Honors Physics Syllabus – Volume 1 of 1 – Units 1-7

Unit 1: Kinematics in One Dimension (3 weeks)

This unit is designed to introduce the students to the concept of uniformly accelerated motion while simultaneously setting the academic tone for the balance of the course. By the end of this unit each student should be able to: algebraically determine the displacement and velocity of an accelerating object as a function of time in one dimension generate and use kinematics graphs to develop the equations for uniformly accelerated motion, determine the approximate error in a kinematics lab, and write a clearly written lab report.

Lesson 1:1 Introduction to Displacement, Velocity & Acceleration
Lesson 1:2 Freefall Lab - Introduction
Lesson 1:3 Graphical Analysis – Velocity vs. Time
Lesson 1:4 Graphical Analysis – Slopes & Areas - *Quiz*
Lesson 1:5 Graphical Analysis – Displacement vs. Time
Lesson 1:6 Displacement vs. Time – Slopes & Areas
Lesson 1:7 Graphical Analysis – Acceleration vs. Time
Lesson 1:8 Writing a Quality Lab Report
Lesson 1:9 Relating Displacement, Velocity & Acceleration
Lesson 1:10 Problem Solving in One Dimensional Kinematics – *Quiz*
Lesson 1:11 One Dimensional Kinematics – Two Objects
Lesson 1:12 One Dimensional Kinematics – Consolidation - *Quiz*
Lesson 1:13 One Dimensional Kinematics – Review
Lesson 1:14-15 One Dimensional Kinematics – *Unit Test*

Unit 2: Kinematics in Two Dimensions (3 weeks)

This unit is designed to introduce the students to the vector nature of displacement, velocity and acceleration. The principle emphasis of this chapter will be regarding the special techniques required to handle kinematics in two dimensions. In addition, the students will learn how to run a controlled experiment and in doing so determine the relationships when there are two or more independent variables.

Lesson 2:1 Projectiles in Two Dimensions – Introduction
Lesson 2:2 Projectiles in Two Dimensions – Projectile Problems
Lesson 2:3 Projectiles in Two Dimensions – Lab Activity
Lesson 2:4 Projectiles in Two Dimensions – Lab Activity
Lesson 2:5 Projectiles in Two Dimensions – *Quiz*
Lesson 2:6 Vectors in Two Dimensions – Vector Addition
Lesson 2:7 Vectors in Two Dimensions – Boats & Planes – Problem Solving
Lesson 2:8 Vectors in Two Dimensions – Boats & Planes – Problem Solving
Lesson 2:9 Vectors in Two Dimensions – Boats & Planes – *Quiz*
Lesson 2:10 Centripetal Acceleration – Introduction
Lesson 2:11 Centripetal Acceleration – Lab Activity

Unit 2 – continued

Lesson 2:12 Centripetal Acceleration – Lab Activity
Lesson 2:13 Centripetal Acceleration – Quiz
Lesson 2:14 Two Dimensional Kinematics – Review
Lesson 2:15-16 Two-dimensional Kinematics – Unit Test
Lesson 2:17 Two Dimensional Kinematics – Wrap-up

Unit 3: Newton's Laws of Motion (6 weeks)

This unit is designed to introduce the students to Newton's Laws of motion. This topic has two very different aspects: conceptual and mathematical. These two aspects are complementary and one without the other will be counterproductive and so activities in this section are particularly critical. Most students will come into this topic with many ideas that are incompatible with Newtonian Mechanics and one of the primary difficulties in this unit will be to change the student's misconceptions. This will not be easy and it will be easy to assume too much about their fundamental understanding.

Lesson 3:1 Newton's 1st Law – Introduction to Newton's 1st Law
Lesson 3:2 Newton's 1st Law – Freebody Diagrams – Lab Activity
Lesson 3:3 Newton's 1st Law – Problem Solving – Lab Activity
Lesson 3:4 Newton's 1st Law – Forces at Equilibrium – Lab Activity
Lesson 3:5 Newton's 1st Law – Problem Solving
Lesson 3:6 Newton's 1st Law – Oral Lab Reports - *Quiz*
Lesson 3:7 Newton's 1st Law – Introduction to the Force of Friction
Lesson 3:8 Newton's 1st Law – Force of Friction – Lab Activity
Lesson 3:9 Newton's 1st Law – Force of Friction – Problem Solving
Lesson 3:10 Newton's 1st Law – Force of Friction – Oral Lab Reports
Lesson 3:11 Newton's 1st Law – Force of Friction – *Quiz*
Lesson 3:12 Newton's 1st Law – Torques at Equilibrium – Introduction
Lesson 3:13 Newton's 1st Law – Torques at Equilibrium – Problem Solving
Lesson 3:14 Newton's 1st Law – Torques at Equilibrium – Lab Activity
Lesson 3:15 Newton's 1st Law – Torques at Equilibrium – Lab Activity
Lesson 3:16 Newton's 1st Law – Torques at Equilibrium – Problem Solving - *Quiz*
Lesson 3:17 Newton's 1st Law – Torques at Equilibrium – Oral Lab Reports
Lesson 3:18 Newton's 2nd Law – Linear Acceleration – Introduction
Lesson 3:19 Newton's 2nd Law – Linear Acceleration – Lab Activity
Lesson 3:20 Newton's 2nd Law – Linear Acceleration – Lab Activity
Lesson 3:21 Newton's 2nd Law – Linear Acceleration – Oral Reports
Lesson 3:22 Newton's 2nd Law – Centripetal Acceleration – Introduction
Lesson 3:23 Newton's 2nd Law – Centripetal Acceleration – Problem Solving
Lesson 3:24 Newton's 3rd Law – Introduction
Lesson 3:25 Action at a Distance – Universal Gravitation – Introduction
Lesson 3:26 Newton's 2nd Law – Universal Gravitation – Problem Solving
Lesson 3:27 Newton's 2nd Law – Universal Gravitation – *Quiz*

Unit 3 – continued

Lesson 3:28 Newton's Laws - Review
Lesson 3:29 and 3:30 Newton's Laws – *Unit Test*

Unit 4: Energy Conservation (4 weeks)

This unit is designed to introduce the students to the concept of energy conservation. Initially, the topic will be developed in stages: work, gravitational energy, kinetic energy, elastic energy. Work will be introduced as a defined quantity while energy will be developed as the ability to do work. After the students have become proficient at calculating work and energy, the students will then begin to develop an understanding of energy, its conservation and the application of energy conservation to problem solving. After establishing the concept of energy conservation, the students will then apply this concept to simple machines, heat *engines, universal gravitation and the formation of black holes*.

Lesson 4:1 Work & Energy - Introduction
Lesson 4:2 Kinetic Energy, Hooke's Law & Elastic Potential Energy
Lesson 4:3 Energy Conservation – *Quiz*
Lesson 4:4 Hooke's Law & Energy Conservation – Lab Activity
Lesson 4:5 Hooke's Law & Energy Conservation – Lab Activity
Lesson 4:6 Work & Energy – Problem Solving – Oral Reports
Lesson 4:7 Energy Conservation – Problem Solving
Lesson 4:8 Energy Conservation and Simple Machines – *Quiz*
Lesson 4:9 Simple Machines - Introduction
Lesson 4:10 Simple Machines – Lab Activity
Lesson 4:11 Simple Machines – Lab Activity
Lesson 4:12 Simple and Compound Machines – *Quiz*
Lesson 4:13 Simple Machines and Thermal Efficiency - Introduction
Lesson 4:14 Universal Gravitational Energy - Introduction
Lesson 4:15 Universal Gravitational Energy and Escape Velocity
Lesson 4:16 Universal Gravitational Energy and Black Holes – Problem Solving
Lesson 4:17 Universal Gravitational Energy and Black Holes – Problem Solving – *Quiz*
Lesson 4:18 Energy Conservation – Review
Lesson 4:19,20 Energy Conservation – *Unit Test*

Unit 5: Momentum Conservation (3 weeks)

This unit is designed to introduce the students to the concept of momentum conservation. Initially, momentum will be introduced as a defined quantity and will then be developed into a problem solving tool involving two [or more] interacting objects. Three different kinds of interactions will be investigated: elastic collision, inelastic collision and explosion. Momentum conservation in one dimension will be used to solve for the velocities of two objects before and after their interaction. The coefficient of restitution, combined with momentum conservation and energy conservation, will be introduced as a measure of a collision's elasticity. Finally, momentum conservation will be generalized to problems involving two dimensions, forcing a review of the techniques used earlier in the year involving vector *addition*.

Unit 5: Momentum Conservation (3 weeks)

Lesson 5:1 Momentum Conservation – Introduction
Lesson 5:2 One Dimensional Linear Momentum Conservation – Lab Introduction
Lesson 5:3 One Dimensional Linear Momentum Conservation – Lab Activity
Lesson 5:4 Linear Momentum Conservation – Lab Activity
Lesson 5:5 One Dimensional Linear Momentum Conservation – Oral Reports - *Quiz*
Lesson 5:6 One Dimensional Linear Momentum Conservation – Oral Reports
Lesson 5:7 Two Dimensional Momentum Conservation – Introduction
Lesson 5:8 Two Dimensional Momentum Conservation – Lab Activity
Lesson 5:9 Two Dimensional Momentum Conservation – Lab Activity
Lesson 5:10 Two Dimensional Momentum Conservation – Oral Reports - *Quiz*
Lesson 5:11 Momentum Conservation - Review
Lesson 5:12-13 Momentum Conservation – *Unit Test*

Unit 6: Rotational Motion (2 weeks)

This unit is designed to introduce the students to the concept of rotational motion. This chapter will serve as an excellent review of all that we have done throughout the year. As you develop rotational motion the students will review kinematics, Newton's Laws, energy conservation and momentum conservation; all within the framework of rotational motion. In addition, the students will learn about some of the neatest things in mechanics! Of all topics in physics mechanics, none is more intriguing the rotational momentum conservation.

Lesson 6:1 Rotational Motion – Introduction
Lesson 6:2 Rotational Motion – Moment of Inertia
Lesson 6:3 Rotational Motion – Lab Activity
Lesson 6:4 Rotational Motion – Lab Activity
Lesson 6:5 Rotational Motion – Oral Reports – *Quiz*
Lesson 6:6 Rotational Motion – Rotational Energy Conservation – Introduction
Lesson 6:7 Rotational Motion – Rotational Energy Conservation – Problem Solving
Lesson 6:8 Rotational Motion – Rotational Energy Conservation – *Quiz*
Lesson 6:9 Rotational Motion – Angular Momentum Conservation – Introduction
Lesson 6:10 Rotational Motion – Angular Momentum Conservation – *Quiz*
Lesson 6:11 Rotational Motion – Review
Lesson 6:12-13 Rotational Motion – *Unit Test*

Unit 7: Simple Harmonic Motion (2 weeks)

This unit is designed to be a transition between the mechanics we have been studying all year with the other half of physics, the world of wave motion. In this section students will learn about the connection between rotational motion and that special class of motion called "simple harmonic." This in turn will then lead us to the study of simple harmonic waves and their importance to our understanding of sound and light.

Lesson 7:1 Simple Harmonic Motion – Introduction
Lesson 7:2 Simple Harmonic Motion – Simple Pendulums – Hypotheses – Lab Activity
Lesson 7:3 Simple Harmonic Motion – Period vs. Length – Lab Activity
Lesson 7:4 Simple Harmonic Motion – Undamped – Lab Activity
Lesson 7:5 Simple Harmonic Motion – Damped SHM – Lab Activity
Lesson 7:6 Simple Harmonic Motion – Undamped SHM – Oral Reports
Lesson 7:7 Simple Harmonic Motion – Problem Solving [graphical] – Oral Reports
Lesson 7:8 Simple Harmonic Motion – Problem Solving [word] – Oral Reports
Lesson 7:9 Simple Harmonic Motion – Damped – *Quiz [graphical]*
Lesson 7:10 Simple Harmonic Motion – Word Problems – Review – *Quiz [word]*
Lesson 7:11 Simple Harmonic Motion – *Unit Test*