GC 170A1 FINAL EXAM STUDY GUIDE - Fall 2014

Practice Test Questions for the final exam *[pdf]*
11 pages when printed -- contains 50 questions to give you lots of practice!

Try to do the Practice Questions FIRST before consulting the Answer Key which is linked to the Final Exam Study Guide in D2L under STUDY GUIDES

Final Exam is **THURSDAY December 18th@ 10:30 am – 12:30 pm** in our regular classroom, **BioWest 301**
Remember: this exam **STARTS at 10:30 am**, NOT 12:30 pm when our class usually starts!! The exam period is 2 hours
Don't forget to bring a coin, etc. for scratching on the IF-AT form! A Catcard works well too!

FORMAT OF THE EXAM:

- The Final Exam will be worth **205 points, with about 25-30 multiple choice questions and the rest of the points in other question formats, including at least one essay question** *(i.e. a format similar to the Midterm Exam)***.**

- Like the MIDTERM, the exam will consist of questions in a variety of forms: **multiple choice, fill in the blank, figure interpretation, make-a-sketch, short answer / essay.** It will **focus PRIMARILY ON MATERIAL SINCE THE MIDTERM,** but several concepts from earlier in the course are still very important (see below for earlier concepts you should review).

- For the multiple-choice part of the test you will answer on the **IF-AT FORM,** for the other questions you will sketch or write on the test itself. You will probably not need a calculator.

- "**PRACTICE" ESSAY QUESTIONS --** There will be one or more short answer / essay questions on the exam, examples are listed for you in the PRACTICE QUESTIONS -- you can "practice" these at home. One of the essays that might be on the exam is a question about the Greenhouse Effect (see **# 50 in the PRACTICE QUESTIONS)** -- Sample answers to this question from the are provided **HERE** to guide you in how to write a good essay question.

GENERAL SUGGESTIONS:

The content and **"TOP TEN THINGS TO STUDY"** are a good summary of most of the key concepts from the course that you should know and understand. If you haven't done so already, print out the Top Tens (for Tests #3 and #4 especially) and go through each one to structure your studying.)

Do a quick review of all the **CLASS FOLLOW-UP PAGES since the Midterm** to be sure you haven't missed any key topics.
ST's & RQ's -- You should also review the content of **Self Tests & Readiness Quizzes Self Test/RQ-5, 6, 7, 8, and 9.**
HOW DO YOU REVIEW AN RQ THAT YOU'VE TAKEN? Click **HERE** to find out.

Review the basics of these physical science concepts to see how they tie into topics since the Midterm:

ELECTROMAGNETIC SPECTRUM & THE RADIATION LAWS -- These are essential to understanding the **energy balance** and nearly every other topic in the course – review them, know the key wavelength ranges of UV, visible and IR radiation, understand and be able to apply absorption curves to global change issues such as global warming and ozone hole depletion, etc.)

ENERGY & THERMODYNAMICS (Review key items on heat transfer**, sensible heat (H)** and **latent energy (LE)** and be able to tie these into the topics of global warming, the effect of deforestation on climate, etc.

The **MOST IMPORTANT CONCEPT** that ties together and synthesizes just about everything in this class: **THE ENERGY BALANCE!** (Review, study, and thoroughly understand Topic #8 (Global Energy Balance) and the class presentations on this topic and be ready to tie these concepts into each of the topics we've covered since the Midterm Exam. -- more specific details are given below)

As with the Midterm Exam, an important part of your studying should be to **TIE TOGETHER different topics** that we've covered and **to make connections between topics.** Several questions will be asked that require you to link up different parts of the course.

TOPICS & CONCEPTS YOU ARE RESPONSIBLE FOR:

The FINAL EXAM will emphasize the topics in Class Notes, lecture presentations, & assigned reading material **since the Midterm Exam,** so, as noted above, the very **FIRST thing you should do to focus your studying is to refer to the "TOP TEN" for Tests #3 & #4 for details on each of the topics below . (**NOTE: The Top Ten's for Test #3 & #4 list several "specific hints" which are not going to be repeated here, so refer back to the Top Ten's for these.)

SOME BASICS TO REVIEW FROM THE FIRST HALF OF THE SEMESTER

Detailed specifics from these topics won't be asked, but you will need to know the basics of the items mentioned below under these topics in order to tied them in to the topics in the second half of the semester:

TOPIC # 4 Electromagnetic Spectrum (know these wavelength range cutoffs: **ultraviolet < 0.4, visible 0.4 - 0.7 , and infrared radiation > 0.7**)

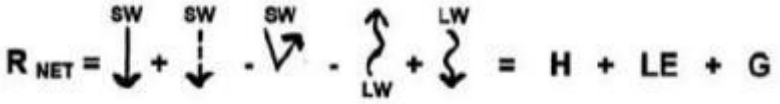
TOPIC # 5 The Radiation Laws (be sure you understand Law 6: "Selective emission and absorption" and how to interpret an absorption curve**;** also be sure you fully understand the ***"Solar vs Terrestrial Radiation Class Concepts Self Test"* on p 33 of Class Notes** – It's a good review of past material and would help you write an essay about the Greenhouse Effect.)

TOPIC # 6 Atmospheric Structure & Chemical Composition (review **p 36 in Class Notes** with respect to the **stratospheric ozone layer and it's place in the structure of the atmosphere** review the "*Greenhouse Gas Overview*" table (**p 38**) and the top of **p 37 in Class Notes**, including the definition of *Radiative Forcing*; fully understand the ***Summary* of this topic on p 39** in Class Notes.)

Specific hint: Know what the "Greenhouse Signature" looks like with respect to Atmospheric Structure (p 37 in Class Notes) and how this is different from the "signature" after a climatically effective explosive volcanic eruption (which you learned in G-5 would lead to *cooling* in the troposphere and *warming* in the stratospheric -- just the opposite of the Greenhouse signature – see p 74 in class notes) Be sure you know what causes the cooling and warming in different layers during each of these "signatures" and why it happens. Also review the "Solar Irradiance Signature" (p 73). Which "signature" is the solar signature like: The "Greenhouse Warming Signature" or the "Volcanic Aerosol Signature"? What different processes are heating up the atmosphere in the layer that is warming in each of these three "signatures?"

TOPICS SINCE THE MIDTERM EXAM *Following are the main topics that will be covered on the Final Exam:*

TOPIC # 8 The Global Energy Balance (This topic is the KEY to understanding nearly all of the other topics!) Know and understand the symbols of the Energy Balance Equation and the difference between what the left-hand and right-had sides of the equation represent:



Know the different processes involved in the pathways of incoming and outgoing energy *(NOTE: you don't need to memorize how many "units" are involved in each pathway, just get a good sense of the relative amounts: only about half is actually absorbed at the surface, about 30 % is reflected back out to space, LOTS of IR (LW) energy is radiated from the surface, absorbed by GH gases, and then re-radiated back to the surface, etc.).* Know the link to everyday life of some of the energy balance terms (G-3 and p 53 in Class Notes) , fully understand what Fig 4-2 in SGC-E-Text represents and how it might change with adjustments in incoming solar energy and outgoing infrared energy, **SPECIFC HINT: see the 4 graphs at the end of the TOP 10 for Test #4 and think about how different kinds of radiative forcing might affect curve A or B and change the graph.**

TOPIC # 9 Systems & Feedbacks -- Know the difference between a coupling and a loop; be able to recognize positive and negative couplings and loops; understand how all the loops on p 59 of Class Notes work; be able to do the Self Test on p 61 of Class Notes; know how feedback loops link to equilibrium states and what the difference between a perturbation and a forcing is.

TOPIC # 10 How the Climate Works-- Focus on pp 65-66 in Class Notes and the link to the surplus & deficits in the Energy Balance; review "Earth-Sun Relationships" (p 63-64 in Class Notes) and "Astronomical Forcing of Climate Change" (p 71)

TOPIC # 11 Natural Climatic Forcing -- Understand the different ways that these processes "force" climate change: astronomical forcing/Earth-Sun orbital relationships, solar variability, and ESPECIALLY **volcanism** since we had a group activity on it: **review the G-5 GROUP ACTIVITY on Volcanism & Climate (pp 76-77 in Class Notes) and know how to do it on your own.**

TOPIC # 12 Ozone Depletion in the Stratosphere -- The key things to know are stated for you on p 79-81 of Class Notes -- see especially "Ozone Depletion: What, Why & Where" on p 81 -- if you can answer the following questions , you will have the beginnings of a good answer to a possible essay question on comparing and contrasting the ozone issue with the global warming issue!

Ozone Questions to Ponder:

- *Do you understand the difference between stratospheric and tropospheric ozone concentrations and effects?*
- *Can you tie the ozone hole discussion to earlier material on the electromagnetic spectrum, atmospheric structure and composition, and the time-latitude curve of solar radiation to answer: Why is the loss of ozone a concern? and, What's so special about spring in the polar regions that influences the onset of the chemical reactions that destroy ozone?*
- *Think about the connections between the ozone hole problem and the greenhouse effect problem. Are they the same thing? Do they occur in the same part of the atmosphere? Do they involve radiation in the same part of the electromagnetic spectrum? Are they related to each other? Do media sources and the general public sometimes err In confusing the two? Are the "solutions" to both problems the same? Why are scientists currently concerned that global warming will SLOW the healing of the ozone layer?*

TOPIC # 13 Global Warming & Anthropogenic Forcing -- This topic was addressed in several parts:

Part A emphasized Carbon Reservoirs & Fluxes, especially the role of photosynthesis, respiration, and decomposition. Be sure you know how this links to the zig-zags on the Keeling Curve, and what it has to do with why DEFORESTATION is a major contributor to increasing CO_2 in the atmosphere. Be familiar with the relative contribution of land use change (mostly deforestation) and combustion of fossil fuels to CO2 emissions (graph on top of p 84 in Class Notes). What parts of the world are currently contributing the most to forest carbon emissions? (graphs in middle of p 84 in Class Notes).

Part B emphasized the extremely important **Radiative Forcing Diagram** (p 87 in Class Notes). The exam will contain one or more questions based on this key figure, so be *sure* you understand it . See the slides and clicker questions in the presentation on **Topic #13 Global Warming & Anthropogenic Forcing Part B** (Nov 20) to sharpen your understanding and give you an idea of what kinds of questions might be asked. (See also **Self Test 8** and **Self Test 9**, each has a question on some aspect of this graph.)

The "**Solar Dimming"** issue we learned about relates directly to this Radiative Forcing diagram. Can you figure out which part?? *(HINT: look for the bar for **Total Aerosol – Direct Effect** on the top Forcing Diagram on p 87 and **Aerosol-radiation interact** on the bottom Forcing Diagram on p 87.).* Does these bars on the diagram indicate cooling or warming? Can you explain why scientists are quite concerned that global warming could be even stronger than experienced to date now that the "masking" effect of aerosols is being reduced by cleaning up air pollution?

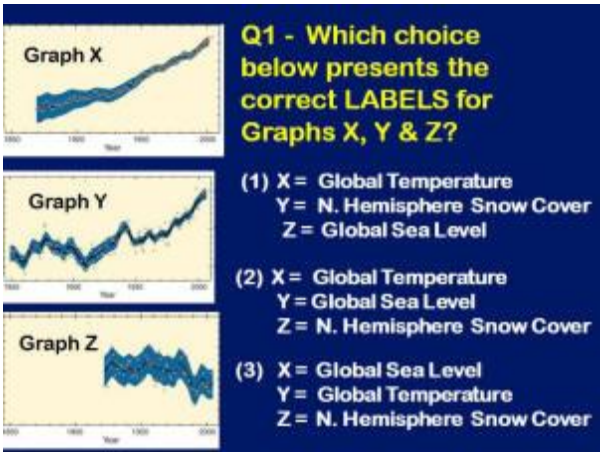
Part C emphasized Evidence from Natural Archives and brought tree rings back to our attention, along with other natural archives. This part was tied in with the "iconic" figure of the **Hockey Stick diagram**, along with the earlier "Noodle diagram" and the newer, updated version of the Hockey Stick graph from the 2007 IPCC - AR4 (the **Spaghetti Plate**") which depicts results from many different research groups, not just the Hockey Stick scientists -- both graphs are shown on p 88 in Class Notes – See also p 47 in *Dire Predictions*). Know why these graphs constitute an important line of evidence pointing to anthropogenic causes for the observed late 20th century / early 21st century global warming.

Part D emphasized Evidence from Natural vs. Anthropogenic Model Comparisons. Know how to interpret the graphs in Fig 15-5 on SGC p 302 and the similar graphs on pp 68-69 in Dire Predictions: (Do you understand how to read Graphs #1, #3 & #4 on Dire Predictions pp 68-69?) Also understand how to read the Land vs Ocean and the Regional Continental Trends graphs on p 89 in Class Notes (similar graphs are on p 71 in *Dire Predictions.* Can you explain why ALL of these graphs which show different MODEL RUN results are compelling lines of evidence pointing to anthropogenic causes for the observed recent warming – but in a different way than in the Hockey Stick? (Review the Topic #13 presentation on Nov 20th)

Also review the **Indicators of a Warming World** diagram on p 91 in Class Notes. The "Too Hot Not to Handle" video addressed nearly all of the the indicators on it. Could you list and explain several of these indiators? We also briefly discussed the **10 Indicators of a Human Fingerprint on Climate Change** (p 92 in Class Notes). Don't worry about having to explain them all – the three we've addressed the most this semseter are: (a) cooling stratosphere, (b) less heat escaping to space and (c) all the CO2 being emitted into the atmosphere each year – so be sure you can state these 3 as indicators pointing to a human fingerprint on climate change (rather than natural forcing mechanisms alone).

Specific Hint: Here's a sample of a question you might see on the Final Exam ➔ It shows 3 graphs without labels. Could you reason out which graph is which if a list of possible graph titles was given to you? This type of question tests your basic understanding of the observed trends, how familiar you are with the shapes of some of the key global change graphs, and how well you understand the nature of the processes that are changing (i.e. if temperatures warm up, snow cover would tend to decrease; sea level has been rising slowly and steadily, whereas temperature has more ups and downs because it is forced more readily by different mechanisms, etc)

More graphs that could be used in a question like this are provided on p 90 in Class Notes..



TOPIC #14 Climate Change: Impacts & Issues With respect to specific **Impacts**, what do you need to know???-- Here are some guidelines. The table on the top of p 94 in CLASS NOTES contains a succinct summary of what impacts we can expect under different amounts of warming (1° to 5 ° C) with respect to: **Water, Ecosystems, Food, Coasts, and Health.** Many of these things were effectively illustrated in the *Dire Predictions* text and in *Too Hot Not to Handle*.. Be generally familiar with the impacts named on p 94 , but you do NOT need to memorize them or any others from the *Dire Predictions* text !! Just be able to give examples of 2-3 projected impacts if asked. You might also be given a list of a few impacts and asked to link them to some other aspect of the course already mentioned above in this study guide.

Climate Change: Adaptations & Solutions: With respect to **ADAPTATION & MITIGATION** -- just be sure you know what the terms mean and be able to give (or recognize) an example of each. (see p 96 in Class Notes).

APPENDIX A -- Introduction to Tree-Rings & Dendrochronology (pp 99 –101)) -- Do you know what sensitive and complacent tree rings series are and why they are important? Could you recognize a sensitive tree-ring pattern vs. a complacent tree-ring pattern in a figure, like those on p 100 in Class Notes? · Do you know which type of pattern (sensitive or complacent) is important for accurate cross-dating? Could you decide if a wood sample was useful or not useful for dendrochronology (see the **The G-4 Wood Kit Activity** (pp 102-103)

Reading for SELF TEST & RQ-9: Climate Literacy: The Essential Principles of Climate Sciences - This is a broad-brush overview of many of our class topics that will help you see the "big picture" summarized as 7 key principles. Self Test and RQ-9 will steer you to the things you need to know from this final topic.
Lastly: You should also re-read or skim Chapter 1 in the SGC-E-Text on Global Change for a good overview of many of our key global change topics

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A FINAL WORD: When I am assigning **the final letter grades** for the course and find that a student is right on the borderline between two grades, what I always do is **go to the student's Final Exam and review the write-in part and essay question answers.** It is here that I can get the best insight into whether or not the student REALLY understands the material or not. If a good understanding is demonstrated, this will help your case for earning the higher letter grade. So it is to your best advantage to do as well as you can on the write-in and essay parts of the test!

STUDY SESSIONS

PLEASE BRING A COPY OF THIS STUDY GUIDE & THE PRACTICE QUESTIONS WITH YOU!

in Bannister Tree-Ring Lab Room 110

MONDAY: Dec 15th 3:30 –5:30 pm

TUESDAY: Dec 16th3:30 –5:30 pm

WEDNESDAY: Dec 17th 1:00 –3:00 pm
