

Name: \_\_\_\_\_

## AP Physics 2 Unit 9 Thermodynamics

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

- 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  $\epsilon_0$
- 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

$$|F_E| = \frac{1}{4\pi\epsilon_0} \frac{|q_1 q_2|}{r^2} = k \frac{|q_1 q_2|}{r^2}$$

$$\vec{E} = \frac{\vec{F}_E}{q}$$

$$U_E = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r} = k \frac{q_1 q_2}{r}$$

$$V = \frac{1}{4\pi\epsilon_0} \sum_i \frac{q_i}{r_i}$$

$$\Delta V = \frac{\Delta U_E}{q}$$

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

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

$$C = \kappa\epsilon_0 \frac{A}{d}$$

$$E_C = \frac{Q}{\kappa\epsilon_0 A}$$

$$U_C = \frac{1}{2} Q \Delta V$$

$$U_E = q \Delta V$$

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  $\epsilon$ )
- 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  $\mathcal{E}$
- 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  $\tau$  of an RC circuit
- Charging and discharging a capacitor

$$I = \frac{\Delta q}{\Delta t}$$

$$R = \frac{\rho l}{A}$$

$$I = \frac{\Delta V}{R}$$

$$P = I\Delta V$$

$$P = I^2 R = \frac{(\Delta V)^2}{R}$$

$$R_{\text{eq,s}} = \sum_i R_i$$

$$\frac{1}{R_{\text{eq,p}}} = \sum_i \frac{1}{R_i}$$

$$\Delta V_{\text{terminal}} = \mathcal{E} - Ir$$

$$U_E = q\Delta V$$

$$\sum \Delta V = 0$$

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

$$\frac{1}{C_{\text{eq,s}}} = \sum_i \frac{1}{C_i}$$

$$C_{\text{eq,p}} = \sum_i C_i$$

$$\tau = R_{\text{eq}} C_{\text{eq}}$$

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

$$F_B = qvB \sin \theta$$

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

$$F_B = IlB \sin \theta$$

$$\Phi_B = BA \cos \theta$$

$$|\mathcal{E}| = \left| \frac{\Delta \Phi_B}{\Delta t} \right|$$

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

$$\mathcal{E} = Blv$$

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
- Index 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

$$\theta_i = \theta_r$$
$$\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f}$$
$$|M| = \left| \frac{h_i}{h_o} \right| = \left| \frac{s_i}{s_o} \right|$$
$$n = \frac{c}{v}$$
$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$
$$\theta_{\text{critical}} = \sin^{-1} \left( \frac{n_2}{n_1} \right)$$

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 destructive 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
-

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

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

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

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

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

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

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

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

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  $\phi$
- Compton scattering
- Fission
- Fusion

- Nuclear decay
- Half life  $t_{\frac{1}{2}}$
- Decay constant  $\lambda$
- 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

$$E = hf$$

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

$$\lambda = \frac{h}{p}$$

$$F_e = \frac{kq_1q_2}{r^2}$$

$$F_{\text{net}} = \frac{mv^2}{r}$$

$$\lambda_{\text{max}} = \frac{b}{T}$$

$$P = A\sigma T^4$$

$$K_{\text{max}} = hf - \phi$$

$$\Delta\lambda = \frac{h}{m_e c} (1 - \cos\theta)$$

$$E = mc^2$$

$$\lambda = \frac{\ln 2}{\frac{t_1}{2}}$$

$$N = N_0 e^{-\lambda t}$$

$$\ln\left(\frac{N}{N_0}\right) = -\lambda t$$