AP Physics Study Guide
Modern Physics

I. Atomic Physics and Quantum Effects

1. Who is generally credited with the discovery of the electron?

2. What was it that J. J. Thomson actually measured?

3. Regarding the cathode ray, which plate emits the electrons: cathode or anode?

4. Describe J. J. Thomson's model of the atom [do not just give me a name but a description].

5. What exactly did Robert A. Millikan discover and why was it important?

6. Describe Rutherford's contributions to the atomic theory.

7. Describe the Geiger-Marsden Experiment.

8. What is a blackbody?

9. If energy is radiated by all objects, why can we not see them in the dark?

10. All objects emit radiation whose total intensity is proportional to… (finish this).

11. What is blackbody radiation?

12. What was Planck's Quantum Hypothesis?

13. What is the difference between a continuous quantity and a quantized quantity?

14. What are some quantities that are quantized?

15. What is the smallest quantum of charge?

16. What is the smallest quantum of energy?

17. What is a photon? [Describe its mass, its speed and its energy]

18. Explain what "E = hf" means.
19. List the following quantities: (you will refer to them often, so here is a quick reference for you)
    a. Speed of light (c) = _____
    b. Fundamental unit of charge (e) = _____
    c. Planck's constant (h) = _____
    d. Planck's constant x speed of light (hc) = _____
    e. Mass of an electron = _____

20. What did Albert Einstein postulate with regards to light and energy?

21. What is the photoelectric effect?

22. Describe the how the photoelectric effect works.

23. How is the frequency and wavelength related if the speed of a wave is constant?

24. Starting with the lowest frequency of electromagnetic radiation name 7 recognized regions of the electromagnetic spectrum.

25. What are the basic recognized colors of light? (7 of them)

26. Since photons are massless, how can we say they have momentum?

27. What is stopping potential or stopping voltage?

28. Which color of light has the lowest energy photons? Red, yellow, blue or green

29. The energy of a photon depends on… (finish the sentence).

30. According to the wave theory of light, if the light intensity is increased, what happens to the number of electrons ejected and the KE from a metal?

31. Answer the above question but use the photon theory.

32. According to wave theory, does frequency affect the KE?

33. Answer the above question using photoelectric theory.

34. Calculate the energy of a photon of blue light $\lambda = 450$ nm. [4.4×10^{-19} J]

35. Convert your answer to 34 into electron volts.

36. What is the kinetic energy and the speed of en electron ejected from a sodium surface whose work function is $W_o = 2.28$ eV when illuminated by light of wavelength (a) 410 nm (KE = 3.03 eV, v = 5.1×10^5 m/s) (b) 550 nm (KE = 2.26 eV, 0 m/s)

37. How much energy in joules, is carried by a photon with a frequency of 150 GHz (that is gigahertz). [9.9×10^{-23} J]

38. How much energy, in joules is carried by a photon of wavelength 660 nm? [3.01×10^{-19} J]

39. The ratio of energy to frequency for a given photon gives _____.

40. What is the charge on a photon?

41. If the wavelength of a photon is halved, by what factor does its energy change?

42. What is the photon energy of red light having a wavelength of 640 nm? [3.1×10^{-19} J]

43. A metal has a work function of 4.5 eV. Find the maximum KE of the photoelectrons if the wavelength of light is 250 nm. [0.46 eV]

44. The KE of the photoelectron depends on which of the following:
    a. Intensity of light
    b. Duration of illumination
    c. Wavelength of light
    d. Angle of illumination
45. Which of the following would tend to have the smallest wavelength if they are moving with the same speed? An electron or a bowling ball.

46. As a particle travels faster, what happens to its de Broglie wavelength?

47. Use the power point presentation on the website and describe an experiment that illustrates the wave properties of electrons.

48. A person of mass 50 kg has a wavelength of 4.4×10^{-36} m when running. How fast is she running? [3.0 m/s]

49. An electron has a wavelength of 0.123 nm. What is its energy in eV? [100 eV]

50. Describe Compton's experiment and state what results were observed.

51. Explain Compton scattering.

52. What is meant by the ground state of an electron?

53. What is meant by the excited state?

54. What is binding energy or ionization energy?

55. What is total binding energy?

56. How do you calculate the average binding energy per nucleon?

57. Describe Alpha decay and write the general equation.

58. Describe Beta Decay and write the general equation.

59. What is the law of conservation of Nucleons?

60. What is the strong nuclear force?

61. What is meant by a stable nucleus? Unstable nucleus?
62. What is meant by half-life?