Saint Joseph High School Summer Physics/Honors Physics

Mechanics

A. Kinematics
   1. Measurement, Units and Graphs
   2. Accuracy and precision
   3. Significant digits and measurement uncertainty
   4. Meter-kilogram-second (MKS) units
   5. Unit conversions
   6. Graph data and equations
   7. Interpret graphs—direct (linear), indirect (inverse), power (parabolic or root)

B. Mechanics
   1. Straight line motion
      a. Vector quantities
      b. Scalar quantities
      c. Displacement versus distance
      d. Velocity versus speed
      e. Acceleration
   2. Two-dimensional motion
      a. Free fall motion
      b. Projectile motion
      c. Circular motion

C. Dynamics
   3. Force
      a. Free-body diagrams
      b. Newton's 1^{st}, 2^{nd} and 3^{rd} Laws
      c. Normal force
      d. Static and kinetic friction coefficients
      e. Friction force
   4. Gravity
      Universal Law of Gravitation
   5. Momentum
      a. Momentum
      b. Impulse and change in momentum
      c. Elastic and plastic collisions
   6. Work
      a. Work in physics
      b. Power
      c. Efficiency
   7. Conservation of energy
      a. Kinetic energy

b. Potential energy
c. Work-Energy Theorem

8. Simple harmonic motion
   a. Periodic motion
   b. Period and frequency
   c. Energy transformation
   d. Pendulum motion
   e. Spring-mass motion

D. Electricity and Magnetism
1. Fields
   a. Electric fields
   b. Magnetic fields
   c. Interaction of electric and magnetic fields
   d. Force between charges—Coulomb's Law
   e. Potential difference and voltage
2. Ohm's Law
   a. Electrical power
   b. Series resistance
   c. Parallel resistance
   d. Dissipated power

E. Waves, Sound, and Optics
1. Waves
   a. Types of wave motion
   b. Period, frequency and wave speed
   c. Wave interactions
   d. Energy transported by wave
   e. Constructive and destructive interference – Superposition Principle
   f. Reflection, refraction and diffraction of waves
   g. Resonance and standing waves along a string – nodes and antinodes

2. Sound
   a. Production of sound
   b. Speed in different medium and temperature
   c. Doppler Effect and sonic boom
   d. Sound intensity level and the threshold of hearing
   e. Resonance in musical instruments and harmonics
   f. Production of beats from two sound waves

3. Light
   a. Characteristics and properties of light
      i. Electromagnetic spectrum
      ii. Intensity of light

b. Reflection of light – ray tracing to find images produced by plane and spherical mirrors
c. Refraction of light - Snell's Law - ray tracing to locate images produced by lenses
d. Diffraction, dispersion, polarization and interference of light
e. Wave-Particle Duality of Light
f. Young's Experiment
g. The photon and quantum physics
h. Mass and the speed of light – relativistic effects of mass and length
i. The sources of spectral lines and electromagnetic radiation as a function of frequency
j. The operation of LASER

E. Waves and Optics
1. Wave properties
   a. Wave velocity
   b. Wavelength
   c. Frequency
   d. Wave formula
2. Wave propagation and properties
   a. Reflection
   b. Refraction
   c. Interference
   d. Diffraction
   e. Standing waves
3. Light
   a. Electromagnetic spectrum
   b. Speed of light, wavelength, and frequency
   c. Law of Reflection
   d. Index of Refraction
   e. Snell's Law of Refraction
4. Mirror images
   a. Plane mirrors
   b. Curved mirrors
   c. Mirror equation
5. Lens images
   a. Coverging lenses
   b. Diverging lenses
   c. Lens equation

AP Physics topics may be added into this curriculum if students are planning on taking AP Physics C in the fall after this summer program.

SUGGESTED LAB EXERCISES

1. Measurement and significant digits
2. Uniform velocity motion
3. Uniform acceleration motion
4. Gravitational acceleration—freefall motion
5. Determine gravitational acceleration constant
6. Friction
7. Inclined plane—vector components
8. Projectile motion
9. Centripetal force
10. Work and energy
11. Impulse and one-dimensional momentum
12. Collisions and two-dimensional momentum
13. Simple harmonic motion--pendulum
14. Hooke's Law
15. Simple harmonic motion—spring and mass
16. Static charge
17. Force between charged spheres
18. Electric field around a wire
19. Ohm's Law
20. Series resistance circuits
21. Parallel resistance circuits
22. Series and parallel circuits
23. Wave properties in a coil spring
24. Pulses in a ripple tank
25. Periodic waves
26. Refraction of waves
27. Young's double-slit experiment
28. Reflection from a plane mirror
29. Refraction of light through different materials
30. Refraction and diffraction of light
31. Images from concave mirrors
32. Images from convex mirrors
33. Images from converging lenses
34. Images from diverging lenses
35. Light intensity and photometry