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Teach Yourself SAT Chemistry Visually in 24 Hours

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Introduction to SAT Chemistry

SAT Chemistry Rapid Learning Series

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Learning Objectives

By completing this tutorial, you will learn:

- What is SAT Chemistry
- What is the SAT Exam?
- Tips for the Multiple Choice Section
- Problem-solving strategies for use throughout the course
- How to study Chemistry

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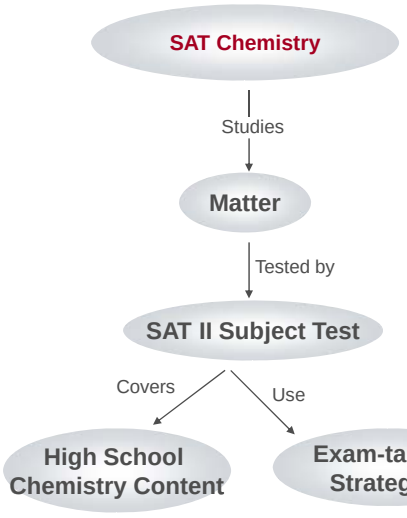
Concept Map



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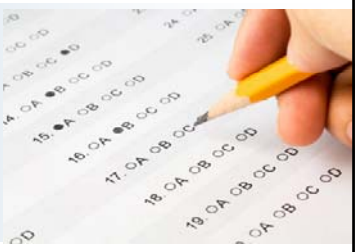
What is SAT Chemistry?



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SAT Chemistry

SAT Chemistry – High school general chemistry.

This is not a “AP” or “IB” course.

It tests the content covered in a typical college-prep high school course.

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What is the SAT Chemistry Exam?

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SAT Chemistry Exam

SAT II Subject Tests – 1 hour tests that show student's knowledge in a specific content area (subject).

Scores range from 200 to 800 (highest).

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SAT Chemistry Exam Format

Time – 1 hour

Format – 85 multiple-choice questions

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"CE" questions

There is one type of question that is only found on the SAT subject tests—"Correct explanation" questions

There will be 2 columns

Column I	Column II
Reaction rate increases with concentration	Reactants must collide with the minimum energy to react

The answer sheet will have two sets of True/False columns and a column for "CE".

Determine if the first and second statements are true or false (independently of each other) and darken in the appropriate circle.

Determine if the second statement is the correct explanation for the first statement. If it is, darken in the "CE" bubble.

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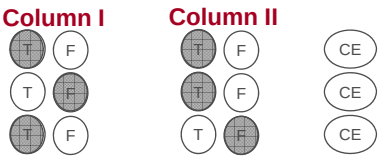
Practice “CE” questions

Since you haven’t learned much chemistry yet, we’ll practice with other content so that you can learn this question type.

Column I	Column II
2 + 3 = 3 + 2	Order of operations says to add and subtract first
All rectangles are squares	Any 4-sided object with all right angles is a rectangle
1, 3 and 5 are prime numbers	“Prime number” is another term for “odd number”



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Scope of the Exam

You won’t know everything!

The writers acknowledge that teachers vary a little in the content and emphasis of a High School Chemistry Course.

Therefore, they write questions over every topic and do not expect any one student to know them all!

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Problem-Solving

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What is Problem Solving?

You are here

Problem Solving Strategy

You need to get there

A "problem" is when you don't know how get from here…

to there.

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Why is Problem Solving Important?

Problem solving is needed in every aspect of chemistry.

- ✓ Labs & investigations
- ✓ Practice problems
- ✓ Exams
- ✓ Anytime you apply concepts to different situations

Knowing how to break a problem down into steps is the key to solving any kind of problem!

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General Problem Solving Strategy

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5 Step Problem Solving Strategy

General steps for solving any type of problem in chemistry

1. **Identify what is being given**
2. **Clarify what is being asked**
   If unclear, try to rephrase it.
3. **Select a strategy**
   Trial & error, search, deductive reasoning, working backwards or knowledge-based.
4. **Solve using selected strategy**
5. **Review**
   Check for reasonableness, units and significant figures.

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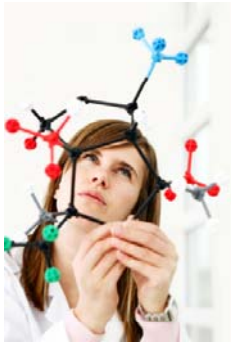
Applying the “General” Strategy

This general strategy will work for any type of problem in chemistry, not just “math” problems.



Calculations, concepts, mechanisms, etc.

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Problem Solving Example #1

Example: How many significant digits are in 1020 g?

Step	Description	Information
1	Identify what's given	1020 g
2	Identify what's being asked	# Significant digits
3	Strategy: Knowledge based	Use your knowledge of significant digits to count. There is no decimal point—count digits between the first and last non-zero number.
4	Apply strategy: Count the significant digits	1020 g → 3 significant digits
5	Review	The rule without a decimal place is count between the non-zero numbers. There are 3 "102" significant figures.

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Problem Solving Example #2

Example: What is the relationship between atomic radius and ionization energy?

Step	Description	Information
1	Identify what's given	Atomic radius & Ionization energy
2	Identify what's being asked	What is the relationship? Is it direct (as one increases, the other does also) or indirect (as one increases, the other decreases).
3	Strategy: Deductive reasoning	Use the definitions of ionization energy and atomic radius to deduce the relationship. Ionization energy = energy needed to remove an electron from the outermost electron shell or orbital. As radius increases, the electron is farther from nucleus.
4	Apply the strategy: Deduce the relationship	As the electron is farther from nucleus, the pull between the + nucleus and - electron decreases. So the electron will be easier to remove (ionization energy decreases). This is an indirect relationship.
5	Review	As atomic radius increases, it becomes easier to take away an electron—this is an indirect relationship between radius and ionization energy.

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Word Problem Solving Strategy

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Word Problem Woes

Many people are intimidated by word problems…they don't know where to begin.

Instead of seeing them as word problems, use the KUDOS method to turn them into simple calculation problems.

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KUDOS Method

Known
Unknown
Definition
Output
Substantiation

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Step "K"

"Known"

K Identify what is known

Tip	Example	
Use units to identify information	A sample is 2.67 g	"g" (grams) is a mass unit. The statement is giving mass ("m")
Write information symbolically	A sample is 2.67 g	m = 2.67 g
Look for implied information	A sample contains A & B. It is found to be 75% A	Therefore, B = 25%
Write out chemical reactions	The copper reacts with hydrochloric acid.	Cu + HCl → $CuCl_2 + H_2$

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Step "U"

"Unknown"

U Identify what is unknown

Tip	Example	
What is the problem looking for?	How many milliliters…	→ Milliliters is a volume unit
Write information symbolically	How many milliliters…	→ V = ? mL

This helps you focus on the "goal".

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Step "D"

"Definition"

D Define needed information

Tip	Example	
Find equalities to convert	Volume needs to be converted to "mL"	→ 1 mL = 0.001 L
Choose & re-arrange equations	Solve for "m" knowing density and volume	→ $D = \frac{m}{V}$ So $m = V \times D$
Look other places for missing info	The atomic mass of oxygen is needed	→ Look on the periodic table
Re-evaluate your approach if needed	You're missing a piece of information and cannot find it elsewhere	→ Look for another equation or approach

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Step "O"

"Output"

O Find the output of your information

Tip	Example	
Plug values into equations	$V \times D = m$	12.5mL × 1.25g/mL = m
Use fundamental constants if needed	$PV = nRT$	R is the gas constant
Check unit cancellation	12.5mL × 1.25g/mL = m	12.5~~mL~~ × 1.25g/~~mL~~ = m
Perform the calculation	12.5mL × 1.25g/mL = m	15.6 g = m

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Step "S"

"Substantiation"

S Substantiate your results with a 1-2-3 check

Tip	Example	
Check Validity	Is the results reasonable & possible?	Is it 10,000 when it should be 10?
Check Units	Are the units left after cancellation appropriate?	When solving for mass, you should get a mass unit
Check Significant Figures	Are the significant figures in the answer correct?	× or ÷ use least # of s.f in problem + or - use least # of decimal places in problem

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Connecting the Known and Unknown

One of the hardest things for students is determining how to get from the known to the unknown…

The "Definitions" (Step "D") show the connections!

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KUDOS Example #1

Example: *What is the partial pressure of H_2 if the total pressure is 1.75 atm and the partial pressure of H_2O is 0.22 atm?*

Step	Source Information	Write down
K	Total pressure is 1.75 atm	P_{total} = 1.75 atm
	Partial pressure of H_2O is 0.22 atm	P_{H2O} = 0.22 atm
U	What is the partial pressure of H_2	Given pressures in "atm," P_{H2} = ? atm
D	Dalton's Law of Partial Pressure	$P_{total} = P_{H2} + P_{H20}$ solved for P_{H2}: $P_{H2} = P_{total} - P_{H2O}$
O	Calculate P_{H2}	$P_{H2} = P_{total} - P_{H2O}$ P_{H2} = 1.75 atm – 0.22 atm P_{H2} = 1.53 atm
S	✓ validity, units & sig figs	✓ 1.53 atm is a reasonable answer ✓"atm" is a pressure unit ✓ 2 decimal places given → 2 in answer

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KUDOS Example # 2

Example: *How many molecules of H_2O are made from 7.89×10^{28} molecules of O_2?* $2H_2 + O_2 \rightarrow 2H_2O$

Step	Source Information	Write down
K	7.89 x 10^{28} molecules of O_2	O_2 = 7.89 x 10^{28} molecules
U	How many molecules of H_2O	H_2O = ? molecules
D	Balanced equation (gives relationship between compounds in a chemical reaction)	1 O_2 = 2 H_2O
O	Use the ratio to covert	7.89×10^{28} molecules O_2 × (2 Molecules H_2O / 1 Molecules O_2) = 1.58×10^{29} molecules H_2O
S	✓ validity, units & sig figs	✓ 1.58×10^{29} molecules H_2O is a reasonable number for 7.89 x 10^{28} molecules reacted. ✓ molecules H_2O is what the question asked for ✓ 3 s.f. given → 3 s.f. in answer

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KUDOS Example # 3

Example: *What is the mass (in grams) of a 0.125 L sample with a density of 2.57 g/mL?*

Step	Source Information	Write down
K	A 0.125 L sample. "L" is a volume ("V") unit	V = 0.125 L
	Density of 2.57 g/mL	D = 2.57 g/mL
U	What is the mass in grams	m = ? g
D	The volume units don't match…a conversion will be needed	1 mL = 0.001 L
	Define density & solve for unknown variable	$D = \frac{m}{V}$ So $m = V \times D$
O	Convert units	0.125 L × (1 mL / 0.001 L) = 125 mL
	Solve for mass	$m = V \times D$ m = 125mL × 2.57g/mL m = 321 g
S	✓ validity, units & sig figs	✓ 321 g is reasonable for 125 mL ✓ "g" is a valid unit for mass ✓ 3 s.f. given → 3 s.f. in answer

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Connecting the “General” Strategy & KUDOS

Problem Solving

For any type of problem, use

5-Step General problem-solving strategy

For word problems, the 5-step process becomes

KUDOS method

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Exams Tips

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Help For Chemistry Exams

So now that you know how to attack individual problems using the Problem-Solving Strategy, or the KUDOS method for word problems…

How do you attack the big problem…the exam?

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Multiple-Choice Tip #1

Here are some helpful hints for multiple-choice exams

1. **Scan all the choices**

   Often, one choice looks good…but a later one is better. Look at them all before choosing.

Example: Which of the following would cause the largest error in a lab to measure the mass & volume of several samples to determine average density?

A. Misreading the balance
B. Misreading the graduated cylinder
C. Having the samples be inconsistent in make-up

While A & B would cause errors, C would cause the largest error.

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Multiple-Choice Tip #2

2 Avoid the word trap

There's often more than one way to say something…the test may use another word than the one you're used to, but they may mean the same thing.

Example: **Thermal energy flows from an object with ____ kinetic energy to an object with ____ kinetic energy.**

A. More, less
B. Less, more
C. High, the same
D. Thermal energy does not flow from one object to another

Rephrase using more familiar terms:

"Thermal energy" = heat

"Kinetic energy" = energy of motion, proportional to temperature

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Multiple-Choice Tip #3

3 Be aware of absolutes

It only takes one exception to break the "absolute"—not very many things are absolutely true in chemistry!

Example: **Atomic radius _____ as you move left to right across a period.**

A. Always increases
B. Generally increases
C. Always decreases
D. Generally decreases

In general the radius decreases, but not always.

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How to Study Chemistry

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Tips for Studying Chemistry

- ✓ **Memorize basic information to save time later**
  - Example: commonly used element symbols and charges, solubility rules, etc.
- ✓ **Learn vocabulary quickly for understanding when it's used later**
  - Make flashcards if needed.
- ✓ **Brush up on your algebra**
  - Don't try to remember every variation of each equation.
- ✓ **Look for the commonalities between problems**
  - Don't treat each type problem as different.

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More Tips for Studying Chemistry

- ✓ **Take each problem in steps**
  - Identify the information “given” and “wanted”.
- ✓ **Try to understand why behavior occurs & look for patterns**
  - Focus on concepts rather than memorizing.
- ✓ **Connect each thing you learn with previous concepts**
- ✓ **Keep up with the work**
  - Chemistry builds on prior knowledge.
- ✓ **Ask for help when you need it**
  - Don’t be afraid to seek out help early…find a instructor, TA, tutor or friend that can help!

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Learning Summary

Use the KUDOS method for solving word problems.

Know the format of the SAT exam and get used to working within its constraints.

Remember the tips for studying chemistry!

Follow the tips for multiple choice.

Use general problems solving strategies throughout the course and exams.

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Congratulations

You have successfully completed the tutorial

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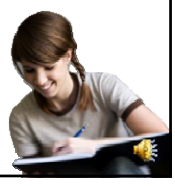
What's Next …

Step 1: Concepts – Core Tutorial (Just Completed)

→ **Step 2: Practice – Interactive Problem Drill**

Step 3: Recap – Super Review Cheat Sheet

Go for it!



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