1. What is the approximate radius of an atom in metres?

A 300×10^{-1}
B 30×10^{-5}
C 3000×10^{-7}
D 3×10^{-13}

Your answer ☐

[1]

2. The mass number of an element is 23.

The atomic number of the same element is 11.

(i) How many protons and how many neutrons are there in an atom of this element?

Number of protons: _____

Number of neutrons: _____

[2]

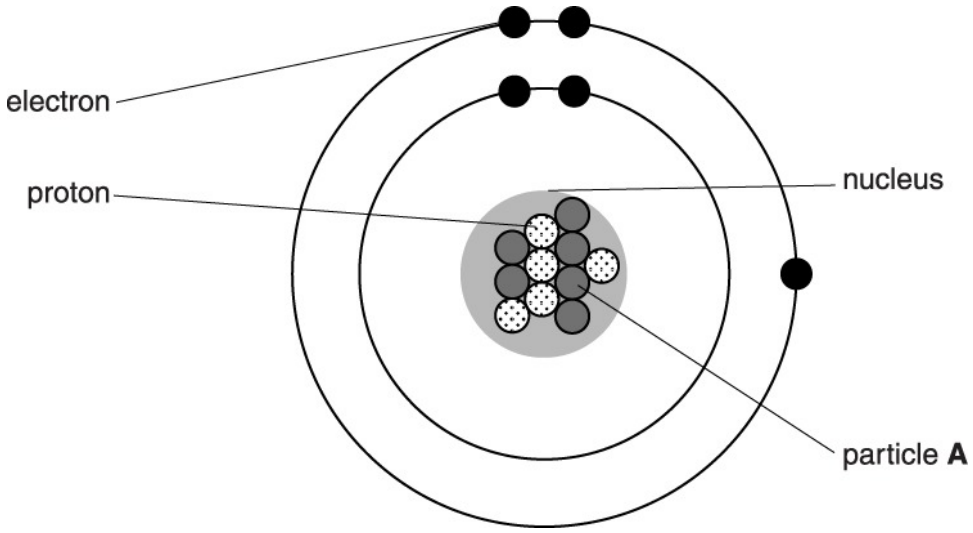
(ii) This element forms an **ion** with a charge of +1.

Work out the number of electrons in an **ion** of this element.

Number of electrons: _____

[1]

3. Look at the diagram of an atom of boron.



(i) What is the name of particle **A**?

---------- [1]

(ii) The relative electric charge of each electron is ?1.

What is the total relative electric charge of the **nucleus** of a boron atom?

---------- [1]

(iii) What is the electric charge of a boron atom?

Choose from

negative

neutral

positive

answer _____ [1]

4. A particle has the formula $^{55}_{26}Fe^{2+}$

Complete the following table about this particle.

Number of protons in particle	
Number of electrons in particle	
Number of neutrons in particle	

[3]

5. Many scientists have worked to discover the structure of the atom.

Dalton believed that elements were made of atoms.

He also believed that atoms could not be split.

J J Thomson did some experiments.

What did J J Thomson discover that showed that not all of Dalton's ideas were correct?

Choose from:

electron shells

electrons

nucleus

neutrons

protons

answer _____

_____ [1]

6. Many scientists have been involved in the development of the Periodic Table and the structure of the atom.

The early theories of atomic structure were replaced by newer ideas.

Explain why.

---

[1]

7. An atom of chlorine can be represented as

$$^{35}_{17}Cl$$

Different **isotopes** of chlorine exist.

Nick thinks the following are three isotopes of chlorine.

Only one is correct.

Which one?

$$^{35}_{16}Cl \qquad ^{37}_{17}Cl \qquad ^{37}_{18}Cl$$

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[1]

8. Look at the symbol for a particle.

$$^{32}_{16}S^{2-}$$

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

Explain your answer.

---

[3]

9. An atom has both an **atomic number** and a **mass number.**

What do these **two** terms mean?

---

[2]

10. Helen has bought a new bottle of perfume.

Helen's friends are able to smell her perfume because it is **volatile** (evaporates easily).

Explain, using ideas about particles, why Helen's perfume evaporates easily.

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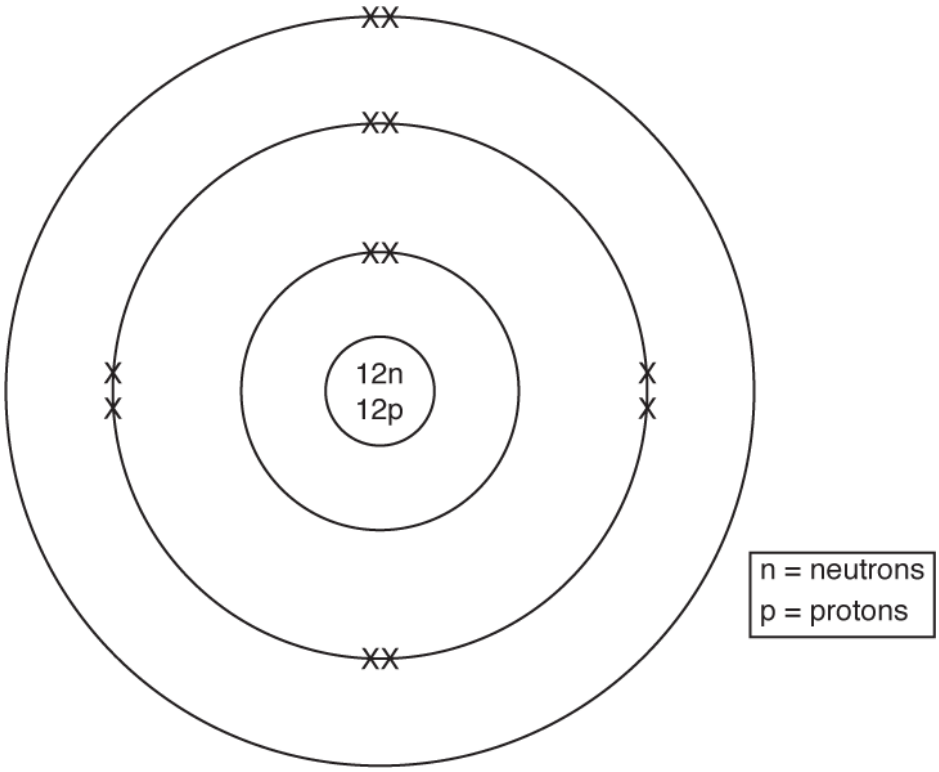
[2]

11. Look at the diagram of the structure of an atom of an element.



To which **group** of the Periodic Table does the element belong?

---

[1]

12. An element has a **relative atomic mass** of 19.0.

Find this element on the Periodic Table.

How many protons does this element contain?

A 9

B 10

C 19

D 28

Your answer [1]

13. Which statement is correct about a **chemical** change?

A A solid changes to a liquid.

B No new substances are formed.

C The change is irreversible.

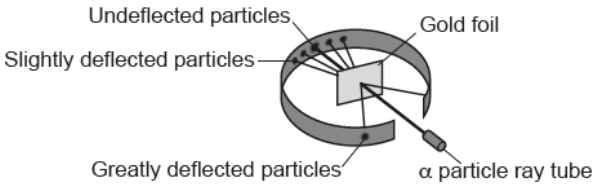
D The change is reversible.

Your answer [ ] [1]

14. The atomic model has changed over time.

J.J.Thomson suggested the 'plum pudding' model of atoms. Rutherford, working with Geiger and Marsden, tested J.J.Thomson's 'plum pudding' model.

Look at the diagram of the experiment they did.



What conclusions did Rutherford, Geiger and Marsden draw from the experiment?

Explain how their results supported their conclusions.

[4]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			C	1	
			Total	**1**	
2		i	Protons = 11 (1) Neutrons = 12 (1)	2	
		ii	10	1	**ECF** number of electrons/protons minus 1 (1)
			Total	**3**	
3		i	neutron (1)	1	**Examiner's Comments** Candidates were given a partially labelled diagram of a boron atom and asked to name one of the particles in the nucleus. The majority correctly identified it as a neutron, Examiners were lenient in the spellings accepted but newton and neuron were not accepted as they were incorrect words correctly spelt.
		ii	+5 (1)	1	**ignore** positive or + on its own **Examiner's Comments** Candidates were asked for the relative charge on a boron nucleus. This question proved extremely challenging for the majority of candidates and few correct answers of +5 were seen.
		iii	neutral (1)	1	**allow** correct answer indicated on list if answer line is blank **allow** 0 **Examiner's Comments** Candidates were asked for the charge on the boron atom being given three alternatives. The correct answer, neutral, was the least popular response.
			Total	**1**	
4			Number of protons in particle: **26** (1) Number of electrons in particle: **24** (1) Number of neutrons in particle: **29** (1)	3	**Examiner's Comments** This question produced a good spread of marks with no real discernable pattern.

Question			Answer/Indicative content	Marks	Guidance
			Total	3	
5			electrons (1)	1	**allow** correct answer ticked, circled or underlined in list if the answer line is blank or fully crossed out **not** electron shells Examiner's Comments Electron shells was by far the most common incorrect answer here.
			Total	1	
6			idea of more evidence / experiments showed that earlier theories were incorrect (1)	1	**allow** idea that more experiments have been carried out (1) **allow** better equipment or technology available (1) **allow** idea that more scientists looked at the evidence (1) Examiner's Comments Good responses described the idea that more experiments have been carried and/or more evidence is now available.
			Total	1	
7			$^{37}_{17}Cl$ (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank Examiner's Comments Both incorrect responses were seen more frequently than the correct isotope.
			Total	1	

Question			Answer/Indicative content	Marks	Guidance
8			contains 16 protons because this is the atomic / proton number (1) contains 16 neutrons as this is the difference between mass number and atomic number / number of protons (1) contains 18 electrons as two more than proton number (1)	3	**allow** clear indication on symbol that 16 is the number of protons / bottom number on the symbol is the number of protons **allow** 32 – 16 = 16 **allow** ECF eg if they give number of protons as 18, then allow 32 – 18 = 14 **allow** 16 + 2 = 18 if incorrect number of protons given, **allow** a mark for a clear explanation that it has 2 more electrons than the number of protons stated **allow** ECF **allow** 16 protons, 16 neutrons, 18 electrons for one mark if no other marks scored Examiner's Comments This question differentiated well with the most-able candidates being able to give reasoned explanations for their answers.
			Total	**3**	
9			atom number is the number of protons (in the atom) (1) mass number is the number of protons added to the number of neutrons (in the nucleus) / number of particles in a nucleus (1)	2	**ignore** reference to number of electrons **but** **not** idea of number of protons **and** electrons added together Examiner's Comments The meanings of atomic number and mass number were not well known by candidates. Mass number as 'the mass of the atom' was a frequent misconception and many candidates thought that atomic number is the number of protons and electrons added together.
			Total	**2**	

Question			Answer/Indicative content	Marks	Guidance
10			any two from there are weak attractions between particles (in perfume) or weak intermolecular forces (1) particles gain energy / particles with lots of energy escape (from the liquid) (1) forces or attractions between the particles (in the liquid) are overcome or weakened or broken (1)	2	**allow** molecules instead of particles **allow** bonds instead of forces, if clear the bonds are between particles **not** covalent bonds **allow** particles move faster (1) **ignore** particles gain heat **ignore** energy gets stronger **ignore** references to particles becoming more spread out or separated **ignore** references to diffusion Examiner's Comments Only the most able students could explain evaporation in terms of intermolecular forces, many simply described diffusion.
			Total	2	
11			2 (1)	1	**allow** II
			Total	1	
12			A ✓	1 (AO2.1)	ALLOW 9 Examiner's Comments Most candidates correctly selected A, but a few thought that the relative atomic mass indicated the number of protons so chose C.
			Total	1	
13			C ✓	1 (AO 1.1)	Examiner's Comments Candidates could generally recall this information with a large percentage identifying a chemical change as an irreversible reaction. Lower ability candidates tended to choose D as their incorrect response.
			Total	1	

Question			Answer/Indicative content	Marks	Guidance
14			**Any four from:** Idea that most particles went straight through without being deflected ✓ Most of the atom is empty space ✓ Idea that a few particles were (slightly) deflected ✓ The nucleus (deflected the alpha particles because it) is positive ✓ Idea that **very** few particles were (greatly) deflected back towards the source✓ Most of the mass is found in the small nucleus. ✓	4 (AO 4 ×1.2)	**ALLOW** 'some' as AW for 'few' in this marking point only <u>Examiner's Comments</u> The main ideas of the Rutherford et al experiment was that the unexpected movement of the alpha particles lead to a new suggested structure of the atom. Rutherford's conclusions were based on the movement of the alpha particles so it was expected that candidates would be able to link the movement of particles to new ideas about the atom. That was rarely seen. Instead, candidates repeated the information about deflection of particles without giving any further information. 'Most particles went straight through the gold foil showing the atom was mainly empty space' was the most common two marks credited. Candidates had to add the detail about the number of particles involved in each deflection (or not) as this was not given on the diagram. Candidates tended to use the word 'some' as a substitute for knowing the proportions of particles identified in each conclusion. This was allowed for the second idea of 'some' or 'few' alpha particles were slightly deflected due to the nucleus being positive. The last conclusion had to include the idea of 'very few' alpha particles were 'greatly' deflected as these alpha particles showed that most of the mass of the atom was found in a central nucleus. A good distribution of marks were seen for this question.

Question			Answer/Indicative content	Marks	Guidance
			Total	4	