Name: _____

AP Physics 2
Unit 9 Thermodynamics

9.1Kinetic Theory of Temperature and Pressure
9.2The Ideal Gas Law
9.3Thermal Energy Transfer and Equilibrium
9.4The First Law of Thermodynamics
9.5Specific Heat and Thermal Conductivity
9.6Entropy and the Second Law of Thermodynamics

- Pressure a gas exerts on a container
- Temperature
- Maxwell-Boltzmann Distribution
- Average kinetic energy of an ideal gas
- Properties of an ideal gas
- Transfer of energy due to temperature differences
- Thermal contact (heating and cooling)
- Conduction
- Convection
- Radiation
- Thermal equilibrium
- Internal energy
- First law of thermodynamics
- Isolated system
- Closed system
- Open system
- Pressure vs. volume graphs (aka PV diagrams)
- Isotherms
- Area under pressure vs. volume graph
- Isovolumetric
- Isothermal
- Isobaric
- Adiabatic
- Specific heat capacity
- Thermal conductivity
- Entropy
- Second law of thermodynamics

$$P = \frac{F_{\perp}}{A}$$

$$K_{\text{ave}} = \frac{3}{2}k_{\text{B}}T = \frac{1}{2}mv_{\text{rms}}^2$$

$$PV = nRT = Nk_{\text{B}}T$$

$$U = \frac{3}{2}nRT = \frac{3}{2}Nk_{\text{B}}T$$

$$\Delta U = Q + W$$

$$W = -P\Delta V$$

$$Q = mc\Delta T$$

$$\frac{Q}{\Delta t} = \frac{kA\Delta T}{L}$$

Name: _____

AP Physics 2
Unit 10 Electric Force, Field, and Temperature

10.1 Electric Charge and Electric Force
10.2 Conservation of Electric Charge and the Process of Charging
10.3 Electric Fields
10.4 Electric Potential Energy
10.5 Electric Potential
10.6 Capacitors
10.7 Conservation of Electric Energy

- Electrostatic force
- Charge
- Charge is quantized (discrete) and not continuous
- Point charge
- Coulomb's law
- Electric permittivity
- Electric Polarization
- Permittivity of free space ε_0
- Electric conductor
- Electric insulator
- Conservation of electric charge
- Distribution of charge in an object
- Movement of charge from contact, friction, or induction
- Grounding
- Electric field
- Test charge
- Electric field line diagrams
- Net electric field diagrams
- Electrostatic equilibrium
- Electric potential energy
- Electric potential
- Electric potential difference
- Electric field vector maps and equipotential lines
- Isolines
- Parallel-plate capacitor
- Capacitance
- Dielectric
- Moving a charged object with different electric potentials

$$|F_{\mathrm{E}}| = \frac{1}{4\pi\varepsilon_0}\frac{|q_1 q_2|}{r^2} = k\frac{|q_1 q_2|}{r^2}$$

$$\vec{E} = \frac{\vec{F}_{\mathrm{E}}}{q}$$

$$U_{\mathrm{E}} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r} = k\frac{q_1 q_2}{r}$$

$$V = \frac{1}{4\pi\varepsilon_0}\sum_i \frac{q_i}{r_i}$$

$$\Delta V = \frac{\Delta U_{\mathrm{E}}}{q}$$

$$\left|\vec{E}\right| = \left|\frac{\Delta V}{\Delta r}\right|$$

$$C = \frac{Q}{\Delta V}$$

$$C = \kappa\varepsilon_0\frac{A}{d}$$

$$E_{\mathrm{C}} = \frac{Q}{\kappa\varepsilon_0 A}$$

$$U_{\mathrm{C}} = \frac{1}{2}Q\Delta V$$

$$U_{\mathrm{E}} = q\Delta V$$

Name: _____

AP Physics 2
Unit 11 Electric Circuits

11.1 Electric Current
11.2 Simple Circuits
11.3 Resistance, Resistivity, and Ohm's Law
11.4 Electric Power
11.5 Compound Direct Current (DC) Circuits
11.6 Kirchoff's Loop Rule
11.7 Kirchoff's Junction Rule
11.8 Resistor-Capacitor (RC) Circuits

- Electric current
- Electric potential difference (electromotive force emf ε)
- Conventional current and movement of electrons
- Circuit
- Wire
- Battery
- Resistor
- Lightbulb
- Capacitor
- Switch
- Ideal ammeter
- Nonideal ammeter
- Ideal voltmeter
- Nonideal voltmeter
- Closed loop
- Closed circuit
- Open circuit
- Short circuit
- Resistance
- Resistivity
- Resistivity and temperature
- Ohm's law
- Ohmic materials
- Graphs of current vs. potential difference
- Electric power
- Relationship between the brightness of a light bulb and power
- Equivalent resistance
- Resistors in series
- Resistors in parallel

- Ideal wire
- Wires with resistance
- Ideal battery
- Batteries with internal resistance
- emf ε
- Kirchoff's loop rule and law of conservation of energy
- Kirchoff's junction rule and law of conservation of charge
- RC circuits
- Equivalent capacitance
- Time constant τ of an RC circuit
- Charging and discharging a capacitor

$$I = \frac{\Delta q}{\Delta t}$$
$$R = \frac{\rho l}{A}$$
$$I = \frac{\Delta V}{R}$$
$$P = I\Delta V$$
$$P = I^2R = \frac{(\Delta V)^2}{R}$$
$$R_{\text{eq,s}} = \sum_i R_i$$
$$\frac{1}{R_{\text{eq,p}}} = \sum_i \frac{1}{R_i}$$
$$\Delta V_{\text{terminal}} = \mathcal{E} - Ir$$
$$U_{\text{E}} = q\Delta V$$
$$\sum \Delta V = 0$$
$$\sum I_{\text{in}} = \sum I_{\text{out}}$$
$$\frac{1}{C_{\text{eq,s}}} = \sum_i \frac{1}{C_i}$$
$$C_{\text{eq,p}} = \sum_i C_i$$
$$\tau = R_{\text{eq}}C_{\text{eq}}$$

Name: _____

AP Physics 2
Unit 12 Magnetism and Electromagnetism

12.1 Magnetic Fields
12.2 Magnetism and Moving Charges
12.3 Magnetism and Current-Carrying Wires
12.4 Electromagnetic Induction and Faraday's Law

- Magnetic fields
- Magnetic dipole
- Magnetic monopole
- Magnetic field lines
- Permanent magnetism
- Induced magnetism
- Relationship between magnetic field strength and distance
- Ferromagnetic materials
- Paramagnetic materials
- Diamagnetism
- Magnetic permeability of free space
- Magnetic permeability of a material
- Magnetic field produced by a moving charge
- Right hand rule
- Force exerted on a moving charged object from an external magnetic field
- Hall effect
- Magnetic field produced by a current carrying wire
- Net magnetic field produced by two or more parallel current carrying wires
- Force exerted on a current carrying wire by an external magnetic field
- Magnetic flux
- Induced electric potential difference from a change in magnetic flux
- Faraday's law
- Len's law

$$F_{\mathrm{B}} = qvB\sin\theta$$

$$B = \frac{\mu_0}{2\pi}\frac{I}{r}$$

$$F_{\mathrm{B}} = IlB\sin\theta$$

$$\Phi_{\mathrm{B}} = BA\cos\theta$$

$$|\mathcal{E}| = \left|\frac{\Delta\Phi_{\mathrm{B}}}{\Delta t}\right|$$

$$\mathcal{E} = -\frac{\Delta\Phi_{\mathrm{B}}}{\Delta t} = -\frac{\Delta(BA\cos\theta)}{\Delta t}$$

$$\mathcal{E} = Blv$$

Name: _____

AP Physics 2
Unit 13 Geometric Optics

13.1 Reflection
13.2 Images Formed by Mirrors
13.3 Refraction
13.4 Images Formed by Lenses

- Rays and wavefronts
- Laser light
- Monochromatic light
- The normal
- Law of reflection
- Diffuse reflection
- Specular reflection
- Images formed by a mirror
- Plane mirror
- Concave mirror
- Convex mirror
- Principal axis
- Center of curvature
- Focal point
- Real image
- Virtual image
- Location of an image
- Magnification of an image
- Ray diagrams
- Principal rays
- Indes of refraction
- Law of refraction
- Snell's law
- Critical angle
- Total internal reflection
- Images formed by a lens
- Convex lens
- Concave lens
- Focal point
- Real image
- Virtual image
- Thin lens equation

$$\theta_{\mathrm{i}} = \theta_{\mathrm{r}}$$

$$\frac{1}{s_{\mathrm{i}}} + \frac{1}{s_{\mathrm{o}}} = \frac{1}{f}$$

$$|M| = \left|\frac{h_{\mathrm{i}}}{h_{\mathrm{o}}}\right| = \left|\frac{s_{\mathrm{i}}}{s_{\mathrm{o}}}\right|$$

$$n = \frac{c}{v}$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\theta_{\mathrm{critical}} = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

Name: _____

AP Physics 2
Unit 14 Waves, Sound, and Physical Optics

14.1 Properties of Wave Pulses and Waves
14.2 Periodic Waves
14.3 Boundary Behavior of Waves and Polarization
14.4 Electromagnetic Waves
14.5 The Doppler Effect
14.6 Wave Interference and Standing Waves
14.7 Diffraction
14.8 Double-Slit Interference and Diffraction Gratings
14.9 Thin-Film Interference

- Wave
- Wave pulse
- Wavelength
- Speed
- Frequency
- Period
- Medium
- Mechanical wave
- Electromagnetic wave
- Speed of light in a vacuum
- Speed of wave pulse in a string
- Relationship between speed of sound and temperature
- Transverse wave
- Longitudinal wave
- Regions of compression and rarefaction
- Equilibrium position
- Amplitude
- Equilibrium pressure
- Relationship between amplitude and loudness
- Relationship between amplitude and energy
- Relationship between frequency and energy
- Relationship between frequency and pitch
- Sinusoidal wave
- Transmission and reflection of a wave between two mediums
- Polarization of transverse waves
- Intensity of a wave
- Doppler effect
- Superposition of waves

- Constructive and destruction wave interference
- Beats
- Beat frequency
- Use of tuning forks
- Standing wave
- Nodes and antinodes
- Open-open pipe
- Open-closed pipe
- Closed-closed pipe
- Fundamental wave
- First harmonic
- Second harmonic
- Diffraction
- Constructive and destructive interference from diffraction
- Path length difference between two waves
- Bright fringes
- Dark fringes
- Single slit diffraction
- Double slit diffraction
- Wave envelope
- Diffraction grating
- Thin film interference
- Transmission, reflection, and absorption during thin film interference
- Phase change during thin film interference
- Soap bubbles and oil films
- Antireflection coatings
-

$$v_{\text{string}} = \sqrt{\frac{F_{\text{T}}}{m/l}}$$

$$T = \frac{1}{f}$$

$$x(t) = A\cos(\omega t) = A\cos(2\pi f t)$$

$$\lambda = \frac{v}{f}$$

$$|f_{\text{beat}}| = |f_1 - f_2|$$

$$a\left(\frac{y_{\text{min}}}{L}\right) \approx m\lambda$$

$$\Delta D = d\sin\theta$$

$$d\left(\frac{y_{\text{max}}}{L}\right) \approx m\lambda$$

Name: _____

AP Physics 2
Unit 15 Modern Physics

15.1 Quantum Theory and Wave-Particle Duality
15.2 The Bohr-Model of Atomic Structure
15.3 Emission and Absorption Spectra
15.4 Blackbody Radiation
15.5 The Photoelectric Effect
15.6 Compton Scattering
15.7 Fission, Fusion, and Nuclear Decay
15.8 Types of Radioactive Decay

- Discrete/quantized and continuous values
- Atomic spectra
- Blackbody radiation
- Photoelectric effect
- Wave-particle duality
- Photons
- Young's double slit experiment
- De Broglie wavelength
- Properties of an atom
- Nucleus of an atom
- Nuclear notation
- Ion
- Isotope
- Mass of an atom
- Bohr model of the atom
- Standing wave model of electrons in an atom
- Photon emission and absorption spectra
- Lower and higher energy levels of electrons in an atom
- Atomic spectra of an atom
- Binding energy
- Blackbody
- Wein's law
- Stefan-Boltzmann law
- Photoelectric effect
- Threshold frequency
- Work function of a material ϕ
- Compton scattering
- Fission
- Fusion

- Nuclear decay
- Half life $t_{\frac{1}{2}}$
- Decay constant λ
- Alpha decay
- Alpha particle
- Beta minus decay
- Beta plus decay
- Neutrino
- Antineutrino
- Positron
- Gamma decay
- Conservation of nucleon number, lepton number, and charge in all nuclear decays

$$E = hf$$
$$\lambda = \frac{c}{f}$$
$$\lambda = \frac{h}{p}$$
$$F_{\mathrm{e}} = \frac{kq_1q_2}{r^2}$$
$$F_{\mathrm{net}} = \frac{mv^2}{r}$$
$$\lambda_{\mathrm{max}} = \frac{b}{T}$$
$$P = A\sigma T^4$$
$$K_{\mathrm{max}} = hf - \phi$$
$$\Delta\lambda = \frac{h}{m_{\mathrm{e}}c}(1 - \cos\theta)$$
$$E = mc^2$$
$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$$
$$N = N_0e^{-\lambda}$$
$$\ln\left(\frac{N}{N_0}\right) = -\lambda t$$