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UNIVERSITY PHYSICS I (Calculus-Based)

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MODULE 1

MATH REVIEW

Review and practice of the prerequisite mathematical concepts you will be using to complete various physics problems in this course.

1.1 Algebraic Review
1.2 Ratios and Proportions
1.3 Logarithms
1.4 Quadratics
1.5 System of Linear Equations
1.6 Trigonometry
1.7 Derivatives
1.8 Integration

MODULE 2

UNITS AND MEASUREMENTS REVIEW

Review of the various units and measurements you will be using in this course.

MODULE 3

VECTORS AND SCALARS

Motion along a curved path on a flat surface is described by two-dimensional kinematics. Motion not confined to a plane is described by three-dimensional kinematics. Understanding of both will allow us to apply physics to many situations, and reveal unexpected insights about nature.

3.1 Part 1
3.2 Part 2
3.3 Vocabulary
3.4 Homework
3.5 Videos of Solving Problems

MODULE 4

KINEMATICS

Objects are in motion everywhere we look. Everything from a tennis game to a space-probe flyby of the planet Neptune involves motion. But an understanding of motion is also key to understanding other concepts in physics. An understanding of acceleration, for example, is crucial to the study of force.

4.1 Part 1
4.2 Part 2
4.3 Part 3
4.4 Vocabulary
4.5 Homework
4.6 Videos of Solving Problems

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MODULE 5

NEWTON'S LAWS OF MOTION

Dynamics considers the forces that affect the motion of moving objects and systems. Newton's laws of motion are the foundation of dynamics. These laws provide an example of the breadth and simplicity of principles under which nature functions.

5.1 Part 1
5.2 Part 2
5.3 Vocabulary
5.4 Homework
5.5 Videos of Solving Problems

MODULE 6

APPLICATIONS OF NEWTON'S LAWS

Describe the forces on the hip joint. What means are taken to ensure that this will be a good movable joint? It is difficult to categorize forces into various types. We know that a net force affects the motion, position, and shape of an object. It is useful at this point to look at some particularly interesting and common forces that will provide further applications of Newton's laws of motion. We have in mind the forces of friction, and deformation.

6.1 Part 1
6.2 Vocabulary
6.3 Homework
6.4 Videos of Solving Problems

MODULE 7

CIRCULAR MOTION

Many motions are curved. Recall that Newton's first law tells us that motion is along a straight line at constant speed unless there is a net external force. We will therefore study not only motion along curves, but also the forces that cause it, including gravitational forces.

7.1 Part 1
7.2 Vocabulary
7.3 Homework
7.4 Videos of Solving Problems

MODULE 8

WORK & KINETIC ENERGY

Energy plays an essential role both in everyday events and in scientific phenomena. Not only does energy have many interesting forms, it is involved in almost all phenomena, and is one of the most important concepts of physics.

8.1 Part 1
8.2 Part 2
8.3 Vocabulary
8.4 Homework
8.5 Videos of Solving Problems

MODULE 9

LINEAR MOMENTUM & COLLISION

Momentum, like energy, is important because it is conserved. Only a few physical quantities are conserved in nature, and studying them yields fundamental insight into how nature works, as we shall see in our study of momentum.

9.1 Part 1
9.2 Part 2
9.3 Vocabulary
9.4 Homework
9.5 Videos of Solving Problems

MODULE 10

ROTATIONAL DYNAMICS

Force, energy, and power are associated with rotational motion. These and other aspects of rotational motion are covered in this module. We shall see that all important aspects of rotational motion either have already been defined for linear motion or have exact analogs in linear motion.

10.1 Part 1
10.2 Part 2
10.3 Vocabulary
10.4 Homework
10.5 Videos of Problem Solving

MODULE 11

TEMPERATURE, KINETIC ENERGY AND GAS LAWS

What is heat? How do we define it? How is it related to temperature? What are heat's effects? How is it related to other forms of energy and to work? We will find that, in spite of the richness of the phenomena, there is a small set of underlying physical principles that unite the subjects.

11.1 Part 1
11.2 Vocabulary
11.3 Homework
11.4 Videos of Problem Solving

MODULE 12

HEAT AND HEAT TRANSFER

Energy can exist in many forms and heat is one of the most intriguing. Heat is often hidden, as it only exists when in transit, and is transferred by a number of distinctly different methods. Heat transfer touches every aspect of our lives and helps us understand how the universe functions.

12.1 Part 1
12.2 Part 2
12.3 Vocabulary
12.4 Homework
12.5 Videos of Problem Solving

MODULE 13

LAWS OF THERMODYNAMICS

Basic physical laws govern how heat transfer for doing work takes place and place insurmountable limits onto its efficiency. This module will explore these laws as well as many applications and concepts associated with them. These topics are part of thermodynamics—the study of heat transfer and its relationship to doing work.

13.1 Part 1
13.2 Part 2
13.3 Vocabulary
13.4 Homework
13.5 Videos of Problem Solving

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UNIVERSITY PHYSICS II (Calculus-Based)

MODULE 1

MATH REVIEW

Review and practice of the prerequisite mathematical concepts you will be using to complete various physics problems in this course.

1.1 Algebraic Review
1.2 Ratios and Proportions
1.3 Logarithms
1.4 Quadratics
1.5 System of Linear Equations
1.6 Trigonometry
1.7 Derivatives
1.8 Integration

MODULE 2

UNITS AND MEASUREMENTS REVIEW

Review of the various units and measurements you will be using in this course.

MODULE 3

ELECTRIC CHARGE AND FORCES

In this module, we begin with the study of electric phenomena due to charges that are at least temporarily stationary, called electrostatics, or static electricity.

3.1 Part 1
3.2 Homework
3.3 Example Problem Videos

MODULE 4

ELECTRIC FIELDS

A field, in physics, is a physical quantity whose value depends on position, relative to the source of the field. The value of the electric field (both the magnitude and the direction) depends on where in space it is measured relative to the location of the source electrical charges.

4.1 Part 1
4.2 Homework
4.3 Example Problem Videos

MODULE 5

ELECTRIC FLUX AND GAUSS' LAW

Flux is a general concept in physics. However, in this module, we concentrate on the flux of the electric field. This allows us to introduce Gauss's Law, which is particularly useful for finding the electric fields of charge distributions exhibiting spatial symmetry.

5.1 Part 1
5.2 Homework
5.3 Example Problem Videos

MODULE 6

ELECTRIC POTENTIAL ENERGY

In this module, we shall examine the relationship between voltage and electrical energy and begin to explore some of the many applications of electricity.

6.1 Part 1
6.2 Part 2
6.3 Homework
6.4 Example Problem Videos

MODULE 7

CAPACITORS

Capacitors are important components of electrical circuits in many electronic devices. By themselves, capacitors are used to store electrical energy and release it when needed; with other circuit components, capacitors act as part of a filter that allows only some electrical signals to pass.

7.1 Part 1
7.2 Homework

MODULE 8

CURRENT, RESISTANCE AND OHM'S LAW

The flicker of numbers on a handheld calculator, an ultrasound device sending a signal to a computer screen, the brain sending a message for a baby to twitch its toes — these and many other examples of electricity involve electric current, the movement of charge.

8.1 Part 1
8.2 Homework

MODULE 9

DC CIRCUITS AND KIRCHOFF'S LAWS

Electric circuits are commonplace. Some are simple, such as those in flashlights. Others, such as those used in supercomputers, are extremely complex.

9.1 Part 1
9.2 Part 2
9.3 Part 3
9.4 Homework
9.5 Example Problem Videos

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MODULE 10

MAGNETIC FORCES AND FIELDS

Magnetism plays many important roles in our lives. Physicists' understanding of magnetism has enabled the development of technologies that affect our everyday lives. The iPhone in your backpack, for example, wouldn't have been possible without the applications of magnetism and electricity.

10.1 Part 1
10.2 Part 2
10.3 Homework
10.4 Example Problem Videos

MODULE 11

SOURCES OF MAGNETISM

The Biot-Savart is an empirical law named in honor of two scientists, who investigated the interaction between a straight, current-carrying wire and a permanent magnet. This law enables us to calculate the magnitude and direction of the magnetic field produced by a current in a wire.

10.1 Part 1
10.2 Homework
10.3 Example Problem Videos

MODULE 12

ELECTROMAGNETIC INDUCTION

Faraday and Henry independently demonstrated that magnetic fields can produce currents. The basic process of generating emfs and, hence, currents with magnetic fields is known as induction; this process is also called magnetic induction to distinguish it from charging by induction.

12.1 Part 1
12.2 Part 2
12.3 Homework
12.4 Example Problem Videos

MODULE 13

AC CIRCUITS

Direct current (DC) is the flow of electric charge in only one direction. It is the steady state of a constant-voltage circuit. Alternating current (AC) is the flow of electric charge that periodically reverses direction.

13.1 Part 1
13.2 Homework
13.3 Example Problem Videos

MODULE 14

OSCILLATIONS

What do an ocean buoy, a child in a swing and the beating of hearts all have in common? They all oscillate—-that is, they move back and forth between two points. All oscillations involve force and energy.

14.1 Part 1
14.2 Part 2
14.3 Homework

MODULE 15

WAVES & SOUND

If a tree falls in the forest and no one is around, does it make a sound? The answer to this question depends on how you define sound. If we define sound in terms of physics, then there was a sound, even if nobody was around to hear it.

15.1 Part 1
15.2 Part 2
15.3 Part 3
15.4 Homework

MODULE 16

ELECTROMAGNETIC WAVES

The beauty of a coral reef, the warm radiance of sunshine, the sting of sunburn, the X-ray revealing a broken bone, even microwave popcorn—all are brought to us by electromagnetic waves. These widely varied phenomena are different manifestations of the same thing—electromagnetic waves.

16.1 Part 1
16.2 Homework

MODULE 17

GEOMETRICAL OPTICS

When light interacts with an object that is several times as large as the light's wavelength, its observable behavior is like that of a ray; it does not prominently display its wave characteristics. We call this part of optics "geometric optics."

17.1 Part 1
17.2 Part 2
17.3 Homework

MODULE 18

WAVE PROPERTIES OF LIGHT

If you have ever looked at the reds, blues, and greens in a sunlit soap bubble and wondered how straw-colored soapy water could produce them, you have hit upon one of the many phenomena that can only be explained by the wave character of light.

18.1 Part 1
18.2 Part 2
18.3 Homework

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