OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



EXAM QUESTION PACK

C1.2 ATOMIC STRUCTURE

SCORE	PERCENTAGE
/123	%

STEMUP

These questions belong to OCR, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by OCR. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with OCR and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. OCR has not endorsed, approved or been involved in the production of it. OCR and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

OCR publishes its past papers, mark schemes and examiner reports. Always check the current specification at ocr.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Gateway Chemistry A (9-1)

Atomic structure

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **123**.
- The total number of marks may take into account some 'either/or' question choices.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

1 What is the approximate size of an atom?

A 3×10^{-1} metres
B 3×10^{-5} metres
C 3×10^{-9} metres
D 3×10^{-13} metres

Your answer ☐

[1]

2(a) Look at the table. It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	.....	11	2.8.1
B	9	19	9	10	9	.....
C	.....	37	17	.....	17	2.8.7
D	13	27	.....	.....	10	2.8

Complete the table.

[4]

(b) Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

---

[2]

STEMUP.CO.UK

(c) Particle **C** has the electronic structure 2.8.7.

What does this tell you about the position of particle **C** in the Periodic Table?

Explain your answer.

---

[4]

(d) Complete the table below to give information about protons, neutrons and electrons.

	Charge	Mass in atomic mass units
proton	.....	1
neutron	.....	.....
electron	negative	.....

[2]

(e) Rutherford was a scientist who helped to develop the atomic model.

State how Rutherford's work contributed to the development of the atomic model.

---

[1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

3 Tim is separating the colours in a sample of black ink using paper chromatography.

He puts a spot of black ink onto filter paper.

He dips the filter paper into ethanol in a beaker.

What is the name given to **ethanol** in this experiment?

A gas phase
B mobile phase
C solid phase
D stationary phase

Your answer ☐

[1]

4(a) Look at the table. It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	_____	11	2.8.1
B	9	19	9	10	9	_____
C	_____	37	17	_____	17	2.8.7
D	13	27	_____	_____	10	2.8

Complete the table.

[4]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

(b) Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

---

[2]

(c) Element **C** has the electronic structure 2.8.7.

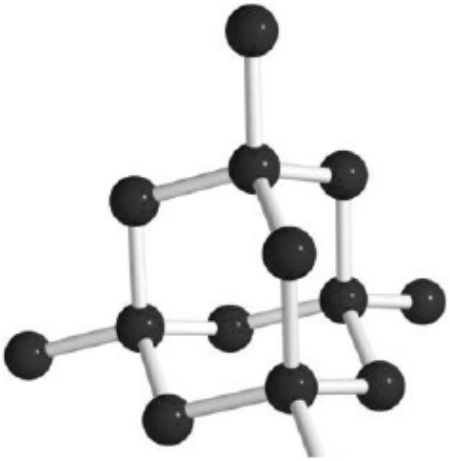
What does this tell you about the position of element **C** in the periodic table?

Explain your answer.

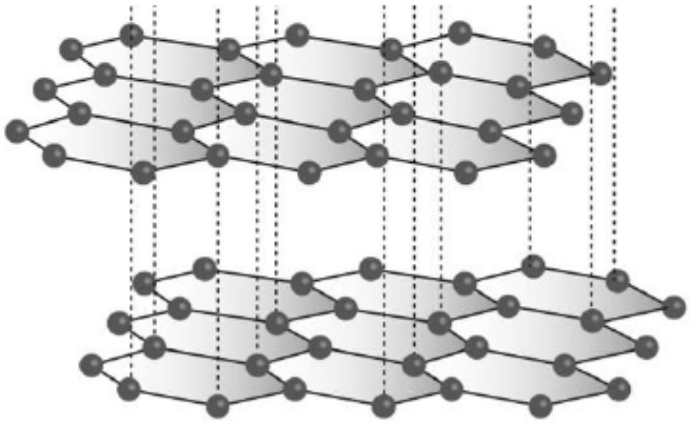
---

[4]

5(a) The diagrams show the structures of two forms of carbon.



diamond



graphite

Graphite is a good conductor of electricity.

Diamond does not conduct electricity.

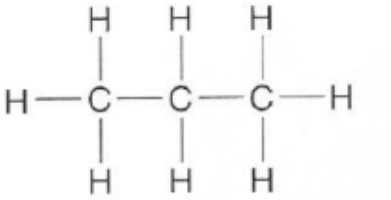
Use ideas about structure and bonding in diamond and graphite to explain these observations.

--- [3]

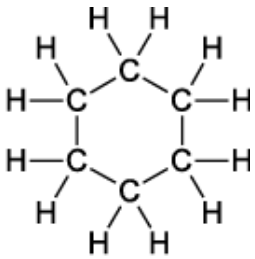
STEMUP.CO.UK

(b) Carbon can form many thousands of different compounds.

Two examples are shown below.



propane



cyclohexane

Why can carbon form many thousands of different compounds?

---

[1]

6(a) Look at the table. It shows some information about three atoms.

Atom	Number of protons	Number of neutrons	Electronic structure
X	17	20	2.8.7
Y	17	18	2.8.7
Z	3	4	2.1

(i) What is the **atomic number** of atom **X**?

answer _____

[1]

(ii) What is the **mass number** of atom **Z**?

answer _____

[1]

(iii) How many electron shells are occupied in atom **Y**?

answer _____

[1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

(b) Atoms **X** and **Y** are **isotopes**.

What is meant by isotopes?

---

[2]

7 Look at the table. It shows some information about four atoms.

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
W	17	37	17	20	17	2.8.7
X	17	35	17	18	17	2.8.7
Y	3	7	_____	_____	3	2.1
Z	6	_____	6	6	6	_____

[3]

Complete the table.

STEMUP.CO.UK

8 Look at the table. It shows some information about four atoms.

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
W	17	37	17	20	17	2.8.7
X	17	35	17	18	17	2.8.7
Y	3	7	_____	_____	3	2.1
Z	6	_____	6	6	6	_____

[3]

Atom **W** and atom **X** are both chlorine atoms.

What is the name given to chlorine atoms such as **W** and **X**?

_____

Explain your answer.

_____

_____

_____

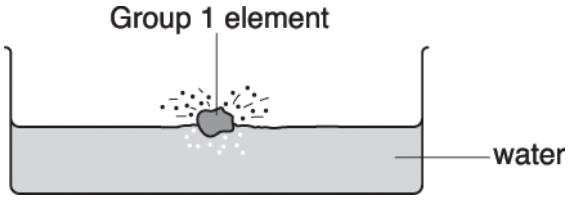
_____ **[2]**

STEMUP.CO.UK

9 This question is about the reaction of Group 1 elements with water.

Lithium, sodium and potassium are Group 1 elements.

They react with water.



Look at the table.

Group 1 element	Time for 0.5 g of metal to react completely in seconds	Observations
sodium	15	melts moves across surface of water makes a gas which burns with a 'pop' makes an alkaline solution
potassium	7	melts and catches fire moves quickly across surface of water makes a gas which burns with a 'pop' makes an alkaline solution
lithium	25	moves slowly across surface of water makes a gas which burns with a 'pop' makes an alkaline solution

Rubidium is another Group 1 element.

It is below potassium in Group 1 of the periodic table.

When the same mass of rubidium reacts with water, **predict**

- what you will see
- the names of the products
- how long rubidium will take to react.

The quality of written communication will be assessed in your answer to this question.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

[6]

10(a) Find magnesium, Mg, on the periodic table.

What is the **atomic number** of magnesium?

answer _____

[1]

(b) The **mass number** of nitrogen, N, is 14.

What is meant by the mass number?

[1]

(c) Magnesium, Mg, is an element.

Use its formula to explain how you can tell.

[1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

(d) Several scientists helped to develop the periodic table.

Write down the names of **two** of these scientists.

---

[2]

11(a) Look at the information about a chlorine atom and an oxide ion.

$^{37}_{17}Cl$ $^{16}_{8}O^{2-}$

Complete the table to show the number of protons, neutrons and electrons in each particle.

Two have been done for you.

	Chlorine atom, *Cl*	Oxide ion, O^{2-}
Number of protons	_____	8
Number of neutrons	_____	_____
Number of electrons	17	_____

[3]

(b) Many scientists have helped in the development of the theory of atomic structure.

Two of these scientists were J. J. Thomson and Niels Bohr.

Describe what J. J. Thomson and Niels Bohr contributed to the theory of atomic structure.

J. J. Thomson

Niels Bohr

---

[2]

STEMUP.CO.UK

12 Look at the electronic structures of some atoms.

Atom	Electronic structure
W	2.8.1
X	2.8.4
Y	2.8.7
Z	2.8.8

(i) One of the atoms is a metal which makes a positive ion.

Which one? Choose from the table.

answer _____

[1]

(ii) One of the atoms has a stable electronic structure and is unreactive.

Which one? Choose from the table.

answer _____

[1]

(iii) Two of the atoms can combine together by **transferring** electrons to form an **ionic** bond.

Which two? Choose from the table.

_____ and _____

[1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

13(a) An aluminium atom can be shown as

$$^{27}_{13}Al$$

What can be deduced from this information about the structure of an aluminium atom and the position of aluminium in the Periodic Table?

The quality of written communication will be assessed in your answer to this question.

[6]

(b) Rutherford was a scientist who contributed to the development of the theory of atomic structure.

He worked with two other scientists called Geiger and Marsden.

Write about Geiger and Marsden's experiment and how it contributed to the development of ideas about atomic structure.

[2]

STEMUP.CO.UK

14 This question is about atomic structure and bonding.

Atoms are made up of protons, neutrons and electrons.

Complete the table.

Particle	Relative charge	Relative mass
proton	+1	1
neutron	0	_____
electron	_____	0.0005

[2]

15 Sodium chloride, NaC*l*, contains sodium ions, Na^+, and chloride ions, Cl^-.

Explain why sodium ions are positively charged and chloride ions are negatively charged.

---

[2]

16(a) Atoms contain electrons, neutrons and protons.

Look at the table. It shows the number of electrons, neutrons and protons in some atoms and ions.

Atom or ion	Number of		
	electrons	neutrons	protons
$^{1}_{1}H$	1	0	1
$^{2}_{1}H$	1	1	1
$^{31}_{15}P$	15	16	15
.....	15	17	15
$^{32}_{16}S^{2-}$	.....	16	16

Complete the table.

[2]

(b) $^{1}_{1}H$ and $^{2}_{1}H$ are **isotopes** of hydrogen.

What is meant by the term **isotope**?

---

[2]

(c) In 1808, a scientist named Dalton published his atomic theory.

About a century later, a scientist called Rutherford published another atomic theory.

Why is it important that scientists publish their theories?

---

[2]

17(a) An aluminium atom can be shown as

$$^{27}_{13}Al$$

What do the numbers 27 and 13 mean?

Explain what the numbers tell you about the structure of an aluminium atom.

The quality of written communication will be assessed in your answer to this question.

[6]

(b) John Dalton developed his work on an atomic theory in 1803.

J.J. Thomson and E. Rutherford made other discoveries about the atom.

Write about these **other** discoveries.

[2]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

18(a) In 1808, a scientist named Dalton published his atomic theory.

Dalton thought that:

- elements were made up of atoms
- atoms could **not** be split into simpler particles.

About a century later, a scientist called Rutherford published another atomic theory.

Rutherford thought that:

- atoms had a positively charged nucleus
- electrons orbited the nucleus.

Why is it important that scientists publish their theories?

---

[2]

(b) Write about one **difference** between Dalton's atomic theory and Rutherford's atomic theory.

---

[1]

(c) What is the electrical charge on an electron?

---

[1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

19(a) The table shows the electronic structures of the atoms of some elements.

Element	Symbol	Electronic structure
helium	He	2
oxygen	O	2.6
neon	Ne	2.8
magnesium	Mg	2.8.2
chlorine	Cl	2.8.7
calcium	Ca	2.8.8.2

How many **electrons** are there in one atom of chlorine?

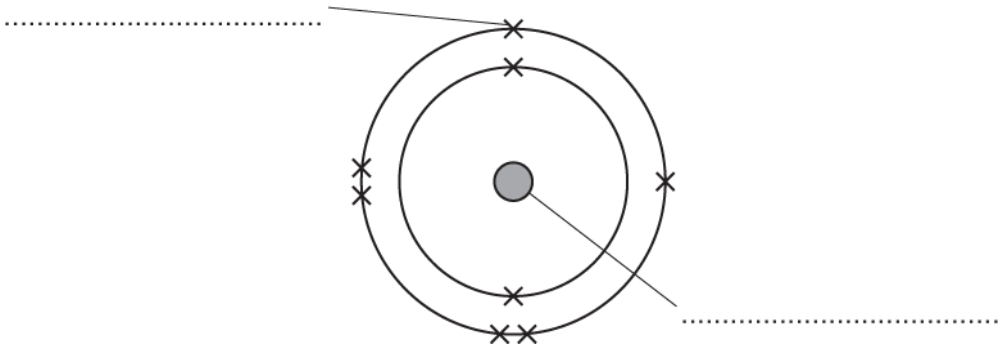
[1]

(b) What is the **atomic number** of magnesium?

[1]

20(a) This question is about atoms and elements.

Look at the diagram.



[2]

Label the diagram to show the main parts of an atom.

[2]

(b) Look at the names of some elements.

aluminium
caesium
carbon
chlorine
copper
tin

Which two elements are in the same **group** of the periodic table?

Explain your answer.

Use the periodic table on the back page to help you.

---

[2]

21(a) The electronic structure of lithium is 2.1.

Lithium is a reactive metal.

Explain **how** and **why** a lithium atom forms a lithium ion.

---

[2]

STEMUP.CO.UK

(b) Sodium reacts with oxygen to make sodium oxide, Na_2O.

Draw a 'dot and cross' diagram to show the ionic bonding in sodium oxide.

Show all of the electrons in each ion.

The electronic structure of sodium is 2.8.1.

The electronic structure of oxygen is 2.6.

Show the charges on each ion.

[3]

22(a) This question is about atoms.

Atoms are made up of protons, neutrons and electrons.

Complete the table.

Particle	Relative mass	Relative charge
electron	0.0005	−1
proton		
neutron		

[2]

STEMUP.CO.UK

(b) Atoms are neutral.

Explain why.

---

[1]

(c) Which of these describes the approximate radius and mass of an atom?

Choose from **A**, **B**, **C** or **D**.

	Radius in metres	Mass in grams
A	10^{-2}	10^{-20}
B	10^{-5}	10^{-15}
C	10^{-10}	10^{-23}
D	10^{-20}	10^{-35}

answer .---------- [1]

23 The atomic radius of a helium atom is 0.031 nm.

What is the atomic radius of a helium atom in standard form?

A 3.1×10^{-1}

B 3.1×10^{-2}

C 3.1×10^{-3}

D 3.1×10^{-4}

Your answer [1]

© OCR 2022. You may photocopy this page.

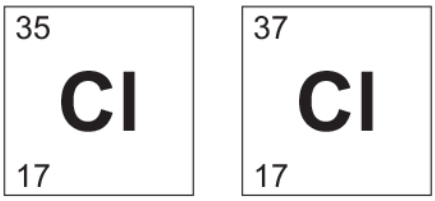
Created in ExamBuilder

STEMUP.CO.UK

(i) Chlorine is a non-metal.

Chlorine has two common **isotopes**.

Look at the information about the common isotopes of chlorine.



Complete the table to show the atomic structure for each isotope of chlorine.

Isotope	Number of protons	Number of neutrons	Number of electrons
Chlorine-35	.....	.....	.....
Chlorine-37	.....	.....	.....

[2]

(ii) Chlorine gas, Cl_2, reacts with barium, Ba.

Barium chloride, $BaCl_2$, is made.

Write a **balanced half** equation for **chlorine** in this reaction.

[1]

(iii) Barium chloride solution reacts with sodium sulfate solution, Na_2SO_4.

A white precipitate of barium sulfate, $BaSO_4$, is made.

Write a **balanced ionic** equation to show the formation of barium sulfate.

Include state symbols.

[2]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

25 In 1803 John Dalton suggested that all matter is made from atoms.

The electron was the first subatomic particle to be discovered by J.J. Thomson in 1897.

J.J. Thomson developed Dalton's model to show the presence of electrons.

What was J.J. Thomson's model called?

A Bohr model

B Particle model

C Planetary model

D Plum-pudding model

Your answer [1]

26 A sodium atom can be shown as:

$^{23}_{11}Na$

How many protons, neutrons and electrons are in a sodium atom?

A 11 protons, 12 neutrons, 11 electrons

B 11 protons, 11 neutrons, 12 electrons

C 12 protons, 12 neutrons, 11 electrons

D 12 protons, 11 neutrons, 11 electrons

Your answer [1]

© OCR 2022. You may photocopy this page.

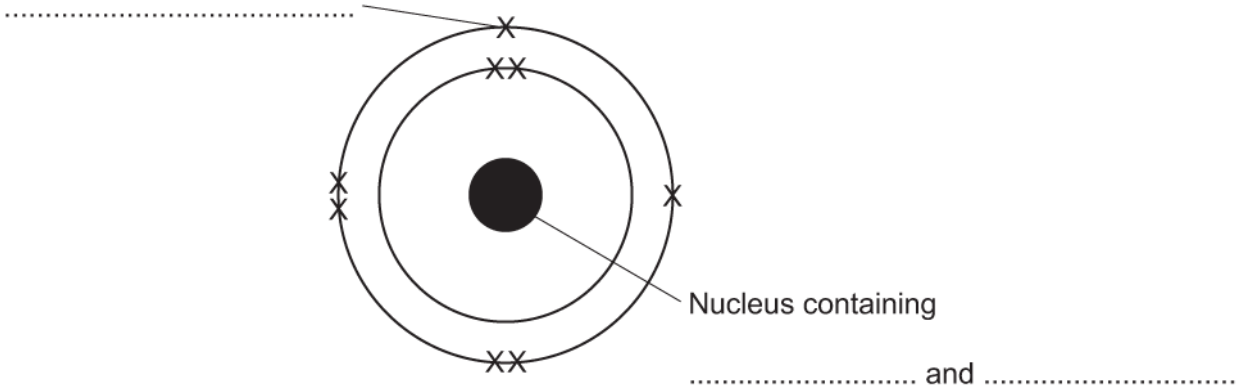
Created in ExamBuilder

STEMUP.CO.UK

27(a) All elements are made of atoms.

Atoms are made of subatomic particles.

(i) Complete the labels on the diagram of an atom.



[2]

(ii) Atoms have no overall charge.

Explain why.

Use ideas about subatomic particles in your answer.

---

[1]

STEMUP.CO.UK

(b) Look at the information about two **isotopes** of carbon.

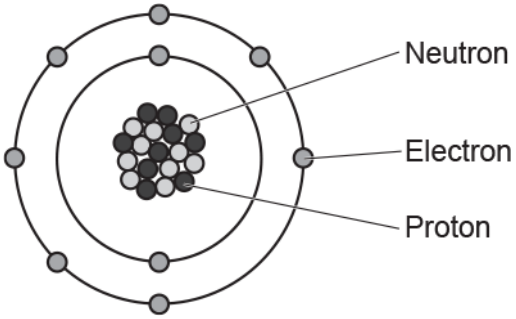
12 C 6	14 C 6

Explain why these are called isotopes.

---

[2]

28 The diagram shows an atom of an element.



What is the name of the element?

A Boron

B Beryllium

C Fluorine

D Neon

Your answer ☐ [1]

STEMUP.CO.UK

29 A potassium isotope can be shown as:

$^{39}_{19}K$

What are the numbers of protons, neutrons and electrons in this potassium isotope?

A 19 protons, 19 neutrons, 20 electrons

B 19 protons, 20 neutrons, 19 electrons

C 20 protons, 19 neutrons, 19 electrons

D 20 protons, 20 neutrons, 19 electrons

Your answer ☐ **[1]**

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

30

(i) Mendeleev did not predict the existence of argon, neon, krypton or xenon.

The electron arrangement of argon is 2,8,8.

What does this tell you about the reactivity of argon?

Explain your answer.

---

[2]

(ii) Neon is an element that has isotopes. Two of the isotopes are shown below.

$^{20}_{10}Ne$ $^{22}_{10}Ne$

Complete **Table 23.3** to show the number of protons, neutrons and electrons in each neon isotope.

	$^{20}_{10}Ne$	$^{22}_{10}Ne$
Proton		
Neutron		
Electron		

Table 23.3

[3]

31 Carbon-12 and carbon-14 are isotopes.

Which statement describes isotopes?

A Atoms with the same number of protons but a different number of electrons.
B Atoms with the same number of electrons but a different number of protons.
C Atoms with the same number of protons but a different number of neutrons.
D Atoms with the same number of neutrons but a different number of protons.

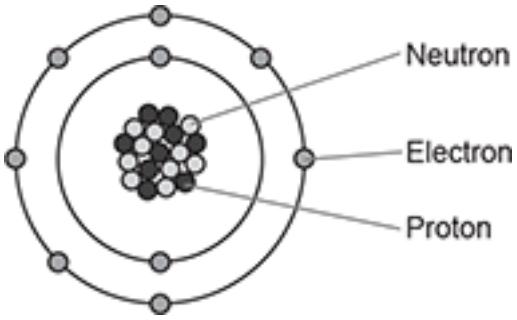
Your answer [ ] [1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

32 The diagram shows an atom of an element.



What is the name of the element?

A Boron
B Beryllium
C Fluorine
D Neon

Your answer [1]

33 The charge on an electron is -1.6×10^{-19} C.

What is the charge on a proton?

A -1.6×10^{19} C
B -1.6×10^{-19} C
C 1.6×10^{-19} C
D 1.6×10^{19} C

Your answer [1]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

(i) Mendeleev did not predict the existence of argon, neon, krypton or xenon.

The electron arrangement of argon is 2,8,8.

What does this tell you about the reactivity of argon?

Explain your answer.

---

[2]

(ii) Neon is an element that has isotopes. Two of the isotopes are shown below.

$^{20}_{10}Ne$ $^{22}_{10}Ne$

Complete **Table 17.3** to show the number of protons, neutrons and electrons in each neon isotope.

	$^{20}_{10}Ne$	$^{22}_{10}Ne$
Proton		
Neutron		
Electron		

Table 17.3

[3]

END OF QUESTION PAPER

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK