TEXAS TECH UNIVERSITY
TTU K-12™

IPC 1B
Integrated Physics and Chemistry, Second Semester
(v.4.0)

To the Student:

After your registration is complete and your proctor has been approved, you may take the Credit by Examination for IPC 1B.

WHAT TO BRING

- calculator
- IPC formula chart, constants/conversion chart, and Periodic Table of Elements included in this document
- several sharpened No. 2 pencils
- blank lined scratch paper

ABOUT THE EXAM

The examination for the second semester of Integrated Physics and Chemistry consists of 51 multiple choice, short answer, and problem-solving questions. The exam is based on the Texas Essential Knowledge and Skills (TEKS) for this subject. The full list of TEKS is included in this document (it is also available online at the Texas Education Agency website). The TEKS outline specific topics covered in the exam, as well as more general areas of knowledge and levels of critical thinking. Use the TEKS to focus your study in preparation for the exam. TEKS covered in this semester are indicated by a checkmark; the exam will focus on the checkmarked TEKS, but may touch on any of the full list.

The CBE for IPC 1B must be completed in one sitting without aid from persons, notes, textbooks, or electronic devices, but you may use a calculator and a formula chart during the entire examination. Where appropriate, show formulas used, essential steps for the solutions of problems, clearly indicate answers, and give appropriate units.

The examination will take place under supervision, and the recommended time limit is three hours. A percentage score from the examination will be reported to the official at your school.

A list of key concepts is included in this document to focus your studies. It is important to prepare adequately. There is no specific textbook for this content. Since questions are not taken from any one source, you may use any Integrated Physics and Chemistry or Physical Science textbook to assist you in your preparation.

Good luck on your examination!

IPC 1B Key Concepts

Topics covered on this exam are:

- motion;
- forces;
- momentum;
- energy;
- waves;
- electricity;
- thermal energy;
- energy conservation;
- connections between physics, chemistry, and other scientific disciplines; and
- physics-related careers.

IPC 1B CBE Charts

EXIT LEVEL SCIENCE CHART

$\text{Density} = \dfrac{\text{mass}}{\text{volume}}$	$D = \dfrac{m}{v}$
$\left(\text{heat gained or lost}\right) = \left(\text{mass}\right)\left(\text{change in temperature}\right)\left(\text{specific heat}\right)$	$Q = (m)(\Delta T)(C_p)$
$\text{Speed} = \dfrac{\text{distance traveled}}{\text{time}}$	$v = \dfrac{d}{t}$
$\text{Acceleration} = \dfrac{\text{final velocity} - \text{initial velocity}}{\text{change in time}}$	$a = \dfrac{v_f - v_i}{\Delta t}$
Momentum = mass × velocity	$p = mv$
Force = mass × acceleration	$F = ma$
Work = force × distance	$W = Fd$
$\text{Power} = \dfrac{\text{work}}{\text{time}}$	$P = \dfrac{W}{t}$
$\%\ \text{efficiency} = \dfrac{\text{work output}}{\text{work input}} \times 100$	$\% = \dfrac{W_O}{W_I} \times 100$
$\text{Kinetic energy} = \dfrac{1}{2}(\text{mass} \times \text{velocity}^2)$	$KE = \dfrac{mv^2}{2}$
Gravitational potential energy = mass × acceleration due to gravity × height	$PE = mgh$
$\text{Energy} = \text{mass} \times (\text{speed of light})^2$	$E = mc^2$
Velocity of a wave = frequency × wavelength	$v = f\lambda$
$\text{Current} = \dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
Electrical power = voltage × current	$P = VI$
Electrical energy = power × time	$E = Pt$

Constants/Conversions		
g = acceleration due to gravity = 9.8 m/s^2		
c = speed of light = 3×10^8 m/s		
speed of sound = 343 m/s at sea level and 20°C		
1 cm^3 = 1 mL		
1 wave cycle/second = 1 hertz (Hz)		
1 calorie (cal) = 4.18 joules		
1000 calories (cal) = 1 Calorie (Cal) = 1 kilocalorie (kcal)		
newton (N) = kg m/s^2		
joule (J) = N m		
watt (W) = J/s = N m/s		
volt (V)	ampere (A)	ohm (Ω)

Periodic Table of the Elements

Key	
Atomic number	14
Symbol	Si
Atomic mass	28.086
Name	Silicon

Period	Group 1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 **H** 1.008 Hydrogen																	2 **He** 4.0026 Helium
2	3 **Li** 6.941 Lithium	4 **Be** 9.012 Beryllium											5 **B** 10.81 Boron	6 **C** 12.011 Carbon	7 **N** 14.007 Nitrogen	8 **O** 15.999 Oxygen	9 **F** 18.998 Fluorine	10 **Ne** 20.179 Neon
3	11 **Na** 22.990 Sodium	12 **Mg** 24.305 Magnesium											13 **Al** 26.982 Aluminum	14 **Si** 28.086 Silicon	15 **P** 30.974 Phosphorus	16 **S** 32.066 Sulfur	17 **Cl** 35.453 Chlorine	18 **Ar** 39.948 Argon
4	19 **K** 39.098 Potassium	20 **Ca** 40.08 Calcium	21 **Sc** 44.956 Scandium	22 **Ti** 47.88 Titanium	23 **V** 50.942 Vanadium	24 **Cr** 51.996 Chromium	25 **Mn** 54.938 Manganese	26 **Fe** 55.847 Iron	27 **Co** 58.933 Cobalt	28 **Ni** 58.69 Nickel	29 **Cu** 63.546 Copper	30 **Zn** 65.39 Zinc	31 **Ga** 69.72 Gallium	32 **Ge** 72.61 Germanium	33 **As** 74.922 Arsenic	34 **Se** 78.96 Selenium	35 **Br** 79.904 Bromine	36 **Kr** 83.80 Krypton
5	37 **Rb** 85.468 Rubidium	38 **Sr** 87.62 Strontium	39 **Y** 88.906 Yttrium	40 **Zr** 91.224 Zirconium	41 **Nb** 92.906 Niobium	42 **Mo** 95.94 Molybdenum	43 **Tc** (98) Technetium	44 **Ru** 101.07 Ruthenium	45 **Rh** 102.906 Rhodium	46 **Pd** 106.42 Palladium	47 **Ag** 107.868 Silver	48 **Cd** 112.41 Cadmium	49 **In** 114.82 Indium	50 **Sn** 118.71 Tin	51 **Sb** 121.763 Antimony	52 **Te** 127.60 Tellurium	53 **I** 126.904 Iodine	54 **Xe** 131.29 Xenon
6	55 **Cs** 132.905 Cesium	56 **Ba** 137.33 Barium	57 **La** 138.906 Lanthanum	72 **Hf** 178.49 Hafnium	73 **Ta** 180.948 Tantalum	74 **W** 183.84 Tungsten	75 **Re** 186.207 Rhenium	76 **Os** 190.23 Osmium	77 **Ir** 192.22 Iridium	78 **Pt** 195.08 Platinum	79 **Au** 196.967 Gold	80 **Hg** 200.59 Mercury	81 **Tl** 204.383 Thallium	82 **Pb** 207.2 Lead	83 **Bi** 208.980 Bismuth	84 **Po** (209) Polonium	85 **At** (210) Astatine	86 **Rn** (222) Radon
7	87 **Fr** (223) Francium	88 **Ra** 226.025 Radium	89 **Ac** 227.028 Actinium	104 **Rf** (261) Rutherfordium	105 **Db** (262) Dubnium	106 **Sg** (263) Seaborgium	107 **Bh** (262) Bohrium	108 **Hs** (265) Hassium	109 **Mt** (266) Meitnerium	110 (269)								

Mass numbers in parentheses are those of the most stable or most common isotope.

Series														
Lanthanide Series	58 **Ce** 140.12 Cerium	59 **Pr** 140.908 Praseodymium	60 **Nd** 144.24 Neodymium	61 **Pm** (145) Promethium	62 **Sm** 150.36 Samarium	63 **Eu** 151.97 Europium	64 **Gd** 157.25 Gadolinium	65 **Tb** 158.925 Terbium	66 **Dy** 162.50 Dysprosium	67 **Ho** 164.930 Holmium	68 **Er** 167.26 Erbium	69 **Tm** 168.934 Thulium	70 **Yb** 173.04 Ytterbium	71 **Lu** 174.967 Lutetium
Actinide Series	90 **Th** 232.038 Thorium	91 **Pa** 231.036 Protactinium	92 **U** 238.029 Uranium	93 **Np** 237.048 Neptunium	94 **Pu** (244) Plutonium	95 **Am** (243) Americium	96 **Cm** (247) Curium	97 **Bk** (247) Berkelium	98 **Cf** (251) Californium	99 **Es** (252) Einsteinium	100 **Fm** (257) Fermium	101 **Md** (258) Mendelevium	102 **No** (259) Nobelium	103 **Lr** (262) Lawrencium

Revised November 30, 2006

Texas Essential Knowledge and Skills

IPC 1B – Integrated Physics and Chemistry, Second Semester

TTU: IPC 1B CBE, v.4.0	
TEKS: §112.38. Integrated Physics and Chemistry (One-Half Credit)	
TEKS Requirement (Secondary)	**TEKS Covered**
§112.38. Integrated Physics and Chemistry, Beginning with School Year 2010-2011.	
(a) General requirements. Students shall be awarded one credit for successful completion of this course. Prerequisites: none. This course is recommended for students in Grade 9 or 10.	
(b) Introduction.	
(1) Integrated Physics and Chemistry. In Integrated Physics and Chemistry, students conduct laboratory and field investigations, use scientific methods during investigation, and make informed decisions using critical thinking and scientific problem solving. This course integrates the disciplines of physics and chemistry in the following topics: force, motion, energy, and matter.	
(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.	
(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.	
(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).	
(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.	
(c) Knowledge and skills.	
(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:	
(A) demonstrate safe practices during laboratory and field investigations; and	✓
(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.	✓
(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:	
(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;	✓
(B) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology;	✓
(C) collect data and make measurements with precision;	✓
(D) organize, analyze, evaluate, make inferences, and predict trends from data; and	✓
(E) communicate valid conclusions.	✓
(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions. The student is expected to:	
(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	✓
(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;	✓

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TEKS: §112.38. Integrated Physics and Chemistry (One-Half Credit)	
TEKS Requirement (Secondary)	**TEKS Covered**
(C) draw inferences based on data related to promotional materials for products and services;	✓
(D) evaluate the impact of research on scientific thought, society, and the environment;	✓
(E) describe connections between physics and chemistry and future careers; and	✓
(F) research and describe the history of physics and chemistry and contributions of scientists.	✓
(4) Science concepts. The student knows concepts of force and motion evident in everyday life. The student is expected to:	
(A) describe and calculate an object's motion in terms of position, displacement, speed, and acceleration;	✓
(B) measure and graph distance and speed as a function of time using moving toys;	✓
(C) investigate how an object's motion changes only when a net force is applied, including activities and equipment such as toy cars, vehicle restraints, sports activities, and classroom objects;	✓
(D) assess the relationship between force, mass, and acceleration, noting the relationship is independent of the nature of the force, using equipment such as dynamic carts, moving toys, vehicles, and falling objects;	✓
(E) apply the concept of conservation of momentum using action and reaction forces such as students on skateboards;	✓
(F) describe the gravitational attraction between objects of different masses at different distances, including satellites; and	✓
(G) examine electrical force as a universal force between any two charged objects and compare the relative strength of the electrical force and gravitational force.	✓
(5) Science concepts. The student recognizes multiple forms of energy and knows the impact of energy transfer and energy conservation in everyday life. The student is expected to:	
(A) recognize and demonstrate that objects and substances in motion have kinetic energy such as vibration of atoms, water flowing down a stream moving pebbles, and bowling balls knocking down pins;	✓
(B) demonstrate common forms of potential energy, including gravitational, elastic, and chemical, such as a ball on an inclined plane, springs, and batteries;	✓
(C) demonstrate that moving electric charges produce magnetic forces and moving magnets produce electric forces;	✓
(D) investigate the law of conservation of energy;	✓
(E) investigate and demonstrate the movement of thermal energy through solids, liquids, and gases by convection, conduction, and radiation such as in weather, living, and mechanical systems;	✓
(F) evaluate the transfer of electrical energy in series and parallel circuits and conductive materials;	✓
(G) explore the characteristics and behaviors of energy transferred by waves, including acoustic, seismic, light, and waves on water as they superpose on one another, bend around corners, reflect off surfaces, are absorbed by materials, and change direction when entering new materials;	✓
(H) analyze energy conversions such as those from radiant, nuclear, and geothermal sources; fossil fuels such as coal, gas, oil; and the movement of water or wind; and	✓
(I) critique the advantages and disadvantages of various energy sources and their impact on society and the environment.	✓
(6) Science concepts. The student knows that relationships exist between the structure and properties of matter. The student is expected to:	
(A) examine differences in physical properties of solids, liquids, and gases as explained by the arrangement and motion of atoms, ions, or molecules of the substances and the strength of the forces of attraction between those particles;	
(B) relate chemical properties of substances to the arrangement of their atoms or molecules;	
(C) analyze physical and chemical properties of elements and compounds such as color, density, viscosity, buoyancy, boiling point, freezing point, conductivity, and reactivity;	

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TEKS: §112.38. Integrated Physics and Chemistry (One-Half Credit)	
TEKS Requirement (Secondary)	**TEKS Covered**
(D) relate the physical and chemical behavior of an element, including bonding and classification, to its placement on the Periodic Table; and	
(E) relate the structure of water to its function as a solvent and investigate the properties of solutions and factors affecting gas and solid solubility, including nature of solute, temperature, pressure, pH, and concentration.	
(7) Science concepts. The student knows that changes in matter affect everyday life. The student is expected to:	
(A) investigate changes of state as it relates to the arrangement of particles of matter and energy transfer;	
(B) recognize that chemical changes can occur when substances react to form different substances and that these interactions are largely determined by the valence electrons;	
(C) demonstrate that mass is conserved when substances undergo chemical change and that the number and kind of atoms are the same in the reactants and products;	
(D) analyze energy changes that accompany chemical reactions such as those occurring in heat packs, cold packs, and glow sticks and classify them as exothermic or endothermic reactions;	
(E) describe types of nuclear reactions such as fission and fusion and their roles in applications such as medicine and energy production; and	
(F) research and describe the environmental and economic impact of the end-products of chemical reactions such as those that may result in acid rain, degradation of water and air quality, and ozone depletion.	
Source: The provisions of this §112.38 adopted to be effective August 4, 2009, 34 TexReg 5063.	