Please check the examination details below before entering your candidate information			
Candidate surname	serore ente	Other names	
Centre Number Candidate Number Pearson Edexcel Level		:	
Tuesday 14 May 202			
Morning (Time: 1 hour 30 minutes)	Paper reference	8CH0/01	
Chemistry Advanced Subsidiary PAPER 1: Core Inorganic a	and Phy	rsical Chemistry	
You must have: Scientific calculator, Data Booklet		Total Marks	

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer all questions.
- Answer the questions in the spaces provided
 - there may be more space than you need.

Information

- The total mark for this paper is 80.
- The marks for each question are shown in brackets
 - use this as a guide as to how much time to spend on each question.
- For the question marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically, showing the points that you make are related or follow on from each other where appropriate.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Check your answers if you have time at the end.

Turn over ▶







Answer ALL questions.

Some questions must be answered with a cross in a box \boxtimes . If you change your mind about an answer, put a line through the box \boxtimes and then mark your new answer with a cross \boxtimes .

- 1 What is the electronic configuration of the phosphide ion, ${}_{15}^{31}P^{3-}$?
 - \triangle **A** 1s²2s²2p⁶3s²3p³
 - \blacksquare **B** $1s^22s^22p^63s^23p^6$
 - \square **C** $1s^22s^22p^63s^2$
 - \square **D** $1s^22s^22p^63p^6$

(Total for Question 1 = 1 mark)

- Which could be the first four successive ionisation energies, in kJ mol⁻¹, of a Group 4 element?
 - **A** 496 4563 6913 9544
 - **■ B** 900 1757 14849 21007

 - **□ D** 1086 2353 4621 6223

(Total for Question 2 = 1 mark)

- **3** Which pair of responses show the trend in atomic radii of atoms, excluding the noble gases (Group 0)?
 - ⊠ A
 - ⊠ В
 - ⊠ C

Trend across Period 2	Trend down Group 2
increasing	increasing
increasing	decreasing
decreasing	decreasing
decreasing	increasing

(Total for Question 3 = 1 mark)

4 A student was provided with three aqueous solutions of potassium chloride, potassium bromide and potassium iodide.	
To identify the halide present, dilute nitric acid and silver nitrate solution were addeduced to each of the three solutions.	ded
(a) (i) Give the observations that the student would make in each case.	(3)
KCI	
KBr	
KI	
(ii) Describe how the student could confirm the halide ions present in the products of (a)(i) by adding ammonia solutions .	(3)
	(3)



- (b) Nitric acid removes other ions that would interfere with the halide test, for example carbonate ions.
 - (i) State the observation when silver nitrate is added to a solution of carbonate ions in the **absence** of nitric acid.

(1)

(ii) State the observation when nitric acid is added to a solution of carbonate ions.

(1)

(iii) Write the ionic equation for the reaction of nitric acid with carbonate ions. Include state symbols.

(2)

(Total for Question 4 = 10 marks)

BLANK PAGE



5 This question is about chlorine dioxide, ClO_2 , and the chlorate(III) ion, ClO_2^- .

Chlorine dioxide can be used to sterilise drinking water. Chlorine dioxide is a gas at room temperature and pressure (r.t.p.).

Chlorine dioxide can be prepared by reacting sodium chlorate(III) with hydrochloric acid.

The equation for this reaction is shown.

$$5NaClO_2 + 4HCl \rightarrow 5NaCl + 4ClO_2 + 2H_2O$$

(a) Chlorine dioxide is very toxic by inhalation and skin absorption.

State **two** precautions that must be taken when preparing chlorine dioxide in a laboratory.

You may assume that a lab coat and eye protection are worn.

(2)

(b) Calculate the mass of sodium chlorate(III) needed to make 5.40 g of chlorine dioxide.

[
$$A_r$$
 values: H = 1.00 O = 16.0 Na = 23.0 Cl = 35.5]

(4)

(c) (i) Chlorine dioxide decomposes to form chlorine and oxygen.

The equation for this decomposition is shown.

$$2ClO_2(g) \rightarrow Cl_2(g) + 2O_2(g)$$

Calculate the **increase** in volume, in **cm**³, when 0.125 mol of chlorine dioxide gas completely decomposes.

[Molar gas volume = $24.0 \,\mathrm{dm^3} \,\mathrm{mol^{-1}}$]

(2)

(ii) A swimming pool contains 400 m³ water. Chlorine dioxide has been suggested as a disinfectant for use in swimming pools.

Calculate the mass of **chlorine dioxide** needed to produce a concentration of chlorine of 7.82×10^{-8} mol dm⁻³ in this pool. Give your answer to an appropriate number of significant figures.

(3)



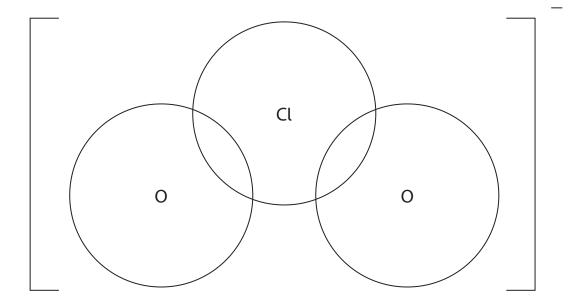
(d) The **strongest** of the attractions between molecules in liquid chlorine dioxide is

(1)

- A covalent bonding
- **B** hydrogen bonding
- C ionic bonding
- **D** permanent dipoles
- (e) (i) Complete a dot-and-cross diagram for the chlorate(III) ion, ClO₂.

Use crosses (\mathbf{x}) for chlorine electrons, dots (\bullet) for oxygen electrons and a triangle (Δ) for the extra electron.

(2)



	(ii)	Prec	lict the bond angle in this ion. Justify your answer.	(3)
(f)	Wha	at is	the oxidation number of oxygen in the chlorate(III) ion, ClO ₂ ?	(1)
	X	A	-1	
	X	В	+1	
	X	C	-2	
	X	D	+2	
			(Total for Question 5	5 - 19 marks)

- **6** This question is about mass spectrometry and relative atomic mass.
 - (a) Compound **A** contains carbon, hydrogen and oxygen only. Analysis shows that the percentage composition, by mass, of **A** is 26.7% carbon, 2.2% hydrogen and the remainder is oxygen.

Molar mass of $\mathbf{A} = 90 \,\mathrm{g} \,\mathrm{mol}^{-1}$

(i) Calculate the empirical formula of compound **A**.

(3)

(ii) Calculate the **molecular** formula of compound **A**.

(1)





(b) A mass spectrometer was used to obtain the mass number and relative abundance of each isotope of an unknown element, **B**.

Mass number of isotope	Relative isotopic abundance/%
50	4.31
52	83.76
53	9.55
54	2.38

Calculate the relative atomic mass of **B**, using data from the table. Give your answer to **two** decimal places.

(2)

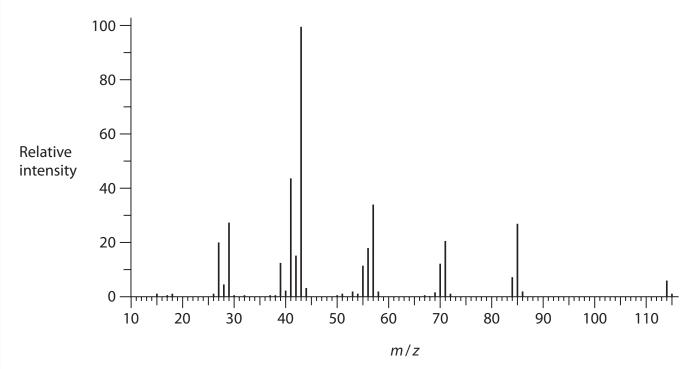
(c) Cations are formed in a mass spectrometer.

Which species is a cation?

(1)

		Number of protons	Number of neutrons	Number of electrons
×	Α	3	4	3
×	В	6	6	6
×	C	12	12	10
×	D	35	44	36

(d) The mass spectrum of another compound, \mathbf{D} , is shown.



Use the spectrum to determine the relative molecular mass of compound **D**.

(1)

(Total for Question 6 = 8 marks)



BLANK PAGE



7	7 This question is about comparing the chemical and physical properties of Group 1 and Group 2 compounds.					
	*(a)	Potassium chloride and potassium bromide are white crystalline solids which react with concentrated sulfuric acid.				
	Give the observations in these reactions and an explanation, using oxidation numbers, of which is the stronger reducing agent.					
		Include equations for any reactions that occur.	(6)			



(b) A student was asked to confirm the cation present in a sample of white powder that was known to be a Group 1 compound. The student carried out a flame test using the procedure shown.

Procedure

- Step **1** A platinum wire was first cleaned by dipping it into concentrated hydrochloric acid and then heating in a colourless Bunsen flame.
- Step 2 After cleaning, the cleaned wire was dipped into a fresh, clean sample of concentrated hydrochloric acid and then into the white powder to pick up a sample for testing.
- Step 3 The sample was tested by placing the wire in the colourless Bunsen flame.

Result

The flame was coloured lilac.

(i) State a reason why, in Step 2, the acid used was hydrochloric acid.

(1)

(ii) Identify the cation present in this sample of white powder.

(1)

- (c) The thermal stability of compounds in Group 2 is investigated.
 - (i) Draw a labelled diagram of apparatus that would enable you to compare the thermal stability of Group 2 carbonates.

(2)



(ii) State the conditions that must be used with the apparatus shown in you	ır
diagram to ensure that the test is fair.	

(2)

(iii) State what data could be obtained in this experiment to compare thermal stability.

(1)

(iv) Which pair of responses show the trend in thermal stability of compounds **down** Group 2?

(1)

		Carbonates	Nitrates
X	A	increasing	decreasing
X	В	decreasing	decreasing
X	C	increasing	increasing
X	D	decreasing	increasing



(d) The table shows the electrical conductivity of some pure substances in the solid and liquid states.

	Electrical conductivity		
Substance	Solid state	Liquid state	
potassium chloride	poor	good	
iron	good	good	
water	poor	poor	

Explain the electrical conductivity	of potassium	chloride,	iron and	water i	n the
solid and liquid states.					

·	(4)

(Total for Question 7 = 18 marks)



8	This question is about the physical properties of some substances.	
	(a) Water is able to dissolve many compounds.	
	(i) Explain, using suitable labelled diagrams, why water is a good solvent for calcium chloride.	(4)
	(ii) Explain why methanol dissolves in water. Include a suitable labelled diagram.	(3)

(3)

- (b) The boiling temperature of a compound is dependent on the intermolecular forces present and the shape of the molecule.
 - (i) Data about two isomeric alkanes are shown.

Compound	Formula	Boiling temperature/K					
2,2-dimethylpropane	C(CH ₃) ₄	283					
pentane	CH ₃ (CH ₂) ₃ CH ₃	309					

Explain why pentane has a higher boiling temperature than 2,2-dimethylpropane.

(-)





(ii) Data about two silicon compounds are shown.

Name of compound	Formula	Boiling temperature/K
silicon(IV) oxide	SiO ₂	2503
silicon tetrachloride	SiCl ₄	331

Explain why these two covalently bonded substances have very different boiling temperatures.

-/	Л	١
u	4	J
		"

(Total for Ouestion 8 = 14 marks)



- **9** This question is about some redox reactions.
 - (a) Iodine is reduced by thiosulfate ions. The relevant half-equations are shown.

$$\frac{1}{2}I_{2} + e^{-} \rightarrow I^{-}$$
 $2S_{2}O_{3}^{2-} \rightarrow S_{4}O_{6}^{2-} + 2e^{-}$

Deduce an overall equation for this reaction. State symbols are not required.

(1)

(b) In a different redox reaction, the chlorate(I) ion, ClO⁻, can react with the chloride ion as shown in this equation.

$$ClO^- + Cl^- + 2H^+ \rightarrow Cl_2 + H_2O$$

(i) State a reason why this is **not** a disproportionation reaction.

(1)

(ii) Identify the reducing agent in this reaction.

(1)

(iii) Which is the half-equation for the chlorate(I) ion, ClO⁻, in this reaction?

(1)

$$\blacksquare$$
 A ClO⁻ + Cl⁻ \rightarrow Cl₂ + ½O₂ + 2e⁻

$$\blacksquare$$
 B $ClO^- + H^+ + e^- \rightarrow \frac{1}{2}Cl_2 + OH^-$

$$\square$$
 C $ClO^- + 2H^+ + e^- \rightarrow \frac{1}{2}Cl_2 + H_2O$

$$\square$$
 D $ClO^- \rightarrow \frac{1}{2}Cl_2 + \frac{1}{2}O_2 + e^-$

(c) A 5.00 g sample of solid potassium chlorate(V) was heated until fully decomposed.

The equation for this reaction is shown.

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

Calculate the volume, **in cm**³, of oxygen produced at a temperature of 30 °C and pressure of 110 000 Pa.

[The ideal gas equation is pV = nRTMolar mass of $KClO_3 = 122.6 \,\mathrm{g} \,\mathrm{mol}^{-1}$ Gas constant $(R) = 8.31 \,\mathrm{J} \,\mathrm{mol}^{-1} \,\mathrm{K}^{-1}$]

(5)

(Total for Question 9 = 9 marks)

TOTAL FOR PAPER = 80 MARKS



		_
	¥	3
	Ž	
	₫	ر
	٤	_
	Q	ļ
Ī	ī	ĺ
	_	_
	Ċ)
	ิด)
-	פת	Ś
-	5	2
ŀ	"	_
•	ı	1
•	<u> </u>	É
		י
•	1	<u>כ</u>
	7	7
(ັ	_
	<u></u>	1
	פר	_
Ī		_
•		

0 (8)	(18)	0.4 0.0	helium	2
7				(17)
9				(16)
2				(15)
4				(14)
m				(13)
	1.0		hydrogen	Key 1
2				(2)
-				(1)

S 01 5		2	a)	Ē	_	6	_	5	∞		uo:		۳.	41	5		7]	_	5				
4.0 He	2	20.	ž	nec	10	39.	₹	argon 18	83.	ᅔ	kryp	36	131	Xe	xeu	2	[222]	~	rad	98		rted	
	(17)	19.0	L	fluorine	6	35.5	บ	chlorine 17	6.6/	В	bromine	35	126.9	Н	iodine	23	[210]	Αt	astatine	82		been repo	
	(16)	16.0	0	oxygen	8			sulfur 16	79.0	Se	selenium	34	127.6	<u>a</u>	tellurium	25	[506]	8	polonium	84		116 have	nticated
	(15)	14.0	z	nitrogen	7	31.0	_	phosphorus 15	74.9	As	arsenic	33	121.8	Sb	antimony	51	209.0	œ.	bismuth	83		nbers 112-	but not fully authenticated
	(14)	12.0	U	carbon	9	28.1	Si	silicon 14	72.6	g	germanium	32	118.7	Sn	tịı	20	207.2	Ъ	lead	82		atomic nur	but not fi
	(13)	10.8	Ω	poron	5	27.0	¥	aluminium 13		Ga		31	114.8	٦	indium	49	204.4	F	thallium	81		Elements with atomic numbers 112-116 have been reported	
	,							(12)	65.4	Zu	zinc	30	112.4	5	cadmium	48	200.6	Ŧ	mercury	80		Elem	
								(11)	63.5	J	copper	29	107.9	Ag	silver	47	197.0	PΓ	plog	79	[272]	Rg	oentgenium 111
								(10)	58.7	Έ	nickel	28	106.4	Pd	palladium	46	195.1	చ	platinum	78	[271]	۵	meitnerium damstadtium roentgenium 109 110 111
								(6)	58.9	ප	cobalt	27		몺	rhodium	45	192.2	<u>_</u>	iridium	77	[368]	₩	neitnerium 109
1.0 H hydrogen	-							(8)	55.8	Fe	iron	76	101.1	Ru	ım ruthenium	44	190.2	S	osmium	9/	[277]		hassium 1
								(7)	54.9	۸	manganese	25	[86]	ည	technetium	43	186.2	&	rhenium	75	[564]	Bh	bohrium 107
		nass	loc O		umber			(9)	52.0		chromium manganes	24	95.9	Wo	molybdenum technetiu	42	183.8	>	tungsten	74			seaborgium 106
	Key	relative atomic mass	atomic symbol	name	atomic (proton) number			(5)	50.9	>	vanadium	23	92.9		Ε	41	180.9	Та	tantalum	73	[797]	P	dubnium 105
		relati	ato		atomic			(4)	47.9	F	titanium	22	91.2	Zr	zirconium	40	178.5	Ŧ	hafnium	72	[261]	¥	rutherfordium 104
								(3)	45.0	Sc	scandium	21	88.9		yttrium	39	138.9	La*	lanthanum	22	[227]		actinium 89
	(2)	9.0	Be	beryllium	4	24.3	W W	magnesium 12	40.1	S	calcinm	20	97.8	S	strontium	38	137.3	Ва	barium	26	[526]	Ra	radium 88
	(1)	6.9	ב	lithium	3	23.0	R	_	39.1	¥	potassium	19	85.5	&	rubidium	37	132.9	ర	caesium	22	[223]	ት	francium 87

* Lanthanide series * Actinide series

Yb ytterbium 70 nobelium [254] **No** 102 169 **Tm** thulium mendelevium [256] ÞΨ 101 69 [253] **Fm** fermium 167 **Er** erbium 100 89 163 165

Dy Ho

dysprosium holmium Es einsteinium 29 66 californium [251] **Cf** 99
 141
 144
 [147]
 150
 152
 157
 159

 Pr
 Nd
 Pm
 Sm
 Eu
 Gd
 Tb

 praseodymium neodymium promethium promethium samarium neodymium promethium prom berkelium [245] **Bk** 65 6 [247] **Cm**curium
96 4 Np Pu Am neptunium plutonium [243] 63 95 [242] **Pu** 62 4 [237] 6 93 uranium 238 **U** 9 92 protactinium [231] Pa 29 9 140 **Ce** cerium thorium 232 **Th** 28 8

Lu lutetium

lawrencium

103

[257] Ľ