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SPECA

GCSE Combined Science (AQA Trilogy) · Physics

Atomic Structure (Physics) · Tiered Worksheet

Section A: Foundation

Atomic structure and the history of the atomic model

1) Describe the structure of an atom, including the charges and locations of protons, neutrons, and electrons, and state how the radius of the nucleus compares with the radius of the whole atom. **[4]**

2) An atom of an element has atomic number 11 and mass number 23. State the number of protons, neutrons, and electrons it contains. **[3]**

3) Define isotope. **[1]**

4) Explain how a sodium atom becomes a positive ion. **[2]**

5) Describe the plum pudding model of the atom, and explain how the results of the alpha particle scattering experiment led scientists to replace it with the nuclear model. **[4]**

6) Put these four developments in the correct chronological order: Bohr's model of electrons at fixed distances; the discovery of the proton; the discovery of the neutron; the nuclear model. **[2]**

Radioactive decay, half-life, contamination and irradiation

7) Define activity, including its unit, and define count-rate. **[3]**

8) State the composition of an alpha particle, and describe what happens to a neutron during beta decay. **[3]**

9) State which type of radiation (alpha, beta, or gamma) is the most ionising, and which travels the furthest through air. **[2]**

10) Complete the nuclear equation for the alpha decay of radium-226 (atomic number 88): state the mass number and atomic number of the nucleus produced. **[2]**

11) Complete the nuclear equation for the beta decay of carbon-14 (atomic number 6): state the mass number and atomic number of the nucleus produced. **[2]**

12) Use the following count-rate data to determine the half-life of the source: 0 minutes = 960 counts/min; 20 minutes = 480 counts/min; 40 minutes = 240 counts/min. **[2]**

13) Define radioactive contamination and irradiation, making clear the difference between them. **[3]**

14) A technician sterilises surgical equipment by exposing it to gamma radiation from a shielded source, using tongs to keep their distance. Explain why the equipment does not become radioactive as a result. **[2]**

15) Explain why it matters that scientific findings on the effects of radiation on human health are published and peer-reviewed. **[2]**

Section B: Higher (in addition to Section A)

Calculating decline after multiple half-lives

16) A radioactive isotope has a half-life of 4 hours. Calculate the fraction of the original nuclei remaining after 12 hours. **[2]**

17) A source has an initial activity of 800 Bq and a half-life of 2 days. Calculate its activity after 8 days. **[3]**

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18) A sample contains 1200 undecayed nuclei of an isotope with a half-life of 5 minutes. Calculate the number of undecayed nuclei remaining after 20 minutes. **[3]**

19) Express, as a ratio of remaining : original, the amount of a radioactive isotope left after 5 half-lives. **[2]**

20) A student calculates that after 3 half-lives, 150% of a sample must have decayed, by adding three lots of one-half together. Explain why this reasoning is incorrect, and state the fraction of the original sample that actually remains after 3 half-lives. **[2]**

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