IG.C2 Atomic Structure, Isotopes and Relative Atomic Mass

Total Marks

EDEXCEL 4CH1 · Calculator allowed · about 40 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State the charge of a proton, as used when describing atomic structure in chemistry.

(Total for Question 1 is 1 mark)

2 State the relative mass of a neutron compared with the mass of a proton, as taught in atomic structure.

(Total for Question 2 is 1 mark)

3 State the charge of an electron, as used in descriptions of atomic particles.

(Total for Question 3 is 1 mark)

4 A chemist writes the nuclide symbol 23 11 Na when discussing the element sodium in a sample. From this nuclide symbol, deduce the number of protons, neutrons and electrons in a neutral atom of this sodium isotope.

(Total for Question 4 is 3 marks)

5 A sample contains the radioactive nuclide carbon-14, written 14 6 C when describing its nucleus. Using this nuclide symbol, deduce the numbers of protons, neutrons and electrons in a neutral carbon-14 atom.

(Total for Question 5 is 3 marks)

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6 Complete the definition used in chemistry lesson notes: An isotope of an element is an atom that has the same number of protons but a different number of what? Provide the missing word.

(Total for Question 6 is 2 marks)

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7 Calculate the relative atomic mass (Ar) of chlorine in a sample where 75% of the atoms are chlorine-35 and 25% are chlorine-37, a question a teacher might set for practice with weighted means.

(Total for Question 7 is 3 marks)

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8 A chemistry worksheet gives copper isotopic abundances: copper-63 is 69.2% and copper-65 is 30.8%. Calculate the relative atomic mass (Ar) of copper from these abundances, showing the equation, substitution and final value.

(Total for Question 8 is 3 marks)

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9 Complete the electronic structure for chlorine, element number 17, as used when practising shell notation for the first 20 elements. Write the filled shells as numbers separated by commas.

(Total for Question 9 is 1 mark)

10 Complete the electronic configuration for calcium, element number 20, using shell notation 2,8,8 etc, as in classroom practice.

(Total for Question 10 is 1 mark)

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11 An exam-style question gives the electron configuration 2,8,1 for an element in the first 20. Deduce how many electron shells this atom has and how many electrons are in its outer shell.

(Total for Question 11 is 1 mark)

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12 The nuclide 27 13 Al is used in a lesson exercise. State the number of electrons in the outer shell of a neutral aluminium atom, and give its electronic configuration in shell notation.

(Total for Question 12 is 2 marks)

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13 A teacher writes the nuclide notation 56 26 Fe on the whiteboard. State the atomic number and the mass number for this iron nuclide, as a short notation exercise.

(Total for Question 13 is 2 marks)

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14 Calculate the number of neutrons in a neutral atom of lead-208, written 208 82 Pb, which students often need to find when practising nuclide arithmetic.

(Total for Question 14 is 2 marks)

15 A classroom question asks for the relative atomic mass of element X which has three isotopes: X-10 with 20% abundance, X-11 with 70% abundance and X-12 with 10% abundance. Calculate the Ar of X, showing the equation, substitution and final value.

(Total for Question 15 is 4 marks)

Mark scheme · IG.C2 Atomic Structure, Isotopes and Relative Atomic Mass

Question 1

- **B1** positive (+1) charge
- **Answer: +1 (positive)**

Question 2

- **B1** about 1 (same as a proton) or 1 relative mass unit
- **Answer: Approximately 1 (the neutron has about the same mass as a proton)**

Question 3

- **B1** negative (-1) charge
- **Answer: -1 (negative)**

Question 4

- **B1** protons = 11 (atomic number 11)
- **B1** neutrons = 23 - 11 = 12
- **B1** electrons = 11 (neutral atom has equal protons and electrons)
- **Answer: Protons 11; Neutrons 12; Electrons 11**

Question 5

- **B1** protons = 6
- **B1** neutrons = 14 - 6 = 8
- **B1** electrons = 6 (neutral atom)
- **Answer: Protons 6; Neutrons 8; Electrons 6**

Question 6

- **B1** neutrons
- **B1** accept 'neutron number' or 'number of neutrons'
- **Answer: neutrons**

Question 7

- **M1** writes Ar = (35 x 75/100) + (37 x 25/100) or equivalent weighted mean expression
- **M1** substitutes values and performs multiplication correctly: 35 x 0.75 = 26.25 and 37 x 0.25 = 9.25
- **A1** Ar = 35.5 cao
- **Answer: 35.5**

Question 8

- **M1** writes Ar = (63 x 0.692) + (65 x 0.308) or equivalent
- **M1** performs the multiplications correctly: 63 x 0.692 = 43.596 and 65 x 0.308 = 20.02 (allow awrt)
- **A1** Ar = 63.616 cao, accept 63.62 to 2 dp
- **Answer: 63.616 (awrt 63.62)**

Question 9

- **B1** 2,8,7
- **Answer: 2,8,7**

Question 10

- **B1** 2,8,8,2
- **Answer: 2,8,8,2**

Question 11

- **B1** 3 shells
- **Answer: Three shells; outer shell has 1 electron**

Question 12

- **B1** outer electrons = 3
- **B1** configuration = 2,8,3
- **Answer: Outer electrons 3; configuration 2,8,3**

Question 13

- **B1** atomic number = 26
- **B1** mass number = 56
- **Answer: Atomic number 26; Mass number 56**

Question 14

- **M1** uses neutrons = mass number - atomic number = 208 - 82
- **A1** neutrons = 126 cao
- **Answer: 126**

Question 15

- **M1** writes Ar = (10 x 0.20) + (11 x 0.70) + (12 x 0.10) or equivalent weighted mean
- **M1** performs the multiplications correctly: 10 x 0.20 = 2.0, 11 x 0.70 = 7.7, 12 x 0.10 = 1.2
- **M1** adds the contributions correctly: 2.0 + 7.7 + 1.2
- **A1** Ar = 10.9 cao
- **Answer: 10.9**