Syllabus

Integrated Physics and Chemistry, Semester B

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 B, you will begin your study of chemistry. This includes the atomic and molecular structures that result in different chemical properties and the concepts and tools that will enable you to predict chemical properties and chemical reactions. You will learn about key types of chemical relationships and reactions, including solutions and acid-base reactions. Finally, you will extend your knowledge into the areas of thermal and nuclear energy.

Course Goals

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

- Understand the difference between a chemical change and a physical change and understand the basics of atomic theory, which underlies the study of chemistry.
- Be able to use the periodic table to understand atomic structure and predict the chemical behavior of substances.
- Understand the different types of chemical bonding and how they may result in different molecular structures and different chemical properties.

- Investigate the relationships between energy and matter, including phase changes.
- Describe the dissolving process and be able to apply your understanding of the mechanisms associated with chemical solutions.
- Describe the variables that affect reaction rates.
- Describe acids and bases by their properties.
- Apply your knowledge of oxidation and reduction.
- Apply your knowledge of nuclear energy and thermal energy to solve real-world problems.

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 B 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: Matter and Atomic Structure

Summary

In this unit, you will be introduced to the concept of chemical change as opposed to physical change and you will review atomic theory, which underlies the study of chemistry. You will also explore the periodic table, which helps us understand atomic structure and predict the chemical behavior of substances.

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	**Types of Matter** *Learner will identify different types of matter.*	Lesson
2 days: 4–5	**Physical Changes Versus Chemical Changes** *Learner will identify physical and chemical properties and changes.*	Lesson
2 days: 6–7	**Models of the Atom** *Learner will describe the experimental basis for the atom and identify the parts of the atom.*	Lesson
2 days: 8–9	**Isotopes and Atomic Mass** *Learner will calculate average atomic mass from isotopic information.*	Lesson
2 days: 10–11	**The Periodic Table** *Learner will use the periodic table to identify information about an element and to predict element properties.*	Lesson

2 days: 12–13	**Electron Configurations** *Learner will write electron configurations.*	Lesson
2 days: 14–15	**Periodic Trends** *Learner will identify and compare periodic trends from the periodic table.*	Lesson
2 days: 16–17	**Unit Activity and Discussion—Unit 1**	Unit Activity Discussion
1 day: 18	**Posttest—Unit 1**	Assessment

Unit 2: Chemical Bonding

Summary

In this unit, you will learn about chemical bonding and explore how different types of bonds result in different molecular structures and different chemical properties.

Day	**Activity**/*Objective*	Type
2 days: 19–20	**Ionic, Covalent, and Metallic Bonds** *Learner will Identify ionic, covalent, and metallic substances and describe their bonding.*	Lesson
2 days: 21–22	**Compound Names** *Learner will use rules for naming compounds.*	Lesson
2 days: 23–24	**Lewis Structures** *Learner will draw Lewis structures.*	Lesson
2 days: 25–26	**Electronegativity** *Learner will differentiate between ionic, polar covalent, and nonpolar covalent bonds.*	Lesson
2 days: 27–28	**Three-Dimensional Molecules** *Learner will predict the three-dimensional bond shape of a molecule.*	Lesson
2 days: 29–30	**Unit Activity and Discussion—Unit 2**	Unit Activity Discussion
1 day: 31	**Posttest—Unit 2**	Assessment

Unit 3: Chemical Reactions

Summary
In this unit, you will learn about chemical reactions, including acid-base reactions and oxidation-reduction reactions. You will also learn to use the concept of the mole and learn to balance chemical equations.

Day	**Activity**/*Objective*	Type
2 days: 32–33	**Moles and Molar Mass** *Learner will identify a mole and calculate molar mass.*	Lesson
2 days: 34–35	**Balancing Chemical Equations** *Learner will balance chemical equations.*	Lesson
2 days: 36–37	**Types of Reactions** *Learner will identify different types of chemical reactions.*	Lesson
2 days: 38–39	**Properties of Acids and Bases** *Learner will identify properties of acids and bases.*	Lesson
2 days: 40–41	**Oxidation and Reduction** *Learner will describe the process of oxidation and reduction.*	Lesson
2 days: 42–43	**Unit Activity and Discussion—Unit 3**	Unit Activity Discussion
1 day: 44	**Posttest—Unit 3**	Assessment

Unit 4: Kinetic Molecular Theory

Summary
In this unit, you will investigate the relationships between energy and matter, including phase changes.

Day	**Activity**/*Objective*	Type
2 days: 45–46	**Energy and Chemical Reactions** *Learner will identify different forms of energy and how they relate to chemical reactions.*	Lesson

2 days: 47–48	**Endothermic and Exothermic Reactions** *Learner will differentiate between endothermic and exothermic processes.*	Lesson
2 days: 49–50	**Kinetic Theory** *Learner will describe the kinetic theory.*	Lesson
2 days: 51–52	**States of Matter** *Learner will differentiate between the states of matter.*	Lesson
2 days: 53–54	**Heating Curves and Phase Changes** *Learner will understand a heating curve and describe heat changes during phase changes.*	Lesson
2 days: 55–56	**Unit Activity and Discussion—Unit 4**	Unit Activity Discussion
1 day: 57	**Posttest—Unit 4**	Assessment

Unit 5: Solutions

Summary

In this unit, you will be able to describe the dissolving process and be able to apply your understanding of the mechanisms associated with chemical solutions. You will also be able to describe the variables that affect reaction rates for a chemical reaction.

Day	**Activity**/*Objective*	Type
2 days: 58–59	**The Dissolving Process** *Learner will Describe the dissolving process.*	Lesson
2 days: 60–61	**Rate of Dissolution** *Learner will identify factors that affect rate of dissolution.*	Lesson
2 days: 62–63	**Degrees of Saturation** *Learner will identify different types of solutions based on degrees of saturation.*	Lesson
2 days: 64–65	**Colligative Properties of a Solution** *Learner will identify and describe colligative properties of solutions.*	Lesson
2 days: 66–67	**Reaction Rates** *Learner will describe reaction rates and identify factors that affect them.*	Lesson

2 days: 68–69	**Activation Energy** *Learner will understand activation energy and describe how catalysts affect it.*	Lesson
2 days: 70–71	**Unit Activity and Discussion—Unit 5**	Unit Activity Discussion
1 day: 72	**Posttest—Unit 5**	Assessment

Unit 6: Thermal and Nuclear Energy

Summary
In this unit, you will explore the relationship between temperature, heat, and energy, understand the ways in which heat can be transferred from one body to another. You will also explore a modern physics understanding of matter regarding nuclear forces and nuclear interactions.

Day	**Activity**/*Objective*	**Type**
2 days: 73–74	**Temperature, Energy, and Heat** *Learner will define temperature, thermal energy, conduction, convection, and radiation.*	Lesson
2 days: 75–76	**Specific Heat and Latent Heat** *Learner will define specific heat and latent heat and calculate heat transfer when systems reach thermal equilibrium.*	Lesson
2 days: 77–78	**Heat and the Earth** *Learner will explain heat in terms of its global effect on the earth.*	Lesson
2 days: 79–80	**Nuclear Forces** *Learner will describe strong nuclear force and calculate mass-energy equivalence, comparing it to the binding energy of the nucleus.*	Lesson
2 days: 81–82	**Radioactive Decay** *Learner will identify naturally occurring radioactive isotopes and the ways that they decay.*	Lesson
2 days: 83–84	**Nuclear Fission and Fusion** *Learner will describe nuclear fission and fusion.*	Lesson
3 days: 85–87	**Unit Activity and Discussion—Unit 6**	Unit Activity Discussion

1 day: 88	**Posttest—Unit 6**	Assessment
1 day: 89	**Semester Review**	Review
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												13	14	15	16	17	18
1	1 **H** 1.008	2																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)