

(d) Magnesium reacts with sulfur to make the ionic compound magnesium sulfide.

(i) Predict **two** physical properties of magnesium sulfide.

1. ....

2. ....

[2]

(ii) Explain, in terms of electrons, how a magnesium atom reacts with a sulfur atom to make a magnesium ion and a sulfide ion.

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

[2]

[Total: 10]

(d) Magnesium reacts with fluorine to make the ionic compound magnesium fluoride.

(i) Predict **two** physical properties of magnesium fluoride.

1. ....

2. ....

[2]

(ii) Explain, in terms of electrons, how a magnesium atom reacts with a fluorine molecule,  $F_2$ , to make a magnesium ion and two fluoride ions.

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

[2]

[Total: 10]

3. 5070/21/0/N/16 Q A5c

(c) Potassium chloride can be made by reacting potassium with chlorine.

- (i) Explain in terms of gain and loss of electrons, how potassium ions and chloride ions are formed when potassium reacts with chlorine.

.....  
.....  
..... [3]

- (ii) Predict **two** physical properties of potassium chloride.

.....  
..... [2]

4. 5070/22/0/N/16 Q A4 c,d

- (c) Iodine has several isotopes.

What are isotopes?

.....  
..... [1]

- (d) Astatine, At, is a halogen.

Aqueous iodine reacts with aqueous astatide ions,  $\text{At}^-$ , to produce astatine.

Construct the ionic equation for this reaction.

..... [1]

5. 5070/22/O/N/16 A5 d,

- (d) The proton numbers and accurate relative atomic masses of cobalt and nickel are shown in the table.

	cobalt	nickel
proton number	27	28
relative atomic mass	58.9	58.7

Suggest why cobalt has a higher relative atomic mass than nickel.

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

[2]

6. 5070/22/O/N/16 A6 a

Sodium and rubidium are alkali metals.

- (a) Explain how metals conduct electricity.

.....

[1]

7. 5070/21/M/J/17 Q A2

- (a) Atoms and ions contain three types of sub-atomic particle.

Complete the table about these sub-atomic particles.

sub-atomic particle	relative charge	relative mass
electron		
neutron		1
proton	+1	

[3]

(b) The table shows some information about six particles.

particle	number of protons in particle	number of neutrons in particle	number of electrons in particle
A	37	48	37
B	53	74	54
C	92	143	92
D	92	143	89
E	92	146	92
F	94	150	92

(i) What is the nucleon number for particle A?

..... [1]

(ii) Explain why particle B is a negative ion.

..... [1]

(iii) Which two **atoms** are isotopes of the same element?

..... and .....

Explain your answer.

..... [2]

Calcium chloride,  $\text{CaCl}_2$ , is an ionic compound.

- (a) State the electronic configuration for each of the ions in calcium chloride.

calcium ion .....

chloride ion .....

[2]

- (d) Explain, using ideas about structure and bonding, why calcium chloride has a high melting point.

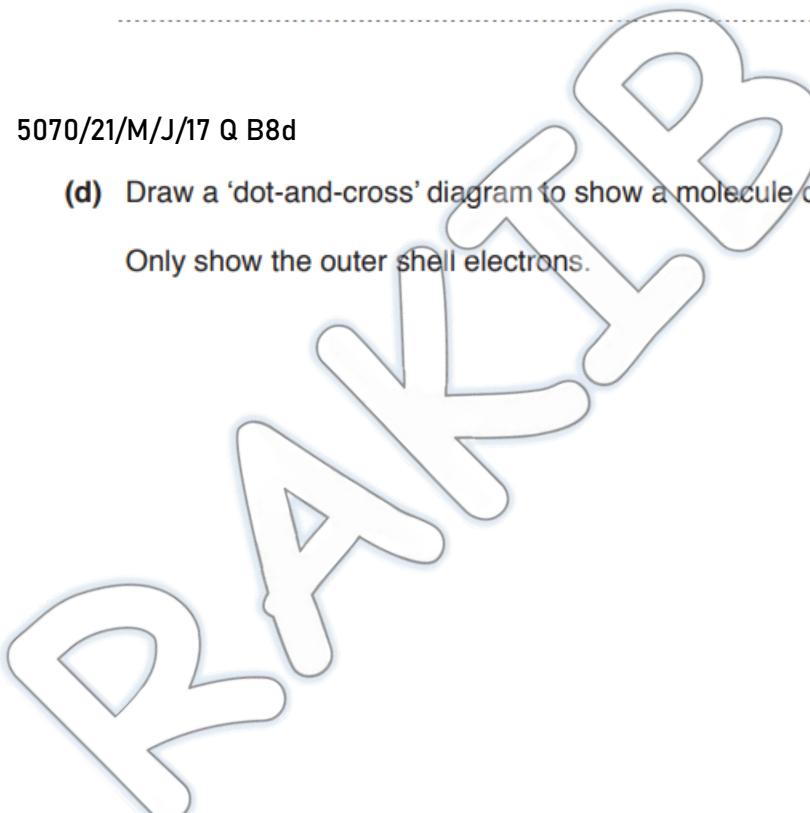
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.....  
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.....

[2]

- (d) Draw a 'dot-and-cross' diagram to show a molecule of iodine(I) chloride.

Only show the outer shell electrons.

[1]



- (c) Explain why the noble gases are very unreactive.

..... [1]

11. 5070/22/M/J/17 Q A2

The table shows some information about six particles.

- (a) Complete the table.

particle	proton (atomic) number	number of neutrons in particle	number of electrons in particle
$^{35}\text{Cl}$	17	18	.....
.....	17	20	17
$^{39}\text{K}^+$	19	.....	18
$^{79}\text{Br}^-$	.....	44	36
$^{81}\text{Br}$	35	.....	35
.....	37	48	36

[6]

- (b) (i) What is meant by the term *isotopes*?

 .....  
 .....  
 ..... [1]

- (ii) Identify two **atoms** which are isotopes of the same element.

..... and ..... [1]

Sodium oxide,  $\text{Na}_2\text{O}$ , is an ionic compound.

- (a) State the electronic configuration for each of the ions in sodium oxide.  
(c) Explain how molten sodium oxide conducts electricity.

[1]

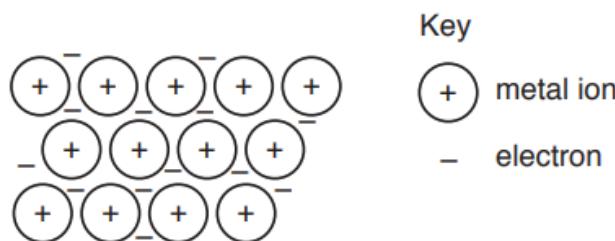
13. 5070/21/O/N/17 A1b

- (b) Complete the table to show the number of electrons and number of neutrons in the sulfur atom and in the magnesium ion.

	number of electrons	number of neutrons
$^{33}_{16}\text{S}$		
$^{25}_{12}\text{Mg}^{2+}$		

[4]

The diagram shows the structure of a metal.



- (a) Refer to this structure to explain why

- (i) metals are malleable,

.....  
..... [2]

- (ii) metals conduct electricity.

..... [1]

### 15. 5070/21/O/N/17 Q B7a

Some properties of the Group IV elements are shown in the table.

element	melting point /°C	relative electrical conductivity
carbon (diamond)	3550	non-conductor
silicon	1410	poor conductor
germanium	937	poor conductor
tin	232	conductor
lead	328	conductor

- (a) (i) Explain in terms of structure and bonding why diamond has such a high melting point.

.....  
..... [2]

- (ii) Use the information in the table to suggest how the type of structure and bonding in carbon (diamond) differs from the type of structure and bonding in tin. Explain your answer.

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

[2]

16. 5070/22/0/N/17 A1b

- (b) Complete the table to show the number of electrons and neutrons in the potassium atom and in the oxide ion.

	number of electrons	number of neutrons
$^{41}_{19}\text{K}$		
$^{17}_{8}\text{O}^{2-}$		

[4]

17. 5070/22/0/N/17 Q A2a,b,c

Sodium chloride,  $\text{NaCl}$ , and magnesium chloride,  $\text{MgCl}_2$ , are both ionic compounds.

- (a) Describe the arrangement of the ions and the type of attractive forces between the ions in solid magnesium chloride.

arrangement .....

type of attractive forces .....

[2]

- (b) Explain why solid magnesium chloride does not conduct electricity but aqueous magnesium chloride does conduct.

.....

[2]

- (c) State the electronic configuration of a magnesium ion and of a chloride ion.

magnesium ion .....

chloride ion .....

[2]

18. 5070/22/O/N/17 B7a,b

The table shows the melting points and relative electrical conductivities of three elements from Period 3 of the Periodic Table.

property	element		
	magnesium	silicon	sulfur
melting point /°C	649	1410	113
relative electrical conductivity	good conductor	poor conductor	does not conduct

- (a) Use ideas of structure and bonding to explain

- (i) the difference in the melting points of magnesium and sulfur,

.....  
 .....  
 .....  
 ..... [2]

- (ii) the difference in the electrical conductivity of magnesium and sulfur.

.....  
 .....  
 ..... [2]

- (b) Silicon has a structure similar to diamond.

Explain why silicon has a high melting point.

.....  
 ..... [2]

(c) Silane has the molecular formula  $\text{SiH}_4$ .

(i) Draw the 'dot-and-cross' diagram for silane.

You only need to show the outer shell electrons of silicon.



(ii) Using ideas about structure and bonding, suggest why silane has a low boiling point.

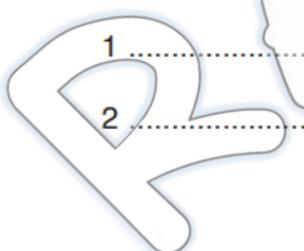
.....  
.....  
.....

[2]

20. 5070/22/M/J/18 Q 4b,c

(b) Phosphorus,  $\text{P}_4$ , is a simple molecular substance.

Suggest two physical properties of phosphorus.



1  
2

[2]

- (c) Using ideas about structure and bonding, suggest why calcium phosphate,  $\text{Ca}_3(\text{PO}_4)_2$ , has a high melting point.

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

[2]

- (d) Complete the table about the number of electrons, neutrons and protons in two particles.

particle	$^{30}_{15}\text{P}$	
number of electrons	.....	18
number of neutrons	.....	16
number of protons	.....	15

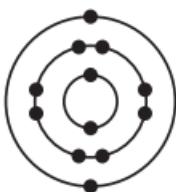
[2]

R  
A  
N  
T  
B

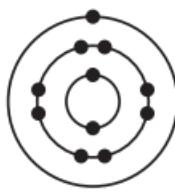
The electronic configurations of five atoms are shown.



**A**



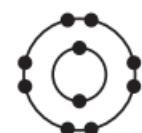
**B**



**C**



**D**



**E**

- (a)** Which electronic configuration represents each of the following descriptions?

Each electronic configuration may be used once, more than once or not at all.

- (i) a sodium atom

..... [1]

- (ii) an atom of a reactive non-metallic element

..... [1]

- (iii) an atom with a proton (atomic) number of 12

..... [1]

- (iv) an atom of a noble gas which is used to fill balloons

..... [1]

- (v) an atom which forms a noble gas electronic configuration when it gains two electrons

..... [1]

- (b)** Chlorine has two naturally occurring isotopes.

One isotope of chlorine is represented by the symbol shown.



- (i) Deduce the number of neutrons in one atom of this isotope of chlorine.

..... [1]

- (ii) Chlorine has diatomic molecules.

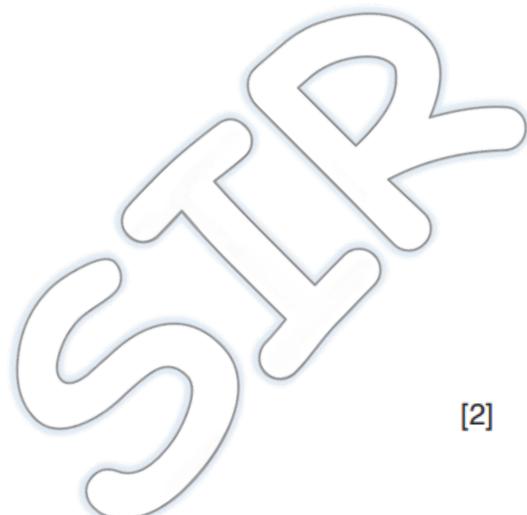
What is the meaning of the term *diatomic*?

..... [1]

22. 5070/21/O/N/18 Q 5d(i)

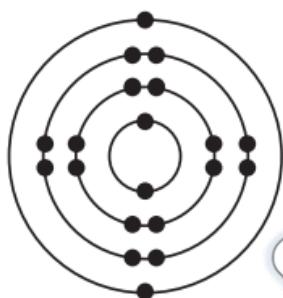
- (d) (i) Draw a 'dot-and-cross' diagram of a molecule of oxygen.

Only draw the outer shell electrons.

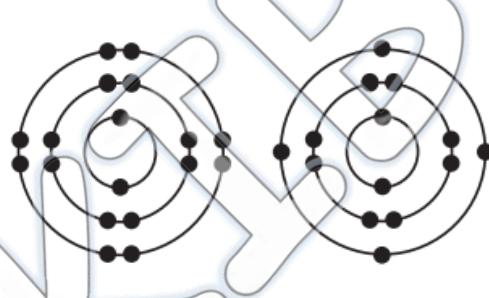


23. 5070/22/O/N/18 Q1

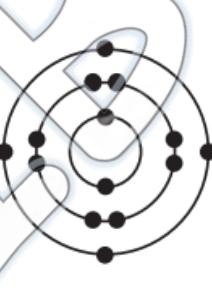
The electronic configurations of five atoms are shown.



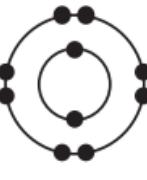
A



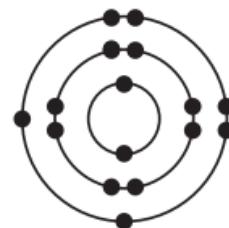
B



C



D



E

- (a) Which electronic configuration represents each of the following descriptions?

Each electronic configuration may be used once, more than once or not at all.

- (i) a sulfur atom

[1]

- (ii) a metal atom

[1]

- (iii) an atom with a proton number of 14

..... [1]

- (iv) an atom of a noble gas with three occupied electron shells

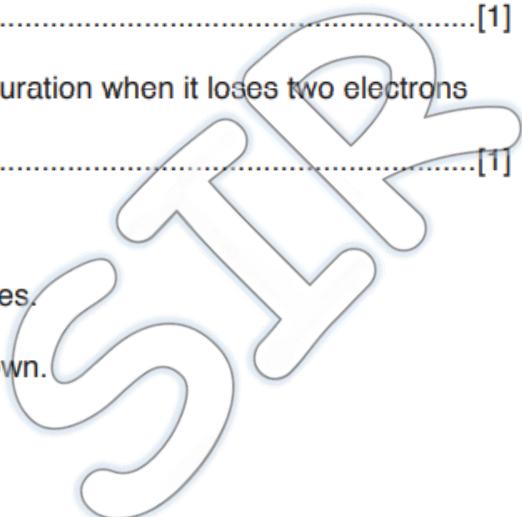
..... [1]

- (v) an atom which forms a noble gas electronic configuration when it loses two electrons

..... [1]

- (b) The element germanium has five naturally occurring isotopes.

An isotope of germanium is represented by the symbol shown.



- (i) What is the meaning of the term *isotopes*?

.....  
..... [1]

- (ii) Deduce the number of neutrons in one atom of this isotope of germanium.

..... [1]

24. 5070/22/0/N/18 Q5c

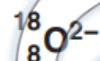
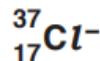
- (c) Phosphine,  $\text{PH}_3$ , is a covalent compound.

- (i) Draw a 'dot-and-cross' diagram of phosphine.

Only draw the outer shell electrons.



Choose from the particles shown to answer the questions.



Each particle can be used once, more than once or not at all.

- (a) Which particle has only 20 protons in its nucleus?

..... [1]

- (b) Which particle has a nucleon number of 35?

..... [1]

- (c) Which particle has an electronic structure of 2.8.8?

..... [1]

- (d) Which particle is an atom with only 10 neutrons in its nucleus?

..... [1]

- (e) Which particle is an atom of a transition element?

..... [1]

- 2 The table shows some of the properties of the elements in Group II of the Periodic Table.

element	proton (atomic) number	atomic radius /nm	melting point /°C
Be	4	0.089	1280
Mg	12	0.136	650
Ca	20	0.174	850
Sr	38	0.191	768
Ba	56	0.198	714
Ra	88		

- (a) Explain why the elements in Group II have similar chemical properties.

.....  
..... [1]

- (b) Explain why it is easier to predict the atomic radius of radium, Ra, than the melting point of radium.

.....  
..... [1]

- (c) Magnesium chloride contains  $Mg^{2+}$  and  $Cl^-$  ions.

- (i) Write the electronic configuration for a magnesium ion.

..... [1]

Molybdenum, Mo, is a transition element.

- (a) Suggest one physical property of molybdenum that is typical of a transition element.

..... [1]

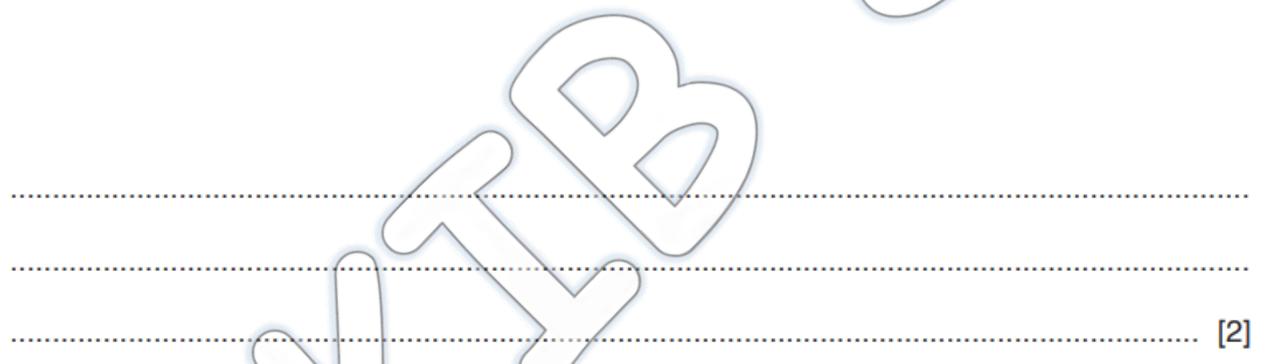
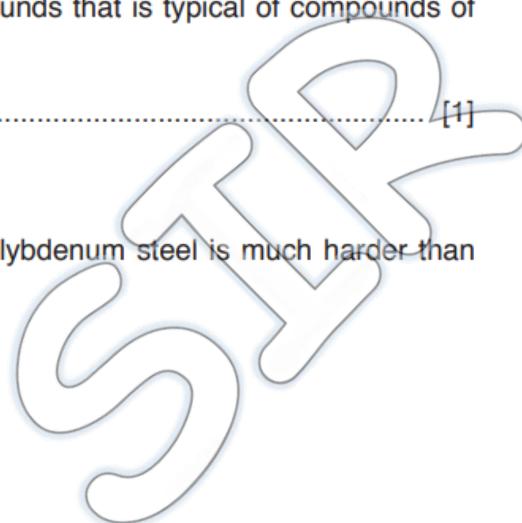
- (b) Suggest one chemical property of molybdenum compounds that is typical of compounds of transition elements.

..... [1]

- (c) Molybdenum steel is an extremely hard alloy.

Suggest, using ideas about metallic structure, why molybdenum steel is much harder than pure iron.

A labelled diagram may help you answer this question.



27. 5070/21/M/J/19 Q7e

Solid ammonium carbonate does not conduct electricity.

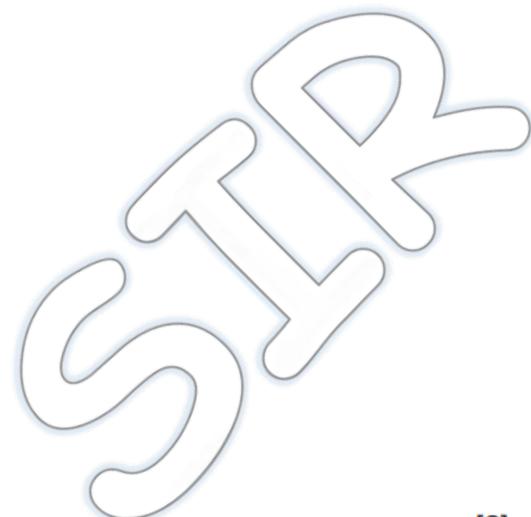
Aqueous ammonium carbonate conducts electricity.

Explain these two observations.

..... [2]

(d) Draw the 'dot-and-cross' diagram for a molecule of  $\text{PCl}_3$ .

Only include the outer shell electrons.

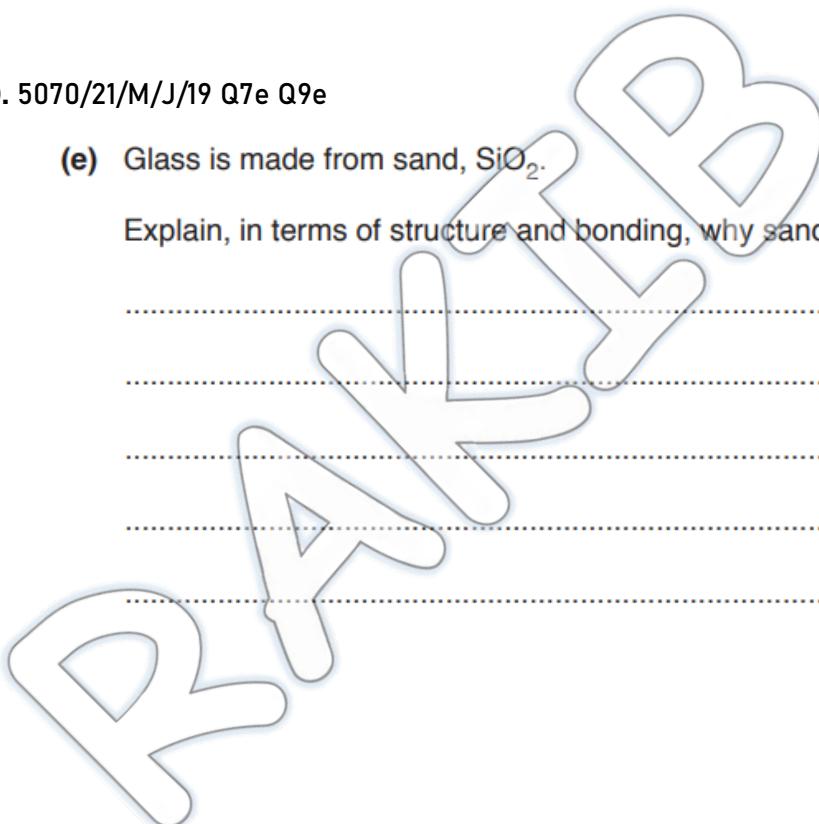


[2]

29. 5070/21/M/J/19 Q7e Q9e

(e) Glass is made from sand,  $\text{SiO}_2$ .

Explain, in terms of structure and bonding, why sand has a high melting point.



[2]

Choose from the particles shown to answer the questions.



Each particle can be used once, more than once or not at all.

- (a) Which particle has only eighteen protons?

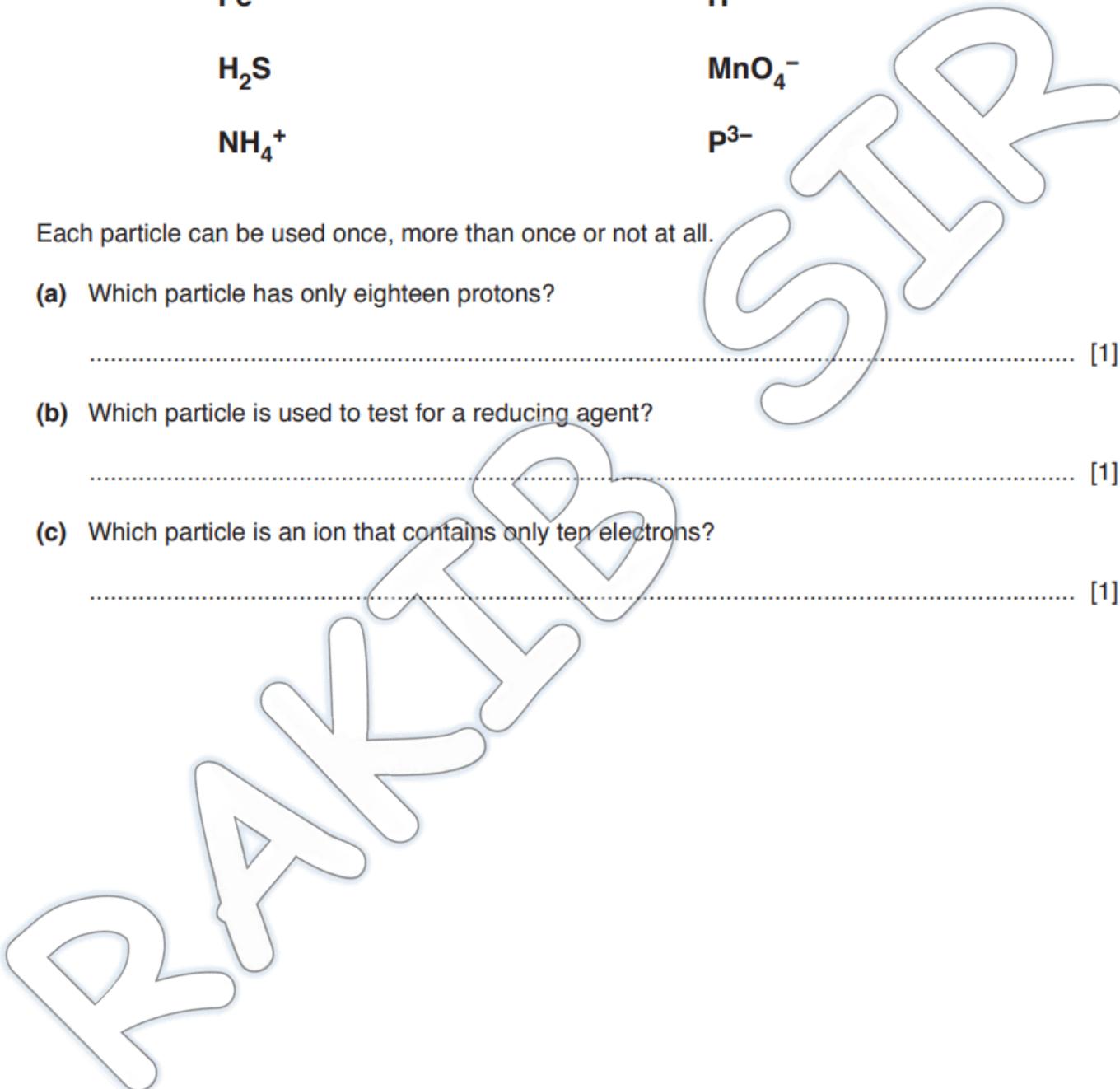
..... [1]

- (b) Which particle is used to test for a reducing agent?

..... [1]

- (c) Which particle is an ion that contains only ten electrons?

..... [1]



- 2 The table shows some of the properties of the elements in Group III of the Periodic Table.

element	proton (atomic) number	atomic radius /nm	melting point /°C
B	5	0.080	2306
Al	13	0.125	660
Ga	31	0.125	30
In	49	0.150	157
Tl	81	0.155	304
Nh	113		

- (a) Nihonium, Nh, has only recently been discovered.

It has not been possible to measure its atomic radius and melting point because it is too radioactive.

- (i) Estimate the atomic radius of Nh.

..... nm [1]

(ii) Explain, using data from the table, why it is difficult to estimate the melting point of nihonium.  
..... [1]

- (b) Boron has a giant covalent structure.

Explain why boron has a high melting point.

..... [1]

- (e) Explain why a piece of aluminium in water does not react.

..... [2]

(b) Titanium(IV) chloride,  $TiCl_4$ , is a colourless liquid that has a low boiling point.

(i) Suggest the structure and bonding in  $TiCl_4$ .

..... [1]

32. 5070/22/M/J/19 Q7e

(e) Solid ammonium iodide does not conduct electricity.

Aqueous ammonium iodide conducts electricity.

Explain these two observations.

.....  
.....  
..... [2]

33. 5070/22/M/J/19 Q8d

(d) Draw the 'dot-and-cross' diagram for a molecule of  $O_2^-$ .

Only include the outer shell electrons.

R  
A  
Y  
E  
M  
I  
C  
H  
A  
N  
D  
S  
T  
R  
U  
C  
T  
U  
R  
E  
..... [1]

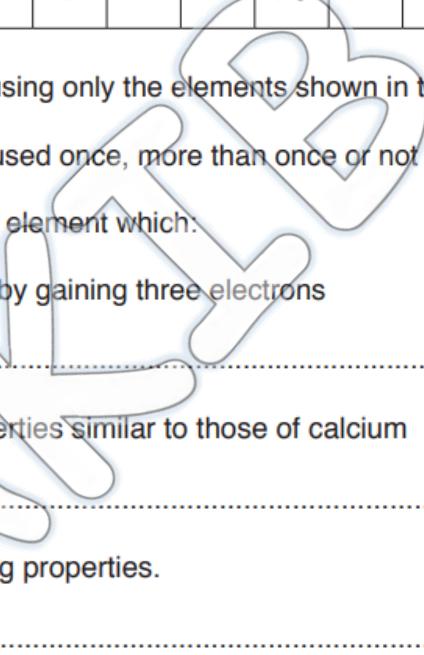
- (e) Explain, in terms of structure and bonding, why copper has a high melting point.

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

[2]

35. 5070/21/O/N/19 Q1

The diagram shows part of the Periodic Table.



	Mg			V			Fe			Cu	Zn	B	C		

Answer the questions using only the elements shown in the diagram.

Each element may be used once, more than once or not at all.

Write the symbol for an element which:

- (a) forms a stable ion by gaining three electrons

..... [1]

- (d) has chemical properties similar to those of calcium

..... [1]

- (e) can have lubricating properties.

..... [1]

Sodium is a metal.

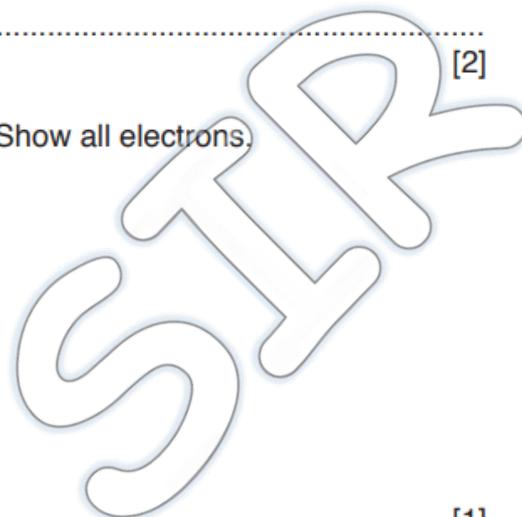
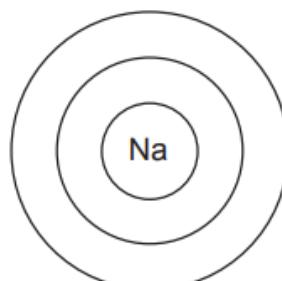
- (a) State two physical properties of sodium which are different from most other metals.

1 .....

2 .....

[2]

- (b) Complete the electronic configuration of a sodium atom. Show all electrons.



[1]

- (d) Sodium reacts with oxygen to form the ionic solid sodium oxide,  $\text{Na}_2\text{O}$ .

Explain, in terms of movement of electrons, how  $\text{Na}_2\text{O}$  is formed by the reaction of sodium with oxygen.

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

[3]

- (e) Sodium chloride is an ionic compound which is a solid at room temperature. It is soluble in water.

- (i) Suggest one other physical property of sodium chloride.

.....

[1]

Silicon is an element in Group IV of the Periodic Table.

- (a) One of the isotopes of silicon is:



Deduce the number of electrons, neutrons and protons in one atom of this isotope of silicon.

number of electrons .....

number of neutrons .....

number of protons .....

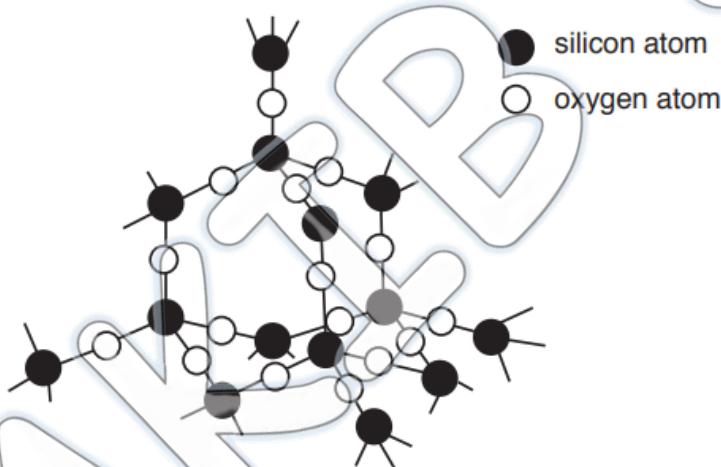
[3]

- (b) Silicon reacts with nitrogen when heated to produce silicon nitride,  $\text{Si}_3\text{N}_4$ .

Construct the equation for this reaction.

..... [1]

- (c) The structure of silicon dioxide is shown.



- (i) Describe two similarities in the structures of silicon dioxide and diamond.

1 .....

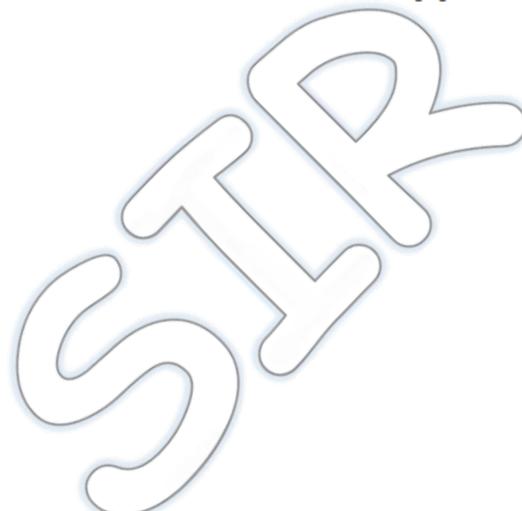
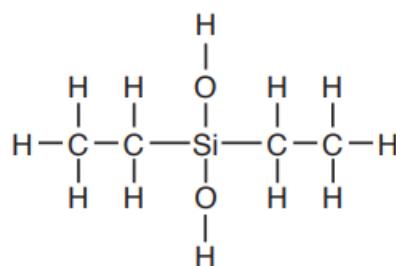
2 .....

[2]

- (ii) Explain why silicon dioxide has a high melting point.

.....  
.....  
..... [2]

- (d) The structure of a compound of silicon is shown.

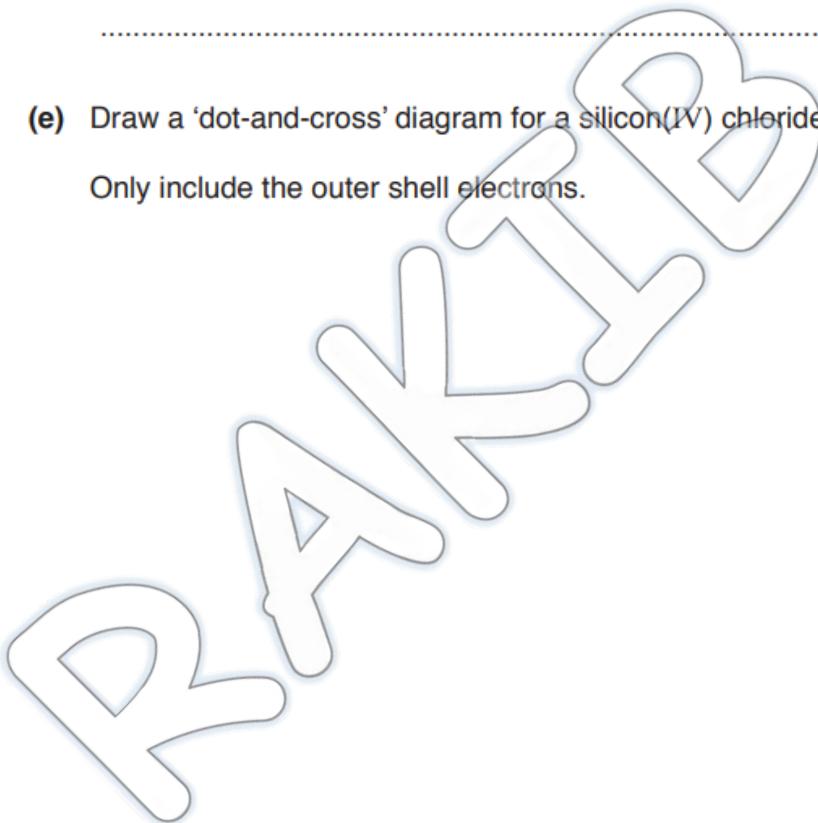


Deduce the molecular formula of this compound.

..... [1]

- (e) Draw a 'dot-and-cross' diagram for a silicon(IV) chloride molecule,  $\text{SiCl}_4$ .

Only include the outer shell electrons.



[1]

Magnesium is a metal.

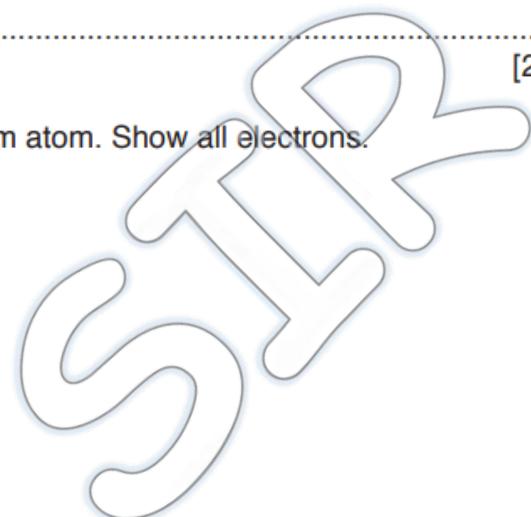
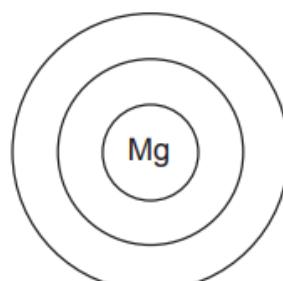
- (a) State two properties which are characteristic of most metals.

1 .....

2 .....

[2]

- (b) Complete the electronic configuration of a magnesium atom. Show all electrons.



[1]

- (c) Magnesium reacts with bromine to form magnesium bromide,  $\text{MgBr}_2$ .

Magnesium bromide is an ionic solid at room temperature.

- (i) Explain, in terms of movement of electrons, how magnesium bromide is formed by the reaction of magnesium with bromine.

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

[3]

- (ii) Magnesium bromide is soluble in water.

Suggest one other physical property of magnesium bromide.

..... [1]

Phosphorus is an element in Group V of the Periodic Table.

- (a) One of the isotopes of phosphorus is:



- (i) Deduce the number of electrons, neutrons and protons in this isotope of phosphorus.

number of electrons .....

number of neutrons .....

number of protons .....

[3]

- (ii) What is the meaning of the term *isotopes*?

..... [1]

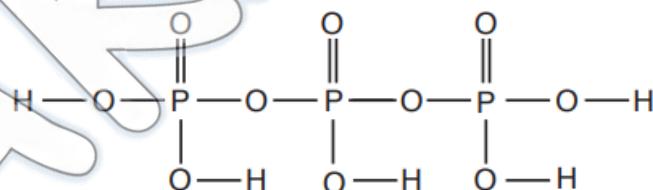
- (b) Phosphorus reacts with potassium chlorate(V) to form potassium chloride and phosphorus(V) oxide.

Complete the equation for this reaction.



[1]

- (c) The structure of a compound of phosphorus is shown.

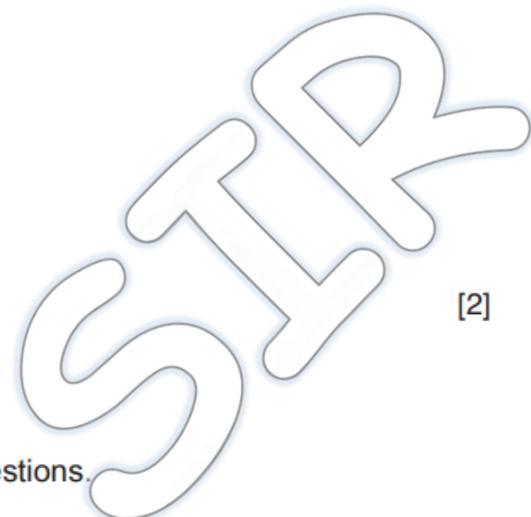


Deduce the molecular formula of this compound.

[1]

- (d) Phosphorus reacts with chlorine to form phosphorus trichloride,  $\text{PCl}_3$ .

Draw a dot-and-cross diagram for a molecule of phosphorus trichloride.  
Only include the outer shell electrons.



40. 5070/22/M/J/20 Q1

Choose from the following chlorides to answer the questions.

aluminium chloride

ammonium chloride

calcium chloride

hydrogen chloride

iron(III) chloride

silver chloride

sodium chloride

Each chloride may be used once, more than once or not at all.

- (a) contains a cation with a 2+ charge

[1]

- (d) has a molecule which has only 18 protons

[1]

- (e) is a coloured solid at room temperature and pressure?

[1]

- (e) Explain why solid carbon dioxide does not conduct electricity.

.....  
..... [1]

42. 5070/22/M/J/20 Q6

- (d) Ethanol is a simple molecular compound.

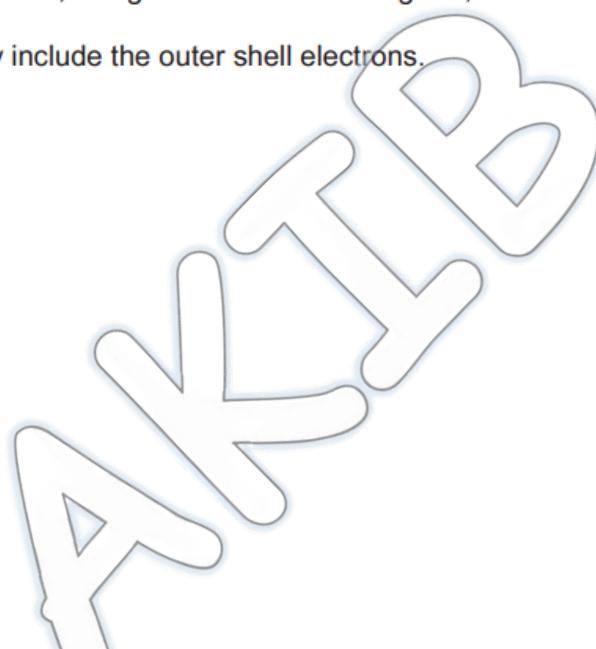
Explain why liquid ethanol does **not** conduct electricity.

.....  
..... [1]

- (e) Ethanol can be dehydrated to form ethene,  $C_2H_4$ .

Describe, using a dot-and-cross diagram, the bonding in a molecule of ethene.

Only include the outer shell electrons.



43. 5070/22/M/J/20 Q7

[2]

- (d) State the structure and bonding in silicon dioxide,  $SiO_2$ .

..... [1]

Choose from the following compounds to answer the questions.

- aluminium iodide
- ethanol
- glucose
- lead(IV) chloride
- lithium bromide
- magnesium carbonate
- methane
- potassium phosphate
- silver nitrate
- sodium sulfate
- sulfur dioxide

Each compound may be used once, more than once or not at all.

Which compound:

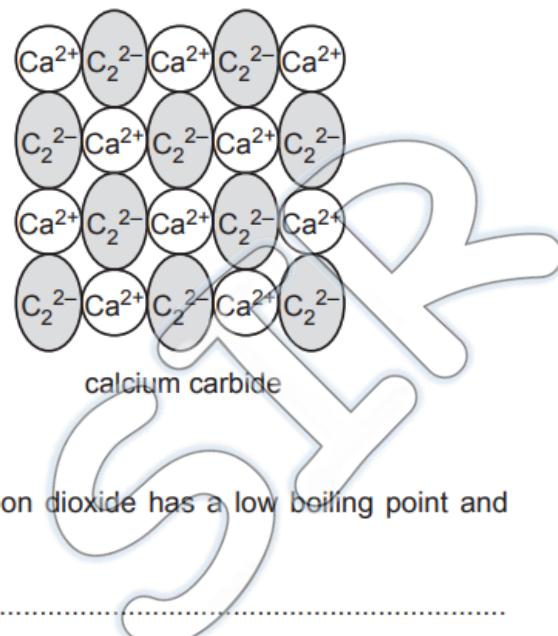
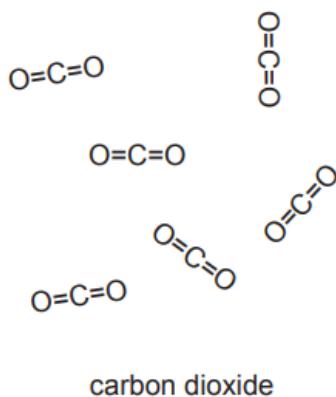
- (b) contains ions with a 1– charge which are present in many fertilisers

[1]

- (c) contains ions with a 2+ charge

[1]

Part of the structures of carbon dioxide and calcium carbide are shown.



- (a) Explain in terms of structure and bonding why carbon dioxide has a low boiling point and calcium carbide has a high boiling point.

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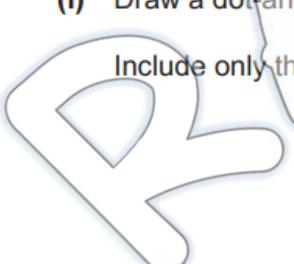
[3]

**46. 5070/21/O/N/20 Q8**

- (d) Hydrazine,  $\text{H}_2\text{N}-\text{NH}_2$ , is a colourless liquid.

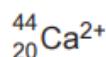
- (i) Draw a dot-and-cross diagram for a molecule of hydrazine.

Include only the outer shell electrons.



[1]

(b) An ion of calcium has the symbol



Deduce the number of electrons and neutrons in this ion.

number of electrons .....

number of neutrons .....

[2]

RAKIB

STP

Choose from the following compounds to answer these questions.

- aluminium sulfate
- ammonia
- calcium carbonate
- carbon dioxide
- chlorofluorocarbons
- copper(II) sulfate
- hydrogen chloride
- potassium nitrate
- sodium chloride

Each compound may be used once, more than once or not at all.

Which compound:

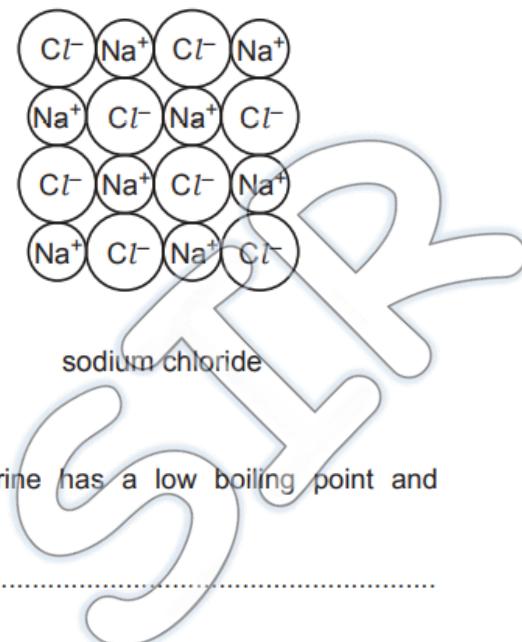
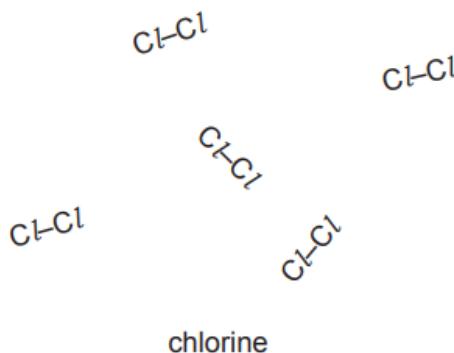
- (c) contains ions with a 3+ charge

..... [1]

RAKIB

STP

Part of the structures of chlorine and sodium chloride are shown.



- (a) Explain in terms of structure and bonding why chlorine has a low boiling point and sodium chloride has a high boiling point.

.....

.....

.....

..... [3]

- (b) Write the electronic configuration of a chlorine atom.

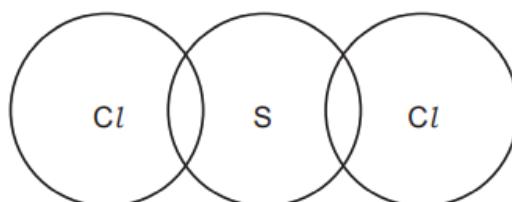
..... [1]

R  
A  
P

(c) Sulfur dichloride, Cl – S – Cl, has a simple molecular structure.

Complete the dot-and-cross diagram for a molecule of sulfur dichloride.

Include only the outer shell electrons.

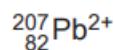


[1]

51. 5070/22/O/N/20 Q9

Lead is a metal in Group IV of the Periodic Table.

(a) An ion of lead has the symbol



Deduce the number of electrons and neutrons in this ion.

number of electrons .....

number of neutrons .....

[2]

R  
A  
Y

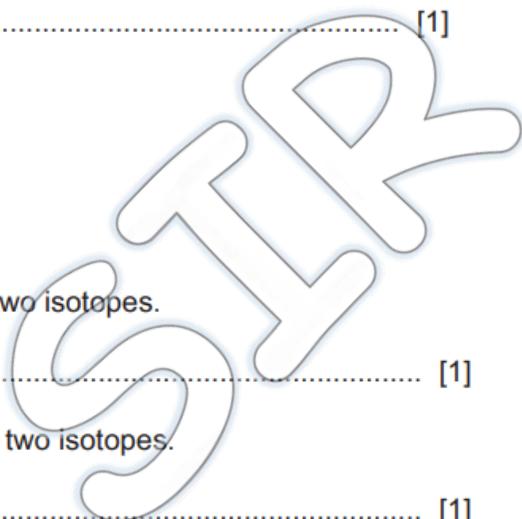
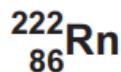
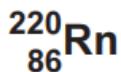
- (c) Radon is very unreactive.

Use the electronic structure of radon to explain why.

.....

[1]

- (d) Two isotopes of radon are shown.



- (i) Give one similarity in the atomic structure of these two isotopes.

..... [1]

- (ii) Give one difference in the atomic structure of these two isotopes.

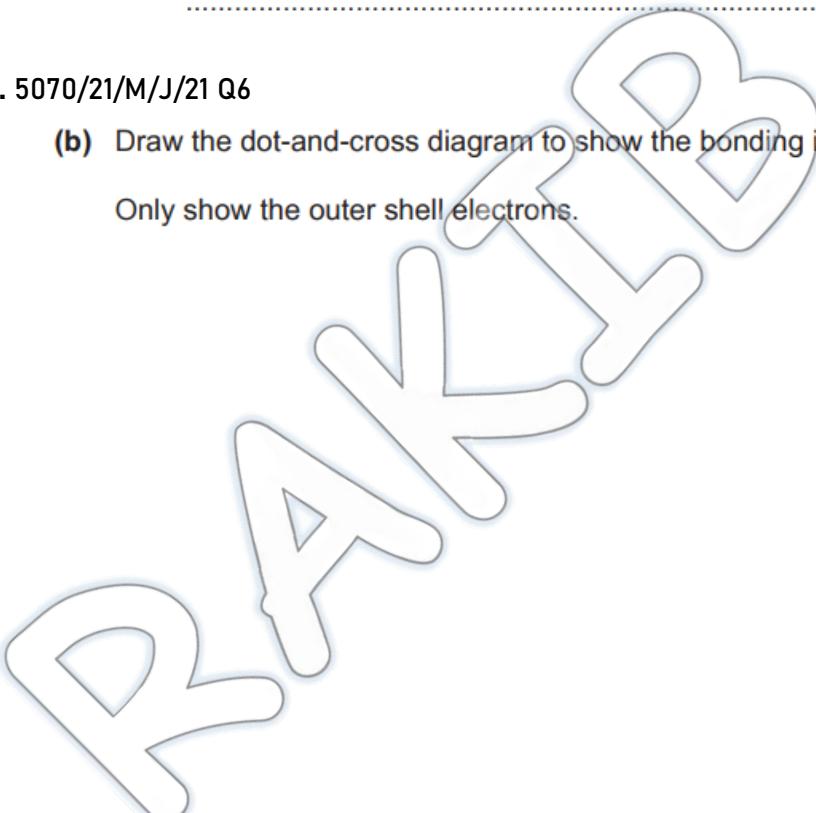
..... [1]

53. 5070/21/M/J/21 Q6

- (b) Draw the dot-and-cross diagram to show the bonding in a molecule of carbon dioxide.

Only show the outer shell electrons.

[1]



Silver is a transition element with proton number 47.

- (a) Use the Periodic Table to state the number of occupied electron shells in an atom of silver.

..... [1]

- (b) Describe, with the aid of a diagram, the metallic bonding in silver.



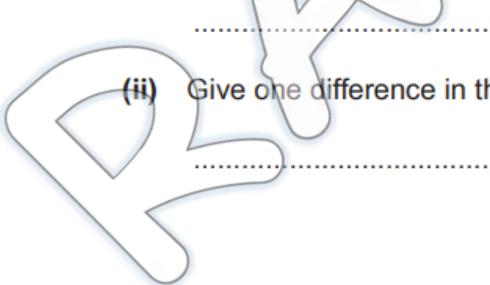
..... [3]

55. 5070/22/M/J/21 Q2

- (c) Two isotopes of polonium are shown.

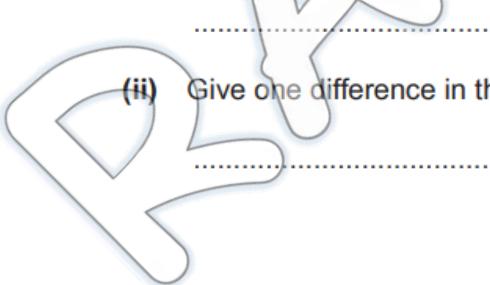


- (i) Explain why both isotopes have the same chemical properties.



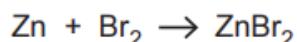
..... [1]

- (ii) Give one difference in the atomic structure of these two isotopes.



..... [1]

(b) Zinc reacts with bromine to make zinc bromide.



Zinc bromide contains  $\text{Zn}^{2+}$  and  $\text{Br}^-$  ions.

Explain, in terms of the movement of electrons, how  $\text{ZnBr}_2$  is formed from zinc atoms and bromine molecules.

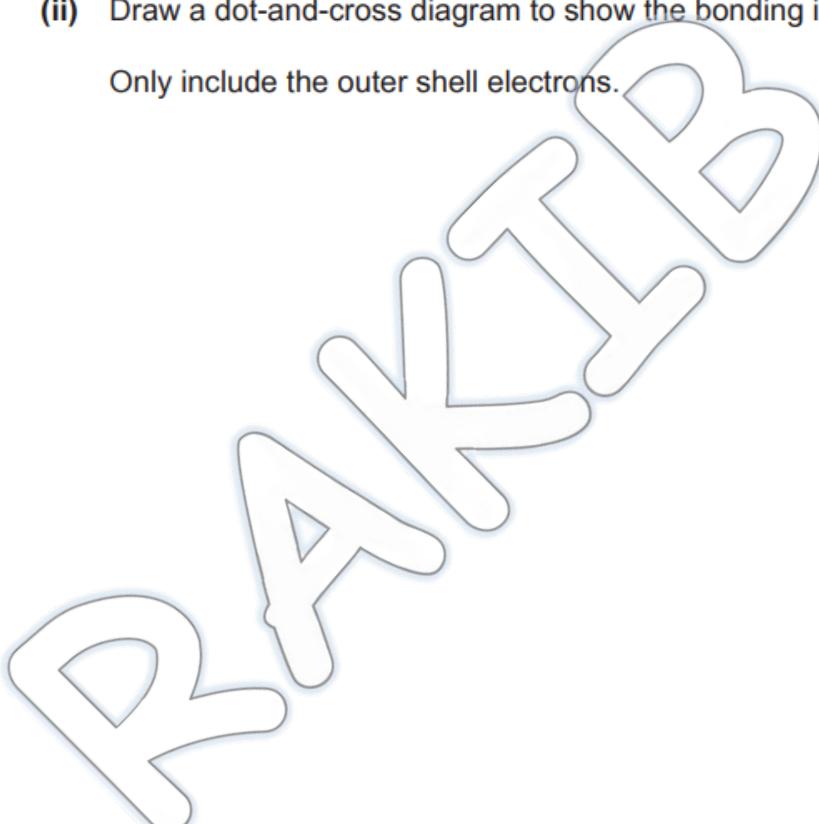
.....  
.....  
..... [2]

57. 5070/22/M/J/21 Q6

(ii) Draw a dot-and-cross diagram to show the bonding in a molecule of nitrogen.

Only include the outer shell electrons.

[1]



Lead is a metal with proton number 82.

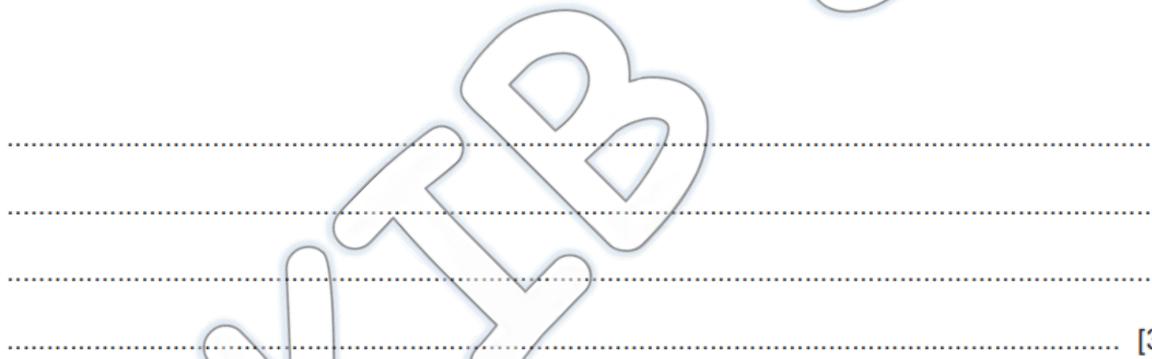
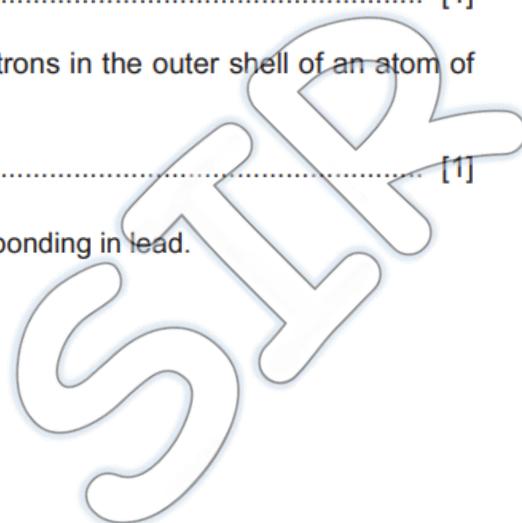
- (a) (i) Use the Periodic Table to state the number of occupied electron shells in an atom of lead.

..... [1]

- (ii) Use the Periodic Table to state the number of electrons in the outer shell of an atom of lead.

..... [1]

- (b) Describe, with the aid of a labelled diagram, the metallic bonding in lead.



[3]

59. 5070/21/O/N/21 Q5

- (d) Silver is a metal.

Use your knowledge of the structure of metals to explain why silver is malleable.



[2]

This question is about metals and metal compounds.

- (a) Silver is a transition element. Potassium is a metal in Group I of the Periodic Table.

State two differences in the physical properties of silver and potassium.

1 .....

2 .....

[2]

- (b) An ion of silver has the symbol



Deduce the number of protons, neutrons and electrons in this ion.

number of protons .....

number of neutrons .....

number of electrons .....

[3]

### 61. 5070/22/O/N/21 Q7

Sodium is a metal in Group I of the Periodic Table. Diamond (carbon) is a non-metal which is a good conductor of heat.

- (a) State two **differences** in the physical properties of sodium and diamond.

1 .....

2 .....

[2]

- (b) An ion of sodium has the symbol



Deduce the number of protons, neutrons and electrons in this ion.

number of protons .....

number of neutrons .....

number of electrons .....

[3]

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

- (a) The table shows some properties of the Group V elements.

element	density at room temperature in g/cm <sup>3</sup>	melting point in °C
nitrogen	$1.17 \times 10^{-3}$	-210
phosphorus	2.34	44
arsenic	5.73	
antimony		631
bismuth	9.80	272

Use the information in the table to:

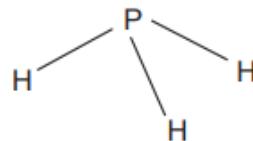
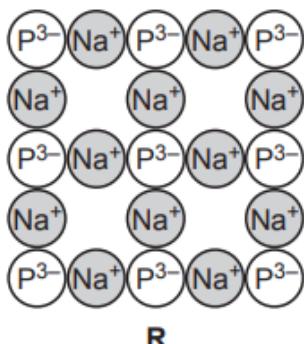
- (i) predict the density of antimony

..... [1]

- (ii) suggest why it is difficult to predict the melting point of arsenic.

..... [1]

(b) The structure of two compounds of phosphorus, **R** and **S**, are shown.



- (i) Explain in terms of structure and bonding why compound **R** has a high melting point and compound **S** has a low melting point.

compound **R** .....

.....

compound **S** .....

.....

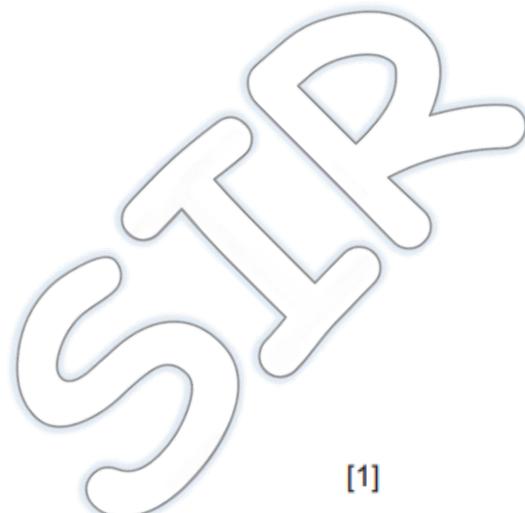
[4]

- (ii) Explain why compound **R** conducts electricity when molten.

[1]

- (iii) Draw a dot-and-cross diagram for a molecule of compound **S**.

Show only the outer shell electrons.



[1]

**63. 5070/21/M/J/22 Q2**

The table shows some information about elements in Group V.

element	electronic configuration	melting point / $^{\circ}$ C	boiling point / $^{\circ}$ C
nitrogen	2, 5	-210	-196
phosphorus		44	280
arsenic	2, 8, 18, 5	817	613
antimony	2, 8, 18, 18, 5	630	1380
bismuth	2, 8, 18, 32, 18, 5		

- (a) State the electronic configuration for phosphorus.

[1]

- (b) Explain why it is easier to predict the boiling point of bismuth than to predict its melting point.

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

[1]

- (c) Use information from the table to explain why antimony is a liquid at 1000 °C.

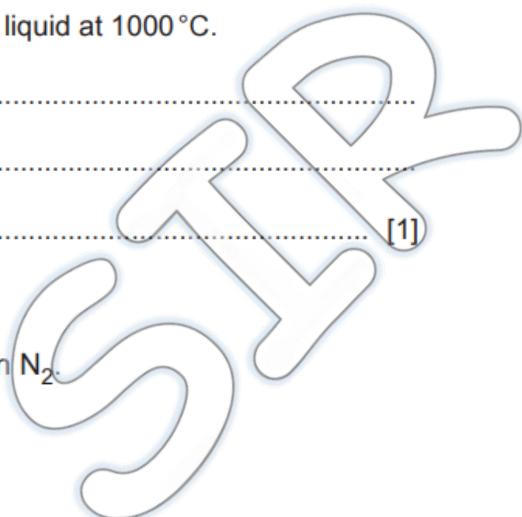
.....  
.....  
.....

[1]

- (d) Nitrogen exists as a diatomic molecule, N<sub>2</sub>.

- (i) Draw the dot-and-cross diagram to show the bonding in N<sub>2</sub>.

Show only the outer shell electrons.



[1]

- (ii) Explain, in terms of structure and bonding, why nitrogen has a low melting point.

.....  
.....

[1]



The table shows information about some particles.

particle	proton number	nucleon number
$^{35}_{17}\text{Cl}$	17	35
$^{35}_{17}\text{Cl}^-$	17	35
$^{39}_{19}\text{K}$	19	39
$^{39}_{19}\text{K}^+$	19	39

- (a) State the number of neutrons in  $^{35}_{17}\text{Cl}$ .

.....

- (b) State the number of electrons in  $^{35}_{17}\text{Cl}^-$ .

.....

[1]

- (c)  $^{39}_{19}\text{K}$  is the full symbol for one isotope of potassium.

Suggest the full symbol for one **other** isotope of potassium.

..... [1]

- (d) Describe how a potassium ion,  $\text{K}^+$ , is formed from a potassium atom, K.

.....  
.....

[1]

- (e) Potassium chloride is an ionic compound.

Potassium chloride has a high melting point and a high boiling point.

- (i) Explain why potassium chloride has a high melting point.

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

[2]

- (ii) Predict two **other** physical properties of potassium chloride.

1 .....  
.....

2 .....  
.....

[2]

- (c) Describe, with the aid of a labelled diagram, the metallic bonding in solid aluminium.

.....  
 .....  
 ..... [2]

66. 5070/22/M/J/22 Q2

The table shows some information about elements in Group VI.

element	electronic configuration	melting point /°C	density in g/cm <sup>3</sup>
oxygen	2, 6	-218	0.0013
sulfur		113	2.1
selenium	2, 8, 18, 6	217	4.8
tellurium	2, 8, 18, 18, 6	450	6.3
polonium	2, 8, 18, 32, 18, 6	254	

- (a) State the electronic configuration for sulfur.

..... [1]

- (b) Predict the density of polonium.

..... g/cm<sup>3</sup> [1]

- (c) Sulfur has a boiling point of 445 °C.

Predict the physical state of sulfur at 200 °C.

Explain your answer.

physical state .....

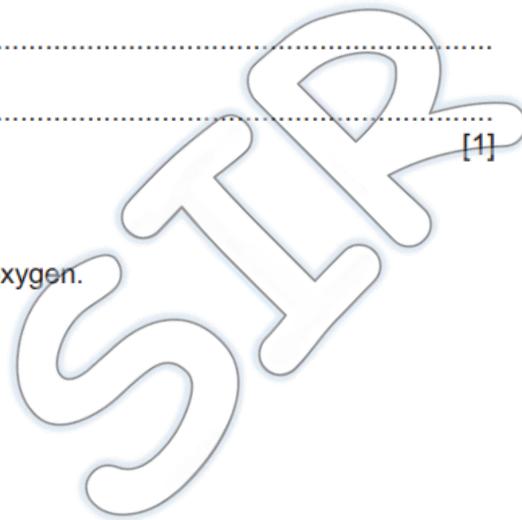
explanation .....

[1]

- (d) Oxygen exists as a diatomic molecule, O<sub>2</sub>.

- (i) Draw the dot-and-cross diagram for a molecule of oxygen.

Show only the outer shell electrons.

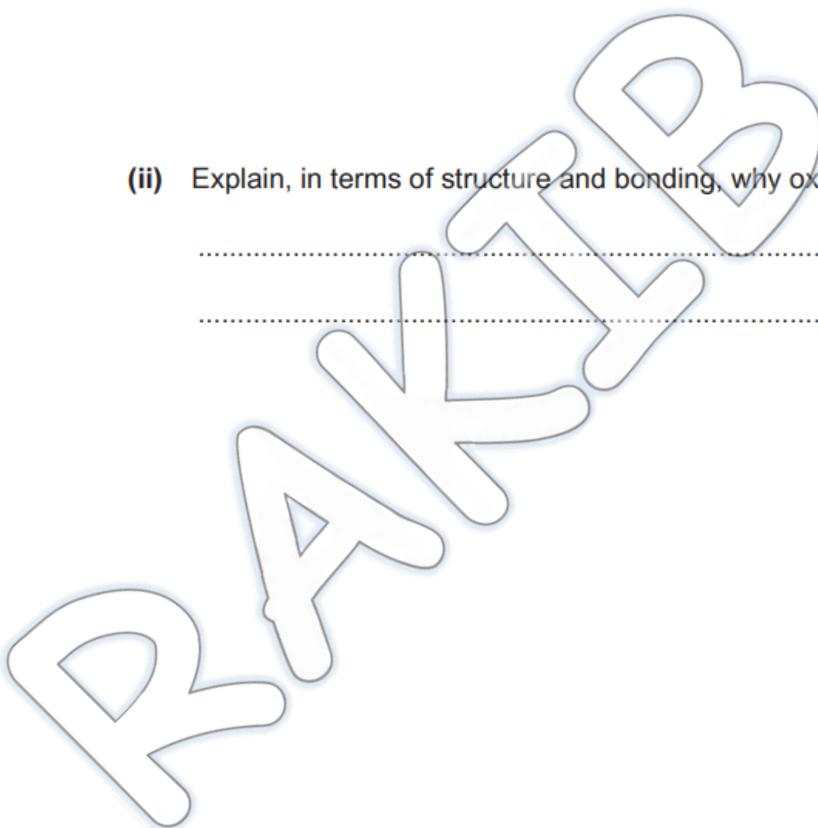


[1]

- (ii) Explain, in terms of structure and bonding, why oxygen has a low melting point.

.....  
.....

[1]



The table shows information about some particles.

particle	number of		
	protons	neutrons	electrons
$^{79}_{35}\text{Br}$	35	44	35
$^{79}_{35}\text{Br}^-$	35	44	
$^{40}_{20}\text{Ca}$	20	20	20
$^{40}_{20}\text{Ca}^{2+}$	20	20	18

- (a) State the nucleon number for  $^{79}_{35}\text{Br}$ .

.....

[1]

- (b) State the number of electrons in  $^{79}_{35}\text{Br}^-$ .

.....

[1]

- c)  $^{40}_{20}\text{Ca}$  is the full symbol for one isotope of calcium.

Write the full symbol for one **other** isotope of calcium.

.....

[1]

- d) Describe how a calcium ion,  $\text{Ca}^{2+}$ , is formed from a calcium atom, Ca.

.....

[1]

- e) Calcium bromide is an ionic compound.

Calcium bromide conducts electricity when molten but not when solid.

- (i) Explain why calcium bromide conducts electricity when molten but **not** when solid.

.....

[2]

- (ii) Predict two **other** physical properties of calcium bromide.

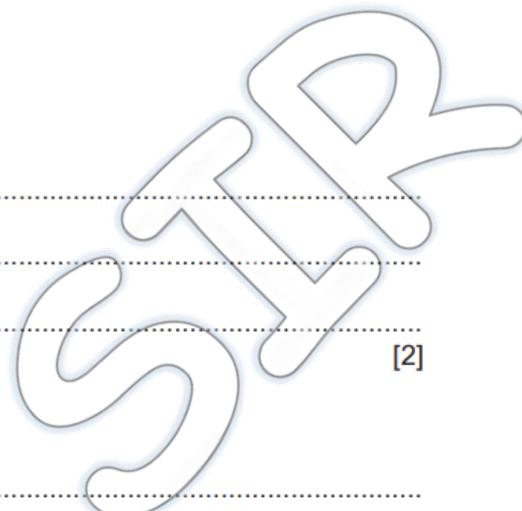
1. ....

2. ....

[2]

(b) Zinc has metallic bonding.

(i) Describe, with the aid of a labelled diagram, the metallic bonding in solid zinc.



(ii) Explain why zinc is a good conductor of electricity.

[1]

69. 5070/21/0/N/22 Q2

Carbon dioxide is a gas at room temperature.

(a) (i) Draw a dot-and-cross diagram to show the arrangement of electrons in a carbon dioxide molecule.

Show only the outer shell electrons.

[2]

70. 5070/21/0/N/22 Q5

(e) (i) Explain why molten magnesium chloride conducts electricity.

[1]

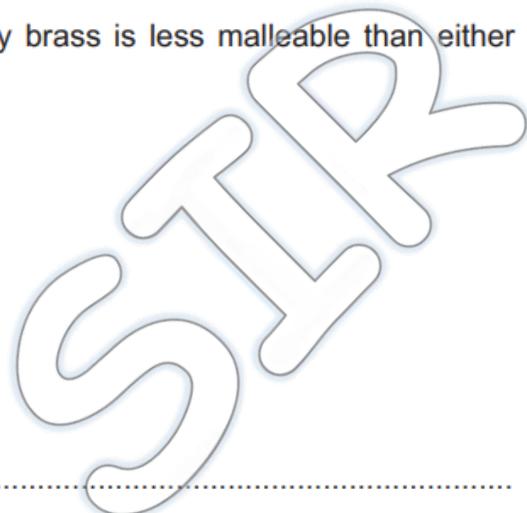
This question is about metals and metal compounds.

- (a) Brass is an alloy of copper and zinc.

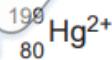
Brass is less malleable than either copper or zinc.

Explain, with reference to the structure of metals, why brass is less malleable than either copper or zinc.

You may include a labelled diagram in your answer.



- (c) The full symbol of an ion of mercury is shown.

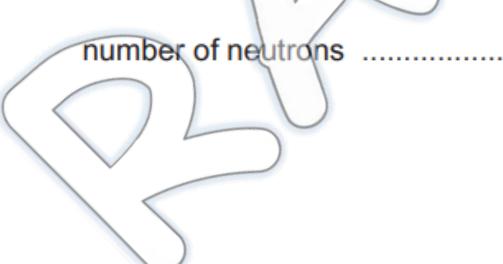


Deduce the number of electrons and neutrons in this ion.

number of electrons .....

number of neutrons .....

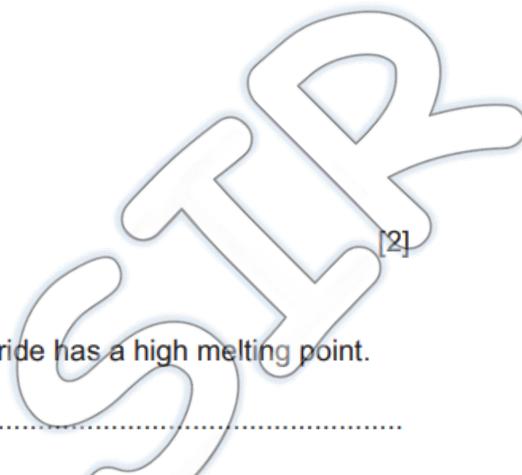
[2]



This question is about halogens and halogen compounds.

- (a) (i) Draw a dot-and-cross diagram to show the arrangement of electrons in a chlorine molecule.

Show only the outer shell electrons.

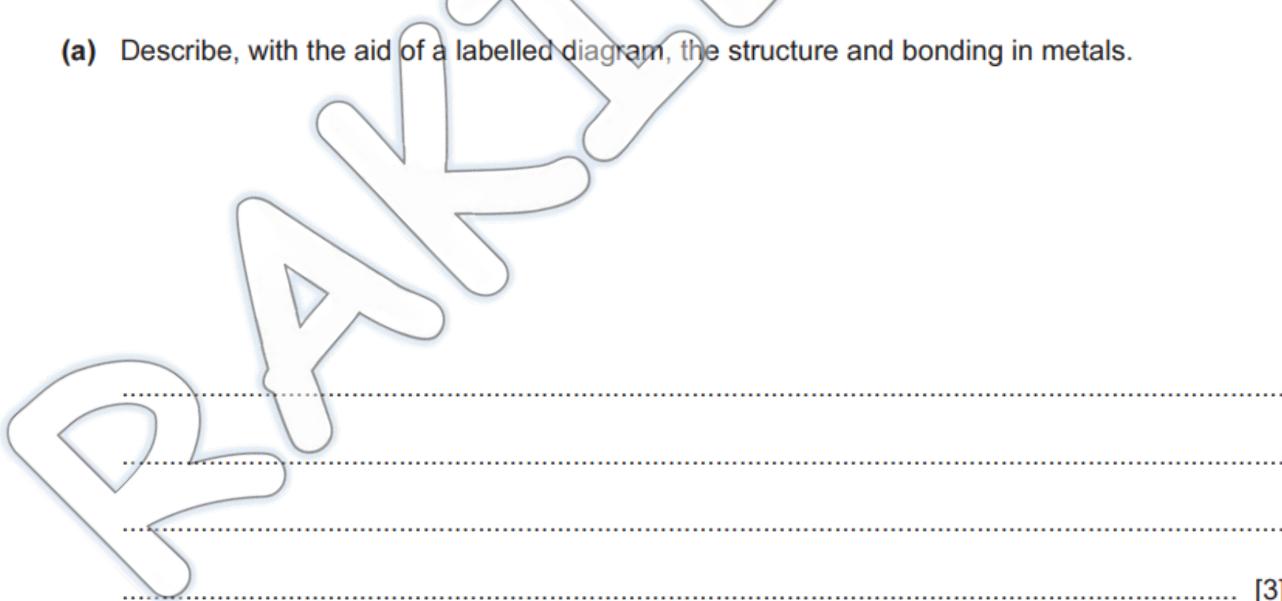


- (ii) Explain, in terms of structure and bonding, why zinc chloride has a high melting point.

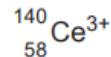
.....  
.....  
..... [2]

This question is about metals and metal compounds.

- (a) Describe, with the aid of a labelled diagram, the structure and bonding in metals.



- (c) The full symbol of an ion of cerium is shown.



Deduce the number of electrons and neutrons in this ion.

number of electrons .....

number of neutrons .....

[2]

RAKIB

STP

RAKIB STR

**1. 5070/21/M/J/16 Q A2d**

A2(d)(i)	<b>1 mark each for any two of:</b> <ul style="list-style-type: none"> <li>• High melting point</li> <li>• Does not conduct electricity as a solid</li> <li>• Soluble in water</li> <li>• Conducts electricity as a molten liquid</li> </ul>	<b>2</b>
A2(d)(ii)	Magnesium (atom) loses 2 electrons (1)  Sulfur (atom) gains 2 electrons (1)	<b>2</b>

**2. 5070/22/M/J/16 Q A2d**

A2(d)(i)	<b>1 mark each for any two of:</b> <ul style="list-style-type: none"> <li>• High melting point/high boiling point</li> <li>• Does not conduct electricity as a solid</li> <li>• Soluble in water</li> <li>• Conducts electricity as a molten liquid</li> </ul>	<b>2</b>
A2(d)(ii)	Magnesium (atom) loses 2 electrons (1)  Fluorine (molecule) gains 2 electrons/each fluorine atom gains an electron (1)	<b>2</b>

**3. 5070/21/0/N/16 Q A5c**

A5(c)(i)	potassium (atom(s)) loses electron(s) (1) chlorine (atom(s)) gains electron(s) (1) so there are 8 electrons in outer shells of both ions (1)	<b>3</b>
A5(c)(ii)	One mark each for any <b>two</b> of : <ul style="list-style-type: none"> <li>• high melting point/high boiling point</li> <li>• dissolves in water</li> <li>• does not conduct electricity when solid/conducts electricity when molten</li> </ul>	<b>2</b>

**4. 5070/22/0/N/16 Q A4 c,d**

A4(c)	<u>atom(s)</u> with same <u>number</u> of protons and different number of neutrons/ <u>atom(s)</u> of the same element with different <u>number</u> of neutrons (1)	<b>1</b>
A4(d)	$I_2 + 2At^- \rightarrow At_2 + 2I^-$ (1)	<b>1</b>

**5. 5070/22/0/N/16 A5 d,**

A5(d)	<u>isotopes</u> (1)  cobalt has greater proportion of heavier isotopes than nickel/nickel has lower proportion of lighter isotopes than nickel (1)	<b>2</b>
-------	--	----------

**6. 5070/22/0/N/16 A6 a,**

A6(a)	electrons move (throughout the structure)/mobile electrons (1)	<b>1</b>
-------	--	----------

7.

A2(a)	<table border="1"> <thead> <tr> <th>sub-atomic particle</th><th>relative electric charge</th><th>relative mass</th></tr> </thead> <tbody> <tr> <td>electron</td><td>-1</td><td>0 / 0.0005</td></tr> <tr> <td>neutron</td><td>0</td><td>1</td></tr> <tr> <td>proton</td><td>+1</td><td>1</td></tr> </tbody> </table> <p>All four correct (3)      Three correct (2)      Two correct (1)      One correct (0)</p>	sub-atomic particle	relative electric charge	relative mass	electron	-1	0 / 0.0005	neutron	0	1	proton	+1	1	3
sub-atomic particle	relative electric charge	relative mass												
electron	-1	0 / 0.0005												
neutron	0	1												
proton	+1	1												
A2(b)(i)	85	1												
A2(b)(ii)	Has more electrons than protons	1												
A2(b)(iii)	C and E (1)  Same number of protons but different number of neutrons (1)	2												

8. 5070/21/M/J/17 Q A4a,d

A4(a)	Calcium ion is 2.8.8 (1)  Chloride ion is 2.8.8 (1)	2
A4(d)	Ionic bonds / attraction between positive ions and negative ions (1)  Idea of having many (strong) bonds – this mark is dependent on the correct bonding (1)	2

9. 5070/21/M/J/17 Q B8d

B8(d)	Correct 'dot-and-cross' diagram	1
-------	---------------------------------	---

10. 5070/21/M/J/17 Q B9c

B9(c)	Atoms do not need to gain or lose electrons / has a stable electronic arrangement	1
-------	---	---

**11. 5070/22/M/J/17 Q A2**

A2(a)	particle	atomic number	number of neutrons in particle	number of electrons in particle	6
	$^{35}\text{Cl}$	17	18	17 (1)	
	$^{37}\text{Cl}$ (1)	17	20	17	
	$^{39}\text{K}^+$	19	20 (1)	18	
	$^{79}\text{Br}^-$	35 (1)	44	36	
	$^{81}\text{Br}$	35	46 (1)	35	
	$^{85}\text{Rb}^+$ (1)	37	48	36	

A2(b)(i)	Atoms with same number of protons but different number of neutrons / atoms with same atomic number but different nucleon number / atoms of the same element with different number of neutrons	1
A2(b)(ii)	$^{35}\text{Cl}$ and $^{37}\text{Cl}$	1

**12. 5070/22/M/J/17 Q A4a,c**

A4(a)	Sodium ion: 2.8 (1) Oxide ion: 2.8 (1)	2
A(c)	Ions move / mobile ions / ions free to move	1

**13. 5070/21/O/N/17 A1b**

A1(b)	number of electrons	number of neutrons	4
	$^{33}\text{S}$	16 (1) 17 (1)	
	$^{25}\text{Mg}^{2+}$	10 (1) 13 (1)	

**14. 5070/21/O/N/17 A3a**

A3(a)(i)	Any two of: reference to layers (1) (layers) slide (1)	2
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**15. 5070/21/O/N/17 Q B7a**

B7(a)(i)	giant (molecular) structure / many covalent bonds (1) takes a lot of energy to break the bonds / needs a high temperature to break the bonds (1)	2
B7(a)(ii)	Diamond has a giant covalent structure whereas tin has a metallic structure (1) because diamond or carbon has a much higher melting point OR diamond does not conduct electricity but tin does (1)	2

**16. 5070/22/O/N/17 A1b**

A1(b)	$^{41}\text{K}$ electrons 19 (1) neutrons 22 (1) $^{17}\text{O}^{2-}$ electrons 10 (1) neutrons 9 (1)	4
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A2(a)	Arrangement: ordered / lattice / regular / layers / uniformly arranged / repeated pattern (1) Type of force: electrostatic (1)	2
A2(b)	Crystals: ions cannot move (1)  Aqueous: ions can move (1)	2
A2(c)	Magnesium ion 2,8 (1) Chloride ion 2,8,8 (1)	2

18. 5070/22/0/N/17 B7a,b

B7(a)(i)	Magnesium has strong bonding between positive ions / cations and electrons / magnesium is a giant structure (1)  Sulfur is a simple molecule / weak forces between sulfur molecules (1)	2
B7(a)(ii)	Magnesium has electrons which move (from place to place) (1)  Sulfur does not have delocalised electrons / no mobile electrons / electrons don't move (1)	2
B7(b)	Giant structure / many covalent <u>bonds</u> (1)  Need high temperature / lot of energy to break the <u>bonds</u> (1)	2

19. 5070/21/M/J/18 Q5c

5(c)(i)	correct 'dot-and-cross' diagram for silane (1)	1
5(c)(ii)	has a simple (molecular or covalent) structure (1)  weak intermolecular forces / van der Waals' forces between molecules / easy to overcome the forces between molecules / weak forces between molecules / easy to break attraction between molecules (1)	2

20. 5070/22/M/J/18 Q 4b,c

4(b)	<p><b>Any two from:</b></p> <ul style="list-style-type: none"> <li>• low melting point / low boiling point (1)</li> <li>• poor conductor of electricity / poor conductor of heat (1)</li> <li>• does not dissolve in water (1)</li> </ul>	2												
4(c)	<p>has a giant (ionic) structure (1)</p> <p>strong attraction between <u>ions</u> / difficult to break attraction between <u>ions</u> / lot of energy needed to overcome (strong) attractive forces between <u>ions</u> (1)</p>	2												
4(d)	<table border="1" data-bbox="290 1649 848 1790"> <tbody> <tr> <td>particle</td> <td><math>^{30}_{15}\text{P}</math></td> <td><math>^{31}_{15}\text{P}^{3-}</math></td> </tr> <tr> <td>number of electrons</td> <td><b>15</b></td> <td><b>18</b></td> </tr> <tr> <td>number of neutrons</td> <td><b>15</b></td> <td><b>16</b></td> </tr> <tr> <td>number of protons</td> <td><b>15</b></td> <td><b>15</b></td> </tr> </tbody> </table> <p>(1) (1)</p>	particle	$^{30}_{15}\text{P}$	$^{31}_{15}\text{P}^{3-}$	number of electrons	<b>15</b>	<b>18</b>	number of neutrons	<b>15</b>	<b>16</b>	number of protons	<b>15</b>	<b>15</b>	2
particle	$^{30}_{15}\text{P}$	$^{31}_{15}\text{P}^{3-}$												
number of electrons	<b>15</b>	<b>18</b>												
number of neutrons	<b>15</b>	<b>16</b>												
number of protons	<b>15</b>	<b>15</b>												

1(a)(i)	C	1
1(a)(ii)	D	1
1(a)(iii)	B	1
1(a)(iv)	A	1
1(a)(v)	D	1
1(b)(i)	20	1
1(b)(ii)	molecule containing two atoms	1

**22. 5070/21/O/N/18 Q 5d(i)**

5(d)(i)	2 pairs of bonding electrons in overlap area (1) only 2 lone pairs on each oxygen atom (1)	2
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**23. 5070/22/O/N/18 Q1**

1(a)(i)	E	1
1(a)(ii)	A	1
1(a)(iii)	C	1
1(a)(iv)	B	1
1(a)(v)	A	1
1(b)(i)	<u>atoms</u> with same number of protons but different number of neutrons / <u>atoms</u> with same atomic number but different mass number (1)	1
1(b)(ii)	44	1

**24. 5070/22/O/N/18 Q5c**

5(c)(i)	correct dot and cross diagram showing 3 pairs of bonding electrons and two non-bonding electrons (2) If two marks not scored, award one mark for one pair of bonding electrons in each of the three overlap areas	2
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**25. 5070/21/M/J/19 Q1 AND Q2**

1(a)	$^{39}_{20}\text{Ca}$ (1)	1
1(b)	$^{35}_{17}\text{Cl}$ (1)	1
1(c)	$^{37}_{17}\text{Cl}^-$ (1)	1
1(d)	$^{20}_{10}\text{Ne}$ (1)	1
1(e)	$^{64}_{29}\text{Cu}$ (1)	1

2(a)	all have 2 electrons in their outer shell (1)	1
2(b)	atomic radius is always increasing / the melting point goes up and down (1)	1
2(c)(i)	2.8 (1)	1
2(c)(ii)	negative electrode: $\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$ (1) positive electrode: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ (1)	2

**26. 5070/21/M/J/19 Q3**

3(a)	high melting point / high boiling point / high density / (good) conductor of electricity / (good) conductor of heat / malleable / ductile / hard / strong / sonorous (1)	1
3(b)	coloured / variable oxidation state / catalyst (1)	1
3(c)	idea that there are atoms or ions of different size in steel (1) in steel the layers (of atoms, ions or particles) cannot move as easily (1)	2

**27. 5070/21/M/J/19 Q7e**

7(e)	in solid ions cannot move (1) in aqueous solution ions can move (1)	2
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**28. 5070/21/M/J/19 Q8d**

8(d)	outer shell of phosphorus is correct (3 bond pairs with chlorine and 2 non-bonding electrons) (1) rest of outer shells of all three chlorine atoms correct (1)	2
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**29. 5070/21/M/J/19 Q9e**

9(e)	sand is a giant molecule / giant covalent / macromolecule (1) has many strong bonds (that have to be broken or overcome) / needs lots of energy to break or overcome the many bonds / difficult to break the many bonds (1)	2
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1(a)	H <sub>2</sub> S (1)	1
1(b)	MnO <sub>4</sub> <sup>-</sup> (1)	1
1(c)	NH <sub>4</sub> <sup>+</sup> (1)	1
2(a)(i)	0.155 – 0.190 (nm) (1)	1
2(a)(ii)	the melting point goes up and down (1)	1
2(b)	has <b>many</b> strong bonds (that have to be broken or overcome) / needs lots of energy to break or overcome <b>many</b> bonds (1)	1
2(c)(i)	aluminium oxide (dissolved) in (molten) cryolite (1)	1
2(c)(ii)	carbon / graphite (1)	1
2(c)(iii)	negative electrode: Al <sup>3+</sup> + 3e <sup>-</sup> → Al (1) positive electrode: 2O <sup>2-</sup> → O <sub>2</sub> + 4e <sup>-</sup> (1)	2
2(d)	Al because it loses electrons (1)	1
2(e)	has a layer of oxide / aluminium oxide layer (1) layer is impermeable (to water) / coating is impermeable (to water) (1)	2

3(b)(i)	simple covalent molecule / simple covalent molecular (1)	1
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7(e)	in solid ions cannot move (1) in aqueous / solution ions can move (1)	2
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8(d)	correct structure (1)	1
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**NO MARKSCHEME AVAILABLE**

1(a)	P	1
1(b)	Fe	1
1(c)	Fe	1
1(d)	Mg	1
1(e)	C	1

2(a)	Any two from  rezaulkarimrakib02@gmail.com 01826992720 low density (1) x soft (1)	2
2(b)	drawing of electronic structure of 2.8.1	1

2(d)	sodium (atom) loses electron(s) (1) oxygen (atom or molecule) gains electron(s) (1) two electrons gained by oxygen (atom) (1)	3
2(e)(i)	high melting point / high boiling point / does not conduct electricity when solid / does conduct electricity when molten / does conduct electricity when in aqueous solution	1

**37. 5070/21/O/N/19 Q8**

8(a)	electrons: 14 (1) neutrons: 16 (1) protons: 14 (1)	3
8(b)	$3\text{Si} + 2\text{N}_2 \rightarrow \text{Si}_3\text{N}_4$	1
8(c)(i)	<b>Any two from:</b>  both have covalent bonds / covalent (lattice) (1)  both have giant structures (1)  tetrahedral arrangement of structure (1)	2
8(c)(ii)	many strong bonds / strong bonding throughout the structure (1)  needs a high temperature to break (all) the bonds / needs a lot of energy to break (all) the bonds (1)	2
8(d)	$\text{SiO}_2\text{C}_4\text{H}_{12}$	1
8(e)	pair of shared electrons between each of the 4 Cl atoms and central Si <b>AND</b> 6 non-bonding electrons around each chlorine	1

**38. 5070/22/O/N/19 Q2**

2(a)	<b>Any two from:</b>  conducts electricity / conducts heat (1) malleable (1) ductile (1) shiny / lustrous (1)	2
2(b)	electronic structure of 2.8.2	1
2(c)(i)	magnesium (atom) loses electron(s) (1)  bromine (atom or molecule) gains electron (1)  two electrons transferred from magnesium (1)	3
2(c)(ii)	high melting point / high boiling point (1)  <b>OR</b>  does not conduct electricity when solid / conducts when molten / conducts in aqueous solution (1)	1

**39. 5070/22/O/N/19 Q8**

8(a)(i)	electrons: 15 (1)  neutrons: 16 (1)  protons: 15 (1)	3
rezaulkarimrakib02@gmail.com 01826992720	atoms with the same number of protons and different numbers of neutrons / atoms of the same element with different numbers of neutrons	Page 62 of 69
8(b)	$5\text{KClO}_3 + 6\text{P} \rightarrow 5\text{KCl} + 3\text{P}_2\text{O}_5$	1

**40. 5070/22/M/J/20 Q1**

1(a)	calcium chloride (1)	1
1(b)	ammonium chloride (1)	1
1(c)	silver chloride (1)	1
1(d)	hydrogen chloride (1)	1
1(e)	iron(III) chloride	1

**41. 5070/21/M/J/20 Q7**

7(e)	electrons cannot move / no mobile electrons	1
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**42. 5070/22/M/J/20 Q6**

6(d)	electrons cannot move / no mobile electrons (1)	1
6(e)	 two shared pairs of electrons between both carbon atoms (1) two shared pairs between carbon and hydrogen atoms for each carbon atom (1)	2

**43. 5070/22/M/J/20 Q7**

7(d)	giant covalent (1)	1
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**44. 5070/21/O/N/20 Q1**

1(a)	silver nitrate	1
1(b)	silver nitrate	1
1(c)	magnesium carbonate	1
1(d)	lithium bromide	1
1(e)	methane	1

**45. 5070/21/O/N/20 Q2**

2(a)	carbon dioxide is a (simple) molecule <b>and</b> calcium carbide is ionic (1) for carbon dioxide: weak (attractive) forces between molecules / weak intermolecular forces(1) for calcium carbide: strong (attractive) forces between ions (1)	3
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**46. 5070/21/O/N/20 Q8**

8(d)(i)	H H .. .. : N : N : .. .. H H	1
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**47. 5070/21/O/N/20 Q9**

9(b)	electrons:18 (1)  neutrons: 24 (1)	2
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**48. 5070/22/O/N/20 Q1**

1(a)	ammonia	1
1(b)	copper(II) sulfate	1
1(c)	aluminium sulfate	1
1(d)	calcium carbonate	1
1(e)	potassium nitrate	1

**49. 5070/22/O/N/20 Q2**

2(a)	chlorine is a (simple) molecule <b>and</b> sodium chloride is ionic (1)  for chlorine: weak (attractive) forces between molecules / weak intermolecular forces(1)  for sodium chloride: strong (attractive) forces between ions (1)	3
2(b)	2,8,7	1

**50. 5070/22/O/N/20 Q8**

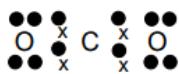
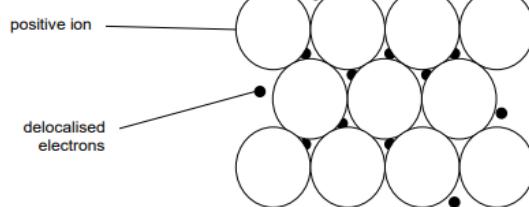
8(c)	: Cl : S : Cl : .. .. .. ..	1
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**51. 5070/22/O/N/20 Q9**

9(a)	electrons = 80 (1)  neutrons = 125 (1)	2
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**52. 5070/21/M/J/21 Q2**

2(c)	outer shell has 8 electrons	1
2(d)(i)	86 protons / 86 electrons / same electronic structure	1
2(d)(ii)	radon-222 has two more neutrons / radon-220 has two fewer neutrons / radon-220 has 134 neutrons and radon-222 has 136 neutrons	1

**53. 5070/21/M/J/21 Q6**
**6(b)**

**1**
**54. 5070/21/M/J/21 Q8**
**8(a)**
**five**
**8(b)**

**1**
**3**
**55. 5070/22/M/J/21 Q2**
**2(c)(i)**

same electronic structure / same electronic configuration

**1**
**2(c)(ii)**

polonium-210 has one more neutron / polonium-209 has one less neutron / polonium-209 has 125 neutrons and polonium-210 has 126 neutrons

**1**
**56. 5070/22/M/J/21 Q4**
**4(b)**

zinc loses electrons and bromine gains electrons (1)

**2**

reference to (transfer of) two electrons (1)

**57. 5070/22/M/J/21 Q6**
**6(c)(ii)**

**1**
**58. 5070/22/M/J/21 Q8**
**8(a)(i)**

six

**1**
**8(a)(ii)**

four

**1**
**8(b)**

**3**

**59. 5070/21/O/N/21 Q5**

5(d)	layers made of ions (1) layers slide (1)	2
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**60. 5070/21/O/N/21 Q7**

7(a)	<b>Any two from:</b>  high melting point for Ag / high boiling point for Ag / ORA for K (1)  high density for Ag / ORA for K (1)  hard for Ag / soft for K (1)	2
7(b)	protons: <b>47</b> (1)  neutrons: <b>62</b> (1)  electrons: <b>46</b> (1)	3

**61. 5070/22/O/N/21 Q7**

7(a)	<b>Any two from:</b>  sodium conducts electricity / diamond does not conduct electricity (1)  sodium malleable / diamond brittle (1)  brittle (1)  sodium ductile / diamond not ductile (1)  sodium soft / diamond hard (1)	2
7(b)	protons: <b>11</b> (1)  neutrons: <b>12</b> (1)  electrons: <b>10</b> (1)	3

**62. 5070/22/O/N/21 Q10**

10(a)(i)	values between 6.00 and 9.50 (inclusive of these values)	1
10(a)(ii)	there is no trend (down the group)	1
10(b)(i)	R is an ionic structure / R has an ionic lattice / R is giant ionic (1)  R bonds (throughout lattice) are strong (1) (dependent on the mention of ions / ionic for R)  S is a simple molecular structure / small molecule / simple molecule (1)  S weak forces between molecules (1)	4

10(b)(ii)	ions can move / has mobile ions	1
10(b)(iii)	3 pairs of bonding electrons between each H and P <b>AND</b> 2 non-bonding electrons on P	1

**63. 5070/21/M/J/22 Q2**

2(a)	2, 8, 5	1
2(b)	boiling point has a trend / melting point does not have a trend	1
2(c)	melting point is below 1000 °C and boiling point is above 1000 °C / 1000 °C is between the melting point and the boiling point	1
2(d)(i)	correct dot-and-cross diagram	1
2(d)(ii)	weak intermolecular forces / intermolecular forces are easy to break or overcome	1

**64. 5070/21/M/J/22 Q4**

4(a)	18	1
4(b)	18	1
4(c)	$^{40}_{19}K$	1
4(d)	loses one electron	1
4(e)(i)	lattice (structure) (1) strong attraction between positive and negative ions / strong electrostatic attraction between ions (1)	2
4(e)(ii)	<b>any two from:</b> conducts electricity as a molten liquid (1) does not conduct electricity as a solid (1) dissolves in water (1)	2

**65. 5070/21/M/J/22 Q7**

7(c)	 positive ion delocalised electrons closely packed positive ions surrounded by delocalised electrons (1) strong attraction between electrons and positive ions (1)	2
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**66. 5070/22/M/J/22 Q2**

2(a)	2, 8, 6	1
2(b)	any value between 6.8 to 9.4 inclusive (g / cm <sup>3</sup> )	1
2(c)	liquid because melting point is below 200 °C and boiling point is above 200 °C / 200 °C is between the melting point and the boiling point	1
2(d)(i)	correct dot-and-cross diagram	1
2(d)(ii)	weak intermolecular forces / intermolecular forces are easy to break or overcome	1

**67. 5070/22/M/J/22 Q4**

4(a)	79	1
4(b)	36	1
4(c)	$^{41}_{20}\text{Ca}$	1
4(d)	loses two electrons	1
4(e)(i)	in solid ions cannot move / in solid ions are in a lattice / in solid ions are fixed (1) in molten liquid ions can move (1)	2
4(e)(ii)	high melting point / high boiling point (1) dissolves in water (1)	2

**68. 5070/22/M/J/22 Q8**

8(b)(i)	 diagram showing closely packed positive ions surrounded by delocalised electrons (1) strong attraction between electrons and positive ions (1)	2
8(b)(ii)	electrons can move / has mobile electrons	1

**69. 5070/21/O/N/22 Q2**

2(a)(i)	2 bonding pairs between the C atom and each O atom (1) 4 non-bonded electrons on each O atom (1)	2
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**70. 5070/21/O/N/22 Q5**

5(e)(i)	the ions can move	1
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**71. 5070/21/O/N/22 Q8**

8(a)	in pure metal the layers of atoms/ions can slide (1) in alloys there are different sized atoms/ions (1) which stop the layers from sliding (1)	3
8(b)	mercury < chromium < uranium < potassium	1
8(c)	number of electrons: 78 (1)	2

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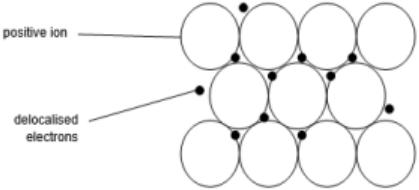
72. 5070/22/0/N/22 Q2

2(a)(i)	one bonding pair between two chlorine atoms (1) 6 non-bonded electrons on each chlorine atom (1)	2
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73. 5070/22/0/N/22 Q5

5(c)(ii)	giant (ionic) structure / (ionic) lattice(1) strong (forces of) attraction between (positive and negative) ions (1)	2
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74. 5070/22/0/N/22 Q8

8(a)	 positive ion delocalised electrons  closely packed positive ions (1) (particles) surrounded by delocalised electrons (1) <b>strong</b> attraction between electrons and positive ions (1)	3
8(b)	nickel < zinc < cerium < rubidium	1
8(c)	<i>number of electrons:</i> 55. (1) <i>number of neutrons:</i> 82 (1)	2