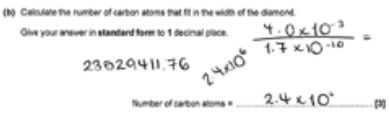
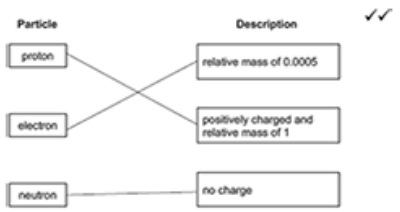
Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			**First check the answer on the answer line** **If answer = 2.4 × 10^7 award 3 marks** 4.0 x 10^{-3} ÷ 1.7 x 10^{-10} ✓ = 23529412 ✓ Standard form and 1 d.p.. = 2.4 x 10^7 ✓	3 (2 x AO 2.1) (1 x AO 1.1)	**ALLOW ECF** if standard form and decimal places are correct from incorrect calculation **Examiner's Comments** Candidates found this very challenging. Many reversed the division, multiplied the numbers or subtracted them. The most competent candidates gave the correct standard form and to one decimal place. Often the answer to the inverted division was given as 4.25 x 10^{-8}. Many candidates gave an answer with no working out shown, so error carried forward marks could not be given. Many omitted the question. Exemplar 6  (b) Calculate the number of carbon atoms that fit in the width of the diamond. Give your answer in **standard form** to 1 decimal place. $\frac{4.0\times10^{-3}}{1.7\times10^{-10}}$ = 23529411.76 2.4×10^{7} Number of carbon atoms = 2.4×10^{7} [3] The answer on the answer line is incorrect, while the number is to 1 decimal place the power of 10 is incorrect. If no working had been shown this response would have been given no marks. However, looking at the working, the division is correct and the answer to the division is also correct and so two marks are given.
			Total	**3**	
2		i	8 ✓	1 (AO 2.1)	**Examiner's Comments** Atomic structure was well known. A small number reversed the atomic number and mass number and gave

					the response 16. A very small number halved the atomic number and gave the response 4.
		ii	0 ✓	1 (AO 2.1)	**Examiner's Comments** Most candidates thought that one of the two numbers on the symbol referred to the number of neutrons, hence 1 was the most popular response. Some thought the atomic number referred to the number of neutrons and so 8 was also quite popular.
		iii	+1 / 1+ ✓	1 (AO 1.1)	**ALLOW** + **IGNORE** positive **Examiner's Comments** Almost all candidates appreciated that the proton is positively charged. However, many omitted to give the magnitude of the relative charge as 1.
			Total	**3**	
3			A ✓	1 (AO 1.1)	**Examiner's Comments** Some candidates recalled the work of Niels Bohr. C and D were popular responses.
			Total	**1**	
4			B ✓	1 (AO 2.1)	**Examiner's Comments** Some candidates used their knowledge of isotopes to choose from the species correctly. Many thought the number of neutrons or electrons needed to be equal, hence responses C and D were popular.
			Total	**1**	
5			A ✓	1 (AO 1.1)	**Examiner's Comments** Atomic structure was well known. Proton was a popular incorrect response.
			Total	**1**	

6	a		 ✓✓	2 (AO 2 x 1.1)	Any one correct = one mark All three correct = two marks
	b	i	(Isotope) 3 ✓	1 (AO 2.1)	
		ii	(Isotope) 1 ✓	1 (AO 2.1)	
		iii	8 ✓	1 (AO 2.1)	**Examiner's Comments** Higher scoring candidates used the atomic number to represent the number of electrons in the neutral atom. Use of the mass numbers 16 or 18 were also popular.
	c		**First check the answer on answer line** **If answer = 0.204 (%) award 2 marks** 99.759 + 0.037 OR 99.796 ✓ 100 – 99.796 = 0.204 ✓	2 (AO 2 x 2.1)	**Examiner's Comments** Many candidates calculated the percentage correctly. A significant number of candidates either found the difference between the two values given rather than adding them, or added the two values but did not take this sum from 100%. **Calculations** It is really important that candidates show their working out in calculations, otherwise it is impossible to award partial marks for responses where only one step is incorrect.
			Total	**7**	
7			**B**	1 (AO 1.1)	**Examiner's Comments** Higher attaining candidates remembered the work of Thompson; A and D were also popular responses.
			Total	**1**	
8			**C**	1 (AO 1.1)	**Examiner's Comments** Protons was a popular incorrect response.
			Total	**1**	

9			**B**	1 (AO 1.1)	
			Total	**1**	
10			C ✓	1(AO1.1)	**Examiner's Comments** More successful responses chose atoms and subatomic particles, response A was very popular and a smaller number chose response B.
			Total	**1**	
11	a		An atom has a nucleus with a **positive** ✓ charge. The nucleus is made up of **protons** ✓ and **neutrons**. ✓	3(3 × AO1.1)	**ALLOW** protons and neutrons in either order **Examiner's Comments** Atomic structure was generally well known. A significant number of candidates gave the nucleus a neutral charge containing protons and electrons.
	b	i	Boron has 11 protons. ☐ The atomic number of boron is 5. ☑ ✓ The electrons are heavier than the protons. ☐ The isotopes of boron have different numbers of neutrons. ☑ ✓ The isotopes of boron have different numbers of protons. ☐ The mass number of boron is the same for both isotopes. ☐	2(2 × AO2.1)	**Examiner's Comments** Many candidates confused atomic number and mass number and so ticked mass number the same for both isotopes and boron has 11 protons. A smaller number chose different numbers of protons.
		ii	(Boron) has three electrons in its outer shell ✓	1(AO2.1)	**Examiner's Comments** More successful responses interpreted the diagram to give three electrons on the outer shell. Common incorrect responses said that boron contained five electrons and has two shells.
			Total	**6**	
12			A ✓	1(AO1.1)	**Examiner's Comments** More successful candidates

					appreciated the role of Rutherford, D was the most popular incorrect response.
			Total	**1**	