Fields

Physics

Nudger

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Gravitational Fields

1. What is a force field?

2. What is a gravitational field? [72]

3. How is gravitational field strength represented graphically? [72]

4. Draw the radial field around the Earth. [72]

5. Under what circumstances does a gravitational field become approximately uniform? [72]

6. Draw the uniform field near the surface of the Earth. [72]

7. What is a point mass? [73]

8. What is the NIII reciprocal force with your weight (and why)? [73]

9. The gravitational force between two touching bodies is F. What will be the effect on this force (in terms of F) of trebling the diameter of each body?

10. Treating the Earth as a perfect sphere (of uniform density), where will you feel heaviest (and why): at the North Pole or at the Equator?

11. Treating the Earth as an oblate spheroid (of uniform density), where will you feel heaviest (and why): at the North Pole or at the Equator?

12. From the centre of the Earth, sketch graphs for: F-d, g-d, V-d and E_{GP}-d. [76-78]

13. Which requires more energy: getting to the Moon or returning?

14. What is the difference between gravitational potential and gravitational potential energy?

15. Why is gravitational potential energy always negative? [78]

16. Why have you not always written this previously (at GCSE, for example)? [78]

17. When would a change in gravitational potential energy be positive? [78]

18. What is the difference between change in gravitational potential and gravitational potential difference? [80]

19. What is an equipotential? [81]

20. Draw three equipotentials around the Earth. [81]

21. Derive Kepler's Third Law from first principles. [82}

22. How do kinetic energy and gravitational potential energy change in a satellite describing an elliptical orbit? [84]

23. What is escape velocity and how is it calculated? [84]

24. What is the difference between a geostationary and a geosynchronous satellite? [85]

25. What is a low polar orbit satellite? [85]

26. How do these differences in satellite orbits suit their functions? [85]

Electric Fields

27. What is an electric field? [87]

28. How is electric field strength represented graphically? [88]

29. What E equation do you use for a radial field? [89]

30. What E equation do you use for a uniform field? [90]

31. Draw an E-d graph for the region around a positive/negative charge. [90]

32. Draw the path of a moving charge through a uniform electric field. [91]

33. Draw a V-d graph for the region around a positive/negative charge. [92]

34. Draw the field lines and equipotentials in the region around a negative point charge. [94]

35. Draw the field lines and equipotentials in the region between two oppositely charged parallel plates (such as in a capacitor). [94]

36. Why is gravity usually neglected when discussing the interaction of charged masses at an atomic level? [97]

37. How does electrostatic repulsion contribute to support forces (and what is electron degeneracy pressure [EDP]?

38. What is Milikan's Experiment?

39. What is a capacitor? [102]

40. Describe an experiment to investigate the V-Q characteristic of a capacitor. [103-104]

41. What is the gradient of a V-Q graph? [≈104]

42. Describe three uses of capacitors. [104]

43. Derive the equation for the energy stored on a capacitor both graphically and algebraically. [≈ 105]

44. Derive the other two energy stored equations from the first. [106]

45. What is a dielectric? [107]

46. What is the dielectric equation? [107]

47. What is relative permittivity also sometimes known as? [107]

48. What are polar molecules? [107-108]

49. What does ‘anti-parallel’ mean in terms of dielectrics? [107]

50. What is the physical capacitance equation? [108]

51. Describe an experiment to investigate the effects of a dielectric on capacitance. [108]

52. Draw I-t, V-t and Q-t graphs for both charging and discharging a capacitor (and what is often wrong with the I-t graph for discharging?). [110-111]

53. Describe experiments to investigate the charging and discharging curves for capacitors. [109-112]

54. Derive the ln (natural log) equation for discharging a capacitor. [112-113]

55. What is the time constant? [114]

56. Derive the 1/eth-life equation for discharging a capacitor. [115-116]

57. Derive the half-life equation for discharging a capacitor. [115-116]

58. Which system of two identical capacitors would store more energy: series or parallel?

59. For two different capacitors (one high capacitance, one low), which stores the most energy when they are in series?

60. For two different capacitors (one high capacitance, one low), which stores the most energy when they are in parallel?

61. What is a linac and how does it work?

Magnetic Fields

62. What is a magnetic field? [122]

63. Draw the magnetic field lines around a wire. [122]

64. Draw the magnetic field lines around (and within) a solenoid. [122-123]

65. Draw the field lines for the ‘catapult effect’. [123]

66. Which field is associated with the First finger in Fleming's Left Hand Rule; the field through with the charge [current] is moving or the field generated by the charge [current]?

67. Under what circumstances are Fleming's Rules valid?

68. What mistake do many people make regarding their index finger when using Fleming's Rules?

69. What mistake do many people make regarding the (moving) charge direction when using Fleming's Rules?

70. What is magnetic flux density? [124]

71. Under what circumstances does F = BIL? [124-125 + 135]

72. Describe an experiment to investigate F = BIL. [126-127]

73. Under what circumstances does F = Bqv? [129]

74. Derive F = Bqv from F = BIL. [129]

75. Under what circumstances will a charge in a magnetic field describe a circle? [129-130]

76. Describe, in detail, the operation of: mass spectrometers; cyclotrons; synchrotrons. [≈ 131-132]

77. What is electromagnetic induction? [133-134]

78. What is flux linkage? [134-136]

79. Describe an experiment to investigate flux linkage. [137-138]

80. What is Faraday's Law? [139]

81. Plot NΦ-t and ∊-t graphs for a conductor moving with a constant velocity through a uniform magnetic field. [139]

82. What is Lenz's Law? [140]

83. Use the example of a wire moving through a uniform magnetic field to demonstrate why Lenz's Law is a consequence of the Law of Conservation of Energy.

84. Use the example of a (initially stationary) current-carrying wire in a uniform magnetic field to demonstrate why Lenz's Law is a consequence of the Law of Conservation of Energy.

85. Describe all four methods for deciding current direction when a magnet is moved towards a solenoid.

86. Describe and explain the comparative results of dropping a magnet through a plastic tube, a copper tube and a laminated copper tube.

87. Describe the structure and operation of a single rotor DC electric motor. [140-141]

88. Describe the structure and operation of a single rotor dynamo. [142]

89. Why can an electric motor not be 100% efficient?

90. Why can a dynamo not be 100% efficient?

91. What are the rotating coil equations? [141]

92. If a NΦ-t and graph is a sine wave, what would the ∈-t graph look like? [≈ 141]

93. If an ∈-t and graph is a sine wave, what would the NΦ-t graph look like? [≈ 141]

94. What is a back emf?

95. What is alternative current? [143]

96. How does AC differ from DC?

97. What are the Y-gain and timebase on an oscilloscope? [143-144]

98. What would a DC trace on an oscilloscope look like with: the timebase turned off; the Y-gain turned off.

99. What would an AC trace on an oscilloscope look like with: the timebase turned off; the Y-gain turned off.

100. What is the frequency and voltage of mains AC in the UK? [145]

101. How does electromagnetic braking work?

102. How do KERS (Kinetic Energy Recovery Systems) work in Formula One?

103. What is a transformer? [147]

104. Why must a transformer's primary and secondary coils be electrically insulated from each other?

105. Draw and eddy current.

106. What is magnetic hysteresis?

107. Why can a transformer not be 100% efficient? [148-149]

108. Why does the national grid need to run on AC? [149-150]

109. Describe an experiment to investigate the relationship between current and voltage in a transformer. [150-151]

110. Much train-crashisms when trying to <u>explain</u> why the emf for a dynamo rotor is at a maximum when the <u>plane of the rotor</u> is parallel to the field, and hence flux linkage is

at a minimum (zero, in fact). Many take the 'flux cutting' route, which is okay, but a better answer would perhaps be: "The induced emf is at a maximum when the plane of the rotor is parallel to the magnetic field because the rate at which flux linkage through the rotor is changing is at a maximum, and emf is directly proportional to the rate of change of flux linkage (Faraday's Law).