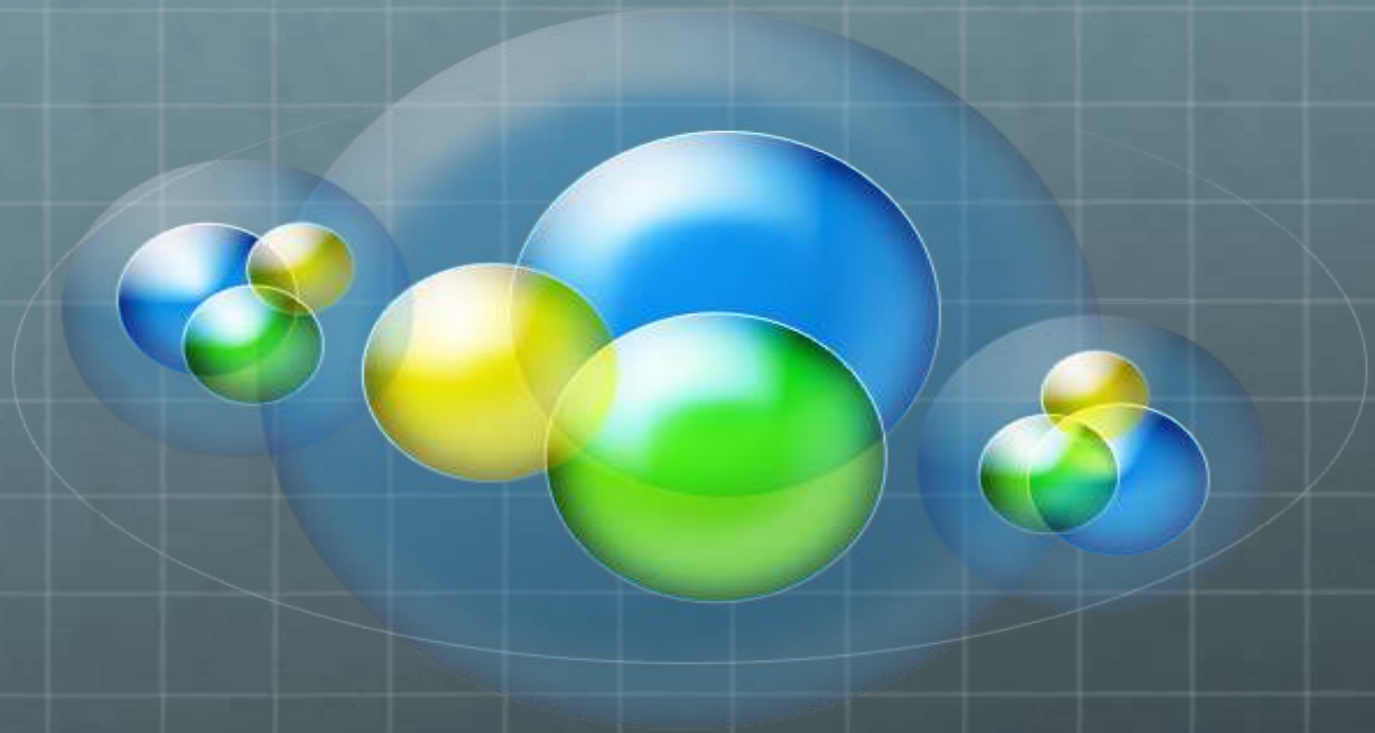


Intro to UIL Science

2020-2021

The Science Contest

- Biology, Chemistry & Physics are all combined on one exam, with awards given for each subject and for overall score.
- The exam is both an individual and a team competition.
- The contest covers a broad base of knowledge, and models STEM degree requirements at most Universities.

Contest Structure

- 60 Multiple Choice Questions, which are divided into 20 of each topic Biology, Chemistry & Physics.
- Contestants are given 6 pts. for a correct answer, 0 pts. for unanswered questions, and lose 2 pts. for incorrect answers.
- The best possible answer is the correct answer.

Academic Meets 2021

- Invitational Meets (practice - not governed by UIL)

  A: Jan 8 – Feb 6 **B**: Feb 12 – Mar 13

- District Meet : Mar 22 – 27
- Regional Meet: Apr 16 – 17
- State Meet: April 29 – May 1

Some Contest Rules

- Contestants have up to 2 hours, but must remain for at least 30 minutes.
- You may use additional scratch paper provided by the contest director.
- Simple Scientific Calculators
  - Casio FX-260Solar
  - Sharp EL-501X
  - TI-30Xa
  - TI-30X II or TI-30X IIs

Biology

Three Levels of Questions

1. **Knowledge and Comprehension:** Advanced recall and identification of subject matter. 25%
2. **Application and Analysis:** Demonstration of quantitative reasoning using and generating graphs and data. 50%
3. **Synthesis and Evaluation:** Using information and prior content knowledge to formulate conclusions and generate hypotheses. 25%

The Test(s) - Normally

- Increase in difficulty
  - Content AND type of question

- Invitational A: mostly basic content, a few higher level questions

- Invitational B: expands the content type from Invitational A, more difficult, more like District

The Test(s) - Normally

- District: Expands on both A and B contents, introduces new content for Regional and State
- Regional: More higher-level Bloom's and advanced content
- State: A mixed bag, at least one really "out there" question, combines topics

Ten Main Topics

1. **Relationship Between Structure and Function**
   - Basic biochemistry, cell biology, biological membranes, membrane transport, structure and function of organic macromolecules

2. **Cellular and Acellular Replication**
   - Cell cycle, regulation of the cell cycle, DNA replication, genome structure, meiosis and sexual reproduction, viral replication

Ten Main Topics

3. **Energy Transformations**
   - Metabolism, cellular respiration, photosynthesis, enzymes

4. **Gene Expression**
   - Protein synthesis, regulation of gene expression, effects of mutations

5. **Genetics and Inheritance**
   - Mendelian inheritance, non-Mendelian inheritance, genetic crosses, DNA technology

Ten Main Topics

6. **Evolution**
   - Natural selection, reproductive success, microevolution (selection, mutation, recombination migration, genetic drift, gene flow), evidence of macroevolution (speciation, extinction), evidence for unity in diversity

7. **Origin and Diversity of life**
   - Taxonomy, domains of life, animal and plant behavior, biological hierarchy

Ten Main Topics

8. **Ecology and the Environment**
   - Population biology, community dynamics, organism relationships, biogeochemical cycles, ecosystem stability

9. **Basic Human Anatomy & Physiology**
   - Tissue types and corresponding cell types, homeostasis (regulation, effects of imbalance), organ systems (any of them!)

Ten Main Topics

10. Diseases

- Eukaryotic diseases, viral diseases, bacterial diseases, pathogenesis, etiologic agents, and disease sign or symptoms (differential diagnosis)
  - The focus this year:
    1. Eukaryotic diseases
    2. “In the news”

HINTS!!

- ***Usually*** two from each main topic
  - Almost never from the same subtopic in a single test
  - Attempt to spread subtopics across tests
  - Topics become more blurred as tests progress, especially State test
- Questions sometimes piggy back on content from other tests
  - Study Tip: Determine why the incorrect answers are wrong, or in what situation/context could they be correct
  - Look up incorrect answers to learn about them
- Bolded words in textbooks are super helpful for creating a foundation
- Diseases
  - Eukaryotes: worms, protists, fungi, vectors
  - In the news…CDC, WHO, NIH, public health

“Piggy Back” Questions

Invitational B: The *cis* face of the Golgi apparatus generally faces towards the

A. plasma membrane.
B. nucleus.
C. endoplasmic reticulum.
D. mitochondria.
E. nucleolus.

District: Modified proteins leaving the Golgi apparatus in secretory vesicles would do so on the_____side of the Golgi body.

A. cis
B. trans
C. cytoplasmic
D. exocytosis
E. endocytosis

Sample Questions

Relationship Between Structure and Function

- Basic biochemistry, cell biology, biological membranes, membrane transport, structure and function of organic macromolecules

Example Question – Level 1

Phospholipids are found in _____.

A) membranes
B) DNA
C) the cytosol
D) proteins

Knowledge and Comprehension

Example Question – Level 2

Molecule X is polar and at a higher concentration within the interstitial fluid than within the cytosol of a cell. Movement of X into the cell will likely occur via _____.

A) active transport

B) simple diffusion

C) facilitated diffusion

D) secondary active transport

E) a pump

Application and Analysis

Example Question – Level 3

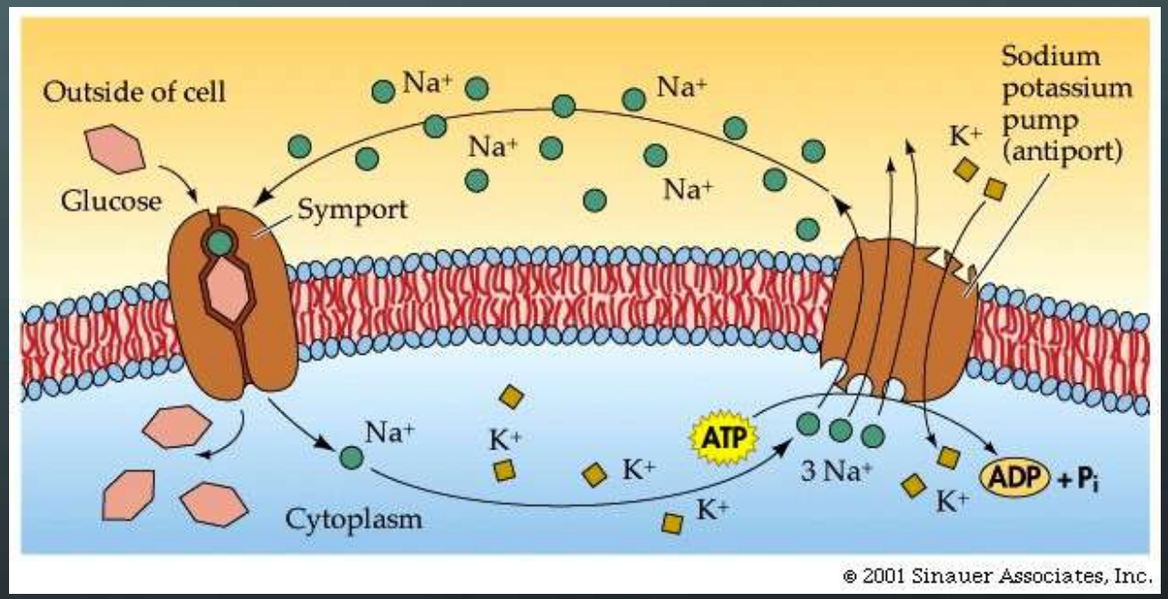
Examine the image. If export of Na^+ could be blocked, which of the following would be an effect?

A) Glucose would decrease inside the cell.

B) More ATP would be hydrolyzed.

C) K^+ would increase in the cytosol.

D) Na^+ would easily diffuse across the membrane.



Synthesis and Evaluation

Chemistry

UIL Chemistry Exams

- 20 multiple choice questions taken from 13 topic areas
- At least one question from each topic on each exam
- Some real world, situational problems
- Some problems with pictures
- Has to fit the three page, two-column test format

Topics in Chemistry

1. Fundamentals
2. Stoichiometry
3. Atomic Theory
4. Chemical Bonding and Structure
5. Gases
6. Liquids and Solids
7. Thermodynamics
8. Physical Equilibria
9. Chemical Equilibria
10. Acids and Bases
11. Solubility Equilibria
12. Electrochemistry
13. Chemical Kinetics

Questions in Chemistry

Each exam will have at least one question from each of the 13 topic areas.

Invitationals A & B
Generally these two exams have the easiest types of questions. Very straightforward information and calculations. Hint: if you see a definition question here, you're gonna need to know it later…

District
The questions go a little deeper into the subject matter. Some problems will be complex in nature but overall, this is a notch down in difficulty from the regional and state exams. Some problems present a situation where the pathway to the answer is not immediately apparent.

Regional and State
Problems will be more complex than on previous exams. More quantitative problems, with multi-step calculations required to get to the answer. Equilibrium problems will require more algebra to solve them. Some problems are designed to take more time. Sometimes the approach to solving the problem is not obvious, and some critical thinking is involved before the problem can be solved.

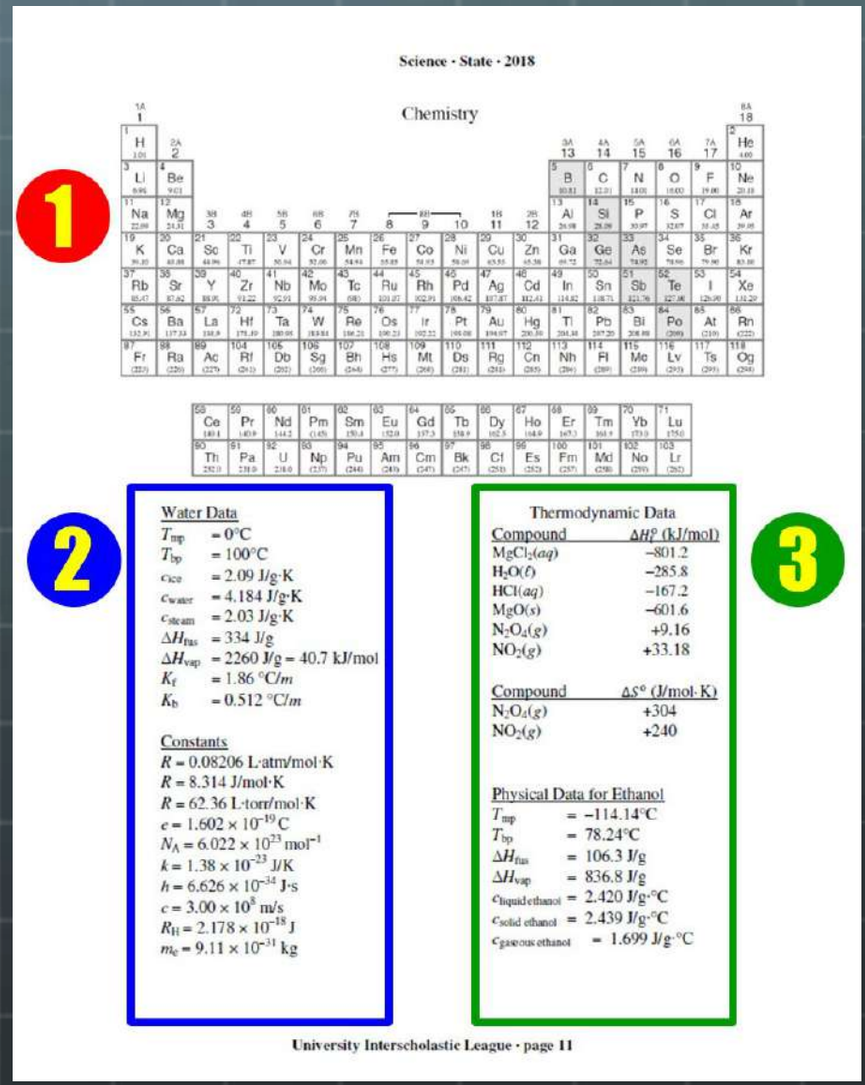
The Chemistry Data Sheet

1) a periodic table

2) water data and commonly used constants

3) information specific to this exam

Sometimes this information is embedded in the problems



Invitational A through State

- "The same test," only harder
- Scalable problems
- Increasingly quantitative
- Quantitative problems have more steps
- More critical thinking – not just applying a formula

Scalable Problems

INVITATIONAL A: What is the molar solubility of barium bromate, $Ba(BrO_3)_2$? $K_{sp} = 2.43 \times 10^{-4}$

INVITATIONAL B: What is the molar solubility of barium bromate, $Ba(BrO_3)_2$, in grams per liter? $K_{sp} = 2.43 \times 10^{-4}$

DISTRICT: 50 grams of solid barium bromate are added to 2.0 liters of water, and 31 grams of the solid dissolves. If 2.0 liters of water are added to the solution, how much additional barium bromate will dissolve?

Ways to make problems harder

- Give the chemical name instead of the formula
- Provide necessary information in different units
- Don't balance the equation for the reaction
- Add more steps to a multi-step problem
- Ask about a quantity that doesn't appear explicitly in the equation. For example, PV=nRT includes density, molecular weight, and the mass of the sample.

Quantitative and conceptual problems

- Quantitative problems are often seen as more difficult because of the math, because you need to know a formula, or just because the problem takes longer to solve
- They don't like to ask "you know it or you don't" conceptual questions. No trivia questions.
- If they ask a definition, expect that you'll need to know that word or concept on a later test
- Conceptual questions are not necessarily easier, especially when they involve common misconceptions.

Real world situational problems

A student tries to make 1000 mL of 0.500 M $ZnCl_2$ by combining 100 mL of a 5.00 M stock solution with 1000 mL of water. He quickly realizes his mistake, and decides to add more stock solution to the new solution to bring the final concentration to 0.500 M. How much additional stock solution should he add?

A chemist performs a crude titration by dropping NaOH pellets into a 50.0 mL solution of 2.24 M HNO_3 and counting how many pellets it takes to reach the phenolphthalein endpoint. If his NaOH is 96.7% pure and each NaOH pellet weighs 0.1602 grams, how many pellets will he have to add to make the solution turn pink?

Be sure to know these

- Naming compounds from formulas and writing formulas from names
- Calculating moles
- Stoichiometry!
- Using equalities as unit conversion factors

C01. For the reaction

$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$$

Hint: 46 g/mol 18 g/mol 63 g/mol 30 g/mol

What is the maximum amount of HNO_3 that could be formed from 184 g of NO_2 and 27 g of H_2O?

a) 126 g

b) 211 g

c) 94.5 g

d) 25.3 g

e) 168 g

C02. Which of the following liquids has the highest vapor pressure?

a) H_2O

b) C_5H_{12}

c) C_2H_5OH

d) $C_{10}H_{12}$

C03. The heat of combustion ($\Delta H°$) for propane is 2220 kJ/mol. How many kJ of energy are released when 5.00 L of propane at 2.45 atm and 25°C is burned?

a) 1110 kJ

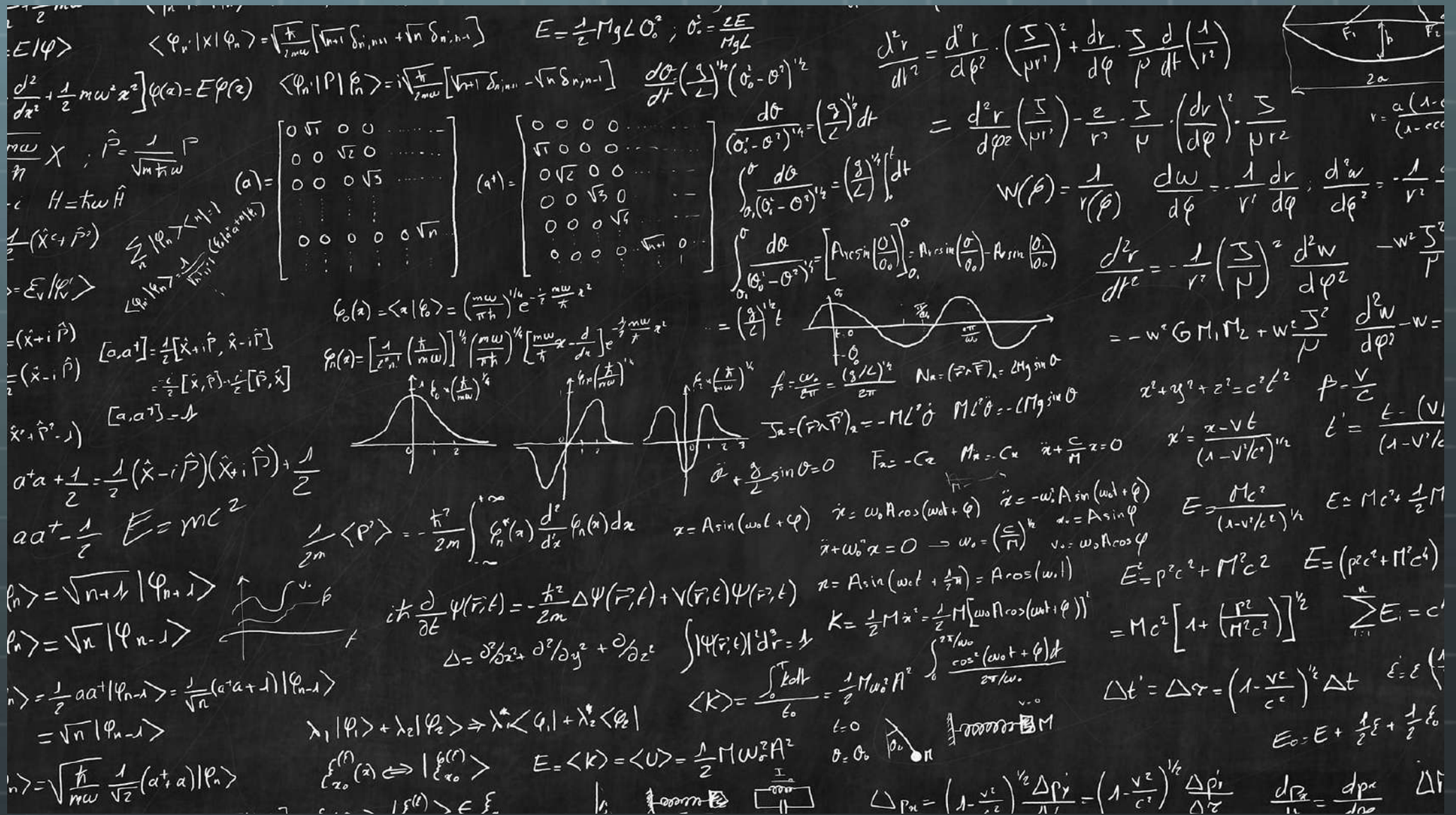
b) 2220 kJ

c) 1875 kJ

d) 555 kJ

e) 3330 kJ

Physics



The 20 questions in Physics

- There will be 3 directed study questions from "Seven Brief Lessons on Physics" by Rovelli.
- Variety of question types: conceptual, symbolic, and numeric questions. Most will be numerical.
- There is a range of difficulty on each contest
- Problems that require vector operations expressed in unit vector notation & calculus will be included on the state contest to help better differentiate the scores for the top students.

Topics by Question:

- **Physics Questions P1 – P3** will be from “Seven Brief Lessons on Physics” by Carlo Rovelli.
- **Physics Question P4** will be from the field of **Astronomy**.
- **Physics Question P5** will be about **Measurement/Dimensional Analysis/Significant Figures/Order of Magnitude**.
- **Physics Question P6** will be about **Uniformly Accelerated Motion**.
- **Physics Question P7** will be about **Forces**.
- **Physics Question P8** will be about **Work/Energy/Power/Momentum**.

Topics by Question:

- **Physics Question P9** will be about **Circular and Rotational Motion/Equilibrium**.
- **Physics Question P10** will be about **Waves/Sound/ Harmonic Motion**.
- **Physics Question P11** will be about **Fluid Statics and Dynamics/ Thermodynamics.**
- **Physics Question P12** will be about **DC Circuits/Resistors/Capacitors**.
- **Physics Question P13** will be about **Electric Fields and Forces/Electric Potential/Gauss' Law**.
- **Physics Question P14** will be about **Magnetic Fields and Forces/Magnetic Materials/Ampere's Law**.

Topics by Question:

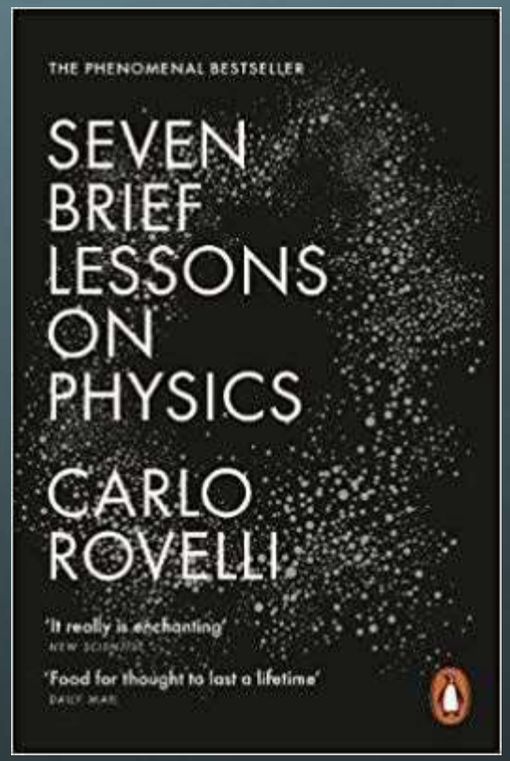
- **Physics Question P15** will be about **Faraday's Law/Induction/EM Oscillation and Waves/AC Circuits**.
- **Physics Question P16** will be about **Geometric Optics/Wave Optics**.
- **Physics Question P17** will be about **Modern Physics/Quantum Physics**.
- **Physics Question P18** will be about **Nuclear Physics/Particle Physics**.
- **Physics Question P19** will be a wildcard question from the topics traditionally covered in a Physics 1 course.
- **Physics Question P20** will be a wildcard question from the topics traditionally covered in a Physics 2 course.

Physics Directed Study Text

Seven Brief Lessons on Physics

by

Carlo Rovelli



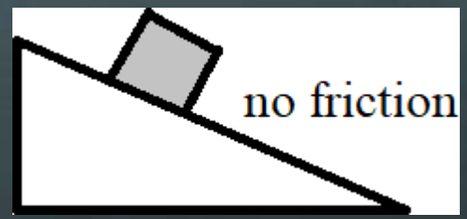
Directed Study Questions

- Invitational A – chapters 1-2
- Invitational B – chapters 1-2-3
- District – chapters 3-4
- Regional – chapters 4-5-6
- State – chapters 5-6-7

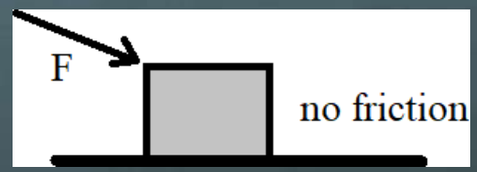
Each Test Increases in Difficulty

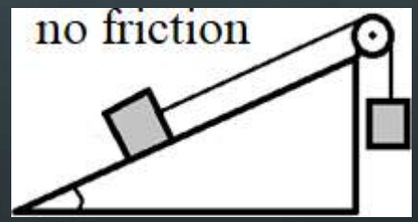
for example, consider questions from P07: Forces

Level 1: Invitational

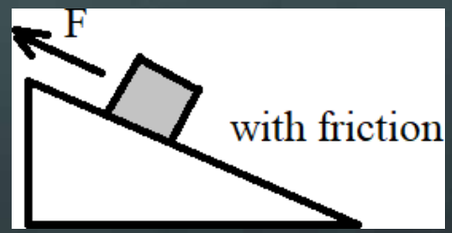


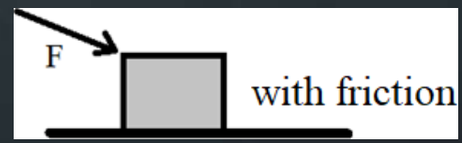
Level 2: District





Level 3: Region and State





Sample Physics Questions

The most intense radiation belt in the solar system is a torus of plasma around Jupiter. This torus is associated with which moon of Jupiter?

A) Amalthea
B) Callisto
C) Ganymede
D) Io
E) Europa

A car travelling at 20.0m/s applies its brakes. After 2.50seconds, the car has slowed to 8.00m/s. How far did the car travel while it was slowing down?

A) 15.0 m
B) 21.0 m
C) 30.0 m
D) 35.0 m
E) 65.0 m

You stand near a long, straight, high power DC electric line. When you are 4.50m away from the power line, you measure the magnetic field strength to be 2600.0 Gauss. To produce this field, what must be the current flowing in the power line?

A) 5.85×10^{4} A

B) 9.31×10^{4} A

C) 1.17×10^{5} A

D) 3.68×10^{5} A

E) 7.35×10^{5} A

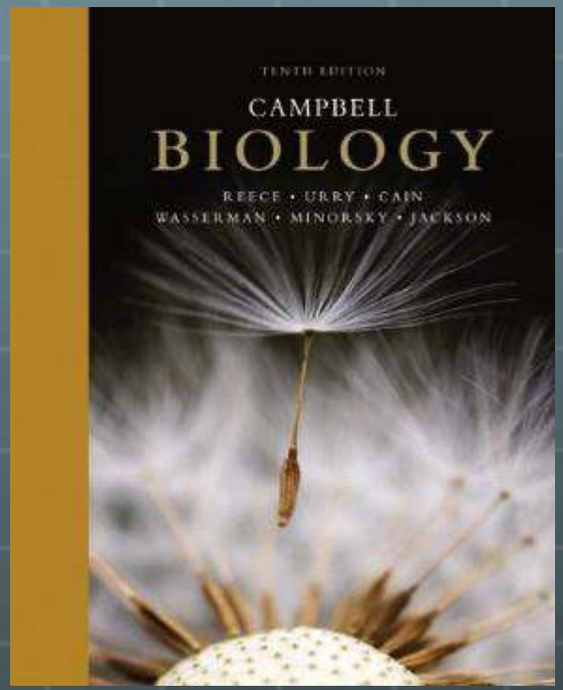
HINTS!!

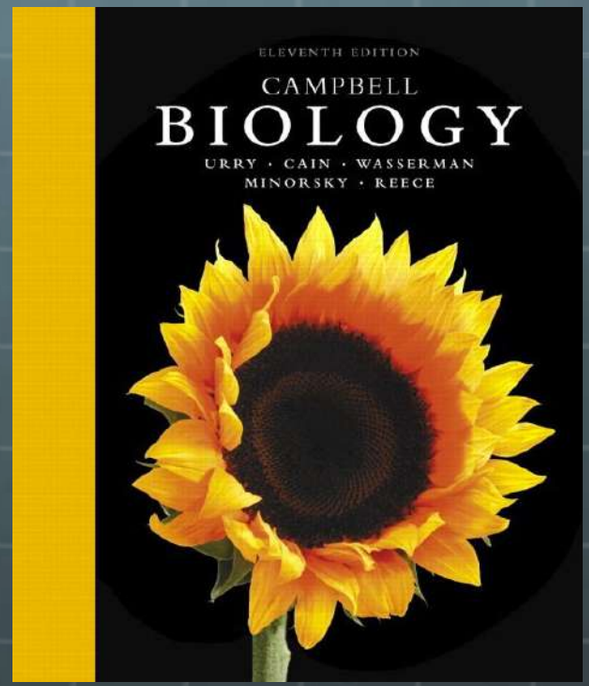
- Watch units!
- Make diagrams with labels (free body diagrams!)
- Look for order of magnitude answers
- Work backwards
- Know your formulas
- If new to Physics: focus on a few easy topics, skip other questions.
- Easier question numbers are P05, P06, P08, P10, P12, P16
- Read the book! P01-P03 are essentially free points.
- P19-P20 are laboratory-based. These can often be figured out…

How to Prepare

- The best book or web site is the one that makes the most sense to the student.
- It doesn't have to be up to date.
- Review and AP Prep books are good for hitting high points of each topic to determine areas of strength or weakness
- YouTube tutorials, free online worksheets
- Understand the concepts, don't just memorize rules

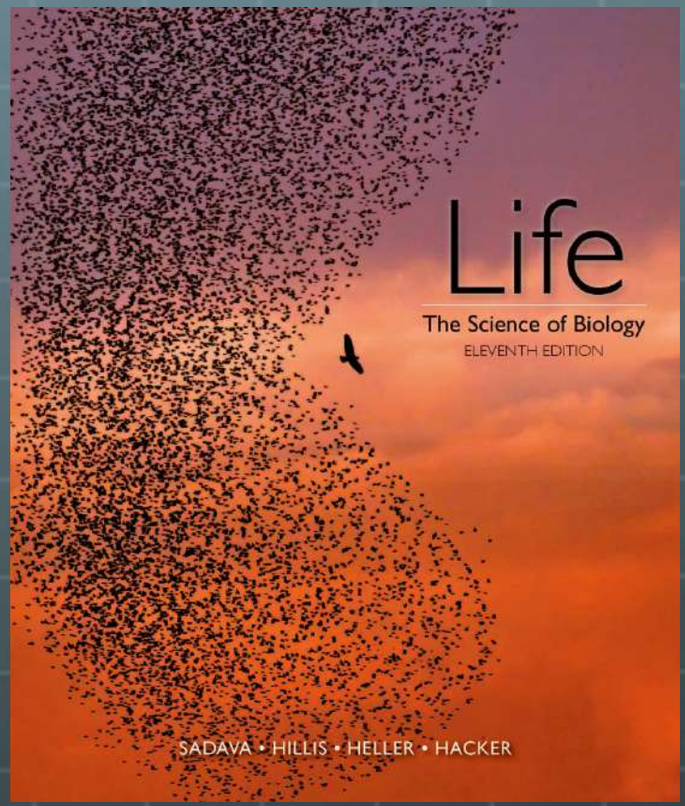
Biology Texts





Pearson's Biology, 10th or 11th edition, Campbell, et. al.

Biology Texts

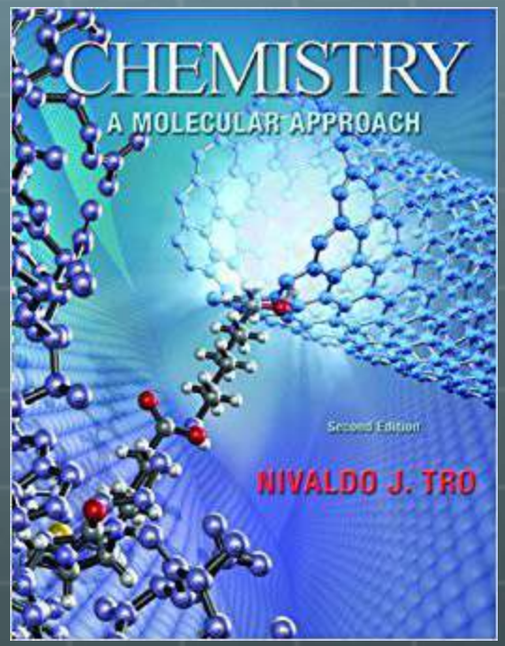


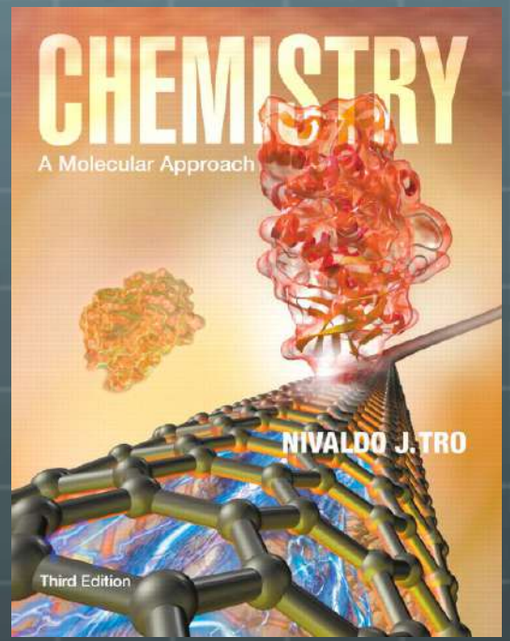
MacMillan's Life, 11th edition, Sadava, et. al.

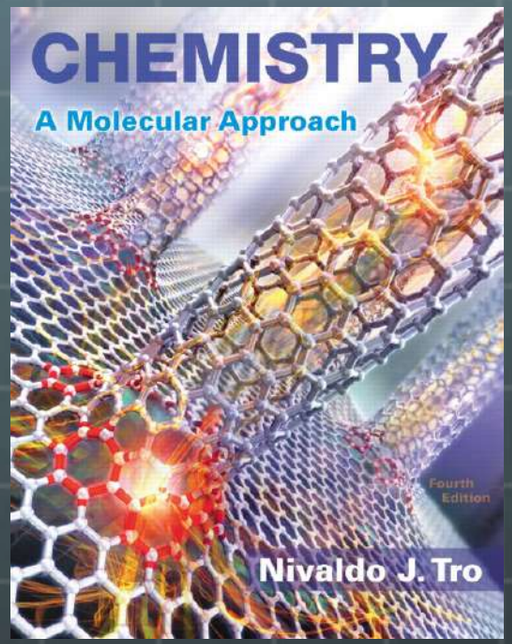
Online Biology Resources

- Learn Genetics University of Utah
  http://learn.genetics.utah.edu/
- Paul Anderson, Bozeman Science
  http://www.bozemanscience.com/about/
- Centers for Disease Control and Prevention
- https://www.cdc.gov/
- World Health Organization http://www.who.int/
- IFL SCIENCE NATURE SCITABLE

Chemistry Texts

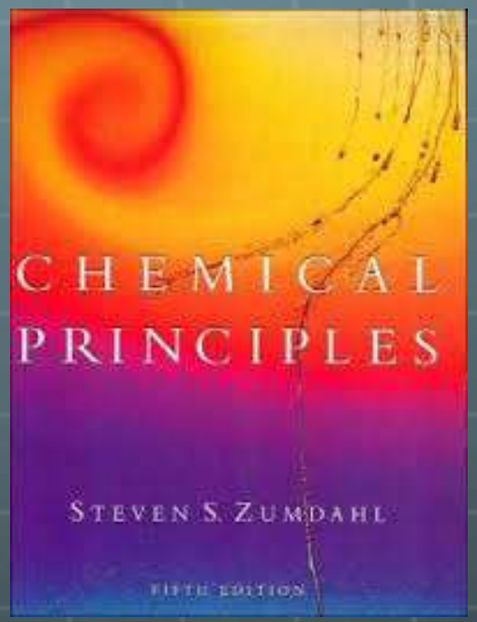


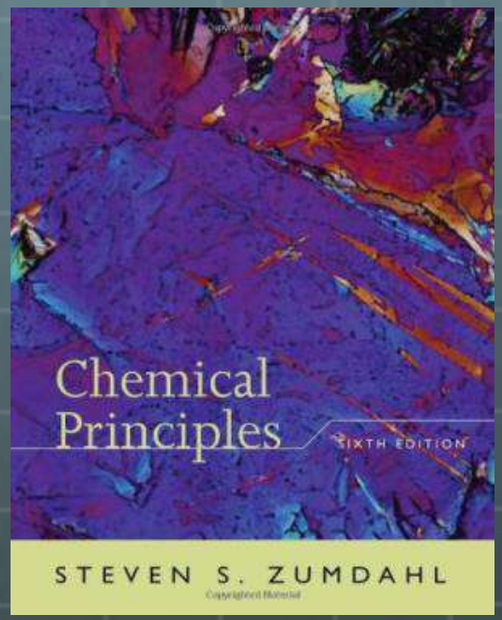


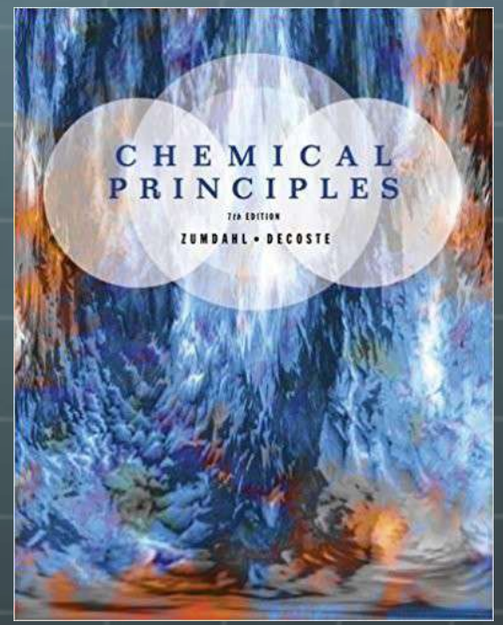


Chemistry: A Molecular Approach
by Nivaldo Tro

Chemistry Texts



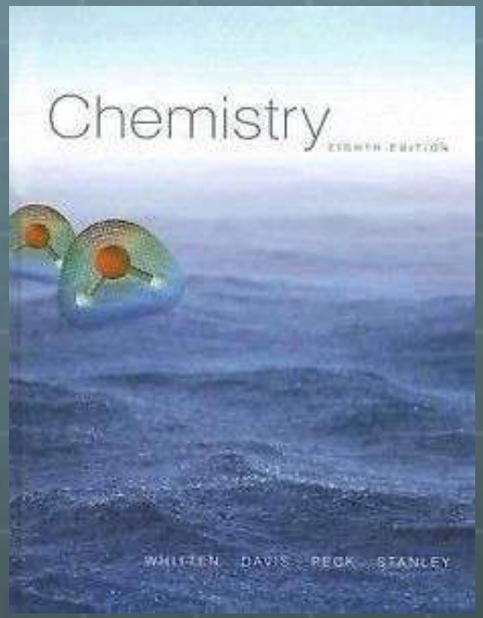


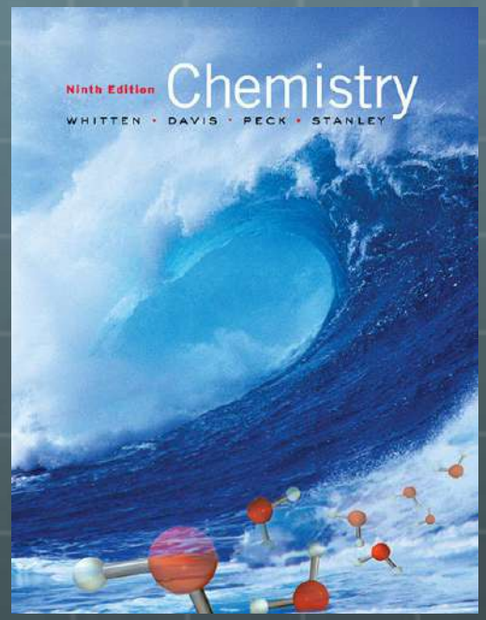


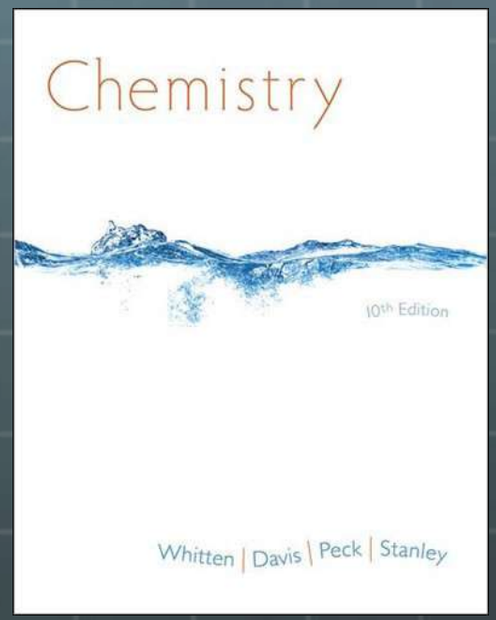
Chemical Principles

by Zumdahl (& Decoste) 5th, 6th, and 7th editions

Chemistry Texts





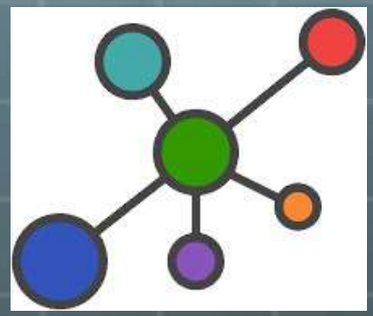


Chemistry

by Whitten, Davis, Peck & Stanley

Online Chemistry Resources

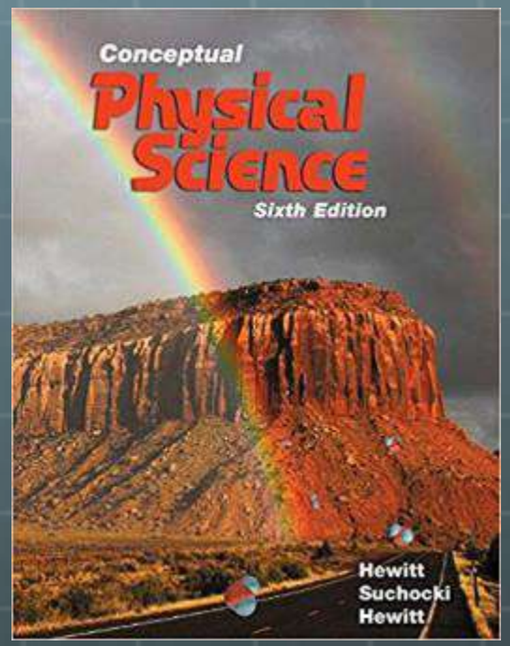
University of Texas gchem site:
https://gchem.cm.utexas.edu/



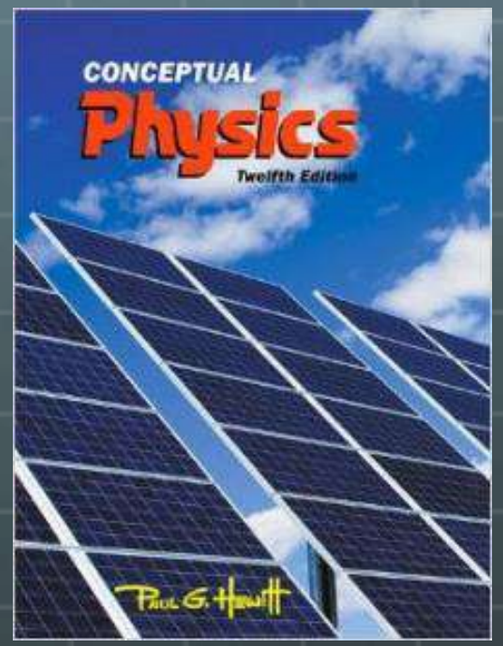
OpenStax Chemistry (Rice University)
https://openstaxcollege.org/textbooks/chemistry

Chemistry LibreTexts (UC Davis)
https://chem.libretexts.org/

Introductory Physics Texts



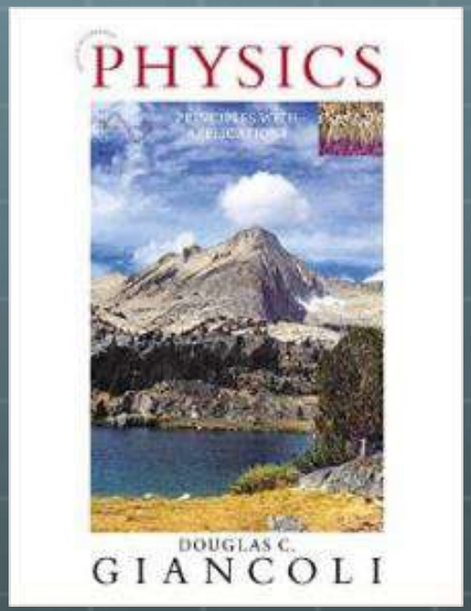
Conceptual Physical Science
by Hewitt



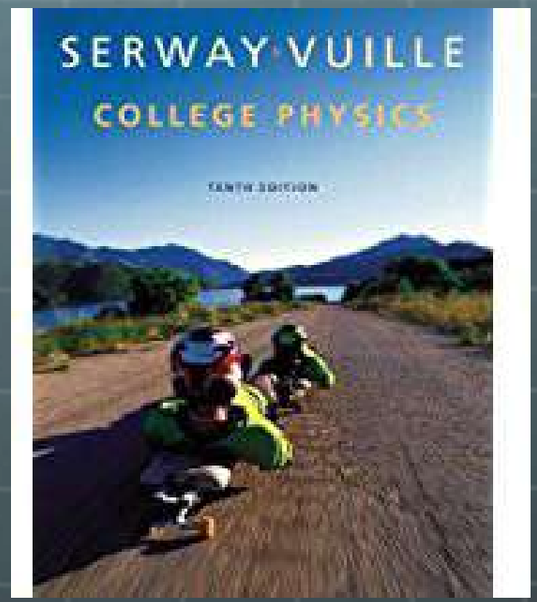
Conceptual Physics
by Hewitt

College Physics Texts

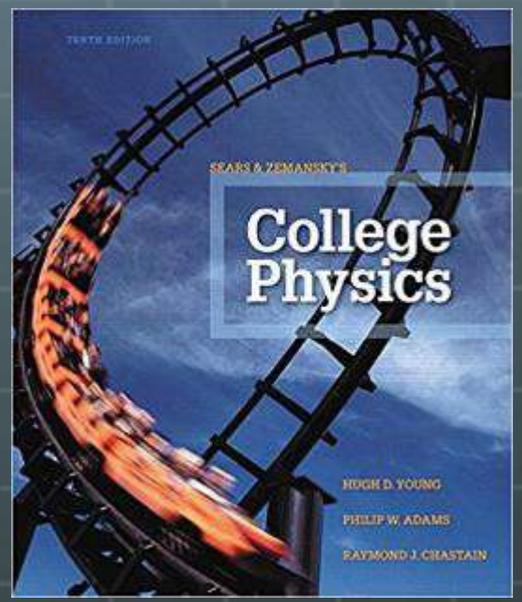
(algebra/trigonometry)



Physics
by Giancoli



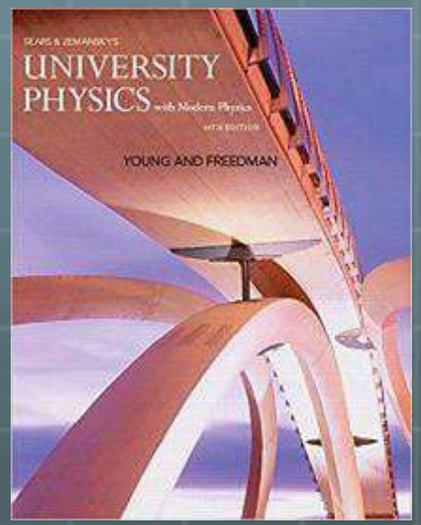
College Physics
by Serway & Vuille



College Physics
by Young

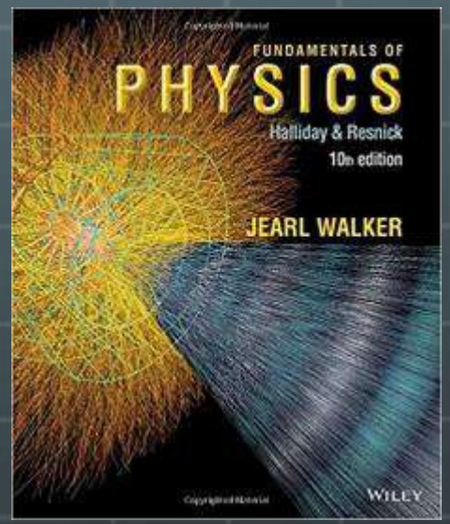
University Physics Texts

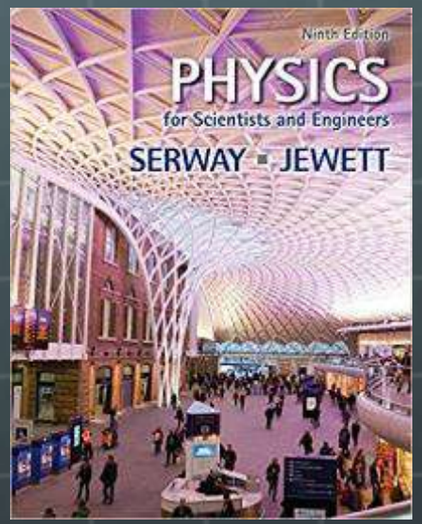
(Calculus)



University Physics
by Young and Freedman

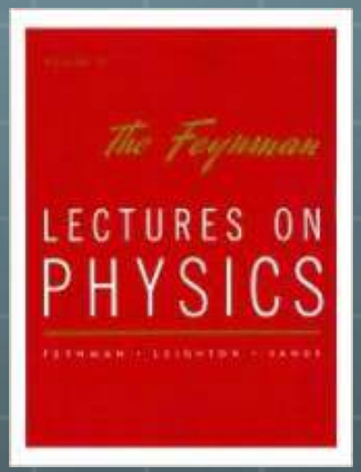
Fundamentals of Physics
by Halliday, Resnick, and Walker

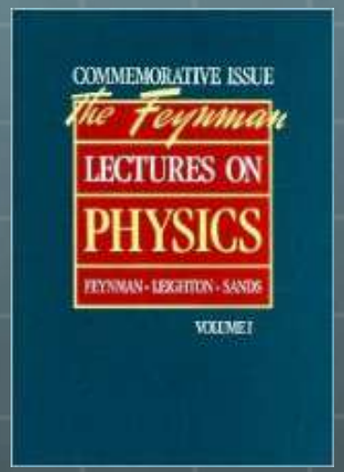


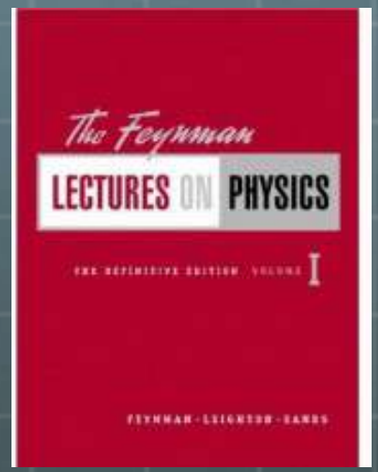


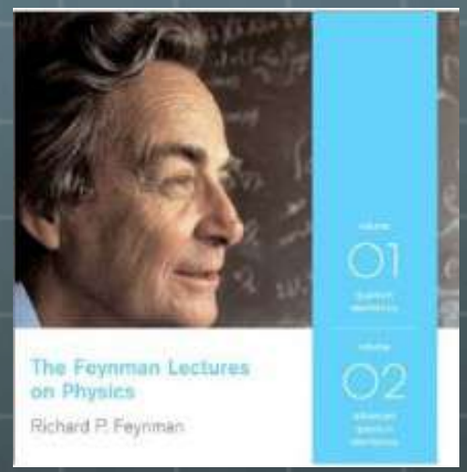
Physics for Scientists and Engineers
by Serway and Jewett

Advanced Physics Texts



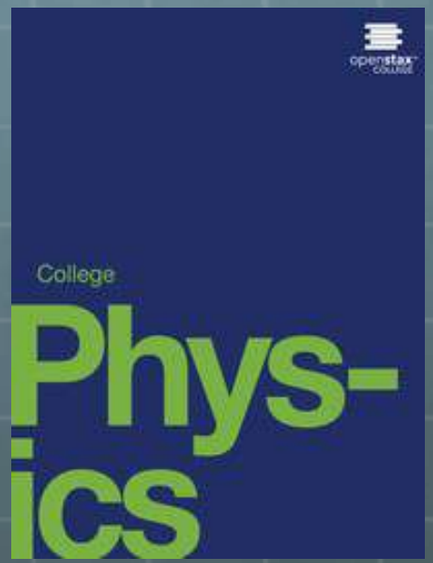






The Feynman Lectures on Physics
by Feynman, Leighton & Sands

Physics Online Resources



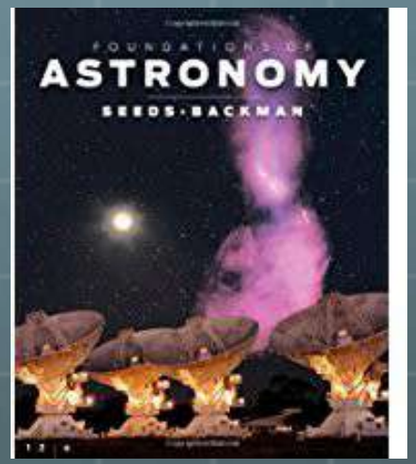
OpenStax Physics Text

https://openstaxcollege.org/textbooks/college-physics

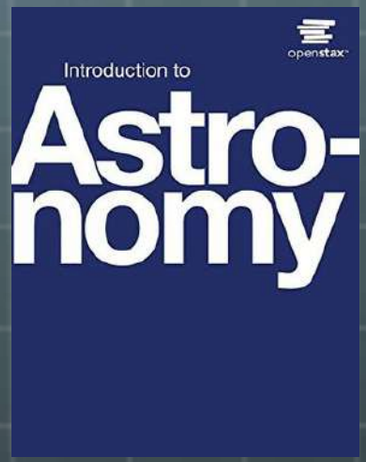
ComPadre Physlet Physics:
http://www.compadre.org/physlets/

ComPadre Interactive Video Vignettes:
http://www.compadre.org/ivv/

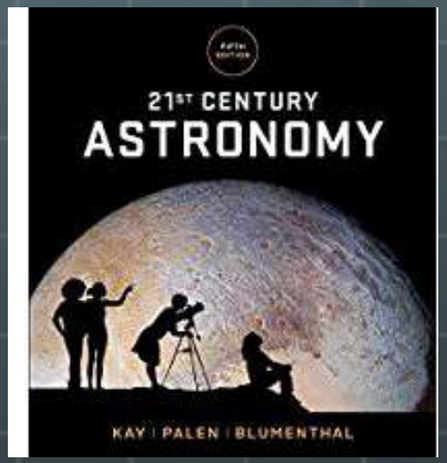
Astronomy Texts



Foundations of Astronomy by Seeds and Backman



Openstax Astronomy



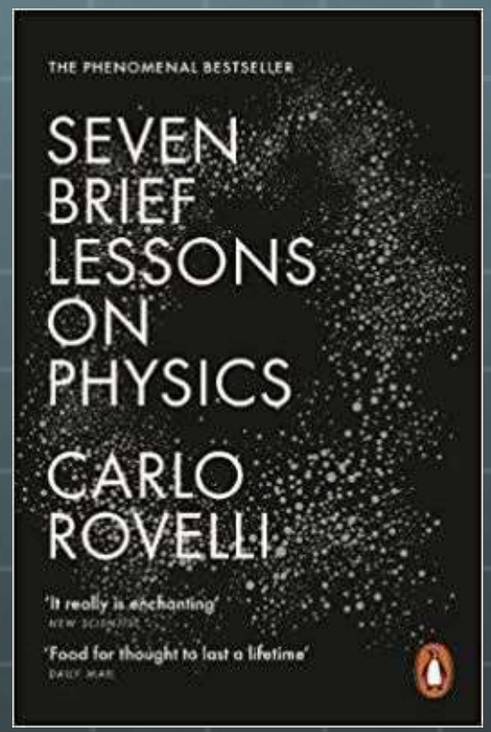
21st Century Astronomy by Kay and Palen

Physics Directed Study Text

Seven Brief Lessons on Physics

By

Carlo Rovelli



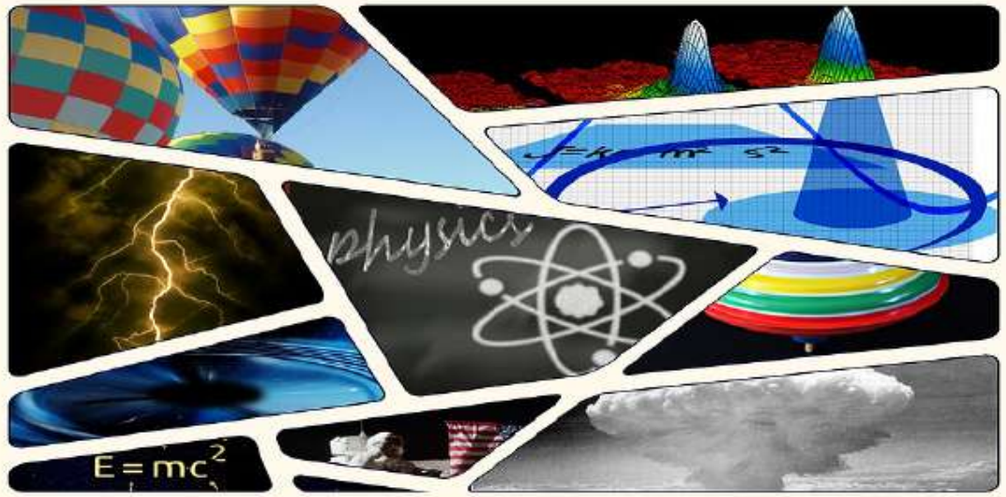
FAQs on Texts

- Do I need to get these exact texts?
- Does it need to be the same edition?
- Does the text matter?
- What about other texts?
- Options:
  - Half-price books / Online book sellers
  - Interlibrary loan
  - Google “Free _____ textbook”

THE VIRTUAL MEET EXPERIENCE

2020 - 2021

HS VIRTUAL CHALLENGE MEET #1



SCIENCE

DO NOT OPEN TEST UNTIL TOLD TO DO SO

UIL Online Resources

- http://www.uiltexas.org/academics
  - UIL Academics home page

- go to STEM > SCIENCE
  - Information from the Contest Directors will be posted here.
  - The new Physics directed study information is posted here.

Coaches/Team Suggestions

- Goal setting for student morale is very, very important!
- Have students solve old UIL or TMSCA exams & help out other students.
- Practice contests as posted on UIL invitational meet site or attend TMSCA contests.
- If possible coordinate with other teachers to arrange for help when needed.
- Positive reinforcement & food are good motivators.

Expectations

	Freshman	Sophomore	Junior	Senior
Biology	10/20	15/20	20/20	20/20
Chemistry	5/20	10/20	15/20	20/20
Physics	3/20	3/20	10/20	20/20

Recruitment

Talk to the other science teachers!!!

Have the students help you out!!

Don’t overwhelm the students.