HILLGROVE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2019
SECONDARY THREE EXPRESS

CANDIDATE NAME ( )

CLASS [ ] - [ ]

CENTRE NUMBER S [ ] [ ] [ ] [ ]

INDEX NUMBER [ ] [ ] [ ] [ ]

PURE CHEMISTRY

6092

7 Oct 2019

2 hour 15 minutes

Additional Materials: Optical Answer Sheet (OAS)

08.00 A.M. to 10.15 A.M.

READ THESE INSTRUCTIONS FIRST

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

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
There are **thirty** questions on this section. 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.

Section B and C
Answer **all** questions.
Write your answers in the space provided on the question paper.
The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is printed on page 25.

For Examiner's Use	
Section A	30
Section B	40
Section C	30
TOTAL	100

Parent's/ Guardian's Signature: _____

Setter: Mr Samson Cher

This document consists of **24** printed pages and **02** blank pages.

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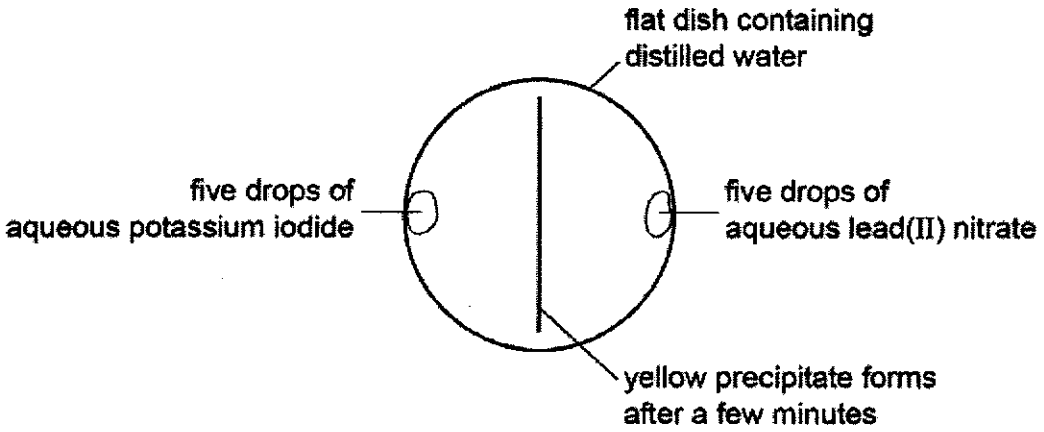
Section A: Multiple Choice Questions [30 marks]
Answer **all** questions.
Choose the most correct answer and shade your choice in the Answer Sheet provided.

1 The diagram shows a cup of tea.

Which row describes the water molecules in the air above the cup compared with the water molecules in the cup?

	moving faster	closer together
A	✓	✓
B	✓	×
C	×	✓
D	×	×

2 A yellow precipitate is formed in the experiment shown.



How is the precipitate formed?

A Particles collide, diffuse and then react.
B Particles collide, react and then diffuse.
C Particles diffuse, collide and then react.
D Particles diffuse, react and then collide.

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3 A student was provided with only a thermometer, a stopwatch and a beaker.

What could the student measure?

A 10.5 g solid and 24.8 cm^3 liquid

B 10.5 g solid and 25°C

C 24.8 cm^3 liquid and 45 seconds

D 25°C and 45 seconds

4 The table gives the density and solubility in water of four gases.

gas	density	solubility in water
1	denser than air	insoluble
2	denser than air	soluble
3	less dense than air	insoluble
4	less dense than air	soluble

Which row correctly shows whether the method of collection could or could not be used to collect each gas?

	gas	method of collection	
		upward delivery	displacement of water
A	1	no	no
B	2	no	yes
C	3	yes	yes
D	4	yes	yes

5 Mixture 1 contains silicon(IV) oxide and water.

Mixture 2 contains sodium hydroxide and water.

Which method of separation could be used to obtain each of the required products from each mixture?

	mixture 1		mixture 2	
	to obtain silicon(IV) oxide	to obtain water	to obtain sodium hydroxide	to obtain water
A	crystallisation	distillation	filtration	filtration
B	crystallisation	filtration	filtration	distillation
C	filtration	distillation	crystallisation	filtration
D	filtration	filtration	crystallisation	distillation

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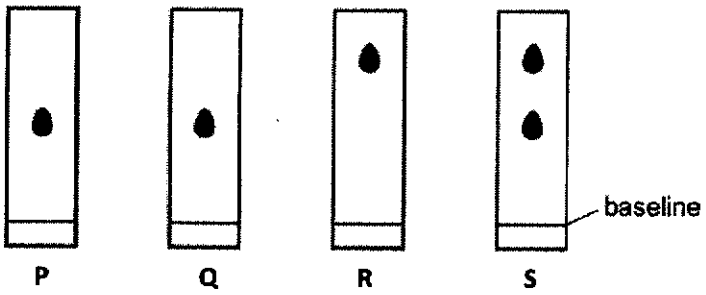
6 Chromatography experiments are carried out on four substances, **P**, **Q**, **R** and **S**.

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 **Q** have the same R_f values.

C **R** and **S** are pure substances.

D **S** is a mixture of substances.

7 Potassium, K, forms a compound with fluorine, F.

Which statements about this compound are correct?

1 The compound is ionic.

2 The formula of the compound is KF.

3 The compound is soluble in water.

A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

8 Which elements are in the compound $BaCO_3$?

A barium and cobalt

B boron, actinium and oxygen

C carbon, oxygen and barium

D oxygen, calcium and boron

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9 The table below describes the structures of four particles.

particle	number of protons	number of neutrons	number of electrons
O	8	8	8
O^{2-}	8	8	**X**
Na	11	**Y**	11
Na^{+}	11	12	**Z**

What are the correct values of **X**, **Y** and **Z**?

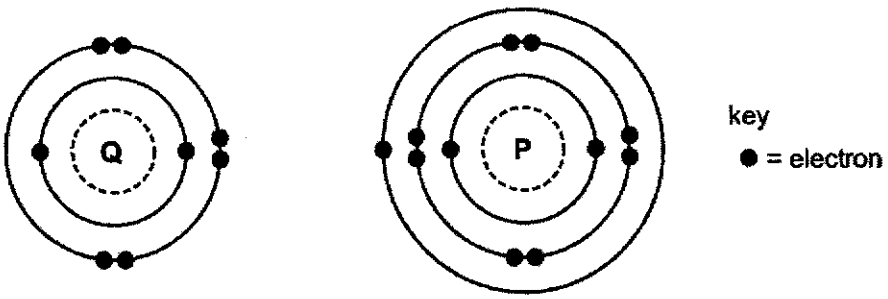
	X	Y	Z
A	9	11	10
B	9	11	11
C	10	12	10
D	10	12	11

10 The table shows the atomic structure of four atoms.

Which atom is **not** a metal?

	electrons	neutrons	protons
A	18	22	18
B	19	20	19
C	19	21	19
D	20	20	20

11 The electronic structures of atoms **P** and **Q** are shown.



P and **Q** react to form an ionic compound.

What is the formula of this compound?

A PQ_2

B P_2Q

C P_2Q_6

D P_6Q_2

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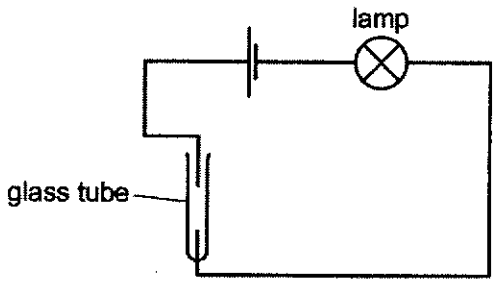
12 Which row shows the correct formula for the corresponding compound?

	compound	formula
A	ammonium chloride	NH_3Cl
B	copper(II) sulfide	CuS
C	iron(II) sulfide	Fe_2S
D	silver nitrate	Ag_2NO_3

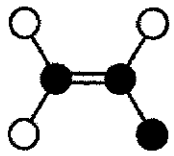
13 The diagram shows an incomplete circuit.



Which substance, when added to the glass tube, will cause the lamp to light up?

A aqueous sodium chloride
B aqueous sugar
C solid sodium chloride
D solid sugar

14 The diagram shows a molecule of vinyl chloride.



key
- a carbon atom
- a chlorine atom
- a hydrogen atom

What is the formula of vinyl chloride?

A CH_2Cl_3
B CH_3Cl_2
C C_2HCl_3
D C_2H_3Cl

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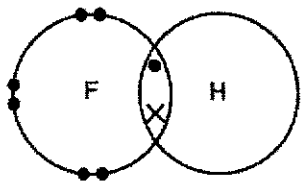
15 The diagram shows a molecule of hydrogen fluoride.



Which statement correctly describes how the molecule of hydrogen fluoride is formed?

A The hydrogen and fluorine share a pair of electrons.

B The hydrogen and fluorine share a pair of protons.

C The hydrogen gives fluorine an electron.

D The hydrogen gives fluorine a proton.

16 Nitrogen and hydrogen react together to form ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

When completely reacted, 7 tonnes of nitrogen gives 8.5 tonnes of ammonia.

How much nitrogen will be needed to produce 34 tonnes of ammonia?

A 7 tonnes

B 8.5 tonnes

C 28 tonnes

D 34 tonnes

17 124 g of phosphorous vapour has the same volume as 71 g of chlorine gas at the same temperature and pressure.

What is the formula of a molecule of phosphorus?

A P_8

B P_4

C P_2

D P

18 The relative formula mass, M_r of copper(II) sulfate, $CuSO_4$, is 160.

Which mass of sulfur is present in 160 g of copper(II) sulfate?

A 16 g

B 32 g

C 64 g

D 128 g

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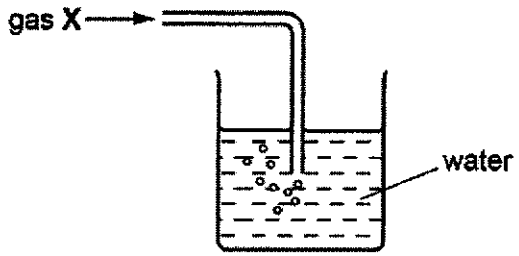
19 An element **E** is burnt in air. A white solid oxide is formed.

The oxide is tested with a damp red litmus paper. The paper turns blue.

What is element **E**?

A calcium
B carbon
C iodine
D sulfur

20 Gas **X** is passed into water as shown.



The pH of the water changes from 7 to 10.

What is gas **X**?

A ammonia
B carbon dioxide
C nitrogen
D sulfur dioxide

21 Which property is **not** characteristic of a base?

A It reacts with a carbonate to form carbon dioxide.
B It reacts with an acid to form a salt.
C It reacts with an ammonium salt to form ammonia.
D It turns Universal Indicator paper blue.

22 An alloy contains copper and zinc.

Some of the zinc has become oxidised to zinc oxide.

What is the result of adding an excess of dilute sulfuric acid to the alloy?

A A blue solution and a white solid remains.
B A colourless solution and a brown solid remains.
C The alloy dissolves completely to give a blue solution.
D The alloy dissolves completely to give a colourless solution.

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23 The results of three tests on a solution of compound **X** are shown.

test	result
aqueous potassium hydroxide added	white precipitate formed, soluble in excess
aqueous ammonia added	white precipitate formed, soluble in excess
dilute hydrochloric acid added	bubbles of gas

What is compound **X**?

A aluminium carbonate

B aluminium chloride

C zinc carbonate

D zinc chloride

24 Equations for the effect of water on anhydrous cobalt(II) chloride and anhydrous copper(II) sulfate are shown.

$$CoCl_2(s) + 6H_2O(l) \rightarrow CoCl_2.6H_2O(s)$$

$$CuSO_4(s) + 5H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

Which statement is **not** correct?

A Both reactions can be reversed by changing the conditions.

B Both reactions can be used as a test for water.

C The colour change observed when hydrated copper(II) sulfate is heated is from blue to white.

D The colour change observed when water is added to anhydrous cobalt(II) chloride is from pink to blue.

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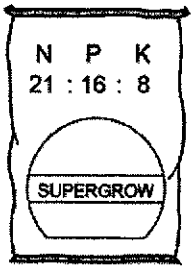
25 Which composition of chemical compounds could be used to produce the fertiliser shown?



A NH_4NO_3, $Ca_3(PO_4)_2$

B NH_4NO_3, $CO(NH_2)_2$

C NH_4NO_3, K_2SO_4, $(NH_4)_2SO_4$

D $(NH_4)_3PO_4$, KCl

26 The equation explains the colour change that occurs when aqueous potassium chromate(VI) is added to aqueous potassium dichromate(VI).

$$\underset{\substack{\text{potassium}\\\text{dichromate(VI)}\\\text{orange}}}{K_2Cr_2O_7} + 2KOH \rightarrow \underset{\substack{\text{potassium}\\\text{chromate(VI)}\\\text{yellow}}}{2K_2CrO_4} + H_2O$$

As a result of adding an excess of aqueous potassium hydroxide to aqueous potassion dichromate(VI), what happens to the oxidation state of the chromium and the pH of the reaction mixture?

	oxidation state of the chromium	pH of the mixture
A	decreases	decreases
B	decreases	increases
C	stays the same	decreases
D	stays the same	increases

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27 The equations for three reactions are shown.

1 $CuO + H_2 \rightarrow Cu + H_2O$

2 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

3 $2H_2 + O_2 \rightarrow 2H_2O$

Which statement about the reactions is **not** correct?

A In reaction 1, copper(II) oxide is reduced to copper.

B In reaction 2, carbon monoxide is oxidised to carbon dioxide.

C In reactions 1 and 3, hydrogen is oxidised to water.

D In reaction 2, iron(III) oxide is oxidised to iron.

28 An element has the following properties.

- It forms coloured compounds.
- It acts as a catalyst.
- It melts at 1539°C.

In which part of the Periodic Table is the element found?

A Group I

B Group IV

C Group VII

D transition elements

29 The Group I elements lithium and potassium are tested.

Which element has the higher melting point and which element reacts more vigorously with water?

	higher melting point	more vigorous reaction with water
A	lithium	lithium
B	lithium	potassium
C	potassium	lithium
D	potassium	potassium

30 In the Haber process, nitrogen and hydrogen react to form ammonia.

What is the source of the hydrogen?

A air

B ethanol

C oil

D sulfuric acid

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Section B: Short Structured Questions [40 marks]
Answer **all** questions.
Write your answers in the spaces provided.

1 Aqueous silver nitrate reacts with aqueous potassium halides to form precipitates.

The precipitates are unstable and break down to form solid silver and a halogen.

These reactions are summarised in the chemical equations below (X represents the symbol for the halogen).

reaction 1: $AgNO_3$ (.....) + KX (.....) → AgX (.....) + KNO_3 (.....)

reaction 2: $2AgX \rightarrow 2Ag + X_2$

(a) Complete the equation for reaction 1 by filling in the missing state symbols. [1]

(b) Table 1.1 shows the colours of some halide precipitates and the observations made when the precipitates are left to stand.

Table 1.1

silver halide	colour of silver halide	observations on standing
silver chloride	white	rapid formation of grey solid
silver bromide	cream	slow formation of grey solid
silver iodide		no visible change after several minutes

(i) Complete Table 1.1 to show the colour of silver iodide. [1]

(ii) What conclusion can you make from the table about the relationship between reactivity of the halogen and the rate of breakdown of the silver halide?

.....

..... [1]

[total: 3]

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2 An element, **M**, has the electron distribution 2. 8. 18. 3.

(a) Which group in the Periodic Table is element **M** likely to be in?

..... [1]

(b) Predict whether element **M** is a poor or a good conductor of electricity.
Give a reason for your answer.

.....

..... [1]

(c) Binary compounds contain two atoms per molecule, for example H*Cl*.
Identify an element which could form a binary compound with element **M**.

..... [1]

(d) Predict the formula of the sulfate of **M**. The formula of the sulfate ion is SO_4^{2-}.

..... [1]

(e) The hydroxide of **M** is a white powder which is insoluble in water.
Using named reagents, describe how you could show that this hydroxide is amphoteric.

.....

.....

.....

..... [2]

[total: 6]

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3 Fig. 3.1 shows the substances present in a bottle of orange fruit drink.

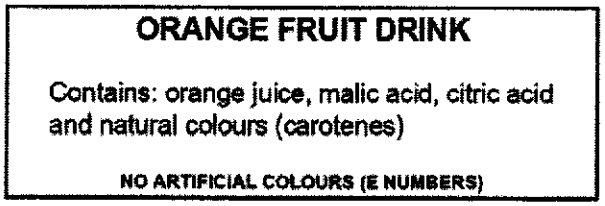

Fig. 3.1

(a) A piece of pH indicator paper was dipped in the drink.

(i) Predict the pH value obtained.

..... [1]

(ii) Why does the pH indicator paper give a more reliable result than adding Universal Indicator solution to the drink?

.....

..... [1]

(b) Describe an experiment you could carry out to show that only natural colours were present in the drink.

A space has been left if you want to draw a diagram to help you answer the question.

.....

.....

.....

.....

..... [4]

[total: 6]

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4 This question is about isotopes.

(a) Fig. 4.1 shows a symbol representing an atom of an isotope of fluorine.

$$^{19}_{9}F$$

Fig. 4.1

Describe the structure of an atom of this isotope of fluorine.
In your answer, include:

- the position of the protons, neutrons and electrons in the atom
- the number of protons, neutrons and electrons present in the atom.

.....

.....

.....

.....

.....

.....

..... [5]

(b) Give **one** medical use of radioactive isotopes.

..... [1]

(c) Which one of the following isotopes is used as a source of energy?
Draw a circle around the correct answer.

$^{127}_{53}I$ $^{235}_{92}U$ $^{131}_{54}Xe$ $^{66}_{30}Zn$

[1]

[total: 7]

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5 Fig. 5.1 shows bar charts comparing the concentration of ions in two samples of water, sample **A** and sample **B**.

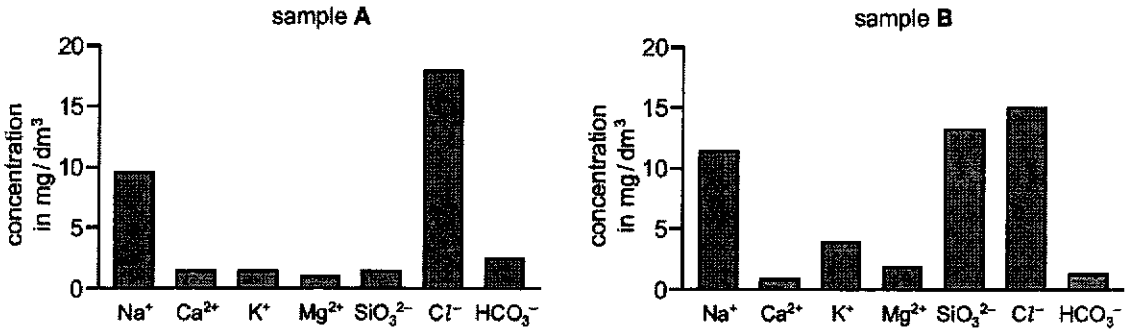

Fig. 5.1

(a) Use information in Fig 5.1 to answer the following questions.

(i) Describe a difference in the composition of sample **A** and sample **B**.

.....

..... [1]

(ii) Calculate the mass of chloride ions present in 100 cm^3 of sample **B**.
Show all your working.

mass = ... mg [2]

(b) Describe a test for chloride ions.

test .....

result ..... [2]

(c) Silicon in river water comes from silicate rocks. Some of these contain silicon(IV) oxide.

(i) Explain why silicon(IV) oxide is an acidic oxide.

..... [1]

(ii) Suggest whether silicon(IV) oxide has a high or low melting point. Explain your answer.

.....

.....

..... [2]

[total: 8]

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6 The hydroxides of the Group I metals are soluble in water. Most other metal hydroxides are insoluble in water.

(a) (i) Fig. 6.1 shows a method to prepare crystals of lithium chloride from lithium hydroxide.

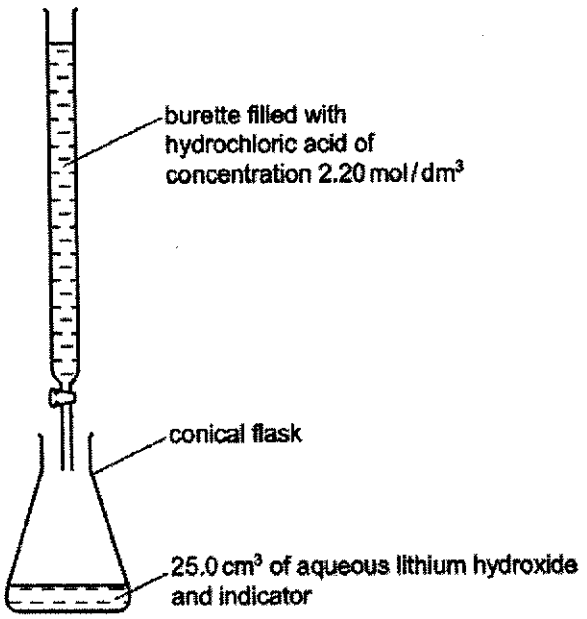

Fig. 6.1

25.0 cm^3 of aqueous lithium hydroxide is pipetted into the conical flask.
A few drops of an indicator are added. Dilute hydrochloric acid is added slowly to the alkali until the indicator just changes colour. The volume of acid needed to neutralise the lithium hydroxide is noted.

A neutral solution of lithium chloride, which still contains the indicator, is left. Describe how you could obtain a neutral solution of lithium chloride which does **not** contain an indicator.

.....

.....

.....

..... [2]

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(ii) You cannot prepare a neutral solution of magnesium chloride by the same method. Describe how you could prepare a neutral solution of magnesium chloride.

.....

.....

.....

.....

.....

..... [3]

(b) The concentration of the hydrochloric acid was 2.20 mol/dm^3. The volume of acid needed to neutralise the 25.0 cm^3 of lithium hydroxide was 20.0 cm^3.

$$LiOH + HCl \rightarrow LiCl + H_2O$$

Calculate the concentration of the aqueous lithium hydroxide.

concentration = ... mol/dm^3 [2]

(c) Lithium chloride forms three hydrates. They are $LiCl.H_2O$, $LiCl.2H_2O$ and $LiCl.3H_2O$.
Which **one** of these three hydrates contains 45.9% of water?
Show how you arrived at your answer.

.....

.....

.....

.....

.....

..... [3]

[total: 10]

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Section C: Long Structured Questions [30 marks]
Answer all questions.
Write your answers in the spaces provided.

7 The modern Periodic Table was put together by Dmitri Mendeleev, based on the element's properties. One such property is the first ionisation energy.

First ionisation energy is defined as the energy required to remove one mole of electrons from one mole of gaseous atoms of that element, forming one mole of gaseous cations.

For example, the first ionisation energy of sodium would be the energy required for the following process:

$$Na(g) \rightarrow Na^{+}(g) + e^{-}$$

Fig. 7.1 shows the first ionisation energies of the elements in Periods 2 and 3.

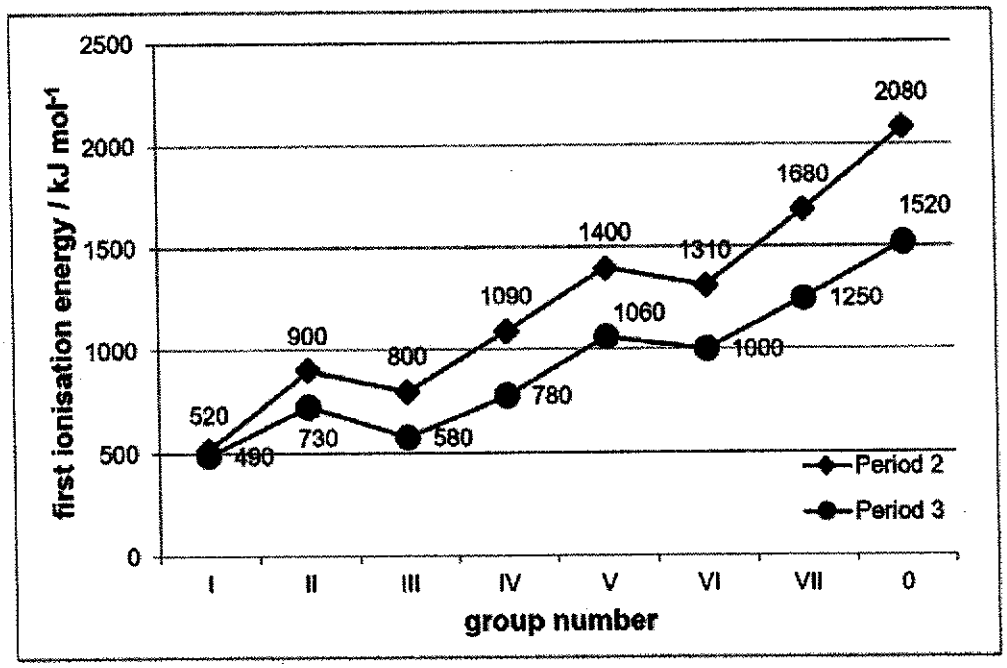

Fig. 7.1

(a) Using information from Fig. 7.1, state the following:

(i) the name of the element with first ionisation energy of 1000 kJ mol^{-1}

..... [1]

(ii) the first ionisation energy of magnesium.

..... [1]

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(b) With reference to Fig. 7.1, describe the general trend in the first ionisation energies of the elements across a period.

.....

.....

.....

..... [2]

(c) **(i)** In the space below, draw the 'dot-and-cross' diagram of an atom of each of the group I elements in Period 2 and Period 3. Show all the electrons.

[2]

(ii) Hence, or otherwise, suggest why the first ionisation energies for Period 2 elements are higher than those of the corresponding Period 3 elements.

.....

.....

..... [2]

(d) Using data from Fig. 7.1, describe the relationship between the reactivity and first ionisation energies of group I elements.

.....

.....

.....

..... [2]

[total: 10]

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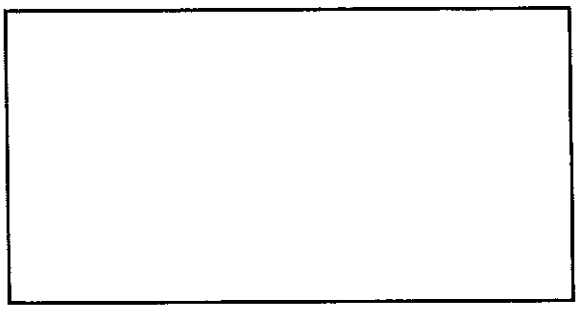
8 Methyl orange and methyl red are both dyes which can be used as pH indicators.

(a) The melting point of methyl red is 180°C.

(i) With the aid of a diagram, describe the arrangement and movement of the particles of methyl red at room temperature.



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..... [3]

(ii) A chemist prepares a sample of methyl red and finds that it melts over the range 173°C to 177°C.

Suggest why the melting point of this sample was different from the actual value.

..... [1]

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(b) A concentrated solution of methyl orange was placed at the bottom of a beaker containing an organic solvent.

After 5 hours, the orange colour had spread throughout the solvent.

Fig. 8.1 shows the set-up at the start and after 5 hours.

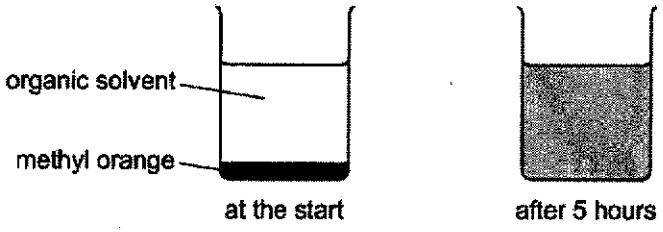

Fig. 8.1

Use the kinetic particle model of matter to explain this observation.

.....

.....

.....

.....

.....

..... [3]

(c) Methyl orange is used as an indicator.

(i) What colour is methyl orange when placed in dilute sulfuric acid?

..... [1]

(ii) Show, using an ionic equation, the formation of the ion that is responsible for the acidic properties of sulfuric acid in water.

.....

..... [2]

[total: 10]

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9 There are three types of giant structure – ionic, metallic and giant covalent.

(a) In an ionic compound, the ions are held in a lattice by strong forces.

Explain the term *lattice*.

.....

..... [2]

(b) Describe the bonding in a typical metal.

.....

.....

.....

.....

..... [3]

(c) The electrical conductivities of the three types of giant structure are given in Table 9.1.

Table 9.1

type of structure	conductivity of solid	conductivity of liquid
ionic	poor	good
metallic	good	good
giant covalent	poor	poor

Explain the differences in electrical conductivity between the three types of giant structure and the difference, if any, between the solid and liquid states of the same structure.

.....

.....

.....

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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											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	28 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

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.).

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(Hillgrove Secondary School
EOY 2019
Secondary 3E Pure Chemistry Mark Scheme

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

Section B		
1(a)	$AgNO_3$ **(aq)** + KX **(aq)** → AgX **(s)** + KNO_3 **(aq)** Award 1M for all correct state symbols.	Most candidates could not identify that AgX is insoluble in water and KNO_3 is.
(b)(i)	Yellow ; CAO	Many candidates did not make the link between the lab practical (precipitation of PbI) with this question.
(ii)	As reactivity increases, the rate of breakdown decreases ; OWTTE	Most candidates were able to provide the correct answer.
2(a)	Group III [R]: Group 3	Many candidates continue to write Group number as 3.
(b)	good conductor and it is a metal / has delocalised (free) electrons ;	Most candidates correctly identified the good conductor of electricity as a property of metals.
(c)	N **or** P **or** As **or** Sb ; [A] Bi	
(d)	$M_2(SO_4)_3$; [A] $Ga_2(SO_4)_3$	
(e)	It would react with / dissolves in a named strong acid ; It would react with / dissolves in in a named alkali ; It shows both basic and acid properties = 1	Strong candidates were able to name hydrochloric acid / sulfuric acid as the strong acid and

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	It reacts with both acids and bases / alkalis = 1 Maximum 2 marks.	sodium hydroxide / potassium hydroxide as the strong alkali ;
3(a)(i)	less than 7 ;	Almost all candidates understood that acids have a pH of less than 7. However, only a handful of candidates remembered that organic acids and acids found in food are weak, therefore, their pH should not fall below 3.
(ii)	colour of orange drink obscures indicator colour ; OWTTE	This question required candidates to understand that fruit juices are coloured and will interfere with the reading of the colours given by the Universal Indicator.
(b)	Award 1 mark for the following correct points [Max 3] Chromatography ; Apply orange drink to chromatography paper / Use of solvent ; Comparison of spot heights or R_f value with E numbers and / or carotenes ; Award 1 mark for conclusion spots should not have the same R_f value as E numbers / ORA ;	Many candidates incorrectly assumed that having one component indicates that only natural colours are present. Very good candidates were able to conclude that the R_f values of artificial / natural colours should be compared with the colouring in the orange juice.
4(a)	One mark each for any 5 of: □ Protons in the nucleus ~~/ centre~~ (of the atom) □ Neutrons in the nucleus ~~/ centre~~ (of the atom) □ Electrons outside the nucleus / electrons surrounding the nucleus / electrons orbiting the nucleus □ 9 protons □ 9 electrons □ 10 neutrons	This question was extremely well answered. Most candidates were awarded the maximum number of marks. Very good candidates went on to describe the arrangement of electrons in an atom of Fluorine. Some candidates made a careless mistakes of stating that there are 2 valence electron shells instead of 2 electron shells.
(b)	Any suitable e.g. treating cancer / checking thyroid function / tracer (in the body) ;	Many candidates gave incorrect answers of x-ray, without specifying the use of radioactive isotopes as tracers. Many candidates showed confusion

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		between radiation (x-ray) and radioactive isotopes.
(c)	Uranium (circle) ;	This question was
5(a)(i)	Any 1 from: □ more Cl^- in **A** □ more HCO_3^- in **A** □ more Ca^{2+} in **A** □ more Na^+ in **B** □ more K^+ in **B** □ more SiO_3^{2-} in **B** □ more Mg^{2+} in **B** ORA	Candidates scored well for this question.
(ii)	1.5 mg ;; (100/1000) x 15 ; **OR** 0.1 x 15 ;	Most candidates scored full marks for this question.
(b)	*Test*: add (nitric acid and) silver nitrate ; Result: white precipitate observed ;	
(c)(i)	Silicon is a non-metal / silicon is on the right-hand side of the Periodic Table ; [A] reacts with bases but not acids ;	Most candidates understood that acidic oxides react with bases but did not mentioned that acidic oxides will **not** reactive with acids.
(ii)	High melting point (no marks) Strong covalent bonds / many covalent bonds in a giant covalent molecule ; High amount of (heat) energy required to overcome the bonds ;	This question is poorly done, with many candidates mistaking that silicon dioxide exists as a simple covalent molecule.

6(a)(i)	repeat experiment without indicator ; using same quantity / volume of acid ; Full credit should include same volume of lithium hydroxide.	Most candidates lost marks due to the incorrect use of amount instead of volume of acid ;
(ii)	add magnesium metal / carbonate / oxide / hydroxide to (hot) (hydrochloric) acid ; condition: until in excess **or** no more dissolves **or** reacts ; condition: filter (to remove unreacted solid) ;	Candidates who did not do well in this question either misread the question or mistook magnesium chloride to be an insoluble salt.
(b)	number of moles of HCl = 0.020 x 2.20 = 0.044 number of moles of LiOH = 0.044 ; concentration of LiOH = 0.044 / 0.025 = 1.76 (mol/dm^3) ; Correct answers scores 2 marks immediately.	Almost all candidates were awarded 2 marks for these questions.
(c)	(for $LiCl.2H_2O$) Mass of one mole = 78.5 ; Percentage water = 36 / 78.5 x 100 45.9 so is $LiCl.2H_2O$ only award the marks if marker can follow the reasoning and it gives 45.9% of water note: if correct option given, mark this and ignore the rest of the response. Allow: max 2 for applying a correct method to another hydrate, [1] for the method and [1] for the correct value, working is ESSENTIAL	

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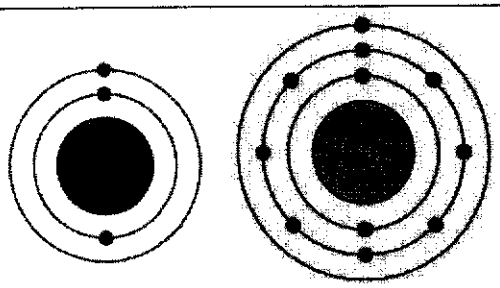
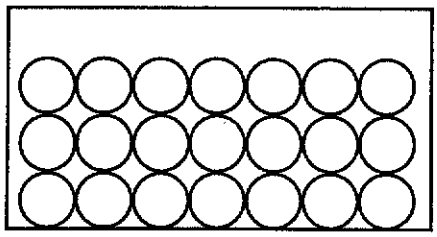
Section C		
7(a)(i)	sulfur ; [Ig] S	Common incorrect answers were Selenium
(ii)	730 kJ mol^{-1} ; [R] missing unit	
(b)	First ionisation energy increases across a period ; Reference to Fig. 9.1 ;	Penalise units if not written (once) Most candidates who scored well here quoted data from Fig. 7.1
(c)(i)		This question was well answered. There are a handful of candidates who identified the wrong period, hence, full credit could not be awarded.
(ii)	outermost electron is further from the positively charged nucleus / more fully filly inner shells ; (electrostatic) attraction weaker / less effective ;	Most candidates understood the principle that electrons further from the nucleus will experience a weaker force of attraction. However many candidates negate their marks by incorrectly referring to the electron shells rather than on the valence electrons. A handful of candidates also incorrectly mentioned atoms having multiple valence electron shells.
(d)	As reactivity increases, the first ionisation energy decreases ; from 520 (kJ mol^{-1}) to 490	Candidates who scored well in this question were able to relate the increasing reactivity of Group I elements down the group. However, similar to question (b), many candidates lost marks due to non-reference to the Fig / not quoting data.

8(a)(i)	 diagram: shows solid state criteria for mark: □ at least 3 layers of particles □ very closely packed □ occupies more than 50% of space provided □ particles of the same / similar size arrangement: very closely packed and vibrating ; movement: vibrate in fixed position ;	
(ii)	the sample is impure ;	Almost all candidates answered this question correctly.
(b)	any 3 from: □ diffusion □ ~~particles move / motion of particles~~ □ (movement is) random / in any direction / in all directions □ ~~particles spread out / particles mix~~ □ particles move from high to low concentration □ dynamic equilibrium	
(c)	red ;	
(d)	H^+ ion / hydrogen ion ; $H_2SO_4(aq) \rightarrow 2H^+(aq) + SO_4^{2-}(aq)$;	Candidates did not identify the ion responsible for the acidic properties of sulfuric acid Candidates found this equation challenging.
9(a)	regular arrangement / repeating pattern **NOT** structure ; condition: ions ; [R] molecules / atoms	This question was extremely poorly answered. Many candidates referred to molecules / atoms when it was indicated in the question that "ions are held in lattice".
(b)	delocalised / mobile / free / sea of electrons ; positive ions / cations ; [R] atoms / protons / nuclei	Common incorrect answers include describing the forces of attraction as intermolecular, describing the nuclei as an atom.

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	electrostatic attraction between these electrons and ions ;	
(c)	**giant covalent** no ions ; no delocalised / free / mobile / sea of electrons **or** all electrons ; **ionic** in ionic solid ions cannot move / not mobile / fixed position ; [R] no ions or no mobile ions liquid ionic compound ions can move / mobile ; **metallic** (both solid and liquid) metals have delocalised (**or** alternative term) electrons ;	

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