

## **WKU Summer Program for Verbally and Mathematically Precocious Youths**

Course Description for

### **Physics**

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The summer program in Physics is an intense three-week study of mechanics, basic electricity and magnetism, sound, and light. Approximately 45 hours of laboratory experiences are used to develop the student's understanding of the concepts presented. The textbook "Conceptual Physics - A High School Program", by Paul Hewitt, is used as a reading resource for conceptual development. A separate set of computational program sheets are given on a daily basis as homework. Laboratory experiences vary from large group activities to individualized data taking and analysis. Tests are given once each week for the purpose of aiding the instructor and the student in the evaluation of the student's comprehension of the material being studied. All of the work done by the student is returned to the student at the end of the course, with the exception of the tests. A brief evaluation of the individual student's work is also included.

In brief, the summer program exposes the students to material covered in approximately  $\frac{3}{4}$  of a full year high school physics class. In most instances, the presentation of each concept studied is as rigorous as the presentation given in most high school courses (Advanced Placement Physics excluded). However, the compact nature of the course does not allow for the inclusion of all of the supplementary activities normally given to enhance the comprehension of the concepts. The specific objectives for the summer course are as follows:

Upon completion of the course, the student should

1. Demonstrate an ability to use scientific notation.
2. Demonstrate a capacity to use trigonometry of a right triangle.
3. Be able to evaluate the validity of an equation by dimensional analysis.
4. State the fundamental units and be able to distinguish between fundamental and derived units.

5. Demonstrate the ability to distinguish between accuracy and precision.
6. Distinguish between constant speed and acceleration.
7. Demonstrate the ability to calculate average speed.
8. Demonstrate an understanding of the term acceleration.
9. Be able to calculate the distance traveled during a period of uniform acceleration.
10. Be able to state the value for acceleration due to gravity and demonstrate the ability to use the acceleration due to gravity in conjunction with standard acceleration equations.
11. Be able to plot and interpret graphs of distance vs. time and velocity vs. time for an object traveling at uniform velocity.
12. Be able to plot and interpret graphs of distance vs. time and velocity vs. time for an object undergoing uniform acceleration.
13. Be able to plot and interpret graphs of an object by computing the slope of its distance vs. time graph.
14. Be able to determine the acceleration of an object by computing the slope of its velocity vs. time graph.
15. Demonstrate an understanding of the difference between a scalar and a vector quantity.
16. Be able to resolve a vector quantity into its horizontal and vertical components.
17. Be able to add vector quantities which are perpendicular to each other.
18. Be able to properly state and sketch the direction of a vector.
19. Demonstrate an understanding of Newton's 1<sup>st</sup> Law of Motion and the corresponding concept of inertia.
20. Be able to determine the net force and use Newton's 2<sup>nd</sup> Law of Motion to determine the resulting acceleration.
21. Distinguish between weight and mass.
22. Use Newton's 2<sup>nd</sup> Law of Motion to determine weight or mass.
23. Understand the implications of Newton's 3<sup>rd</sup> Law of Motion to determine the resulting acceleration.
24. Define impulse and demonstrate an understanding of the relationship between time of impact and force.
25. Define momentum.

26. Demonstrate an understanding of the relationship between momentum and impulse and the ability to calculate changes in momentum.
27. State the law of conservation of momentum, recognizes its implications, and apply the law to problems.
28. Display an understanding of the independence of the vertical and horizontal velocities of a projectile.
29. Be able to find the range of a projectile fired from a position parallel to the ground.
30. Be able to find the range of a projectile fired from a position not parallel to the ground.
31. Define work as a function of energy change.
32. Define work as a function of force and applied distance
33. Define power as a function of work and time.
34. Define potential and kinetic energy.
35. Be able to differentiate between potential and kinetic energy.
36. Demonstrate an understanding of the relationship between work, potential energy, and kinetic energy.
37. Be able to differentiate between elastic collisions and inelastic collisions.
38. Be able to determine the velocity of an object traveling in a circular path.
39. Demonstrate an understanding of the concept of centripetal acceleration and calculate the centripetal acceleration given speed and radius.
40. Demonstrate an understanding of the meaning of the term centripetal when applied to force and acceleration.
41. Be able to differentiate between centripetal force and centrifugal force.
42. Demonstrate an understanding of the concept of center of mass.
43. Demonstrate an understanding of the concepts of angular distance, angular velocity, and angular acceleration.
44. State Newton's Law of Universal Gravitation and use it to calculate the force of gravity between two objects.
45. Be able to calculate the period of a simple pendulum given its length.
46. Demonstrate an understanding of waves as a means of energy transfer.
47. Be able to distinguish between transverse and longitudinal waves.

48. Be able to describe a wave using the characteristics of wavelength, frequency, period, amplitude, and velocity.
49. Demonstrate an understanding of the relationship between velocity, frequency, and wavelength.
50. Recognize the relationship between the velocity of a wave and the medium.
51. Define constructive and destructive interference.
52. Define index of refraction and use it to determine the speed of light in a substance.
53. Be able to use ray diagrams to locate image position in plane, converging, and diverging mirrors.
54. Understand the difference in real and virtual images.
55. Use the simple mirror formula to determine image position, image size, and image type in converging and diverging mirrors.
56. Be able to use ray diagrams to locate image position converging and diverging lenses.
57. Be able to use the thin lens formula to determine image position, image size, and image type in converging and diverging lenses.
58. Demonstrate an understanding of the relationship between wavelength and the colors in the spectrum of white light.
59. Demonstrate an understanding of the concept of light energy being quantized (photon).