AQA (GCSE Notes)

Chapter 4: Atomic Structure

Q1. What is the approximate radius of an atom in metres?

Q2. What particles make up the nucleus of an atom?

Q3. Where are electrons found in an atom?

Q4. What is the charge on a proton?

Q5. What is the charge on a neutron?

Q6. What is the charge on an electron?

Q7. Why does an atom have no overall electrical charge?

Q8. How does the mass of an atom compare to the mass of its nucleus?

Q9. How much smaller is the nucleus compared to the whole atom?

Q10. What happens to an electron when an atom absorbs electromagnetic radiation?

Q11. What happens to an electron when it emits electromagnetic radiation?

Q12. What is meant by energy levels in an atom?

Q13. What is the atomic number of an element?

Q14. What does the atomic number tell us about an atom?

Q15. What is the mass number of an atom?

Q16. What does the mass number represent?

Q17. How can you calculate the number of neutrons in an atom?

Q18. What are isotopes?

Q19. How do isotopes of the same element differ?

Q20. Why do isotopes have different mass numbers?

Q21. Do isotopes of the same element have the same number of protons?

Q22. Why do isotopes have different numbers of neutrons?

Q23. What happens to an atom when it loses an electron?

Q24. Why does losing electrons make an atom a positive ion?

Q25. How is an ion different from a neutral atom?

Q26. Can an atom become negatively charged? How?

Q27. What is the standard form of 0.0000000001?

Q28. Why is standard form used in atomic measurements?

Q29. Write the radius of an atom in standard form.

Q30. If the radius of an atom is 1×10^{-10} m, what would be the approximate radius of its nucleus?

Q31. What is the relative mass of a proton?

Q32. What is the relative mass of a neutron?

Q33. What is the relative mass of an electron?

Q34. How does the electron arrangement in atoms change with energy absorption?

Q35. Why do electrons move to lower energy levels?

Q36. How do you calculate the number of protons in an atom?

Q37. What is the symbol used to represent atomic number?

Q38. What is the symbol used to represent mass number?

Q39. How can the number of electrons in a neutral atom be found?

Q40. Why is the nucleus positively charged?

Q41. What keeps electrons attracted to the nucleus?

Q42. What happens if the number of protons and electrons in an atom are not equal?

Q43. What determines the chemical properties of an atom?

Q44. How can two atoms be of the same element but have different masses?

Q45. What is meant by the term 'neutral atom'?

Q46. Why are electrons said to have negligible mass?

Q47. What is meant by ‘standard form’ in scientific notation?

Q48. Why is most of an atom's mass concentrated in its nucleus?

Q49. How are atoms of different elements identified?

Q50. What does it mean when an atom is described using both mass number and atomic number?

Q51. What was the earliest model of the atom before electrons were discovered?

Q52. Why was the atom once thought to be an indivisible solid sphere?

Q53. What discovery led to the development of the plum pudding model?

Q54. Describe the main idea of the plum pudding model of the atom.

Q55. What role did the electron play in changing early atomic models?

Q56. How did the plum pudding model explain the structure of the atom?

Q57. What was the main conclusion from the alpha particle scattering experiment?

Q58. How did the alpha particle scattering experiment lead to the nuclear model?

Q59. What did most alpha particles do in Rutherford’s experiment?

Q60. What did it mean when some alpha particles were deflected at large angles?

Q61. What did the deflections of alpha particles suggest about the atom?

Q62. Why did the plum pudding model fail to explain the scattering results?

Q63. What is the main difference between the plum pudding model and the nuclear model?

Q64. Who proposed the nuclear model of the atom?

Q65. In the nuclear model, where is most of the mass of the atom found?

Q66. Why is the nucleus considered dense in the nuclear model?

Q67. How are electrons arranged in Bohr’s adaptation of the nuclear model?

Q68. Why did Bohr suggest that electrons orbit at fixed distances?

Q69. What evidence supported Bohr’s idea of fixed electron orbits?

Q70. How did Bohr's model differ from Rutherford's model?

Q71. What was the limitation of Rutherford's atomic model?

Q72. Why was Bohr's model considered an improvement over previous models?

Q73. How did new experiments lead to changes in atomic theory?

Q74. What is meant by the term 'scientific model'?

Q75. How can scientific models change over time?

Q76. Who discovered the proton?

Q77. What did scientists realise about positive charge in the nucleus?

Q78. What are protons and what charge do they carry?

Q79. Why was the discovery of the proton important in atomic structure?

Q80. How was the existence of neutrons discovered?

Q81. Who provided evidence for the existence of neutrons?

Q82. Why was the discovery of the neutron significant?

Q83. Why did it take so long to discover the neutron?

Q84. How did the discovery of the neutron change the nuclear model?

Q85. Why is it important that scientific theories are tested by experiments?

Q86. What does the development of the atomic model tell us about scientific progress?

Q87. How does the nuclear model explain atomic mass better than previous models?

Q88. What charge does the nucleus of an atom carry according to the nuclear model?

Q89. Why were electrons not found inside the nucleus in Bohr's model?

Q90. How do fixed electron orbits prevent electrons from spiralling into the nucleus?

Q91. What is one reason models are replaced in science?

Q92. How did experimental results challenge the plum pudding model?

Q93. What does the atomic model tell us about the internal structure of matter?

Q94. Why was it important to test the structure of atoms using scattering experiments?

Q95. What did the scattering experiment show about empty space in atoms?

Q96. What was one unexpected result from the alpha scattering experiment?

Q97. How did Rutherford interpret the deflection of a few alpha particles?

Q98. What does the term 'nuclear' refer to in the nuclear model?

Q99. Why do we need models to describe atoms?

Q100. How do atomic models help scientists understand chemical behaviour?

Q101. What is meant by the term radioactive decay?

Q102. Why is radioactive decay described as a random process?

Q103. What happens to the nucleus during radioactive decay?

Q104. What is the unit used to measure the activity of a radioactive source?

Q105. Define the term ‘activity’ in relation to a radioactive source.

Q106. What does count-rate measure in a radioactive experiment?

Q107. Name one device that can be used to detect nuclear radiation.

Q108. What is an alpha particle made of?

Q109. How many protons are in an alpha particle?

Q110. How many neutrons are in an alpha particle?

Q111. What is a beta particle?

Q112. What happens in the nucleus during beta decay?

Q113. What is a gamma ray?

Q114. Which type of nuclear radiation is electromagnetic?

Q115. Which type of nuclear radiation has the greatest ionising power?

Q116. Which nuclear radiation can be stopped by paper?

Q117. Which nuclear radiation can travel furthest in air?

Q118. Which type of nuclear radiation has the least ionising power?

Q119. What happens to the mass and charge of a nucleus after alpha decay?

Q120. What happens to the charge of the nucleus during beta decay?

Q121. Why does the mass of the nucleus stay the same during beta decay?

Q122. What is the effect of gamma emission on the nucleus?

Q123. Why is gamma radiation used in medical treatments?

Q124. Why are alpha emitters not suitable for internal medical use?

Q125. Why are beta sources often used in thickness monitoring?

Q126. What kind of material can stop beta particles?

Q127. What kind of material is needed to stop gamma rays?

Q128. Why is lead used to shield against gamma radiation?

Q129. How can the activity of a radioactive source be measured?

Q130. What does it mean if a source has an activity of 500 Bq?

Q131. What is the difference between activity and count-rate?

Q132. What symbol is used to represent an alpha particle in nuclear equations?

Q133. What symbol is used to represent a beta particle in nuclear equations?

Q134. What must be balanced in a nuclear equation?

Q135. In alpha decay, what happens to the atomic number of the nucleus?

Q136. In alpha decay, what happens to the mass number of the nucleus?

Q137. In beta decay, what happens to the atomic number?

Q138. In beta decay, why does the proton number increase?

Q139. How does the emission of a neutron affect the mass number?

Q140. How does a nuclear equation show the conservation of mass and charge?

Q141. What type of nuclear radiation changes both mass and charge of the nucleus?

Q142. Which nuclear radiation leaves the mass and charge of the nucleus unchanged?

Q143. Write the nuclear equation for the alpha decay of uranium-238.

Q144. Write the nuclear equation for the beta decay of carbon-14.

Q145. How do you identify the new atomic number after a beta decay?

Q146. What happens to the neutron during beta decay?

Q147. What is the role of radiation in smoke detectors?

Q148. Why are radioactive sources with short half-lives sometimes used?

Q149. How does the range in air differ for alpha, beta, and gamma radiation?

Q150. What safety precautions are important when working with radioactive materials?

Q151. What does it mean when we say that radioactive decay is a random process?

Q152. How does the random nature of radioactive decay relate to the concept of half-life?

Q153. What is meant by the term half-life of a radioactive isotope?

Q154. How is the count rate from a radioactive source expected to change over time?

Q155. What happens to the number of undecayed nuclei in a sample after one half-life?

Q156. Why does the rate of decay decrease over time in a radioactive material?

Q157. How can a graph of count rate versus time be used to estimate half-life?

Q158. Why can we not predict when an individual radioactive nucleus will decay?

Q159. Describe a method to determine the half-life of a radioactive isotope using experimental data.

Q160. What is the significance of measuring the activity of a radioactive source at regular time intervals?

Q161. Why do two samples of the same isotope with different masses have the same half-life?

Q162. How does knowing the half-life of a radioactive isotope help in its safe use?

Q163. What is meant by net decline in radioactive emissions?

Q164. How do you calculate the net decline after two half-lives?

Q165. A radioactive source has an initial count rate of 800 Bq. What will the count rate be after three half-lives?

Q166. How can the net decline in activity be expressed as a ratio?

Q167. Why is it helpful to express the decline in activity as a ratio rather than an absolute value?

Q168. How many half-lives must pass for a sample's activity to fall to one eighth of its original value?

Q169. Explain the relationship between the number of half-lives and the remaining proportion of undecayed nuclei.

Q170. What is radioactive contamination?

Q171. What makes radioactive contamination hazardous?

Q172. How is the type of radiation emitted important when considering contamination?

Q173. Why does contamination continue to be dangerous even after the source is removed?

Q174. What is the difference between irradiation and contamination?

Q175. Why does an object exposed to radiation not become radioactive?

Q176. In what ways can radioactive contamination be spread?

Q177. Why is internal contamination usually more dangerous than external irradiation?

Q178. What kind of precautions can be taken to avoid radioactive contamination?

Q179. How can radioactive contamination be detected?

Q180. Why is it important to handle radioactive materials with tongs or robotic arms?

Q181. Why should people working with radioactive materials wear protective clothing?

Q182. What is the purpose of using lead shielding during irradiation procedures?

Q183. How is radioactive waste handled to minimise contamination risks?

Q184. In medical applications, how is radiation used in a way that avoids contamination?

Q185. How can the effects of radiation exposure be minimised during medical imaging?

Q186. Why is it important to store radioactive materials in sealed containers?

Q187. Why is it important to distinguish between contamination and irradiation in safety procedures?

Q188. Why must studies on the effects of radiation be published and peer-reviewed?

Q189. How does peer review help improve the reliability of scientific findings?

Q190. Why must the results of radiation studies be shared with scientists around the world?

Q191. How does peer review prevent the spread of false information in science?

Q192. What kind of organisations might be involved in reviewing radiation safety studies?

Q193. How can peer-reviewed studies influence safety regulations for radiation use?

Q194. Why is public confidence increased when research is peer-reviewed?

Q195. How can peer review affect government policy on radioactive waste disposal?

Q196. What is the benefit of international collaboration in radiation research?

Q197. Why might long-term studies be important in understanding radiation's effects?

Q198. How can the public be educated about the risks of radiation through published studies?

Q199. What role do scientific journals play in ensuring radiation studies are reliable?

Q200. How can misinformation about radiation be prevented through peer review and open access research?

Q201. What is meant by background radiation?

Q202. Name two natural sources of background radiation.

Q203. Name two man-made sources of background radiation.

Q204. How can cosmic rays contribute to background radiation levels?

Q205. Why does the amount of background radiation vary by location?

Q206. How can living near granite rocks affect your exposure to background radiation?

Q207. How does working in the nuclear industry affect radiation dose?

Q208. What is the link between occupation and increased radiation exposure?

Q209. What units are used to measure radiation dose?

Q210. How many millisieverts are in one sievert?

Q211. Why is background radiation always present?

Q212. How can flying at high altitudes increase your radiation exposure?

Q213. How can medical procedures contribute to a person's radiation dose?

Q214. Why is it important to monitor radiation dose in medical imaging?

Q215. Why might people who work in hospitals be exposed to higher radiation levels?

Q216. How can nuclear accidents increase background radiation levels in the environment?

Q217. What is meant by the half-life of a radioactive isotope?

Q218. Why is half-life an important factor in assessing the danger of a radioactive substance?

Q219. How does a short half-life affect the risk from radioactive material?

Q220. Why might a substance with a long half-life be dangerous for many years?

Q221. What happens to the radiation level of a substance as time passes?

Q222. Why might a radioactive isotope with a short half-life be preferred for medical diagnosis?

Q223. Why is a long half-life useful in some industrial applications?

Q224. How can the half-life of a substance affect how it is stored or disposed of?

Q225. What kind of radioactive source would be most suitable for exploring internal organs?

Q226. How is nuclear radiation used to explore internal organs?

Q227. What is a radioactive tracer and how is it used?

Q228. Why must tracers used in the body have a short half-life?

Q229. How are radioactive tracers introduced into the body?

Q230. Why must the radiation emitted by a tracer be easily detectable outside the body?

Q231. What type of radiation is most suitable for medical tracers and why?

Q232. Why are alpha emitters not used as medical tracers?

Q233. How is gamma radiation used to detect problems in organs?

Q234. What is meant by using radiation to control or destroy unwanted tissue?

Q235. How is radiation used in the treatment of cancer?

Q236. What is external beam radiotherapy?

Q237. How is internal radiotherapy used to treat cancer?

Q238. Why must the dose of radiation be carefully controlled during cancer treatment?

Q239. How do doctors balance the risks and benefits of radiation in treatment?

Q240. What are the side effects of using radiation to treat cancer?

Q241. How can radioactive implants be used in cancer treatment?

Q242. How do doctors ensure that healthy tissues are protected during radiotherapy?

Q243. How does the use of radiation in medicine demonstrate the principle of risk versus benefit?

Q244. Why might some patients be hesitant to undergo treatment involving radiation?

Q245. What factors influence the perceived risk of using radiation in medical procedures?

Q246. How can data be used to evaluate the safety of radiation treatments?

Q247. Why is it important to inform patients about the risks of radiation in medical use?

Q248. How does using standard form help when dealing with radiation data?

Q249. How can you express a radiation dose of 0.002 Sv in standard form?

Q250. Why is standard form useful when comparing different levels of radiation dose?

Q251. What happens to a large, unstable nucleus during nuclear fission?

Q252. Why is it necessary for an unstable nucleus to absorb a neutron before fission occurs?

Q253. What particles are released when a nucleus undergoes fission?

Q254. Why is energy released during a nuclear fission reaction?

Q255. What is meant by a chain reaction in nuclear fission?

Q256. Why is spontaneous fission considered a rare event?

Q257. How is a fission chain reaction controlled inside a nuclear reactor?

Q258. What causes the explosion in a nuclear weapon?

Q259. Why do fission products have high kinetic energy?

Q260. How can fission reactions lead to a self-sustaining chain reaction?

Q261. Why are only certain isotopes like uranium-235 used in nuclear fission?

Q262. What is the role of control rods in a nuclear reactor?

Q263. What is the purpose of a moderator in a nuclear reactor?

Q264. Why are gamma rays emitted during nuclear fission?

Q265. What are the typical characteristics of the two nuclei produced during fission?

Q266. How does the emission of neutrons help to continue a fission chain reaction?

Q267. What happens if a fission chain reaction is not controlled?

Q268. What are the dangers of an uncontrolled fission chain reaction?

Q269. Why must the fuel in a nuclear reactor be enriched?

Q270. What is the difference between nuclear fission and radioactive decay?

Q271. Why is shielding necessary in a nuclear reactor?

Q272. What happens to the neutrons released in a fission reaction?

Q273. How does a chain reaction differ in a nuclear reactor compared to a nuclear bomb?

Q274. What is meant by critical mass in the context of nuclear fission?

Q275. What properties make uranium-235 suitable for nuclear fission?

Q276. What is the source of energy in a nuclear fission reaction?

Q277. How can diagrams help explain the process of nuclear fission?

Q278. Why is nuclear fission considered a non-renewable energy source?

Q279. What does it mean when a nucleus is described as unstable?

Q280. How is the energy from fission reactions converted into electricity?

Q281. What is meant by induced fission?

Q282. Why do power stations use chain reactions for energy generation?

Q283. How do control rods prevent a nuclear reactor from overheating?

Q284. What would happen if the control rods were removed from a working reactor?

Q285. What role does the coolant play in a nuclear reactor?

Q286. How is the heat produced by nuclear fission used to drive turbines?

Q287. What safety measures are built into nuclear reactors to manage fission?

Q288. What are the long-term risks of using nuclear fission for energy?

Q289. How does a nuclear fission reactor differ from a fusion reactor?

Q290. What is nuclear fusion?

Q291. What particles are involved in a typical nuclear fusion reaction?

Q292. What condition is necessary for nuclear fusion to occur?

Q293. Why is it difficult to achieve nuclear fusion on Earth?

Q294. What is released during a nuclear fusion reaction?

Q295. How does the mass change during a fusion reaction?

Q296. Why does nuclear fusion release energy?

Q297. What makes fusion reactions safer than fission reactions?

Q298. What happens to the nuclei during a fusion process?

Q299. How is the energy from fusion reactions related to mass?

Q300. What temperature is required for fusion to take place?