Syllabus

Integrated Physics and Chemistry, Semester A

Course Overview

Chemistry is the study of how a set of substances with particular physical properties—like solid paper and the oxygen in the air—can react with each other to form different substances with entirely different properties—like gaseous water and carbon dioxide. In most cases, these chemical changes result in an energy change as well, either giving off energy or absorbing energy. The development of new types of materials, new methods of producing or storing energy, or new methods of interacting with genetic material all depend upon knowledge of chemistry.

Physics is one of the three main fields of science, along with biology and chemistry. Physics often seems like a grab bag of topics, including motion, magnets, machines, light, sound, and electrical circuits. The common thread running through all these things is that they each illustrate some very basic mathematical laws in our physical world. In brief, physics is the scientific study of matter, energy, and their most fundamental physical interactions, including attractions, repulsions, and collisions.

In Integrated Physics and Chemistry A, you will first learn about the "basics" of physics, since physics is actually the foundation of chemistry. In this course, you will learn how to describe and analyze motion, how forces interact with matter, and how to further describe these interactions with the aid of the concepts of energy and momentum. You will also learn about waves, electricity, and magnetism.

Course Goals

By the end of this course, you will be able to do the following:

- Accurately describe and analyze motion along a linear path in mathematical terms, including distance, velocity, and acceleration.
- Explore and apply the laws of dynamics, relating forces and motion.
- Use the concepts of energy, work, and momentum to analyze physical situations.
- Observe, analyze, and predict effects of periodic motion, including such everyday motions as a child swinging back and forth on a swing, an object bobbing up and down on a spring, or a planet traveling in an orbit around a star.
- Learn about the behavior and special properties of waves, such as the ability to bend and to reflect the direction of waves as they travel.

- Explore electric charges and their interactions with each other and understand the relationship between electricity and magnetism.
- Learn about simple electric circuits and be able to determine important values related to that circuit, including current, resistances, and voltage.

Math and Science Skills

Successful completion of Algebra 1 and Geometry provide the prerequisite mathematical skills for Integrated Physics and Chemistry.

In addition, you should have a good working understanding of inquiry science methods, including:

- Experimental design, including the importance of experimental controls.
- Basic data analysis skills, including the ability to interpret mathematical patterns from data tables and graphs.
- The ability to use experimental results and/or real data sets to propose general rules.

General Skills

To participate in this course, you should be able to do the following:

- Complete basic operations with word processing software, such as Microsoft Word or Google Docs.
- Perform online research using various search engines and library databases.
- Communicate through email and participate in discussion boards.

For a complete list of general skills that are required for participation in online courses, refer to the Prerequisites section of the Plato Student Orientation document, found at the beginning of this course.

Credit Value

Integrated Physics and Chemistry A is a 0.5-credit course.

Course Materials

- Notebook
- Computer with Internet connection and speakers or headphones
- Microsoft Word or equivalent
- Test and Study References found at the end of this syllabus. They include a table of physics formulas, a periodic table for testing purposes and a periodic table for student study.

Course Pacing Guide

This course description and pacing guide is intended to help you keep on schedule with your work. Note that your course instructor may modify the schedule to meet the specific needs of your class.

Unit 1: Physics and Motion

Summary

In this unit, you will learn what physics is and how it relates to other major sciences. You will also begin your study of physics in this unit by exploring the mathematical description of motion.

Day	**Activity**/*Objective*	Type
1 day: 1	**Syllabus and Plato Student Orientation** *Review the Plato Student Orientation and Course Syllabus at the beginning of this course.*	Course Orientation
2 days: 2–3	**Introduction to Physics** *Learner will define physics, consider how it relates to other sciences, and examine how scientists have contributed to our understanding of the physical world.*	Lesson
2 days: 4–5	**Describing Motion** *Learner will identify kinematic quantities that are used to describe motion, distinguishing between scalar and vector quantities.*	Lesson
2 days: 6–7	**Mathematics for Physical Sciences** *Learner will understand basic mathematical concepts important to the physical sciences and successfully carry out mathematical operations.*	Lesson
2 days: 8–9	**Graphs and Relationships** *Learner will plot graphs and recognize relationships in data.*	Lesson
2 days: 10–11	**Measures of Motion** *Learner will define distance, displacement, speed, velocity, and acceleration and understand how they are related.*	Lesson
2 days: 12–13	**Equations of Motion** *Learner will solve problems for objects with constant acceleration, relating displacement, velocity, acceleration, and time.*	Lesson
2 days: 14–15	**Graphing Motion** *Learner will analyze, interpret, and construct graphs that track displacement, velocity, and acceleration over time.*	Lesson

2 days: 16–17	**Unit Activity and Discussion—Unit 1**	Unit Activity Discussion
1 day: 18	**Posttest—Unit 1**	Assessment

Unit 2: Newton’s Laws

Summary

In this unit, you will investigate the relationship between forces and motion.

Day	**Activity**/*Objective*	**Type**
2 days: 19–20	**Newton's Laws** *Learner will understand the basic terms, concepts, and laws that relate force and motion.*	Lesson
2 days: 21–22	**Using Newton's First Law** *Learner will examine the concepts of mass, inertia, and equilibrium.*	Lesson
2 days: 23–24	**Using Newton's Second Law** *Learner will solve problems that involve application of Newton’s second law of motion in one dimension.*	Lesson
2 days: 25–26	**Using Newton's Third Law** *Learner will determine the value of normal and tension forces by applying Newton's third law of motion.*	Lesson
2 days: 27–28	**Universal Gravitation** *Learner will describe the universal nature of gravity and solve two-body gravity problems.*	Lesson
2 days: 29–30	**Unit Activity and Discussion—Unit 2**	Unit Activity Discussion
1 day: 31	**Posttest—Unit 2**	Assessment

Unit 3: Energy and Momentum

Summary
In this unit, you will learn about and use the concepts of energy, work, and momentum to analyze common physical situations and interactions.

Day	**Activity**/*Objective*	**Type**
2 days: 32–33	**Work** *Learner will solve problems that relate work, force, and displacement*	Lesson
2 days: 34–35	**Kinetic and Potential Energy** *Learner will solve problems involving kinetic energy and potential energy.*	Lesson
2 days: 36–37	**Relating Work and Energy** *Learner will analyze the relationship between work and energy, including the law of conservation of energy.*	Lesson
2 days: 38–39	**Periodic Motion** *Learner will define and describe periodic motion and solve problems related to it.*	Lesson
2 days: 40–41	**Momentum** *Learner will define momentum and relate it to energy.*	Lesson
2 days: 42–43	**Conservation of Momentum** *Learner will solve problems involving elastic and inelastic collisions in one dimension using conservation of momentum and energy.*	Lesson
2 days: 44–45	**Unit Activity and Discussion—Unit 3**	Unit Activity Discussion
1 day: 46	**Posttest—Unit 3**	Assessment

Unit 4: Waves

Summary
In this unit, you will learn about waves, which include—or can help describe—a wide range of physical phenomena, including earthquake waves, sound waves, and electromagnetic waves. You will learn about the behavior and special properties of waves, such as the ability to bend and to reflect the direction of waves as they travel.

Day	**Activity**/*Objective*	Type
2 days: 47–48	**Introduction to Waves** *Learner will define a wave, distinguish between mechanical and electromagnetic waves, and describe transverse and longitudinal mechanical waves.*	Lesson
2 days: 49–50	**Wave Characteristics** *Learner will describe waves in terms of their fundamental characteristics of velocity, wavelength, frequency (period), and amplitude.*	Lesson
2 days: 51–52	**Universal Wave Equation** *Learner will use the universal wave equation to solve problems involving speed, frequency (period), and wavelength.*	Lesson
2 days: 53–54	**Wave Behaviors** *Learner will describe reflection and interference of both sound and light waves and the refraction and diffraction of light waves.*	Lesson
2 days: 55–56	**Resonance and the Doppler Shift** *Learner will describe and give real-world examples of resonance and the Doppler shift.*	Lesson
2 days: 57–58	**Transmission of Sound** *Learner will describe the production and transmission of sound waves.*	Lesson
2 days: 59–60	**Detecting and Perceiving Sound** *Learner will describe the detection of sound.*	Lesson
2 days: 61–62	**The Electromagnetic Spectrum** *Learner will describe the electromagnetic spectrum.*	Lesson
2 days: 63–64	**Reflection and Refraction of Light** *Learner will describe reflection and refraction, relating them to light.*	Lesson
2 days: 65–66	**Unit Activity and Discussion—Unit 4**	Unit Activity Discussion
1 day: 67	**Posttest—Unit 4**	Assessment

Unit 5: Electric and Magnetic Forces

Summary

In this unit, you will explore electric charges and their interactions with each other. You will also find out about the relationship between electricity and magnetism, and explore some of the special interactions between magnetic and electric forces.

Day	**Activity**/*Objective*	**Type**
2 days: 68–69	**Introduction to Electrostatics** *Learner will describe the types of charges, attraction and repulsion of charges, polarization, and induced charges.*	Lesson
2 days: 70–71	**Coulomb's Law** *Learner will apply Coulomb's law to analyze electric forces.*	Lesson
2 days: 72–73	**Magnets and Their Fields** *Learner will understand the basic properties of magnets, including their interactions, field lines, and relationship to electricity.*	Lesson
2 days: 74–75	**Magnetic Forces** *Learner will apply the right-hand rule to determine the magnetic forces on single charges and current-carrying wires.*	Lesson
2 days: 76–77	**Magnetic Induction** *Learner will describe magnetic induction and relate it to a change in flux.*	Lesson
1 day: 78	**Unit Activity and Discussion—Unit 5**	Unit Activity Discussion
1 day: 79	**Posttest—Unit 5**	Assessment

Unit 6: Electric Circuits

Summary

In this unit, you will learn about simple electric circuits and be able to determine important values related to that circuit, including current, resistance, and voltage.

Day	**Activity**/*Objective*	**Type**
1 day: 80	**Electric Current** *Learner will define conventional electric current and relate it to the direction of electron flow in a conductor and the potential difference across the circuit.*	Lesson

2 days: 81–82	**AC and DC Currents** *Learner will describe and compare alternating current (AC) and direct current (DC).*	Lesson
2 days: 83–84	**Resistance and Ohm's Law** *Learner will describe resistance and relate current and voltage for a resistor using Ohm's law.*	Lesson
2 days: 85–86	**Circuit Diagrams** *Learner will analyze circuit diagrams and describe how to measure voltage and current in a circuit.*	Lesson
2 days: 87–88	**Series and Parallel Circuits** *Learner will describe and analyze both series and parallel connections.*	Lesson
1 day: 89	**Posttest—Unit 6**	Assessment
1 day: 90	**End of Semester Test**	Assessment

Test and Study References

Newtonian Mechanics

(Note: All vectors are expressed in terms of x-components only.)

Physics and Motion

$$v_x = \frac{\Delta x}{\Delta t} \quad \text{and} \quad a_x = \frac{\Delta v_x}{\Delta t}$$

$$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$$

$$v_x = v_{x0} + a_x t$$

$$v_x{}^2 = v_{x0}{}^2 + 2a_x x$$

Newton's Laws

$$\sum F = ma \quad \text{or} \quad F_x = ma_x$$

$$F_f = \mu_s F_N \quad \text{and} \quad F_f = \mu_k F_N$$

$$F_g = mg \quad \text{or} \quad F_g = G\frac{m_1 m_2}{r^2}$$

Energy and Momentum

$$W = Fd \cdot \cos\theta$$

$$KE = \frac{1}{2}mv^2$$

$$PE = mgh$$

$$p_x = mv_x$$

Waves and Optics

$$v = f\lambda$$

$$T = \frac{1}{f}$$

$$n = \frac{c}{v}$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\sin\theta_c = \frac{n_2}{n_1}$$

$$v = 331 + (0.6 \cdot T)$$

Mathematical Formulas

Interpolation

$$y - y_0 = \left[\frac{(y_1 - y_0)}{(x_1 - x_0)}\right] \times (x - x_0)$$

Trigonometry

$$\sin\theta = \frac{opposite}{hypotenuse} = \frac{a}{c}$$

$$\cos\theta = \frac{adjacent}{hypotenuse} = \frac{b}{c}$$

$$\tan\theta = \frac{opposite}{adjacent} = \frac{a}{b}$$

$$\arctan\left(\frac{a}{b}\right) = \theta$$

Electricity and Magnetism

Electric & Magnetic Forces

$$F = k\frac{q_1 q_2}{r^2}$$

$$E = \frac{F}{q} \quad \text{and} \quad E = k\frac{Q}{r^2}$$

$$\Delta V = \frac{W}{q}$$

$$F = qvB$$

$$F = qvB\sin\theta$$

Circuits

$$V = IR$$

$$R = \frac{\rho L}{A}$$

Thermal and Nuclear Energy

$$C° = (F° - 32) \times \left(\frac{5}{9}\right) \quad \text{and} \quad K = C° + 273$$

$$E = mc^2$$

	1												13	14	15	16	17	18
1	1 **H** hydrogen 1.008	2																2 **He** helium 4.00
2	3 **Li** lithium 6.94	4 **Be** beryllium 9.01											5 **B** boron 10.81	6 **C** carbon 12.01	7 **N** nitrogen 14.01	8 **O** oxygen 16.00	9 **F** fluorine 19.00	10 **Ne** neon 20.18
3	11 **Na** sodium 22.99	12 **Mg** magnesium 24.31	3	4	5	6	7	8	9	10	11	12	13 **Al** aluminum 26.98	14 **Si** silicon 28.09	15 **P** phosphorus 30.97	16 **S** sulfur 32.07	17 **Cl** chlorine 35.45	18 **Ar** argon 39.95
4	19 **K** potassium 39.10	20 **Ca** calcium 40.08	21 **Sc** scandium 44.96	22 **Ti** titanium 47.87	23 **V** vanadium 50.94	24 **Cr** chromium 52.00	25 **Mn** manganese 54.94	26 **Fe** iron 55.85	27 **Co** cobalt 58.93	28 **Ni** nickel 58.69	29 **Cu** copper 63.55	30 **Zn** zinc 65.38	31 **Ga** gallium 69.72	32 **Ge** germanium 72.63	33 **As** arsenic 74.92	34 **Se** selenium 78.97	35 **Br** bromine 79.90	36 **Kr** krypton 83.80
5	37 **Rb** rubidium 85.47	38 **Sr** strontium 87.62	39 **Y** yttrium 88.91	40 **Zr** zirconium 91.22	41 **Nb** niobium 92.91	42 **Mo** molybdenum 95.95	43 **Tc** technetium (98)	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
6	55 **Cs** cesium 132.9	56 **Ba** barium 137.3	57–71 *	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium 209	85 **At** astatine 210	86 **Rn** radon 222
7	87 **Fr** francium (223)	88 **Ra** radium (226)	89–103 **	104 **Rf** rutherfordium (267)	105 **Db** dubnium (268)	106 **Sg** seaborgium (269)	107 **Bh** bohrium (270)	108 **Hs** hassium (269)	109 **Mt** meitnerium (278)	110 **Ds** darmstadtium (281)	111 **Rg** roentgenium (280)	112 **Cn** copernicium (285)	113 **Nh** nihonium (286)	114 **Fl** flerovium (289)	115 **Mc** moscovium (289)	116 **Lv** livermorium (293)	117 **Ts** tennessine (294)	118 **Og** oganesson (294)

*	57 **La** lanthanum 138.9	58 **Ce** cerium 140.1	59 **Pr** praseodymium 140.9	60 **Nd** neodymium 144.2	61 **Pm** promethium (145)	62 **Sm** samarium 150.4	63 **Eu** europium 152.0	64 **Gd** gadolinium 157.3	65 **Tb** terbium 158.9	66 **Dy** dysprosium 162.5	67 **Ho** holmium 164.9	68 **Er** erbium 167.3	69 **Tm** thulium 168.9	70 **Yb** ytterbium 173.0	71 **Lu** lutetium 175.0
**	89 **Ac** actinium (227)	90 **Th** thorium 232.0	91 **Pa** protactinium 231.0	92 **U** uranium 238.0	93 **Np** neptunium (237)	94 **Pu** plutonium (244)	95 **Am** americium (243)	96 **Cm** curium (247)	97 **Bk** berkelium (247)	98 **Cf** californium (251)	99 **Es** einsteinium (252)	100 **Fm** fermium (257)	101 **Md** mendelevium (258)	102 **No** nobelium (259)	103 **Lr** lawrencium (262)

	1																	18
1	1 **H** 1.008	2											13	14	15	16	17	2 **He** 4.00
2	3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.31	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
6	55 **Cs** 132.9	56 **Ba** 137.3	57–71 *	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** 209	85 **At** 210	86 **Rn** 222
7	87 **Fr** (223)	88 **Ra** (226)	89–103 **	104 **Rf** (267)	105 **Db** (268)	106 **Sg** (269)	107 **Bh** (270)	108 **Hs** (269)	109 **Mt** (278)	110 **Ds** (281)	111 **Rg** (280)	112 **Cn** (285)	113 **Nh** (286)	114 **Fl** (289)	115 **Mc** (289)	116 **Lv** (293)	117 **Ts** (294)	118 **Og** (294)

*	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
**	89 **Ac** (227)	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)