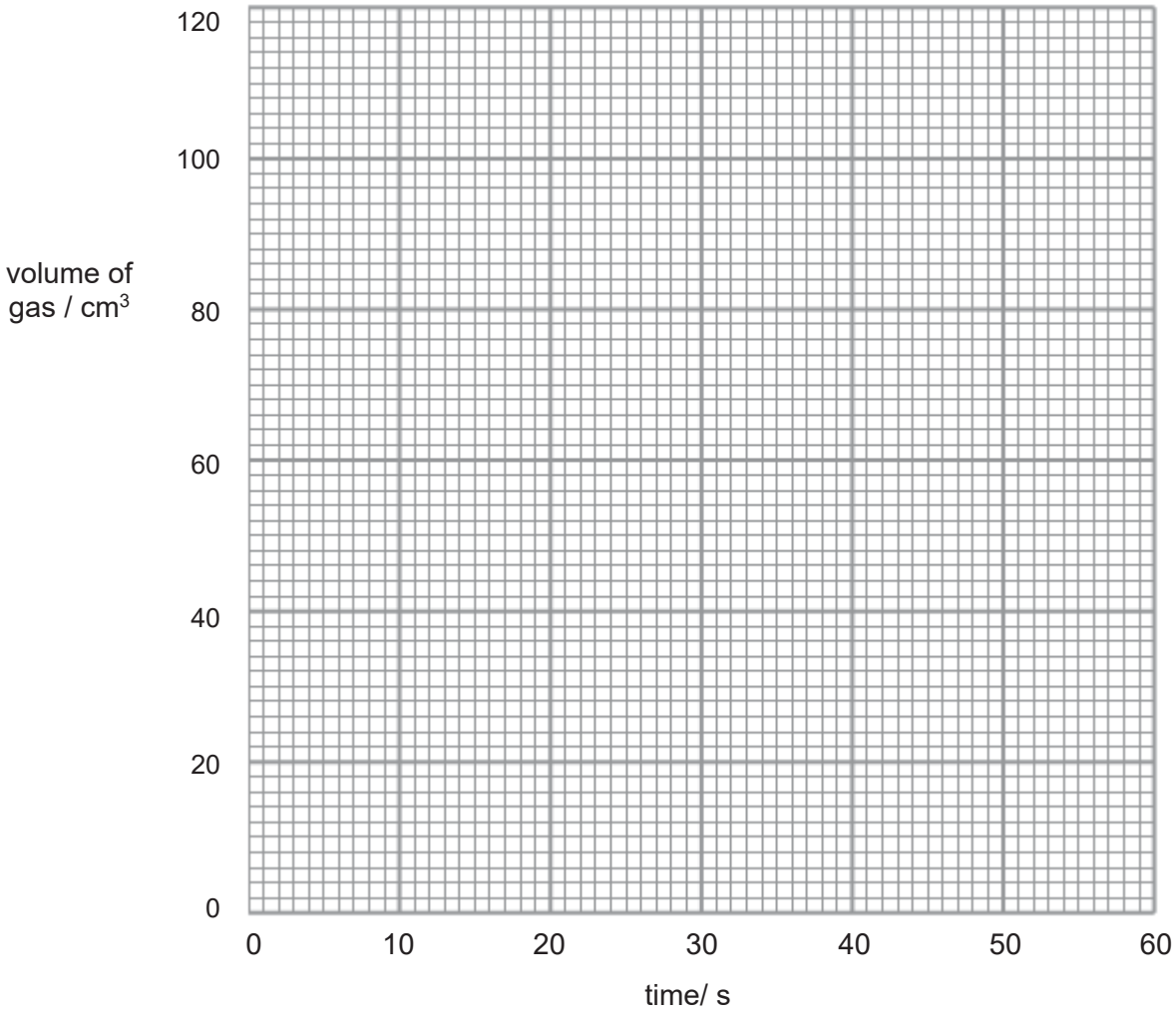
Answer any **two** questions from this section in the spaces provided.

5 A student added 0.1 g of magnesium ribbon to sulfuric acid at room temperature. The gas is collected in a syringe and the volume of gas is noted every 20 seconds in Table 5.1.

Table 5.1

time/s	0	10	20	30	40	50	60
volume of gas/cm^3	0	30	60	80	90	100	100

(a) Plot a graph of these results, marking each point with a cross (x).
Draw a best-fit curve taking into account all the plotted points. [2]



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(b) Predict the volume of gas collected if the experiment is allowed to proceed to 80 s. Explain why. [1]

……

(c) Describe a test for the gas produced in the above experiment and hence, state the results. [2]

Test: ……

Result: ……

……

(d) **(i)** Identify the salt formed in the reaction. [1]

……

(ii) Describe how pure and dry crystals can be obtained from the salt solution. [2]

……

……

……

……

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6 Chlorine is commonly used as an antiseptic and is used to make drinking water safe and to treat the water in swimming pools.

(a) A student uses the apparatus in Fig 6.1 to bubble chlorine through a colourless sodium iodide solution in a fume cupboard.

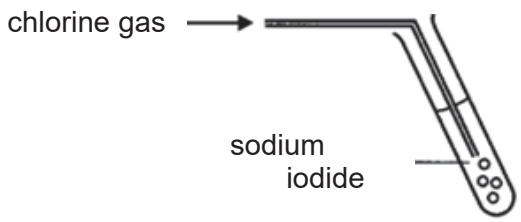


Fig. 6.1

(i) Write a balanced chemical equation for the reaction that occurs between chlorine and sodium iodide solution. [2]

……

(ii) Describe an observation that could be made during this chemical reaction. [1]

……

(b) Bromine, another member of Group VII, is used to test for unsaturation in hydrocarbon molecules.

(i) What is the physical state of bromine used in this test? [1]

……

(ii) Describe an observation which would prove that the sample being tested is an unsaturated hydrocarbon. [1]

……

(iii) Name the type of reaction that occurs between bromine and the unsaturated hydrocarbon. [1]

……

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(c) Acidic aqueous chlorine was accidentally spilled on a plot of land during transportation.

(i) Suggest a suitable chemical that farmers can use to reduce the acidity of soil. [1]

……..…….

(ii) Explain how the chemical in **c(i)** can reduce the acidity of soil. [1]

……..…….

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7 Fig. 7.1 shows the burning of methane gas using a Bunsen burner with the air hole open.

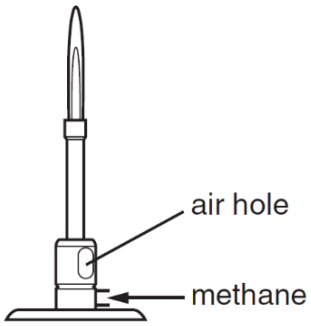


Fig. 7.1

(a) Methane burns completely when the air hole is open. Write a balanced chemical equation for the complete combustion of methane. [1]

……..

(b) Methane burns incompletely when the air hole is closed. Name a pollutant that will be formed and explain why it is dangerous to use a Bunsen burner in a poorly ventilated room with the air hole closed. [2]

……..……

…..……

(c) Organic compounds are grouped into families called homologous series. Describe two characteristics of a homologous series. [2]

……..……

…..……

…..……

(d) Methane is the first member of a homologous series. Draw the full structural formula of the third member of the homologous series. [1]

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(e) Suggest one difference in physical property of the structure you have drawn in **(d)** as compared to methane. [1]

……..

(f) Methane reacts with chlorine to form chloromethane. The equation for the reaction is shown below.

$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

Name this type of reaction and state the condition needed for the reaction to occur. [1]

……..

……..

- END OF PAPER -

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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 proton (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.).

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SGS PRELIM 2018
4NA SCIENCE(CHEMISTRY)
MARK SCHEME

Paper 3

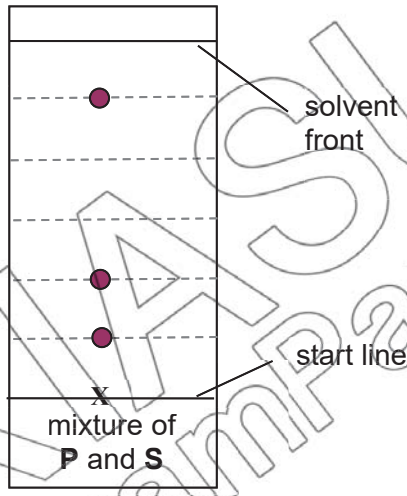
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	A	D	B	B	C	A	C	A	A
Q11	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**
B	D	A	B	C	C	C	B	C	D

1

(a) water [1]

(b) P, Q and S, can be separated into two spots of dyes [1]

(c) [1]



2

(a) Particles move freely and randomly to occupy any available space [1]

(b) **(i)** number of electrons = 18
number of neutrons = 22 Both correct [1]

(ii) $^{39}_{18}Ar$ or $^{41}_{18}Ar$ any feasible answer [1]

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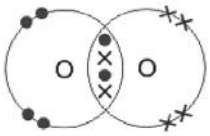
3 **(a)**

gas	formula	relative molecular mass, M_r	pH of aqueous solution of the gas
ammonia	NH_3	17	12
carbon dioxide	CO_2	44	6
sulfur dioxide	SO_2	64	4
oxygen	O_2	32	7

1 mark per correct answer [2]

(b) carbon dioxide and sulfur dioxide [1]

(c) [1]



(d) 0.75 [1]

(e) volcanic eruption [1]

4 Steel is harder/stronger than pure nickel or copper [1]
Atoms of different elements have different sizes, disrupts orderly layers of atoms, harder to slide over one another [1]

5 **(a)** All points plotted correctly [1]
Best-fit curve [1]
(b) $100cm^3$, reaction has stopped [1]
(c) **(i)** hydrogen [1]
(ii) Test: Insert lighted/burning splint into gas [1]
Result: Lighted/burning splint extinguished with 'pop' sound [1]
(d) **(i)** magnesium sulfate [1]
(ii) Heat solution until saturated [1]
Leave to cool and form crystals, filter and dry crystals [1]

6
(a) **(i)** $Cl_2 + 2NaI \rightarrow 2NaCl + I_2$
Correct equation [1]
Correct balancing [1]
(ii) Colourless solution turns brown [1]
(b) **(i)** aqueous [1]
(ii) Reddish brown/orange aqueous bromine turns colourless [1]
(iii) Addition / bromination [1]
(c) **(i)** Calcium hydroxide / calcium oxide/ calcium carbonate [1]
(ii) Neutralise acidic soil [1]

7
(a) $CH_4 + 3O_2 \rightarrow CO_2 + 2H_2O$ [1]
(b) Carbon monoxide [1]
Prevents blood from transporting oxygen around the body, causing death [1]

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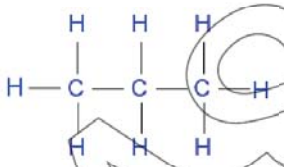
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(c)

- Same general formula
- Similar chemical properties
- Each member differs from the next by $-CH_2-$ group

Any two points [2]

(d) [1]



(e) Higher boiling point/ more viscous/ less soluble than methane [1]

(f) Substitution, presence of light [1]

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