Mechanics

1. Average velocity is the total distance traveled per unit time. Average speed is not the magnitude of the average velocity.
2. The slope of the distance-time graph is velocity.
3. The slope of a velocity-time graph is acceleration.
4. Free fall problems can be solved like other acceleration problems by substituting *a* for *g* = 9.8 m/s2. The sign of the gravitational acceleration is + or depending on whether you choose up or down as the positive direction.
5. For projectile motion the velocity at the maximum height is zero and the acceleration is *g*.
6. For projectile motion the velocity on the x-axis is constant.
7. An object in equilibrium has no resultant force acting on it. The sum of all the *x* force components is zero, the sum of all the *y* force components is zero.
8. The equilibriant force is equal in magnitude but opposite in direction to the resultant vector.
9. Static friction exists between two surfaces when motion is impending($_{max}F_s = \mu_s R$); kinetic friction occurs when two surfaces are actually moving against each other($F_k = \mu_k R$).
10. The measure of the inertia of an object is its mass.
11. Weight is the force of gravity upon a mass. (Wt = mg).
12. An unbalanced force must produce acceleration. ($\Sigma F = ma$)
13. Uniform circular motion refers to motion in a circle where the speed is constant and only the direction changes. ($a_c = v^2/r$)
14. Centripetal force and centripetal acceleration vectors are toward the center of the circle while the velocity vector is tangent to the circle. ($F_c = mv^2/r$)
15. The impulse is the product of the average force and the time interval through which it acts. (Inpulse =Ft)
16. The momentum of a particle is its mass times velocity. (p = mv)
17. Momentum is conserved in all collision systems. Kinetic energy is conserved only in elastic collisions.
18. The gravitational force is directly proportional to the product of the masses and inversely proportional to the square of the distance between them. ($F_g = Gm_1m_2 /r^2$)

Work, Energy and Power

19. Kinetic energy is the capacity of doing work as a result of motion. ($KE = \frac{1}{2} mv^2$)
20. Gravitational potential energy is the energy which results from the position of an object relative to the earth. (PE = mgh)
21. Net work is equal to the change in kinetic energy.
22. Conservation of mechanical energy under the action of a dissipative ('energy wasting') force includes the work due to frictional forces.
23. Power is the rate at which work is done. (P = W / t)

Simple Harmonic Motion

24. Simple harmonic motion is periodic motion in which the restoring force is proportional to the displacement.
25. The maximum displacement of an object from its equilibrium position is the amplitude.
26. At the maximum displacement the object experiences the maximum acceleration.
27. At the equilibrium position the object experiences zero acceleration and maximum velocity.
28. The period of a pendulum depends on its length and the value of g at that particular location.

Thermal Energy and Thermodynamics

29. Thermal energy represents the total internal energy of an object, the sum of its molecular kinetic and potential energies.
30. The change in thermal energy is related to a change in temperature.
31. Conservation of thermal energy requires that in any exchange of thermal energy the heat lost must equal the heat gained.
32. 273 Kelvin is equal to zero degrees Celsius.
33. Internal energy always flows from an object at higher temperature to one of lower temperature.
34. First Law of Thermodynamics: Q = W + U
35. Adiabatic process: Q = 0
36. Isovolumetric process: W = 0
37. Isothermal process: U = 0
38. Isobaric process: Q = U + W

Wave Motion

39. Transverse wave particles vibrate back and forth perpendicular to the wave direction and longitudinal wave particles vibrate parallel to the direction of the wave propagation.
40. Sound waves are longitudinal and mechanical. Light waves are transverse and electromagnetic.
41. The energy of a wave is directly proportional to the square of the amplitude.
42. Superposition Principle: When two or more waves exist simultaneously in the same medium, the resultant amplitude at any point is the algebraic sum of the amplitudes of each wave.
43. Standing sound waves may be set up in a vibrating air column for a pipe that is open at both ends or for one that is closed at one end.
44. Only the odd harmonics are possible for a closed pipe.
45. Whenever two waves are nearly the same frequency and exist simultaneously in the same medium, beats are set up.
46. Doppler effect is the apparent change in frequency of a source of sound when there is relative motion of the source and the listener.

Light and Geometric Optics

47. Wave behavior is proven by diffraction, interference and the polarization of light.
48. The electromagnetic spectrum (radio, microwaves, infrared, visible, ultraviolet, x-ray and gamma) are listed from lowest frequency to highest.
49. The range of wavelengths for visible light goes from 400 nm for violet to 700 nm for red.
50. As the frequency of a wave increases its energy increases and its wavelength decreases.
51. Coherent light waves are all in phase.
52. In Young's double-slit experiment interference and diffraction account for the production of bright and dark fringes.
53. Single slit diffraction produces a much wider central maximum than double slit.
54. When light reflects from a medium with higher index of refraction than that of the medium in which it is traveling, a 180 degree phase change (1/2 wavelength) occurs.
55. All angles in reflection and refraction are measured with respect to the normal.
56. Real images are always inverted.
57. Virtual images are always upright.
58. Concave mirrors are converging and convex mirrors are diverging. Concave lenses are diverging and convex lenses are converging.
59. Convex mirrors produce only small virtual image

60. Diverging lens produce only small virtual images.
61. At the critical angle a wave will be refracted to 90 degrees.
62. Total internal reflection occurs at angles greater than the critical angle.
63. Light rays bend away from the normal as they gain speed and a longer wavelength by entering a slower (n) value (less optical density) medium while the frequency remains constant.
64. Light slows down, bends toward the normal and has a shorter wavelength when it enters a higher (n) value (high optical density) medium
while the frequency remains constant.

Electricity
65. Coulomb's law: the force of attraction or repulsion between two point charges is directly proportional to the product of the two charges and inversely proportional to the separation between the charges.
66. Use the sign of the charges to determine the direction of the forces and Coulomb's law to determine their magnitudes.
67. Electric forces are greater than gravitational forces.
68. Electric fields point in the direction of the force on a positive test charge.
69. Electric fields between two parallel plates are uniform in strength except at the edges.
70. The electric potential energy increases as a positive charge is moved against the electric field, and it decreases as a negative charge is moved against the same field.
71. The electric potential (V) is equal to the work per unit charge.
72. Capacitance is the ratio of charge to the potential for a given conductor.
73. The insertion of a dielectric has an effect on the electric field and the potential between the plates.
74. The capacitance for a parallel-plate capacitor depends on the surface area of each plate, the plate separation and the permittivity or dielectric constant.
75. A source of electromotive force (*emf*) is a device that converts chemical, mechanical, or other forms of energy into electric energy.
76. Resistance depends on the kind of material (resistivity), the length, cross-sectional area, and temperature.
77. Adding a resistor in parallel decreases the total resistance of a circuit.
78. Adding a resistor in series increases the total resistance of a circuit.
79. All resistors in series have equal current (I).
80. All resistors in parallel have equal voltage (V).

Magnetism
81. Magnetic fields point from the north to the south outside the magnet.
82. Magnetic field is measured in Teslas, magnetic flux is measured in Webers.
83. Flemings Left hand rule is for using electricity and Flemings Right hand rule is for making electricity.
84. If a conductor cuts field lines, an emf will be induced in the conductor.
85. The direction of the induced *emf* depends upon the direction of motion of the conductor with respect to the field. (Flemings RHR)
86. The magnitude of the *emf* is directly proportional to the rate at which magnetic flux lines are cut by the conductor. (EMF = $\Delta\Phi$ / Δt)
87. According to Lenz's law, the induced current must be in such a direction that it produces a magnetic force which opposes the force causing the motion. (No free lunch!)
88. A step-down transformer can be constructed by making the number of primary turns greater than the number of secondary turns.

Modern Physics
89. The particle behavior of light is proven by the photoelectric effect.
90. The kinetic energy of the ejected electrons is the energy of the incident radiation minus the work function of the surface.
91. Increasing light frequency increases the kinetic energy of the emitted photoelectrons.
92. Increasing light intensity increases the number of emitted photoelectrons but not their KE.
93. De Broglie proposed that all objects have wavelengths related to their momentum.
94. All electromagnetic waves originate from accelerating charged particles.
95. The lowest energy state of an atom is called the ground state.

Nuclear physics
96. Alpha particles are the same as helium nuclei: 2 protons, 2 neutrons.
97. The atomic number is equal to the number of protons.
98. The number of nucleons is equal to protons + neutrons.
99. Alpha decay: Emission of an alpha particle.
100. Beta decay: A loss of a beta particle results in an increase in atomic number.
101. Gamma decay: High energy, no change in mass or atomic number.
102. All nuclei weigh less than their parts. This mass defect is converted into binding energy. (E=mc2) One amu of mass is equal to 931 meV of energy.
103. Isotopes have different neutron numbers and atomic masses but the same number of protons (atomic numbers).
104. Rutherford discovered the positive nucleus using his famous gold-foil experiment.
105. Fusion requires that hydrogen be combined to make helium. This fusion of small atoms gives out energy.
106. Fission requires that a neutron causes uranium to be split into middle size atoms and produce extra neutrons. This fission of large atoms gives out energy.
107. Nuclear forces are strong and short ranged.