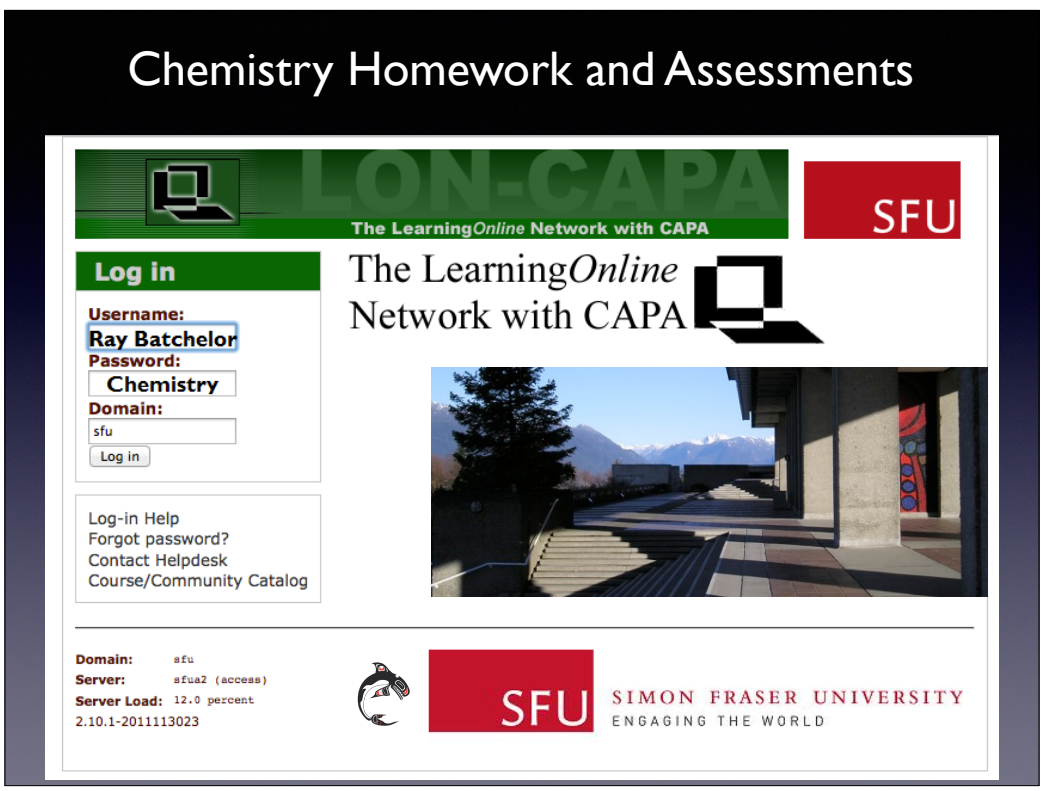
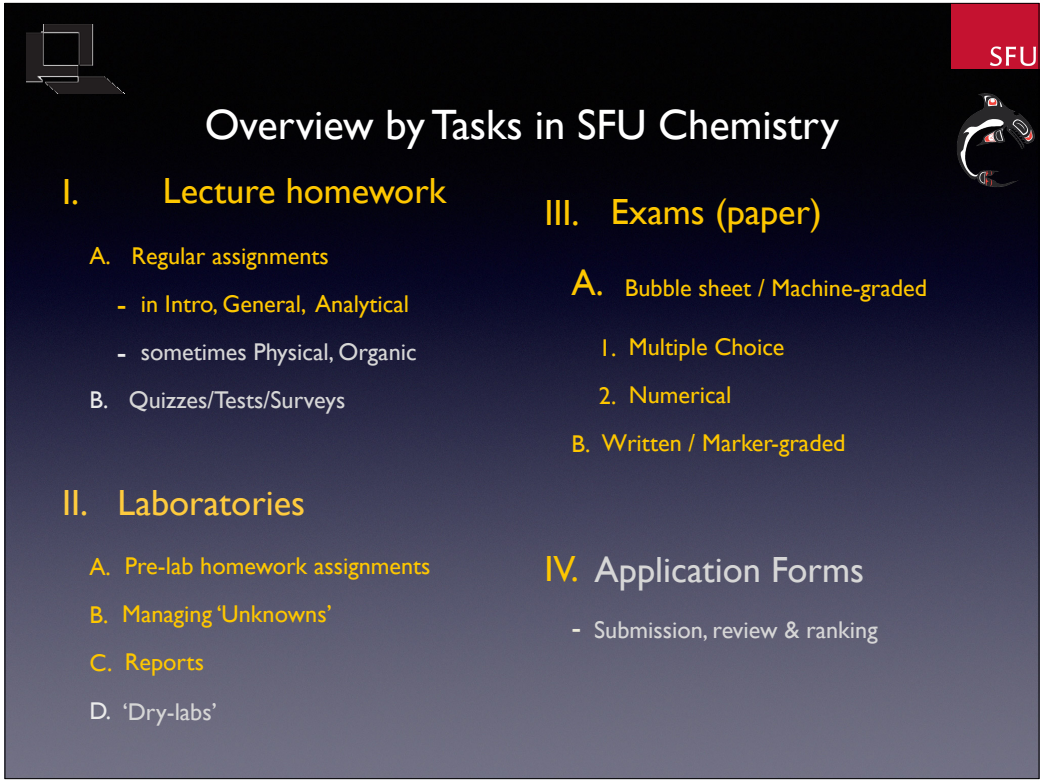
# Chemistry Homework and Assessments

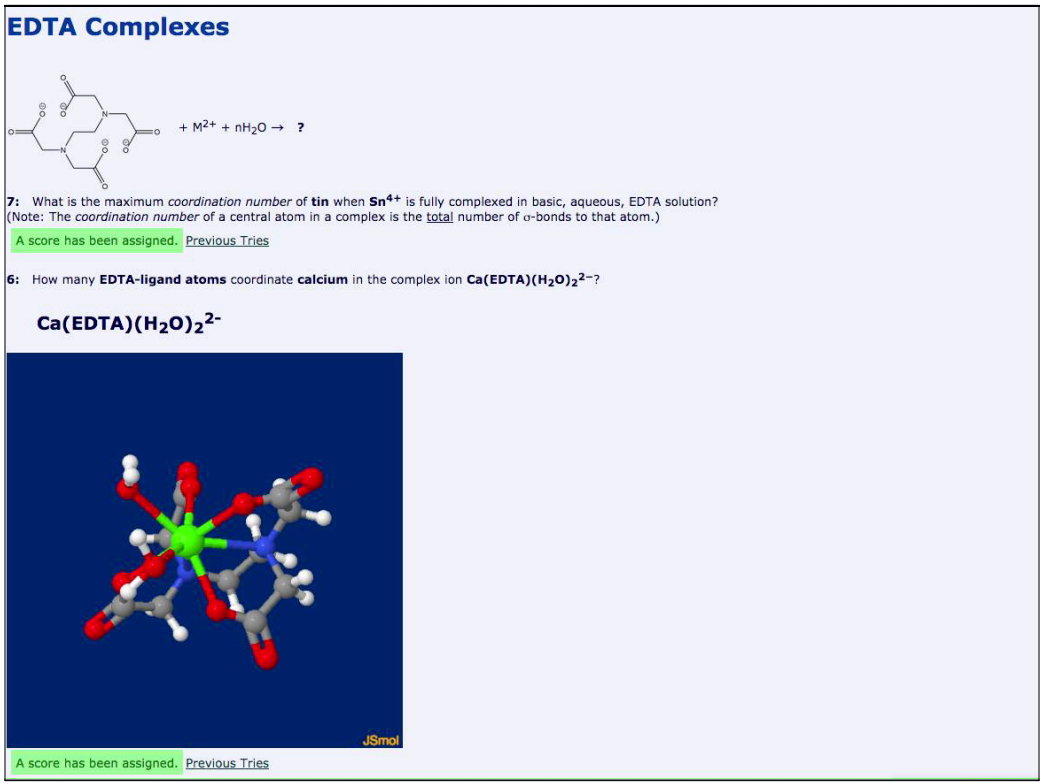



"SFU Chemistry used CAPA from 1996 and in 2001 migrated to LON-CAPA.




Summary of regular an intermittent usages.
Orange text -- in constant use.
SFU: trimester system with different people teaching -- each with their own preferences and methods.

2017, taking stock: creating new resources, making obsolete some old resources.
Organizing sequences according to topics.




3-d animated visualizations.
SFU resources which used JMOL, are now revised to use JSMOL.

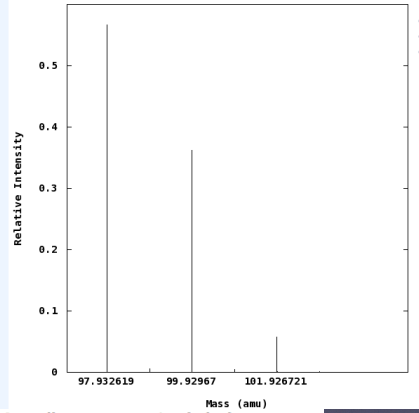
2758 mol or pdb files published in LON-CAPA.
1883 in MSU domain.
630 in NAU domain.
129 in SFU domain.
107 in FSU domain.

3 homework point(s)

## Mass Spectrum of Molecular Parent Ion

In a *mass spectrometer*, molecules can be ionized into singly positively charged molecular ions which are then separated according to their masses and counted. The resulting *spectrum* is essentially a histogram showing the relative numerical abundances of ions of different masses.

*Phosgene*, a highly toxic, gasesous, industrial chemical (used somewhat unsuccessfully as a chemical warfare agent in WWI) has the molecular formula **$COCl_2$**.
A portion of the mass spectrum of phosgene is represented below.




Given the following natural isotopic abundances (and atomic masses):

- $^{12}C$ 98.9% (12.000000 amu)
- $^{13}C$ 1.1% (13.003355 amu)
- $^{16}O$ 99.76% (15.994915 amu)

Enter the atomic mass of the **most abundant isotope of chlorine** present in the sample (in amu,to at least 4 decimal places). **34.9689 amu**
1pts

Computer's answer now shown above. Tries 0/5

Assign masses (amu) to the following molecular ions:

**102.930076: $[^{13}C^{16}O^{37}Cl_2]^+$**
**100.933025: $[^{13}C^{16}O^{35}Cl^{37}Cl]^+$**
**99.92967: $[^{12}C^{16}O^{35}Cl^{37}Cl]^+$**

1pts

Computer's answer now shown above. Tries 0/5

Enter the approximate % isotopic abundance of the **most abundant isotope of chlorine** present in the sample (try to get it within ±1%). **75.7700 %**
1pts

Computer's answer now shown above. Tries 0/5

**Overall Assessment Statistical Data**

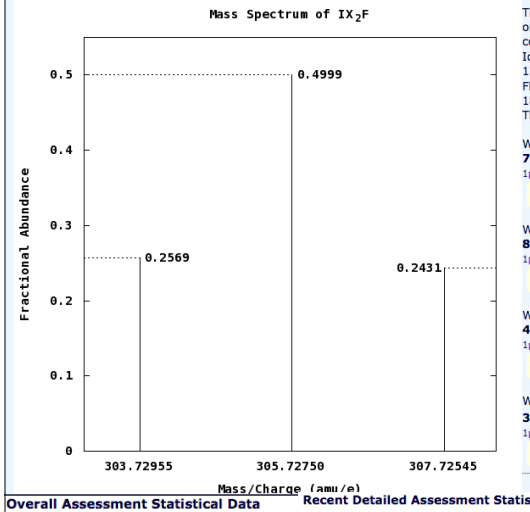
| | |
|---|---|
| **Statistics calculated for number of students:** | 15255 |
| **Average number of tries till solved:** | 2.61 |
| **Degree of difficulty:** | (0.66) |
| **Degree of discrimination:** | (0.14) |

**Recent Detailed Assessment Statistical Data**

| Domain | Course | Section(s) | Num Students | Part | Mean Tries | Degree of Difficulty | D Dis |
|---|---|---|---|---|---|---|---|
| sfu | Chem121 2016-3 Lecture (Burnaby) | all | 506 | 11 | 2.48 | 0.65 | |
| sfu | Chem121 2016-3 Lecture (Burnaby) | all | 494 | 14 | 2.13 | 0.58 | |
| sfu | Chem121 2016-3 Lecture (Burnaby) | all | 462 | 16 | 2.16 | 0.61 | |

This question has been used many years, but is still considered difficult.
In part to avoid scamming of answers off the web, I made new differing versions of this problem, which were intended to be a bit easier AND have different questions and phrasing than the old one — so it is not as easy to search out.

## Mass Spectrum of Molecular Parent Ion (4parts)




The spectrum shows three vertical bars corresponding to the molecular masses labeled on the x-axis. The height of each bar gives the fraction of all molecules having the corresponding mass.
Iodine has only a single, stable, naturally-occurring isotope ($^{127}I$ atomic mass 126.90447 amu).
Fluorine has only a single, stable, naturally-occurring isotope ($^{19}F$ atomic mass 18.98840322 amu).
There are exactly two stable naturally-occurring isotopes of element "X".

What is the atomic mass of the less massive isotope of element X?
**78.91834 amu**
1pts
Computer's answer now shown above. Tries 0/5

What is the atomic mass of the more massive isotope of element X?
**80.91629 amu**
1pts
Computer's answer now shown above. Tries 0/5

What is the percent natural abundance of the more massive isotope of element X?
**49.31 %**
1pts
Computer's answer now shown above. Tries 0/5

What is the molar mass of the compound $IX_2F$?
**305.7 g/mol**
1pts
Computer's answer now shown above. Tries 0/5

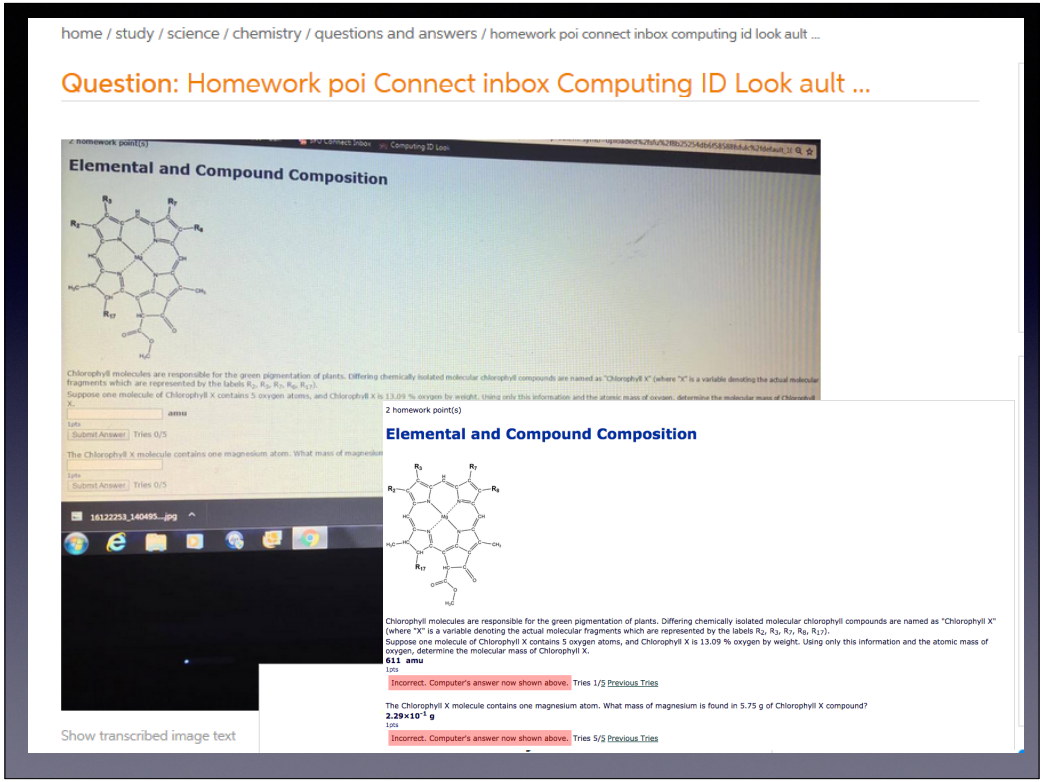
**Overall Assessment Statistical Data**

| | |
|---|---|
| **Statistics calculated for number of students:** | 444 |
| **Average number of tries till solved:** | 2.21 |
| **Degree of difficulty:** | (0.57) |
| **Degree of discrimination:** | (0.23) |

**Recent Detailed Assessment Statistical Data**

| Domain | Course | Section(s) | Num Students | Part | Mean Tries | Degree of Difficulty | Degree of Discrimination | Time of computat |
|---|---|---|---|---|---|---|---|---|
| sfu | Chem121 2017-2 Lecture | D100 | 160 | 11 | 2.51 | 0.65 | 0.21 | Thu May 25 02:45:20 pm |
| sfu | Chem121 2017-2 Lecture | D100 | 157 | 13 | 1.69 | 0.45 | 0.20 | Thu May 25 02:45:20 pm |
| sfu | Chem121 2017-2 Lecture | D100 | 153 | 15 | 3.21 | 0.81 | 0.52 | Thu May 25 02:45:20 pm |
| sfu | Chem121 2017-2 Lecture | D100 | 140 | 17 | 1.58 | 0.42 | 0.09 | Thu May 25 02:45:20 pm |
| sfu | Chem121 2017-1 Lecture | all | 284 | 11 | 2.80 | 0.71 | 0.47 | Tue Jan 24 02:14:38 pm 2 |
| sfu | Chem121 2017-1 Lecture | all | 264 | 13 | 1.81 | 0.48 | 0.21 | Tue Jan 24 02:14:38 pm 2 |
| sfu | Chem121 2017-1 Lecture | all | 261 | 15 | 2.57 | 0.68 | 0.51 | Tue Jan 24 02:14:39 pm 2 |
| sfu | Chem121 2017-1 Lecture | all | 253 | 17 | 1.36 | 0.29 | 0.15 | Tue Jan 24 02:14:39 pm 2 |

Version of problem used in Spring 2017:
Students are quick to use 'tutoring' services online.
Google search for words in the problem statement find services with answers.
NOT free though. $$




Only one student had this particular rendition of this question.
They submitted a photo of their display to a commercial homework help site.
The student was working up to near the deadline on the assignment,
but did not receive the answer in time.
Viewed Sun Jan 15, 2017 6:25PM until 11:25PM (due at 11:59PM).
Student's final view or their problem (at lower right).

## Gravimetric Analysis -- Binary Mixture (2003 - 2016 — 130 courses)

Antimony is alloyed with lead to increase the rigidity of components used in the construction of lead storage batteries.
1.011 g of a particular metallic alloy, compounded of only Pb and Sb, can be quantitatively converted into a 1.172-g mixture of the oxides $PbO_2$ and $Sb_2O_4$.
What was the percentage (by mass) of antimony in the alloy?
____ %

Submit Answer Tries 0/5

**Overall Assessment Statistical Data**

| | |
|---|---|
| **Statistics calculated for number of students:** | 13319 |
| **Average number of tries till solved:** | 2.39 |
| **Degree of difficulty:** | (0.65) |
| **Degree of discrimination:** | (0.21) |

**Recent Detailed Assessment Statistical Data**

| Domain | Course | Section(s) | Num Students | Part | Mean Tries | Degree of Difficulty | Deg Discri |
|---|---|---|---|---|---|---|---|
| sfu | Chem121 2016-3 Lecture (Burnaby) | all | 434 | 0 | 2.20 | 0.64 | |

## Gravimetric Analysis -- Binary Mixture (2017 — 2 courses)

Amounts of tin may be alloyed with copper to produce bronzes of varying composition and properties.
7.8470 g of a particular bronze, compounded of only Cu and Sn, can be quantitatively converted into a 9.8429-g mixture of the oxides CuO and $SnO_2$.
(Use the atomic masses: Cu 63.546, Sn 118.71, O 15.9994.)

What was the percentage (by mass) of tin in the alloy?
____ %

**Overall Assessment Statistical Data**

| | |
|---|---|
| **Statistics calculated for number of students:** | 367 |
| **Average number of tries till solved:** | 2.32 |
| **Degree of difficulty:** | (0.68) |
| **Degree of discrimination:** | (0.00) |

**Recent Detailed Assessment Statistical Data**

| Domain | Course | Section(s) | Num Students | Part | Mean Tries | Degree of Difficulty | Degree of Discrim |
|---|---|---|---|---|---|---|---|
| sfu | Chem121 2017-2 Lecture | all | 130 | 0 | 2.22 | 0.69 | |
| sfu | Chem121 2017-1 Lecture | all | 237 | 0 | 2.38 | 0.68 | |

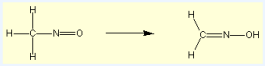
Goggle-search finds a solution for the old problem, but not (yet) for the new problem.
Average number of tries by student and the overall degree of difficulty similar.

**2004-2016**
8 variations
DoD=0.61
<Tries> = 2.28

**2017**
26 variations
DoD=0.67
<Tries>=2.35

## Bond Energies and Heat of Reaction

Use the given bond energy values to estimate $\Delta H$ for the following gas-phase reaction.



(Simple energy units required for the answer.)

*D*-values in **kJ/mol**

| | | |
|---|---|---|
| $D_{H-H}$ = 432 | $D_{H-Br}$ = 363 | $D_{H-C}$ = 413 |
| $D_{H-N}$ = 391 | $D_{H-O}$ = 467 | $D_{C-C}$ = 347 |
| $D_{C=C}$ = 614 | $D_{C\equiv C}$ = 839 | $D_{C-N}$ = 305 |
| $D_{C=N}$ = 615 | $D_{C\equiv N}$ = 891 | $D_{C-O}$ = 358 |
| $D_{C=O}$ = 745 | $D_{C=O\ (CO_2)}$ = 799 | $D_{C\equiv O}$=1072 |
| $D_{C-Br}$ = 276 | $D_{N-N}$ = 160 | $D_{N=N}$ = 418 |
| $D_{N\equiv N}$ = 941 | $D_{O-O}$ = 146 | $D_{O=O}$ = 495 |
| $D_{N-O}$ = 201 | $D_{N=O}$ = 607 | $D_{Br-Br}$ = 193 |

Submit Answer  Tries 0/5

Threaded View  Chronological View  Other Views ...
Export

***Anonymous 1*** Reply (Tue Oct 25 06:06:17 pm 2016 (PDT))

Just in case if anyone wants to know:

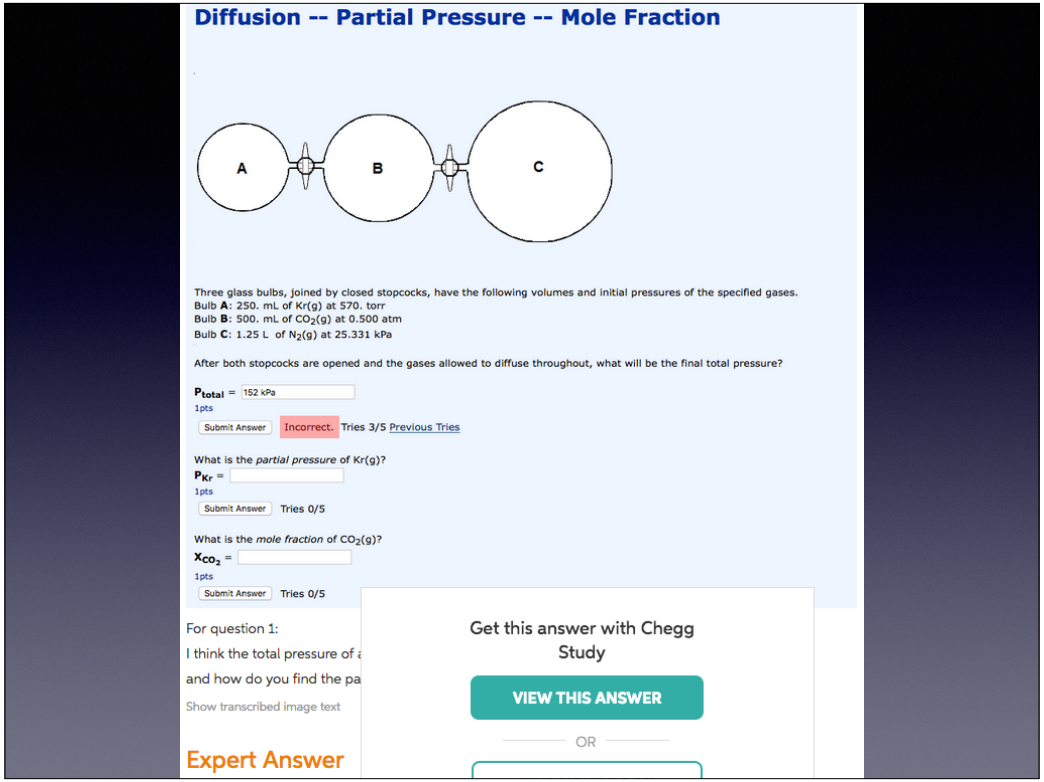
**Hold On, Don't Panic!**

Okay, this question may seem very scary, but it can be broken down easily!

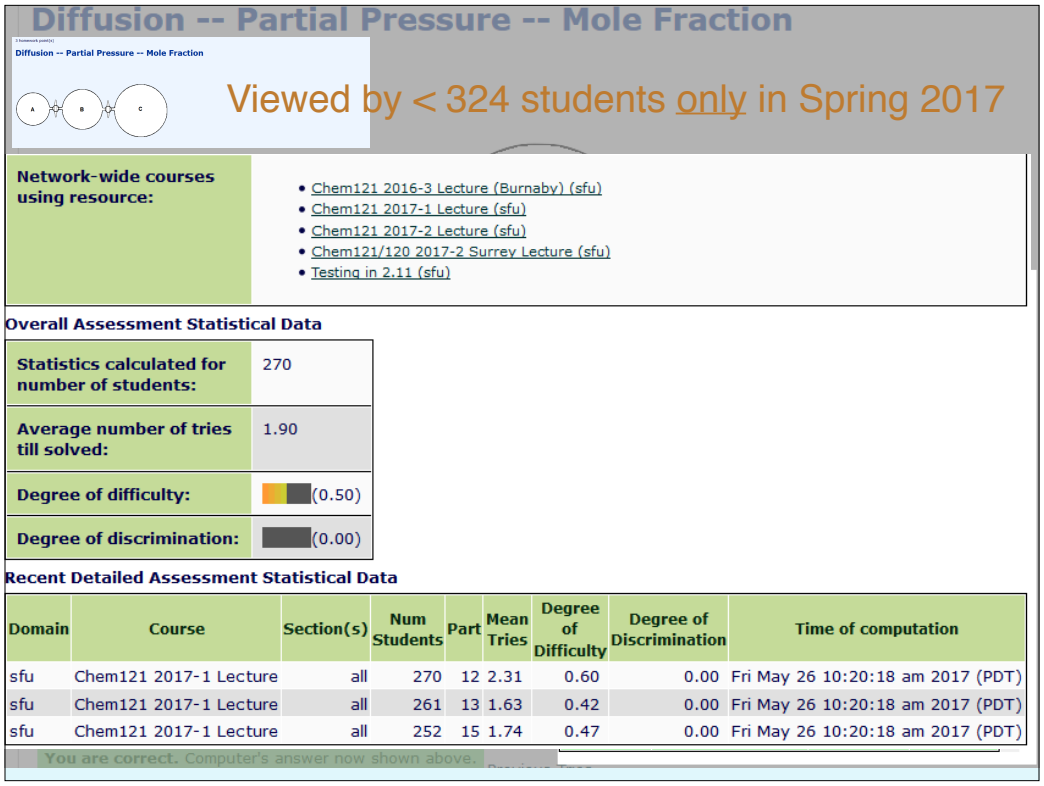
- Look carefully at the diagram, this isn't something new; the last two questions are just the same!
- The table offers WAY more information than you actually need, worry not
- A strategic recommendation is to work left to right, write out what the bonds are, and how many there are
- It is also a good idea to keep the molecules separate of each other until the sum at the end - that way, mistakes can be avoided
- be careful as solid lines aren't the only bond! Elements adjacent to each other **are bonds too**; they will need to be considered
- Note that double (or triple) bonds are NOT the same as single bonds
- Once again, keep in mind the positive and negative signs

Take a deep breath, it's okay! Not too bad, right?

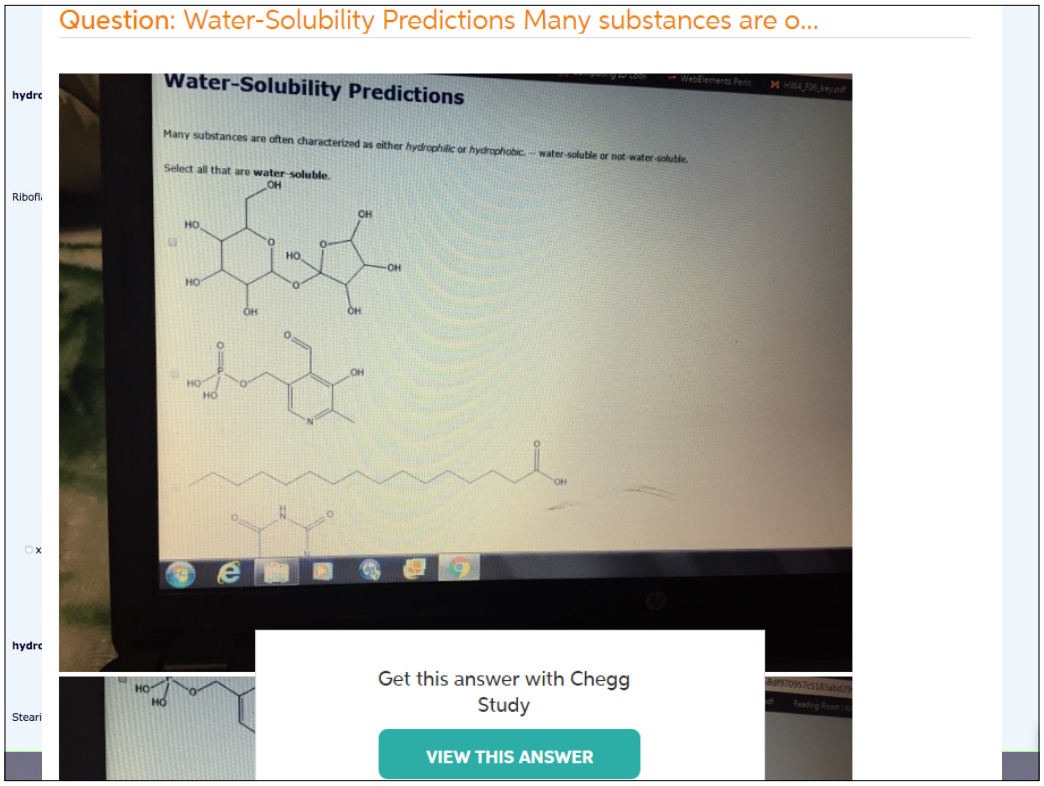
Creating new problems with more variations.
LON-CAPA student discussion/help for others seemed to work well in this instance, without resort to other online 'help' sites. Suspect that student was likely getting 'help' before posting to the in-course discussion.




Chegg ("chicken or egg") : originally started for/by students at Iowa State U.
— is an online textbook rental company, also providing:
homework help (answers) and online tutoring.
It is based in Santa Clara California.
Some students seem prompt to access this service and pay$.

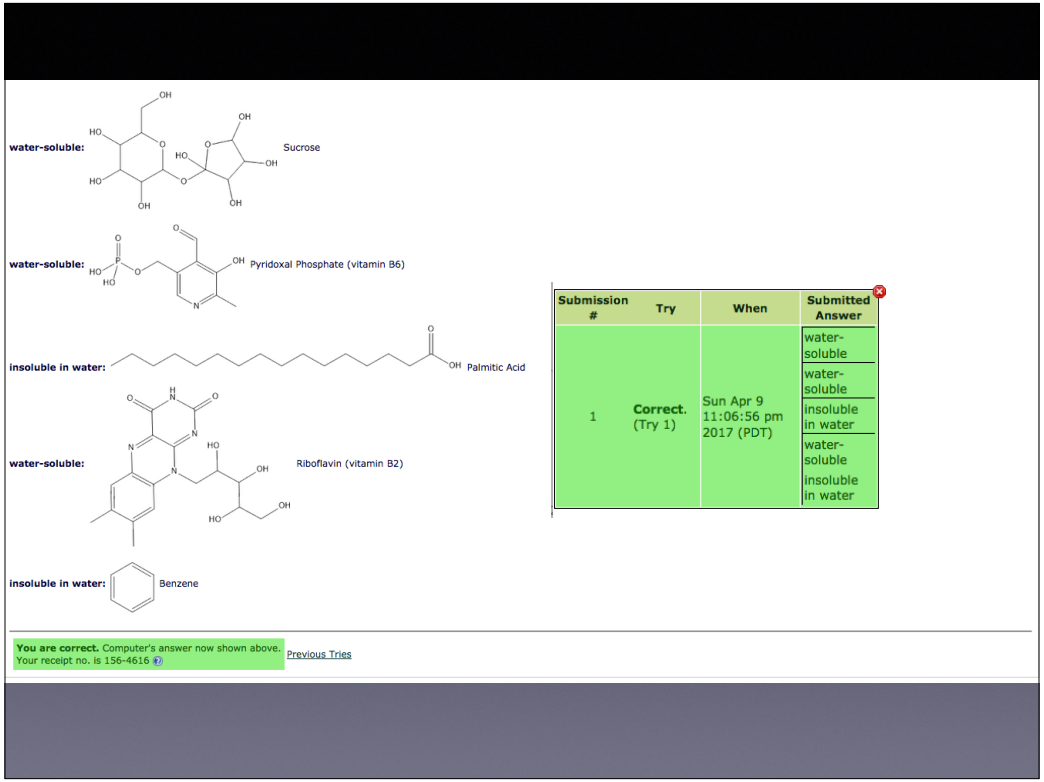



Spring 2017 — Problem restricted to one class of SFU students only.
271 out of 323 registered students (84%) attempted this question.
42 of whom (15%) got all or part of it wrong (5 tries allowed for each part)
Can easily identify the student who posted to CHEGG, because of the many variations of the problem.
This student used his/her 3rd try to input 152 kPa. Feb 3 2017, at 1:18PM, before posting for help.
On 5th and last try they entered the correct answer as 0.375 atm on Sunday Feb 5, 2017 at 4:56 PM. (C student.)
There was only one other student with an identical variation of the problem (in a class of 323)— and that person's submission profile did not match.

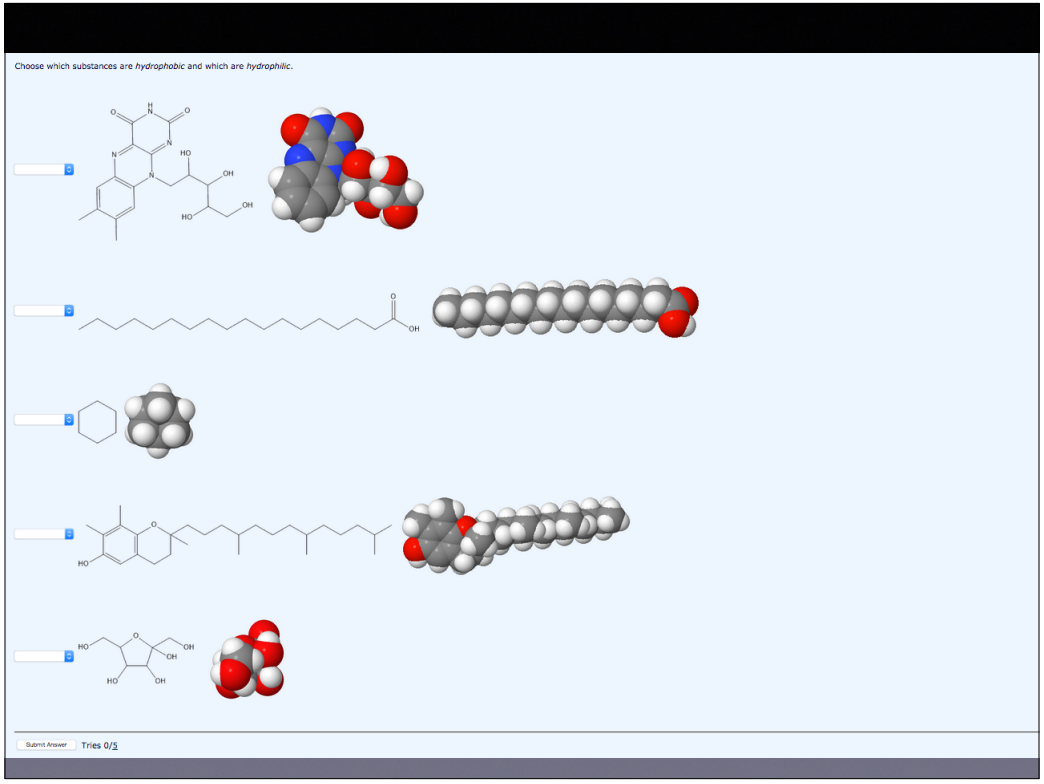



Another problem of which Photo submitted to CHEGG could only have been taken March 29 – April 21 2017
Only one student in course with this combination/permutation of the problem.

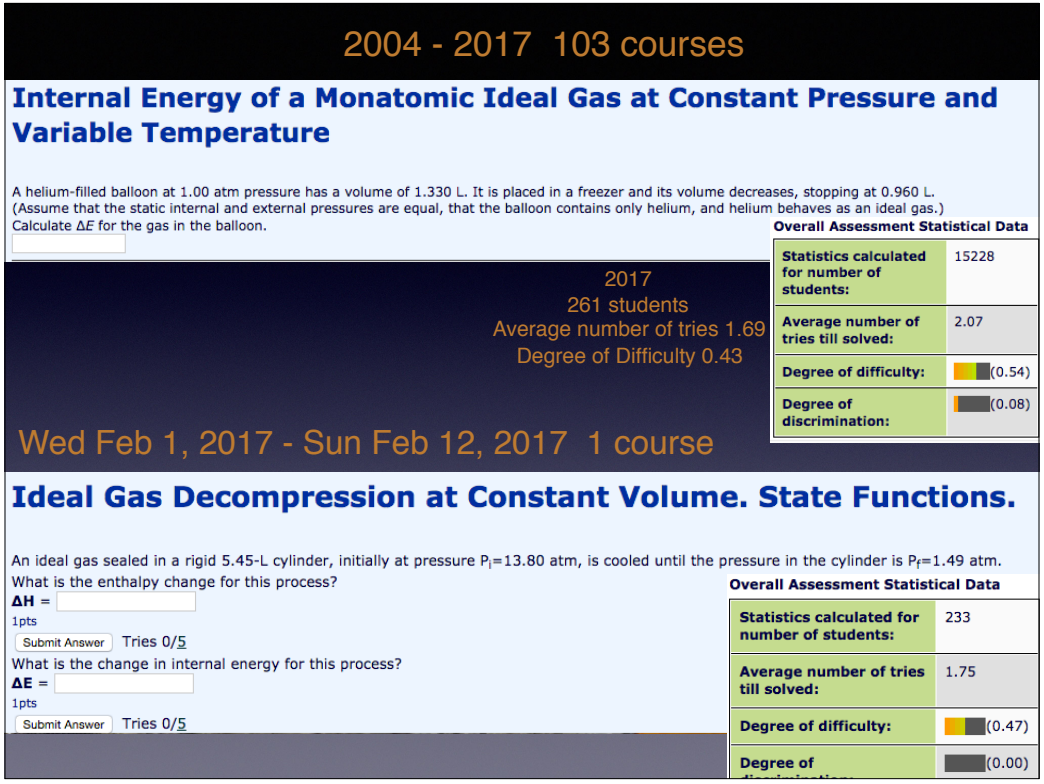
In general: Attempted by 223 of 323 students (83%), 45 of whom (20%) never got it correct, despite answer(s) offered on commercial 'help' site.



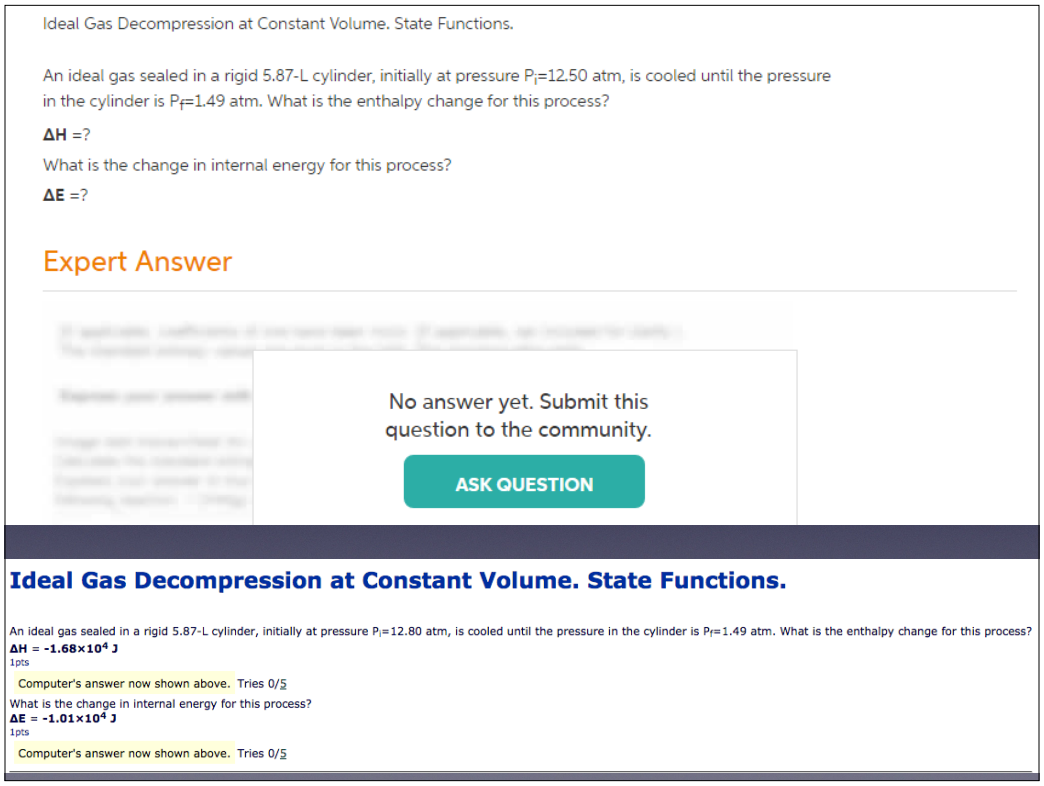

Student first viewed this problem at 5:08PM Sun April 9, 2017.
Answered it on their first try at 11:07PM Sun April 9, 2017 (Due date), presumably after having received the answer from the commercial 'help' site.
C student.



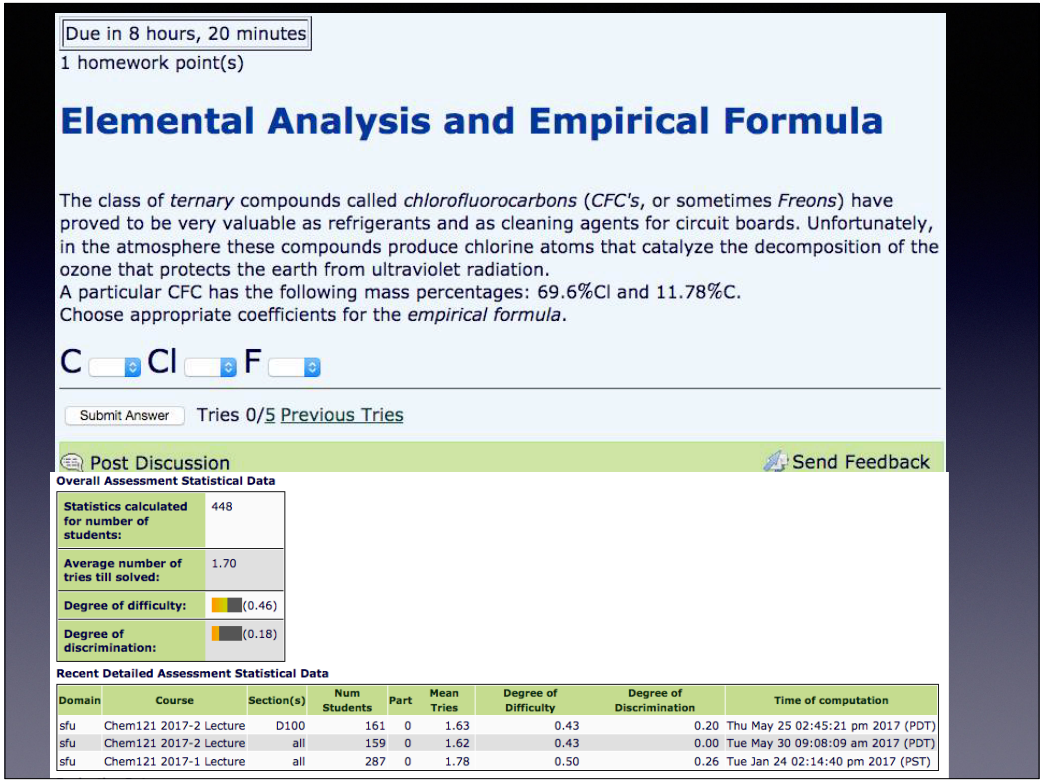

Same problem using JSMOL visualization of molecules as well as the 2-dimensional line drawings.



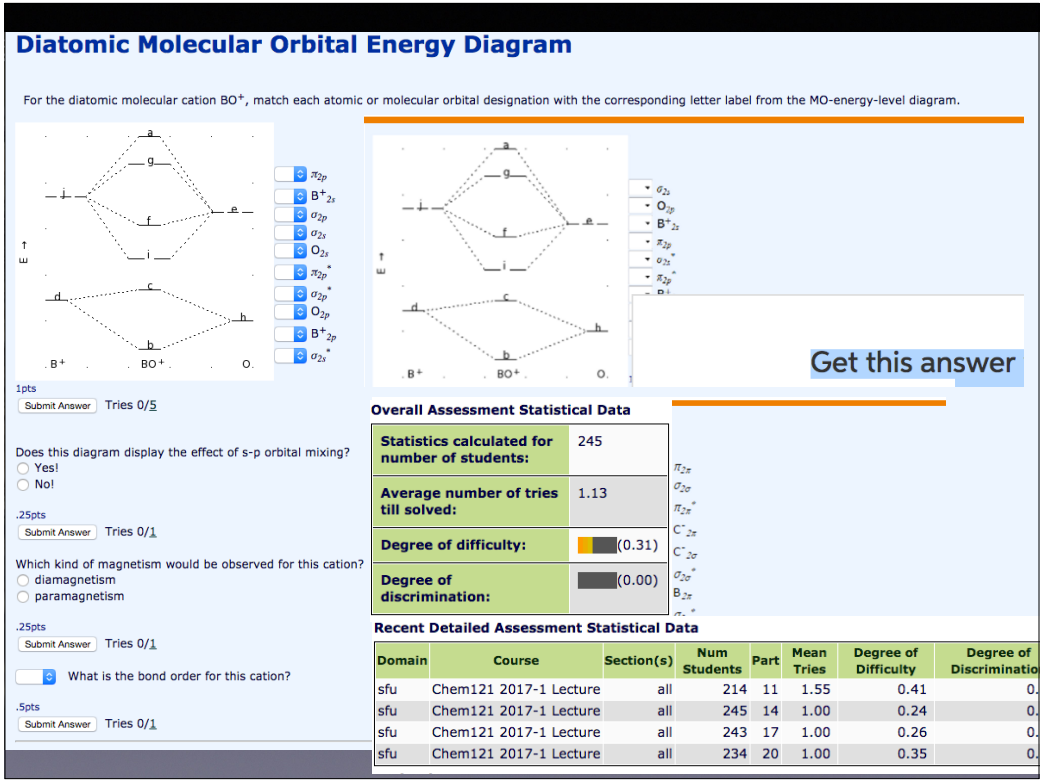

New problem (bottom) possibly a little easier than old problem (top).
Google search for postings containing the wording of the problem.
Next slide




Student submitted their problem to CHEGG.
Only two students had this specific variation.
Neither of them made ANY attempt to answer this problem
(presumably because no answer was forthcoming).
One was working on the assignment over 3 days culminating on the due date.
The other only worked on the assignment on the due date sporadically from 5:41PM until 11:16PM. (Due at midnight).

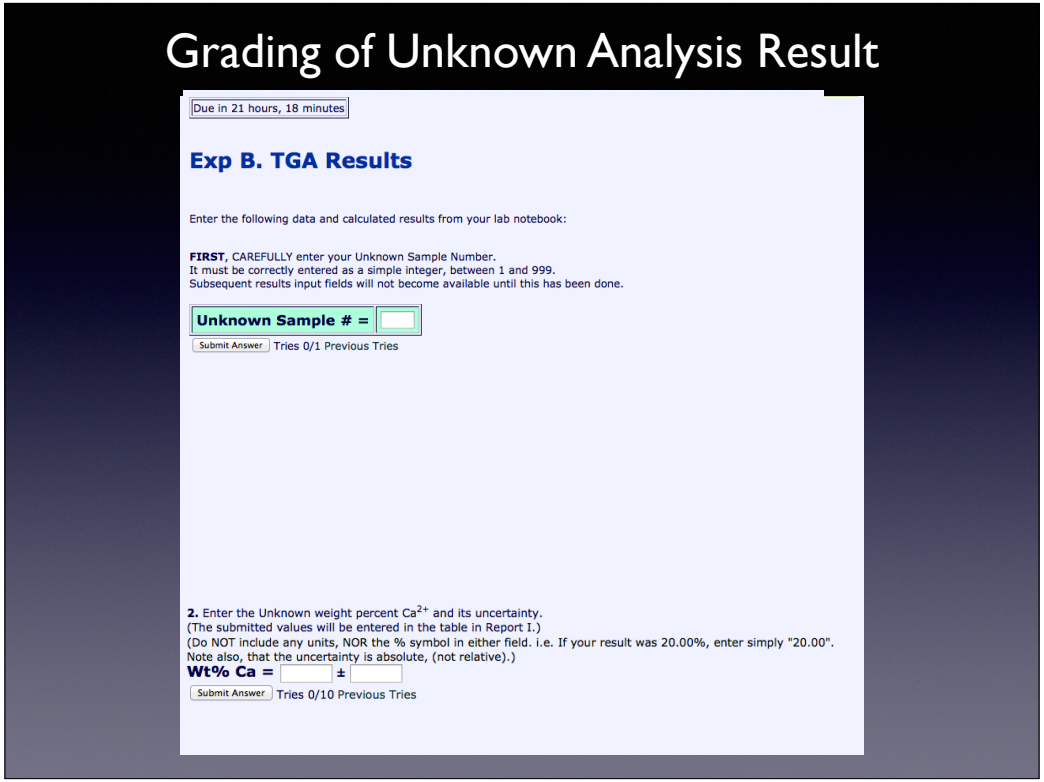



Demo of new rendition of old problem.



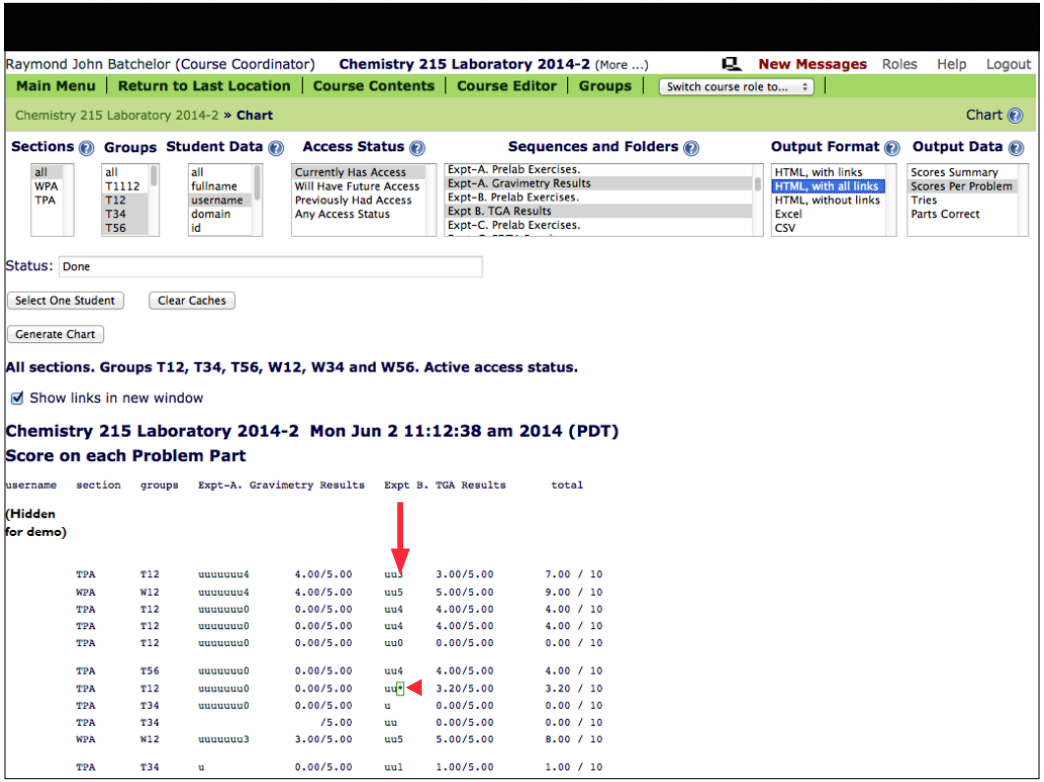

New rather easy problem (2017). Nonetheless students still submitted it to commercial web sites for answers.

# Grading of Unknown Analysis Result

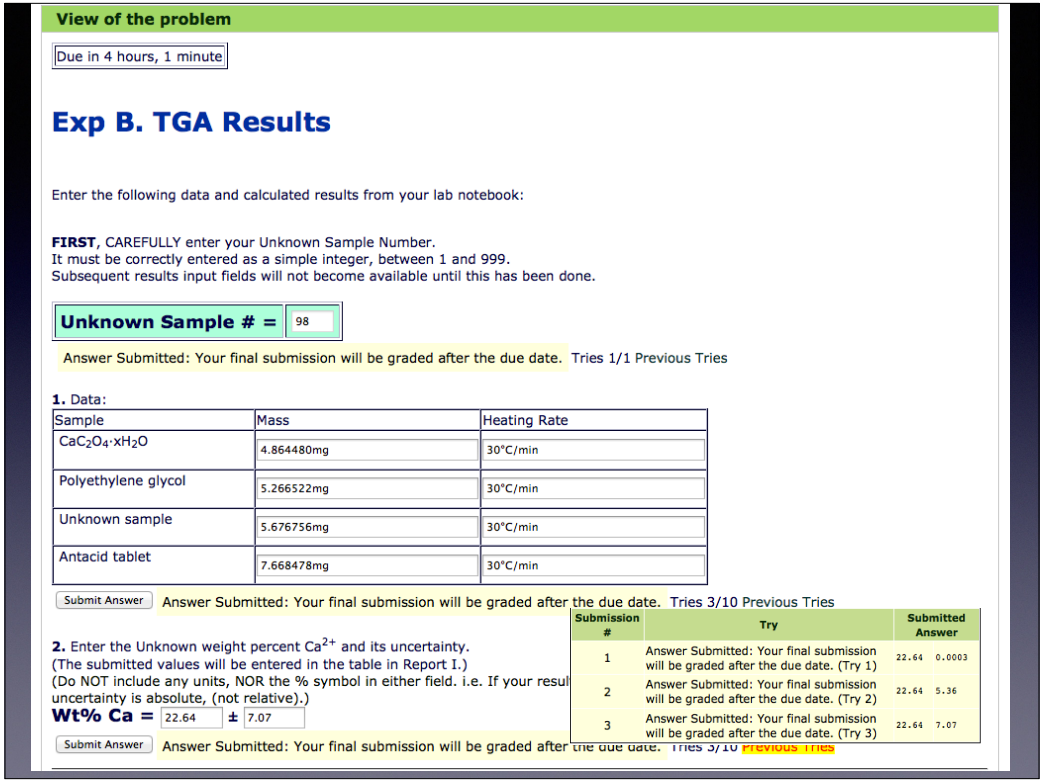



HIDE all until UNKNOWN ID has been accepted. Necessary for auto-grading.
One try only -- grading occurs simultaneously with submission.
Randomized CORRELATION OF UNKNOWN ID## is generated within the program and provided to Lab technician for filling/labelling sample vials, randomly distributed to students.

NEXT, interactive “Chart” of student scores for their determined result Wt% Ca.




Droplists to select filters for display or output of Chart.
Note blue “?”s which appear liberally throughout the interface, give contextual help.
Displayed part scores (integers or single-character symbols) are each a LINK to the grading inter face for that particular resource and the individual student. Very COOL!
When the exact score cannot be represented by an integer, an asterisk is displayed which then pops the actual score when moused-over.
Next, click on the Expt B result for the student who scored 3.2/5.



View of the problem

Due in 4 hours, 1 minute

## Exp B. TGA Results

Enter the following data and calculated results from your lab notebook:

**FIRST**, CAREFULLY enter your Unknown Sample Number.
It must be correctly entered as a simple integer, between 1 and 999.
Subsequent results input fields will not become available until this has been done.

**Unknown Sample # =** 98

Answer Submitted: Your final submission will be graded after the due date. Tries 1/1 Previous Tries

**1.** Data:

| Sample | Mass | Heating Rate |
|---|---|---|
| $CaC_2O_4 \cdot xH_2O$ | 4.864480mg | 30°C/min |
| Polyethylene glycol | 5.266522mg | 30°C/min |
| Unknown sample | 5.676756mg | 30°C/min |
| Antacid tablet | 7.668478mg | 30°C/min |

Submit Answer Answer Submitted: Your final submission will be graded after the due date. Tries 3/10 Previous Tries

| Submission # | Try | Submitted Answer |
|---|---|---|
| 1 | Answer Submitted: Your final submission will be graded after the due date. (Try 1) | 22.64 0.0003 |
| 2 | Answer Submitted: Your final submission will be graded after the due date. (Try 2) | 22.64 5.36 |
| 3 | Answer Submitted: Your final submission will be graded after the due date. (Try 3) | 22.64 7.07 |

**2.** Enter the Unknown weight percent $Ca^{2+}$ and its uncertainty.
(The submitted values will be entered in the table in Report I.)
(Do NOT include any units, NOR the % symbol in either field. i.e. If your resul
uncertainty is absolute, (not relative).)

**Wt% Ca =** 22.64 ± 7.07

Submit Answer Answer Submitted: Your final submission will be graded after the due date. Tries 3/10 Previous Tries

Note student's reported Wt%Ca and the unreasonably large Uncertainty.
Can pop-up the students "Previous Tries".
'Uncertain about uncertainty'.
This student seems to remain confused about the meaning of "absolute" vs "relative" uncertainty.

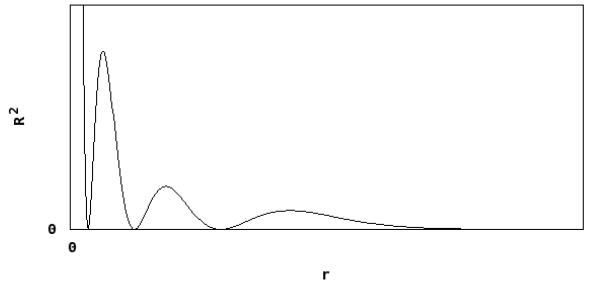
Automatic score of 3.2/5 arises from granting 4/5 for accuracy of Wt% Ca, which is reduced to 3.2/5 for inappropriate uncertainty.

## Quantum Numbers, Valence Electrons, Orbitals

What is the total number of ***p*** electrons in a single (ground state) **Ba** atom?

What is the principal quantum number (***n***) for the valence electrons in **germanium**?

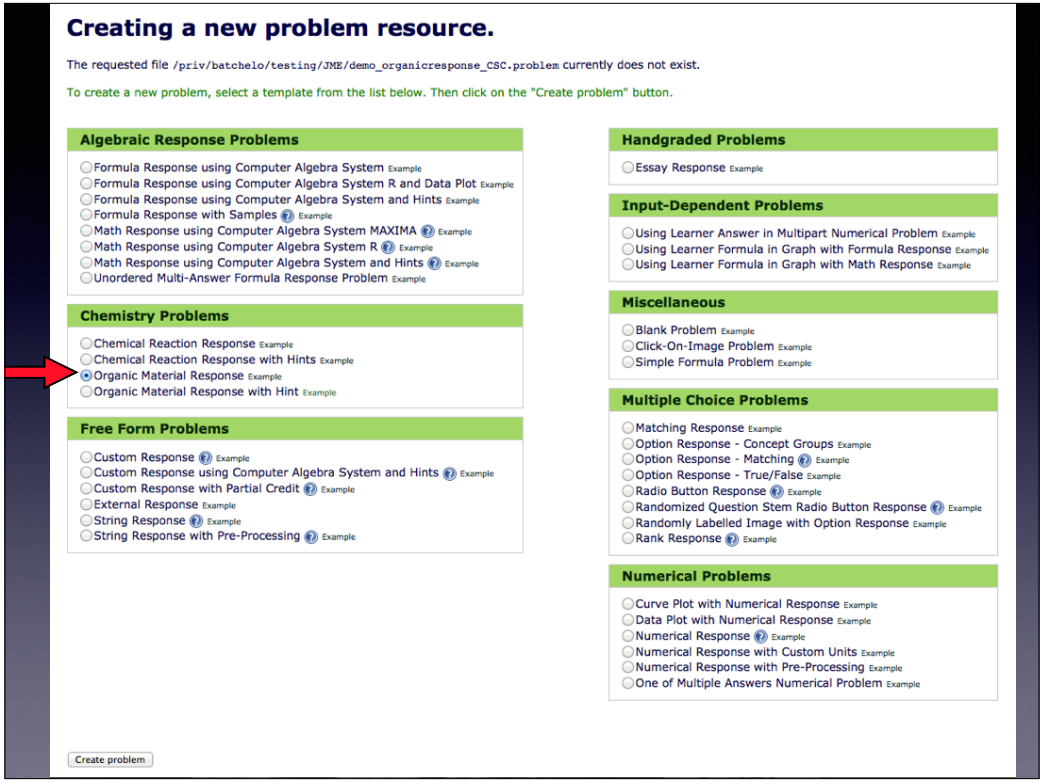
For the hydrogen atom, the square of the wave function $\psi^2(\theta,\varphi,r)$ for an electron in a particular orbital (designated by the quantum numbers *n* and *l*) gives the relative probability of finding that electron at a single point (defined by the angles $\theta$, $\varphi$, and the distance *r* from the nucleus). This also may be called the relative electron density at a single point in the orbital.
The wave function $\psi$ can be factored into the product of the angular and radial functions $\Theta(\theta)\Phi(\varphi)R(r)$.
The graph below represents the relative electron density ($R^2(r)$) for an ***s-orbital***. What is its principal quantum number ***n***?



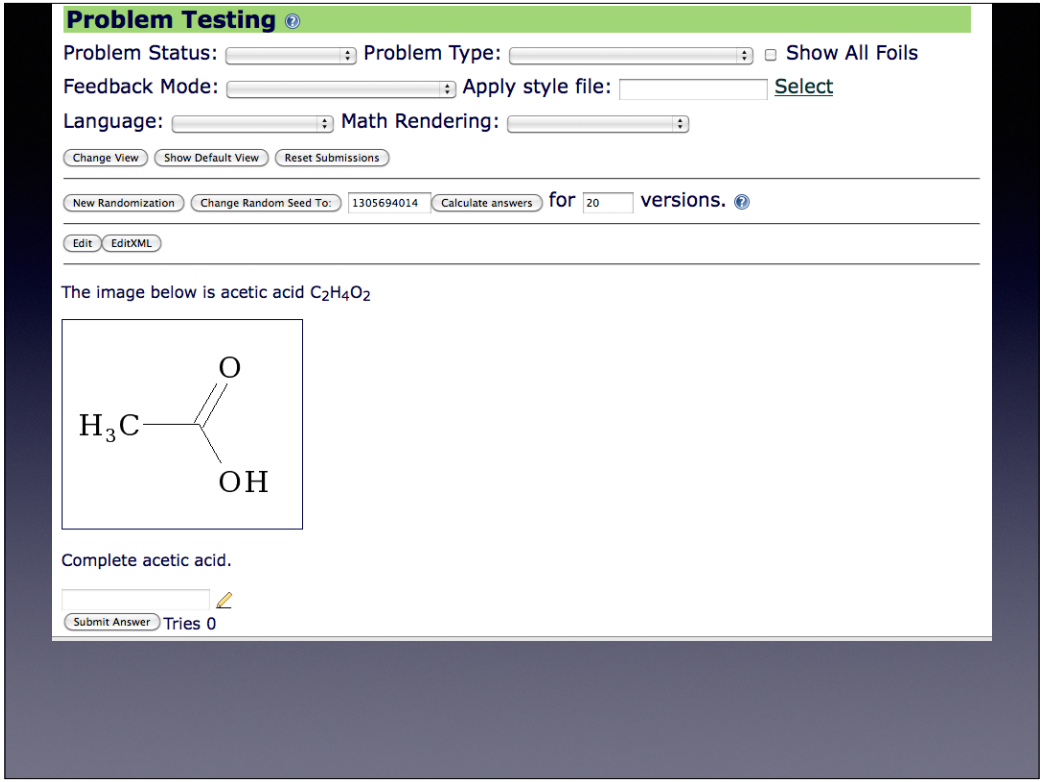

***n*** =

Submit Answer Tries 0

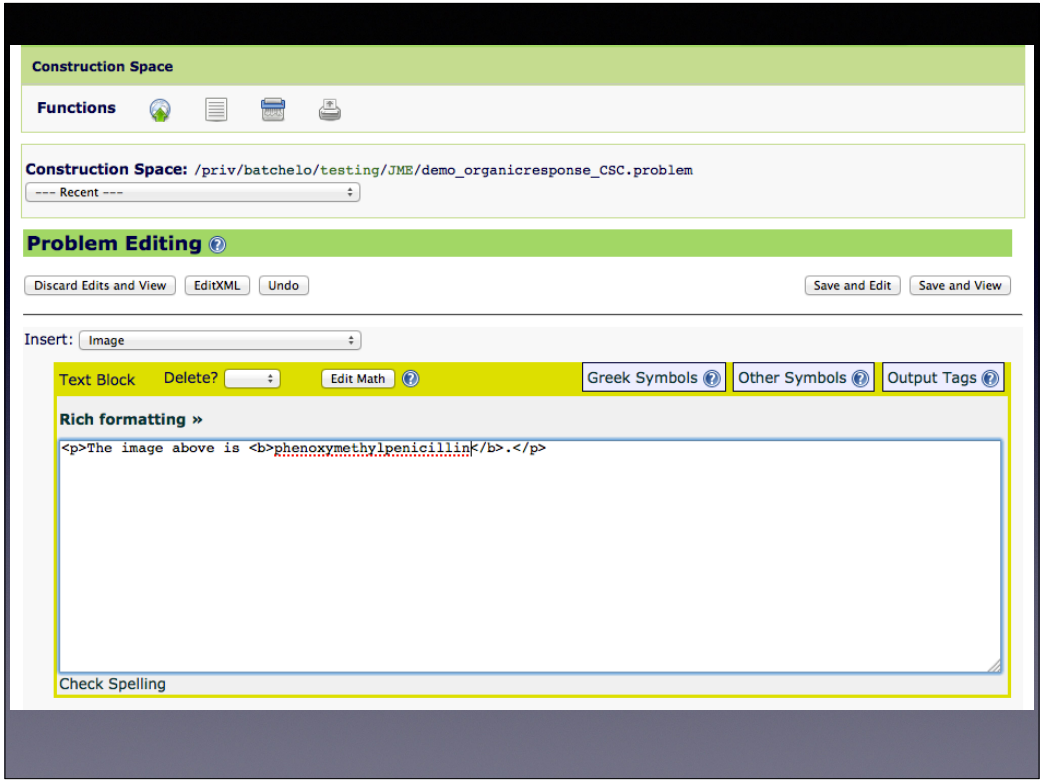
New problem sample using dynamically generated gnu plots for different quantum numbers.



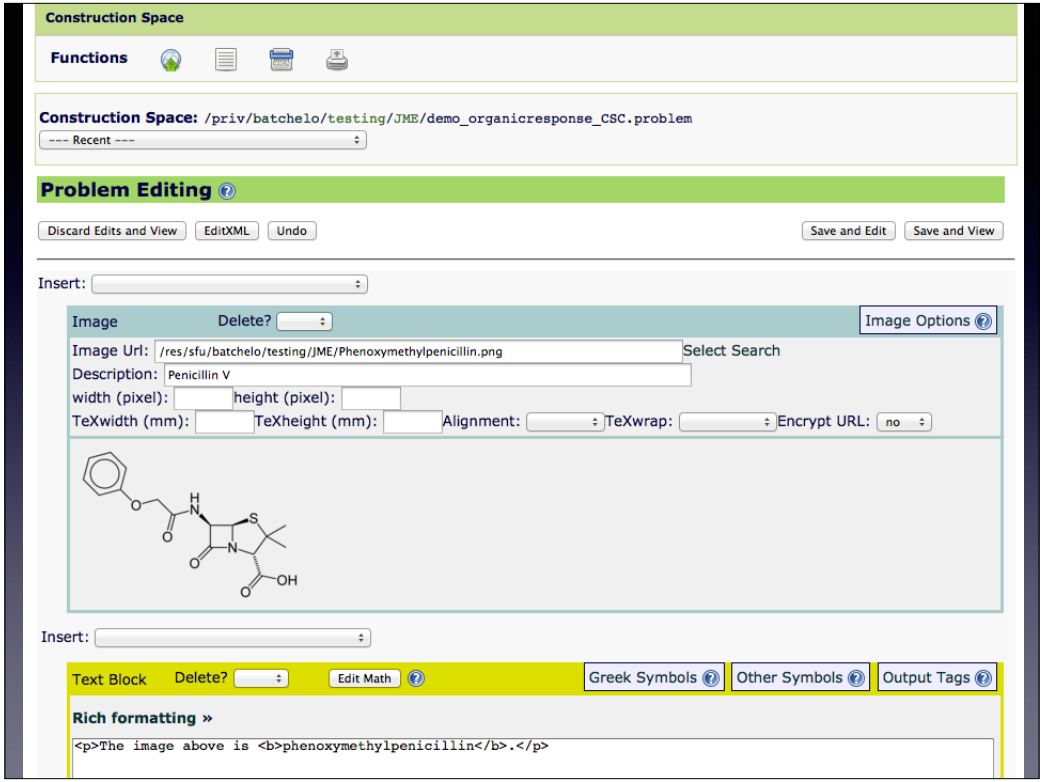

Many templates as shown by the offerings when initiate the creation of a new resource.
Programming definitely NOT required, but can be advantageous.
Can mix and match or devise your own special types of assessments.
Have not even attempted ALL of these templates.
Let's try something a bit different...
In CSTR, create New problem "SampleOrganicResponse" -- click on "Go"




This is the organicresponse TEMPLATE.
Idea is to present a molecule and require the student to draw a molecule, not necessarily the same molecule though.
Will EDIT the question and use a molecule which displays potential stereoisomerism.
Click on “Edit” to go to the GUI editor.

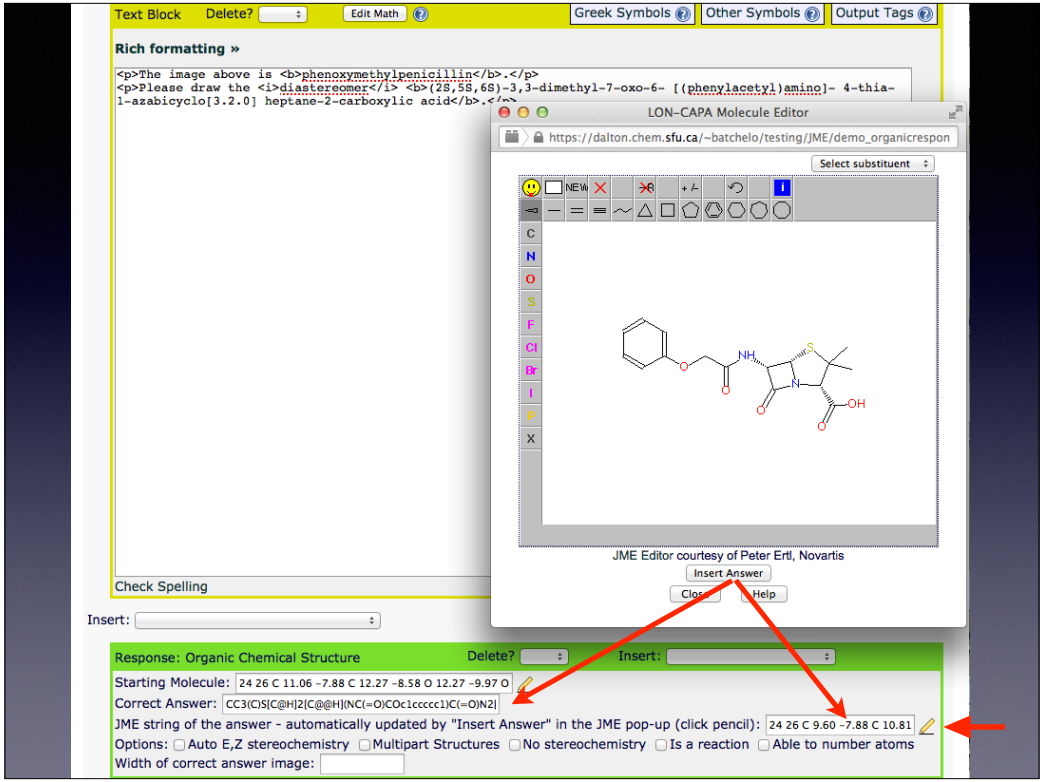



Insert an image “tag” <img />.
I’m going to ask for a specific stereoisomer of penicillin V”.
Click “Save and Edit”




IF one knows where the image is located they can just type it in,
OR one could use “Select” or “Search” to either browse or search in repository for a published image.

Click “Save and Edit”




Notice the pencil icon just after the “Starting Molecule” field. Click on it to use applet to insert and save atomic coordinates & bonds for “starting” point drawing.

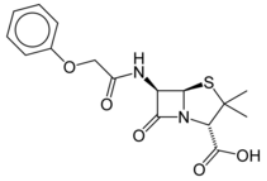
Next click the pencil icon over on the right and draw the CORRECT answer with full stereochemistry using wedge bonds.
Clicking “Insert Answer” in this case does two things:

Saves the coords and bonds needed to produce the “correct” answer displayed.

Saves and inserts the SMILES (Simple Molecular Input Line-Entry System) string which uniquely corresponds to the structure, including stereochemistry. This is required for automatic grading of the student’s submission.

NEXT Scroll down to SAVE and VIEW the problem you have created.

Edit EditXML



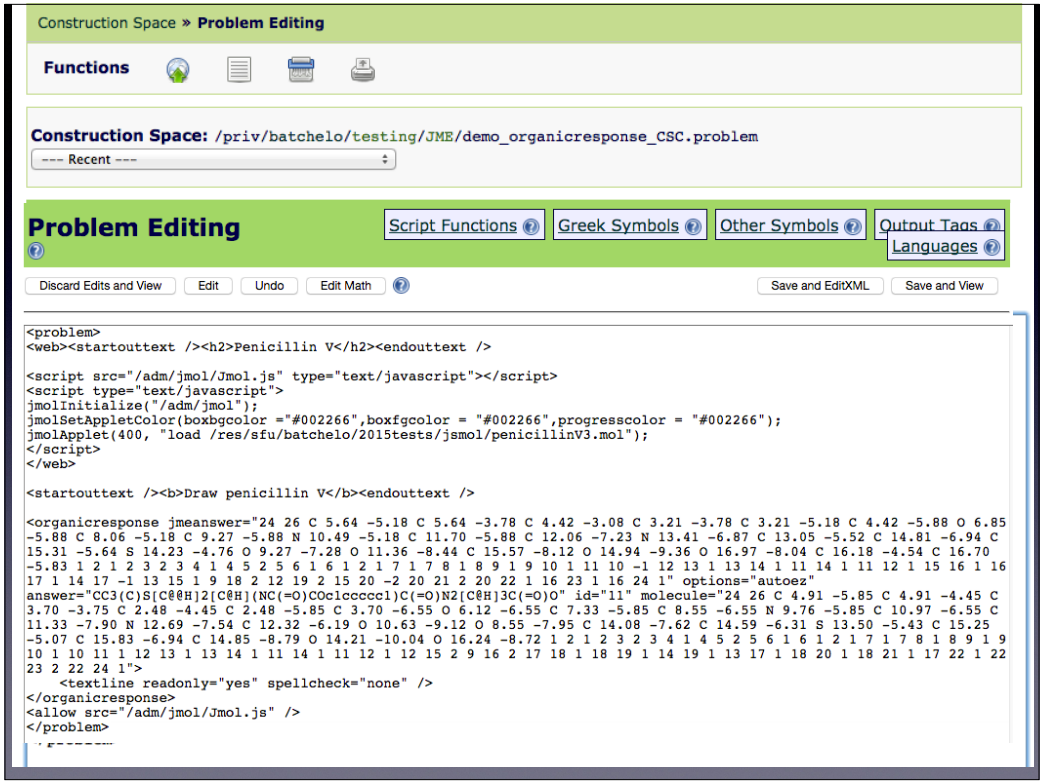
The image above represents **phenoxymethylpenicillin**.

Please draw the diastereomer **(2S,5S,6S)-3,3-dimethyl-7-oxo-6- [(phenylacetyl)amino]-4-thia-1-azabicyclo[3.2.0] heptane-2-carboxylic acid**.

Submit Answer Tries 0

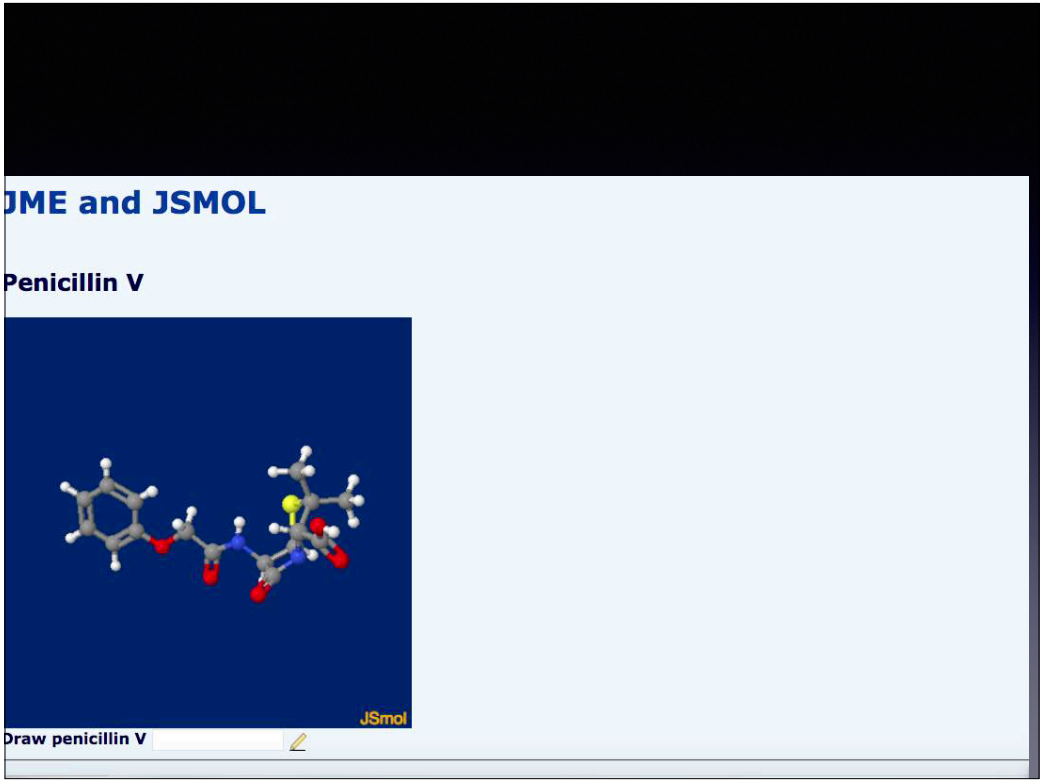
| Answer for Part: 0 | CC3(C)S[C@H]2[C@@H](NC(=O)COc1ccccc1)C(=O)N2[C@H]3C(=O)O |
|---|---|

So, now we have a simple problem to draw a specified stereoisomer of the original molecule.
NEXT Edit XML to show the simple code.

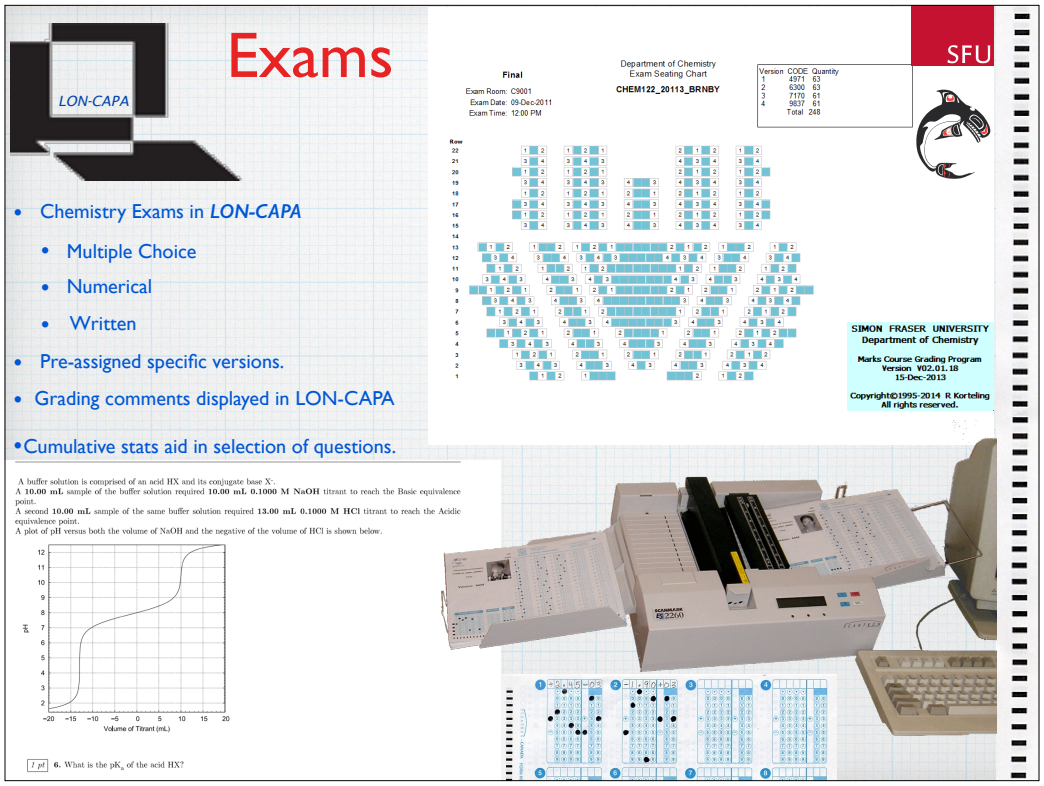



How about 3-D representation of these molecules? JSMOL
Need to generate some xyz coordinates of the structure. There are a variety of ways that you might do this and diverse programs and databases.
Suffice it to say that a file (MDL mol file or Brookhaven PDB file) can be readily obtained or generated for loading into JSMOL to show an interactive 3D-display.
Replaced the original tags for the imported image with appropriate tags for the JSMOL application.

Now shows the entire xml code for the revised problem, shown next...




Video demo:
Still in Author's Construction/Testing environment and want to test out the problem.
Rotate molecule, so that one can visualize the required stereochemistry for the specified answer.
Click Pencil icon to open drawing applet.
Choose appropriate wedge-bonds for the displayed molecule and "Insert Answer" to produce the required SMILES string.
Click Submit and see the system's response "Correct".
...
NEXT: Paper Exams.




Why? Numerous reasons not necessarily individually compelling but collectively so.
Easy to generate new versions of exams, as needed.
Control over dynamically generated content. (show four verisons of one problem with graph).
Numerical answers can also be recorded on custom bubble sheet & machine-graded .
Provides a permanent and cumulative association of assessment resources with statistics reflecting their effectiveness, taking advantage of the analytics within the LON-CAPA system.
We are thus able to easily maintain a semi-quantitative evaluation of every Exam question, which can be reviewed when selecting questions for a new exam.
Prepare seating-plans/room maps showing the distribution of different exam versions to minimize lines of sight.
Lay out collated exams and personalized bubble sheets in advance and seat students according to the design.
Three people could set up this room in 10-15 minutes.
Students can find their exam and seat themselves in ~10 minutes, for a room this size.
Simplifies & streamlines attendance-and-identity checking and grading issues.

# Individual Student's Exam Score as displayed in *LON-CAPA*

## Midterm Results

Total: Mks/Pts = 21.75/24
Multiple Choice: Mks/Pts = 16/18
Numerical: Mks/Pts = 3/3
Written: Mks/Pts = 2.75/3.00

Exam Version: 2222
Your Choices: bdbbdaaead eeaccbec
Exam Answers: bdbbdaaead eeaccebc
Point Values: 1111111111 11111111
Q1: Student Ans = 1.14E+15 Exam Ans = 1.14E+15 ± 5.68E+13 Pts = 1 Score = 1
Q2: Student Ans = 9.28E-06 Exam Ans = 9.29E-06 ± 4.64E-07 Pts = 1 Score = 1
Q3: Student Ans = 0.00499 Exam Ans = 0.00499 ± 9.98E-05 Pts = 1 Score = 1

Class Average: 15.07/24

Scoring broken down and comments provided to individual students.

NEXT Analytics for exam questions (or other assessments).

**Compiling statistics for 34 problems**

**This will take some time.**

## Sequence Statistics

| Sequence | #Items | Score Mean | Score STD | Score Max | Score Min | Score N | Count Mean | Count STD | Count Max | Count Min | Count N | KR-21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final | 36 | 21.99 | 5.48 | 36.00 | 6.00 | 337 | 21.99 | 5.48 | 36.00 | 6.00 | 337 | 0.74 |

## Chemistry 122 Burnaby 2014-1

**Compiled on Wed May 21 10:42:29 pm 2014 (PDT)**

**Final**

| P# | Title | Part | #Stdnts (plot) | Tries (plot) | tries/correct (plot) | #Wrng (plot) | %Wrng (plot) | DoDiff (plot) | DoDisc (plot) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | QvsKEqPos.exam | 0 | 337 | 337 | 1.6 | 125.0 | 37.0 | 0.37 | 0.32 |
| 2 | No Buff | 0 | 332 | 332 | 6.4 | 280.0 | 84.3 | 0.84 | 0.11 |
| 3 | acidic.or.basic.sol.SASB.exam | 0 | 335 | 335 | 1.2 | 58.0 | 17.3 | 0.17 | 0.27 |
| 4 | Ka.rxn.def.exam | 0 | 337 | 337 | 1.6 | 127.0 | 37.6 | 0.38 | 0.42 |
| 5 | pH.water.Kw.Tnot25.exam | 0 | 337 | 337 | 1.6 | 120.0 | 35.6 | 0.36 | 0.39 |
| 6 | pH.wb.exam | 0 | 337 | 337 | 1.4 | 88.0 | 26.1 | 0.26 | 0.40 |
| 7 | me/w.sign.isoT.expans.exam | 0 | 337 | 337 | 1.9 | 158.0 | 46.8 | 0.47 | 0.14 |
| 8 | entropy.fusion.exam | 0 | 337 | 337 | 1.1 | 17.0 | 5.0 | 0.05 | 0.08 |
| 9 | pH.change.concept.exam | 0 | 336 | 336 | 1.2 | 50.0 | 14.8 | 0.15 | 0.21 |
| 10 | acid.str.rel.exam | 0 | 337 | 337 | 1.7 | 133.0 | 39.4 | 0.39 | 0.33 |
| 11 | spontaneity.vs.T.exam | 0 | 337 | 337 | 1.5 | 112.0 | 33.2 | 0.33 | 0.55 |
| 12 | me/rev.delHf0.mult.exam | 0 | 337 | 337 | 2.0 | 170.0 | 50.4 | 0.50 | 0.54 |
| 13 | entropy.spont.exam | 0 | 336 | 336 | 2.8 | 214.0 | 63.6 | 0.64 | 0.12 |
| 14 | ME/NO.Gf.K.exam | 0 | 336 | 336 | 3.3 | 235.0 | 69.9 | 0.70 | 0.42 |
| 15 | delG0.Kps.thermo.exam | 0 | 328 | 328 | 2.5 | 197.0 | 60.0 | 0.60 | 0.42 |
| 16 | std.red.pots.rxn.exam | 0 | 337 | 337 | 1.2 | 55.0 | 16.3 | 0.16 | 0.21 |
| 17 | Selective Electrolysis | 0 | 337 | 337 | 1.7 | 143.0 | 42.4 | 0.42 | 0.18 |
| 18 | Galvanic.cell.simple.conc.eff.exam | 11 | 337 | 337 | 1.2 | 65.0 | 19.2 | 0.19 | 0.41 |
| 19 | Galvanic.cell.simple.conc.eff.exam | 13 | 336 | 336 | 1.9 | 163.0 | 48.5 | 0.49 | 0.44 |
| 20 | ME/car.battery.cell.exam | 0 | 332 | 332 | 1.5 | 116.0 | 34.9 | 0.35 | 0.21 |

KR-21 reliability index (for what it's worth). KR21= (N/(N-1))(1- M(N-M)) Ns^^2
N=number of items in exam; M=mean score; s=stdev
Mostly good degrees of discrimination.
Difficulty level is variant.
How do these results compare with Historical results for the same questions?

Next slide shows dynamic meta data summary of results for a single re-used question.

# Summary Stats for an Individual Question:

**Overall Assessment Statistical Data**

| | |
|---|---|
| **Statistics calculated for number of students:** | 2259 |
| **Average number of tries till solved:** | 1.00 |
| **Degree of difficulty:** | (0.30) |
| **Degree of discrimination:** | (0.40) |

**Recent Detailed Assessment Statistical Data**

| Course | Section(s) | Num Students | Mean Tries | Degree of Difficulty | Degree of Discrimination |
|---|---|---|---|---|---|
| Chemistry 122 Burnaby 2011-Spring | D100 | 454 | 1.00 | 0.35 | 0.39 |
| Chemistry 122 Burnaby 2011-3 | D100 | 235 | 1.00 | 0.34 | 0.46 |
| Chemistry 122 Surrey 2012-Spring | D200 | 95 | 1.00 | 0.22 | 0.46 |
| Chemistry 122 Burnaby 2012-Spring | D100 | 332 | 1.00 | 0.33 | 0.37 |
| Chemistry 122 Burnaby 2012-3 | D100 | 242 | 1.00 | 0.26 | 0.43 |
| Chemistry 122 Surrey 2013-Spring | D200 | 125 | 1.00 | 0.30 | 0.47 |
| Chemistry 122 Burnaby 2013-1 | D100 | 307 | 1.00 | 0.22 | 0.26 |
| Chemistry 122 Surrey 2014-Spring | D200 | 132 | 1.00 | 0.17 | 0.26 |
| Chemistry 122 Burnaby 2014-1 | D100 | 337 | 1.00 | 0.33 | 0.54 |

Example for an individual question used in 6 semesters over 4 years.
Stats averaged over all students summarized at top.
Moderate difficulty
Good degree of discrimination
Stats listed for 9 semester-courses -- 5 different instructors -- 2 campuses.
Note that consistency is reasonable. Though, it appears to suggest that individual instructors get “better” with repeat performances.
Overall averages shown to have good predictive value.

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- eduCog LLC

★ Simon Fraser University

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- Faculty of Science
- Information Technology Services

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