Masconomet Regional High School Curriculum Guide

COURSE NAME: Physics Honors

COURSE NUMBER: 3431

DEPARTMENT: Science

GRADE LEVEL(S): 11-12 / Honors

LENGTH: Year

Course Description:

Physics Honors covers the areas of mechanics, wave phenomena, and electromagnetism. The course stresses both the mathematical and the practical applications of the topics being studied. A significant amount of class time is spent doing laboratory investigations. Physics Honors differs from the College Preparatory curriculum in that the pace is faster, allowing for additional topics to be covered and in its mathematical rigor. This course is similar to an Algebra / Trigonometry based college course. It is well suited to a student who intends to major in science in college. A student who takes this course as a junior will be prepared to take the SAT II examination in physics. Students who intend to major in engineering or physics in college should consider enrolling in the Advanced Placement Physics 'C' course.

Objectives:

On completing the this course, the student will be able to:

1. Define displacement, velocity and acceleration.
2. Distinguish between velocity and speed, distance and displacement.
3. Calculate instantaneous velocity from a graph of position vs. time; calculate acceleration from a graph of velocity vs time; calculate displacement from a graph of velocity vs time.
4. State and use the important equations relating displacement, velocity, acceleration, and time that apply when acceleration is constant.
5. Add and subtract vectors graphically and analytically.
6. Determine the components of vectors.
7. Solve projectile problems using the fact that in projectile motion the horizontal and vertical motions are independent.
8. Discuss the definitions of force and mass and state and understand Newton's laws of motion.
9. Distinguish between mass and weight and state the SI unit of each.
10. Distinguish between action-reaction pairs of forces that act on different bodies and balancing forces that act on the same body.
11. Apply Newton's laws in a systematic way to the solution of a variety of mechanics problems.
12. State the relationship between the maximum static force and the kinetic friction force as they are related to the normal force between the surfaces involved.
13. Apply Newton's laws to problems involving frictional forces.
14. Describe qualitatively motion with a velocity-dependent retarding force.
15. State the definitions of work, kinetic energy, potential energy, and power.
16. State the work-energy theorem and use it in solving problems.
17. State the law of conservation of energy and use it in solving problems.
18. State the definitions of impulse and momentum.
19. Explain why the forces exerted on an automobile driver in a collision are so much smaller when the driver wears a seat belt than when he or she does not.
20. State the law of conservation of momentum and use this law to solve problems.
21. Solve problems dealing with centripetal acceleration when a particle moves in a circle with constant speed given the velocity of the particle and the radius of the circle.
22. Apply Newton's laws to circular motion problems
23. State Newton's law of universal gravitation and use it to solve problems.
24. Describe the general characteristics of simple harmonic motion.
25. Describe the relationship between simple harmonic motion and circular motion.
26. Solve problems with springs and pendulums.
27. Describe the common features of all types of wave motion.
28. State the quantities on which the speed of a mechanical wave depends.
29. State the relationship among the speed, wavelength, and frequency of a wave.
30. Explain why the pitch of a car horn goes down as the car passes and calculate the Doppler frequency shift for various

other examples of moving sources and receivers.
31. Describe the interference-pattern produced by two wave sources.
32. Discuss the conditions under which the bending of waves around corners is significant.
33. Describe how a piano tuner uses beats to tune a piano.
34. Sketch the standing wave pattern for vibrating strings and vibrating air columns in organ pipes-and from them obtain the possible frequencies for standing waves.
35. Explain why the tone quality is different for different musical instruments.
36. State the range of wavelengths in the visible spectrum.
37. State the value of the speed of light in a vacuum.
38. State Coulomb's law and use it to find the force exerted by one point charge on another.
39. State the value of Coulomb's constant.
40. State the magnitude of the fundamental unit of electric charge 'e' in Coulomb's Law.
41. Use Coulomb's law to calculate the electric field due to a set of point charges.
42. Draw lines of force for simple charge distributions and obtain information about the direction and strength of an electric field from such a diagram.
43. Describe the electric field produced inside a spherically charged symmetric shell.
44. Explain why bits of paper are attracted to a comb and why a rubbed balloon will stick to a wall.
45. Define and discuss the concepts of electric current, drift velocity and resistance.
46. State Ohm's law and use it to solve problems.
47. Give the definition of resistivity and describe its temperature dependence.
48. State the general relationships involved in resistivity; apply these relationships in solving problems.
49. Determine the equivalent resistances of resistors connected in series or in parallel.
50. State Kirchhoff's rules and use them to analyze various dc circuits.

These objectives support the following **Academic Expectations from the Masconomet High School Mission Statement**:

1. Students will communicate effectively.
2. Students will use problem solving skills.
3. Students will use a variety of technological and informational resources to gather, analyze, and synthesize facts, results, ideas and concepts.
4. Students will participate in decision making and team building activities
5. Students will demonstrate and practice an understanding of the rights and responsibilities of citizenship.

Materials and Activities:

Each topic of study will last from two to three weeks. For each topic, the student will be given a specific set of learning objectives and activities to be accomplished. These activities include laboratory experiments, problem sets, conceptual question worksheets, and audiovisual material to be viewed. There will be a major test at the conclusion of each topic. There will be a semester exam at the end of Semester I that will include the topics covered during the Semester I.

During each semester, the student will be required to write one formal laboratory report. Students are encouraged (this is not a requirement) to develop a science fair project for which they will be given significant extra credit throughout the year.

For each topic studied, the student will be given approximately five problem sets. Answers to the odd-numbered problems are found in the back of the textbook. Answers to all other problems will usually be provided to the student. The student is to complete problem sets using the following format: state the given information, show the formula(s) that are to be used, show the substitution into the formula, label the answer with the correct units.

For each topic, the student will be given a list of required assignments for that topic. Successful completion of the required work will earn the student a ‘B’ for that part of your work. In order to receive an 'A' for the work, the student must accomplish additional activities. A list of options will be given to the student for each topic. This work could consist of extra problem sets, outline of the textbook, supplementary laboratory experiments and reports, science fair work, review of current science articles, or any other project mutually

agreed upon between the teacher and the student.

If the student misses a test due to absence, that test must be made up within one week. Make-up tests are given between 2:15 pm and 3:00 pm on Monday through Thursday. A time extension may be made for prolonged illness. Extra help is available on Monday through Thursday from 2:15 pm to 3:00 pm.

Textbook**:** Serway, Raymond A. and Faughn, Jerry S.; College Physics, 5th Edition, Saunders College Publishing, 1999 edition.

Assessment

The student's quarter grade is determined as follows: test grades will count towards two-thirds of the grade; laboratory reports will be worth one-sixth, and homework will be worth one-sixth.

The first (second) semester grade will be determined as follows: first (third) quarter grade is worth forty percent, second (fourth) quarter grade is worth forty percent, semester examination grade is worth twenty percent.

I. Topics

First Semester

Motion in One Dimension
- Velocity & Acceleration
- Graphical Analysis of Motion
- Motion Formulas
- Free-Fall

Motion in Two Dimensions
- Vectors
- Projectile Motion

Laws of Motion
- Dynamics
- Laws of Motion
- Applications of Newton's Laws
- Multiple Forces
- Friction

Work and Energy
- Work
- Energy
  - Kinetic
  - Potential
  - Conservation of Energy
- Power
- Non-Constant Forces

Momentum
- Momentum & Impulse
- Conservation of Momentum
- Collisions

Circular Motion & Gravitation
- Centripetal Acceleration
- Centripetal Force
- Gravitation
- Satellite Motion

Second Semester

Vibrations
- Hooke's Law
- Elastic Potential Energy
- Simple Harmonic Motion
- Pendulum Motion

Waves
- Characteristics of waves
- Behavior of Waves at Boundaries
- Interference & Diffraction

Sound
- Characteristics of Sound
- Sound Intensity
- Doppler Effect & Shock Waves
- Sound as a Wave Phenomenon
- Natural Frequency & Resonance

Electric Forces and Fields
- Structure of Atom
- Transfer of Electric Charge
- Coulomb's Law
- Electric Fields

Current and Resistance
- Electric Current
- Ohm's Law
- Electric Energy and Power

Direct Current Circuits
- Series Circuits
- Parallel Circuits
- Kirchhoff's Rules
- Household Circuits