2.1 Atomic Structure and the Periodic Table: Test Pack

AQA 8462 · Calculator allowed · about 45 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 An atom is made from three main particles: protons, neutrons and electrons.

(a) Name the particle in an atom that has a positive charge. **(1)**

(Total for Question 1 is 1 mark)

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2 Sodium is in Group 1 of the periodic table. A sodium atom has 11 protons.

(a) State how many electrons a neutral sodium atom has. **(1)**

(b) Explain why sodium atoms tend to form ions with a charge of +1. **(2)**

(Total for Question 2 is 3 marks)

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3 Lithium and sodium are both in Group 1. A simple reaction is lithium + water -> lithium hydroxide + hydrogen.

(a) State which of lithium or sodium is more reactive with water and give one reason based on atomic structure. **(3)**

(Total for Question 3 is 3 marks)

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4 Define the term proton number (also called atomic number).

(Total for Question 4 is 1 mark)

5 The Group 1 elements are known as the alkali metals.

(a) State the trend in reactivity of the Group 1 metals going down the group. **(1)**

(b) Explain, in terms of electrons, why reactivity increases going down Group 1. **(3)**

(c) Write a word equation for the reaction of sodium with water. **(2)**

(Total for Question 5 is 6 marks)

6 An element X has only two isotopes, of mass number 63 and mass number 65. The relative atomic mass of element X is 63.5.

(a) Calculate the percentage abundance of each isotope of element X. **(3)**

(Total for Question 6 is 3 marks)

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7 The model of the atom has changed over time as new evidence was found.

(a) Before the electron was discovered, John Dalton described atoms in a particular way. Describe Dalton's model of the atom. **(1)**

(b) The discovery of one type of particle led to the 'plum pudding' model. Name this particle and name the scientist whose work led to the plum pudding model. **(2)**

(c) In the α particle scattering experiment, most α particles passed straight through the gold foil but a small number were deflected through large angles. Explain how these two observations led scientists to the nuclear model of the atom. **(3)**

(Total for Question 7 is 6 marks)

8 Explain why ionic compounds conduct electricity when molten but not when solid.

(Total for Question 8 is 3 marks)

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9 Write the full electron configuration (shell notation) for an ion of sulphur with a 2- charge, S^{2-}.

(a) Give the electron configuration in shell notation, e.g. 2,8,1 for sodium. Then give configuration for S^{2-}. **(3)**

(Total for Question 9 is 3 marks)

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10 A sample of an organic compound contains 52.2% carbon, 34.8% oxygen and 13.0% hydrogen by mass. Determine the empirical formula of the compound. (Ar: C = 12.0, H = 1.00, O = 16.0)

(Total for Question 10 is 4 marks)

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Mark scheme · 2.1 Atomic Structure and the Periodic Table: Test Pack

Question 1

(a) proton cao **B1**

(a) Answer: Proton

Question 2

(a) 11 electrons (equal to protons in a neutral atom) cao **B1**

(a) Answer: 11

(b) states that sodium loses one electron to achieve a full outer shell (octet) or to have a noble gas electron arrangement **M1**

(b) forms a positive ion with charge +1 (Na^+), cao **A1**

(b) Answer: Sodium loses one electron to get a full outer shell, forming Na^+

Question 3

(a) identifies sodium as more reactive than lithium (Group 1 reactivity increases down the group) **M1**

(a) because sodium atoms have more electron shells, so the outer electron is further from the nucleus, oe **A1**

(a) so the attraction between the nucleus and the outer electron is weaker and the electron is lost more easily, oe **A1**

(a) Answer: Sodium is more reactive because it has more electron shells so its outer electron is further from the nucleus and lost more easily

Question 4

the number of protons in the nucleus of an atom (cao) **B1**

Answer: The number of protons in the nucleus of an atom.

Question 5

(a) reactivity increases (going down the group) **B1**

(a) Answer: Reactivity increases down the group

(b) going down the group, the outer electron is in a shell further from the nucleus (more shells / more shielding) **B1**

(b) so the attraction between the nucleus and the outer electron is weaker **B1**

(b) so the outer electron is lost more easily, making the atom more reactive **B1**

(b) Answer: Outer electron further from nucleus and more shielded, so weaker attraction, so lost more easily

(c) correct reactants and products identified: sodium + water -> sodium hydroxide + hydrogen **B1**

(c) fully correct word equation (both products named correctly) **B1**

(c) Answer: sodium + water -> sodium hydroxide + hydrogen

Question 6

(a) sets up: (63x + 65(100 - x)) / 100 = 63.5, where x = % of mass-63 (oe) **M1**

(a) solves: -2x = -150 (oe correct rearrangement) **M1**

(a) 75% of mass-63 and 25% of mass-65 **A1**

(a) Answer: 75% mass-63, 25% mass-65

Question 7

(a) atoms are tiny solid spheres that cannot be divided (allow: each element is a different type of sphere) **B1**

(a) Answer: Atoms are tiny, solid spheres that cannot be divided

(b) particle = electron **B1**

(b) scientist = (J J) Thomson **B1**

(b) Answer: Electron; J J Thomson

(c) most passing straight through shows the atom is mostly empty space **B1**

(c) the few deflected/repelled show there is a small region of positive charge (the nucleus) **B1**

(c) which contains most of the mass; this replaced the plum pudding model with the nuclear model **B1**

(c) Answer: Mostly empty space (most pass through); a small, dense, positive nucleus (few deflected) holding most of the mass

Question 8

solid ionic lattice has ions in fixed positions so they cannot move **B1**

when molten the lattice breaks down and ions are free to move **M1**

free moving ions carry charge so molten ionic compound conducts electricity **A1**

Answer: In solid ionic compounds ions are fixed in a lattice and cannot move so they do not conduct. When molten the lattice breaks down so ions are free to move and these mobile ions carry charge, allowing conduction.

Question 9

(a) neutral S is 2,8,6 or equivalent **B1**

(a) adds two electrons to outer shell for S^{2-} (method) **M1**

(a) S^{2-} is 2,8,8 cao **A1**

(a) Answer: S neutral: 2,8,6. S^{2-}: 2,8,8

Question 10

convert percentages to moles: 52.2/12.0, 13.0/1.00, 34.8/16.0 **M1**

divide by smallest number to find simplest ratio **M1**

gives integer ratio C_2H_6O (cao) **A1**

shows working: moles C 4.35, H 13.0, O 2.175 => ratio 2:6:1, i.e. C_2H_6O **B1**

Answer: C_2H_6O

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