Nuclear Physics

Physics

Nudger

www.FairlightTuition.org

Tutorials

www.youtube.com/FairlightTuition

Nuclear Structure

1. What was the 'plum pudding' (or 'Thompson') model of matter? [157]

2. What must you be very careful to do when drawing alpha-particle paths for Rutherford Scattering?

3. How can you use energy considerations to calculate the distance of closest approach for Rutherford Scattering? [160]

4. What effects have been accounted for in the de Broglie equation for electron diffraction? [161]

5. What is the first minimum equation for electron diffraction? [161]

6. Why is the equation for the first minimum, rather than maximum? [161]

7. Draw the intensity-angle pattern for electron diffraction. [162]

8. What is the nuclear radius equation? [165]

Nuclear Radiation

9. Draw the graph of nuclear radius (R) against nucleon number (A) [164]

10. Draw the graph of nuclear radius (R) against the cube-root of nucleon number ($A^{⅓}$) [164]

11. How does the nuclear radius equation lead ultimately to the conclusion that nuclear density is constant for all nuclei, regardless of nucleon number (and what is the physical explanation for this phenomenon)? [165-166]

12. Why do beta+ particles have negligible penetration range? [169]

13. How do radioactive (rather than thermoptic) smoke alarms work? [168]

14. What is PET scanning? [169]

15. What are CAT (CT) and MRi scanning?

16. Why are gamma rays well suited to medical applications? [169 + 182]

17. How does radiotherapy work? [169]

18. What would be the approximate range of alpha particles in a vacuum (and why)?

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

20. What additional equipment do you need to measure count-rate, rather than count?

21. How do you measure the background nuclear radiation count-rate? [171]

22. Why do gamma rays obey an inverse-square law for intensity variation? [171-172]

23. What is the intensity equation for gamma rays? [172]

24. Describe and experiment to investigate how the intensity of gamma rays varies with distance from source. [172-173]

25. Draw the graph of intensity against distance from source for gamma rays. [172-173]

Nuclear Decay

26. How could you use dice to simulate radiactive decay? [177]

27. Derive the half-life equation for both A and N equations. [180-181]

28. Derive the 1/eth-life equation for both A and N equations.

29. How does radioactive dating work? [181-182]

30. What are the approximate maximum values for N and Z for the nuclear stability curve? [184]

31. How do energy level diagrams for nuclear reactions work (and what must you not confuse them with)? [187]

Nuclear Energy

32. What is the definition of u (the atomic mass unit)?

33. What is the energy, in MeV, of 1 u? [188]

34. Calculate the total binding energy for a helium nuclear using both u and $E = mc^2$

35. Why is the binding energy per nucleon curve only an average? [189]

36. What are the approximate end values for BEPN and A for the BEPN curve (and what are values at the peak)? [189]

37. Give one example of a fission process. [190]

38. Give one example of a fusion process. [190]

39. What is a plasma?

40. Why does a plasma have to be at a very high temperature for fusion to occur? [191]

41. Why don't you have to include neutrons in binding energy calculations? [191]

42. How are fast moving neutrons slowed initially in a nuclear reactor? [194]

43. What is a common confusion regarding the numerous elastic collisions between the moderator and the (thermalising) neutrons?

44. Derive (in the way shown) the equation showing that moderators become more efficient the closer the mass of the moderator atoms are to the mass of the (thermalising) neutrons. [194]

45. What are critical and supercritical masses? [194]

46. What is reactor shielding? [195]

47. How does an emergency reactor shutdown work? [125]

48. How are low, medium and high grade waste (a) produced and (b) disposed of?

49. What are some of the benefits and costs of using nuclear power to generate electricity? [195]