

Pre-Lecture Reading Questions

ASTR/PHYS 109

1. Introduction

It is important to learn how to both ask science questions, tell if it is a well-asked question, and to be well prepared for lecture. For these reasons we will have two different types of Pre-Lecture Reading Question (PLRQ) assignments. In particular, there will be eight assignments: In seven you will be evaluating the scientific quality of questions in quizzes (one for each Unit of the reading, but Unit 1 has been broken into 2 smaller quizzes for simplicity) and one, for Unit 2 only, where you will be writing down your own and turning in those questions in to a separate quiz on eCampus. Each of these assignments will be part of your grade as discussed in the Syllabus.

In this Section we will give an overview of what we are looking for, in particular Excellent Questions. In Section 2 we will describe the standards we will be using in the class for determining the quality of the question. In Section 3 we will give example questions and how each is evaluated according to the class standards. Finally, in Section 4, we will talk about the writing assignment you will do for Unit 2.

1.1 Excellent Questions

There is no definition of Excellent scientific questions, but we can tell one when we see one. Excellent are interesting, stimulating and fun. They can break down a complex topic into smaller, more tangible sets of ideas. Perhaps most importantly, they are well set up for useful answers. In short, excellent questions can help keep you focused, and have the added benefit of bringing structure (or rigor) to a complex and open-ended discipline. They help take us from the vague or “fuzzy” to the concrete. Excellent scientific questions take many forms, but they all have many similarities between them. For this course we consider two different types of questions:

1. Questions about anything in the reading that a typical student might find unclear or need help understanding.
2. Questions related to the science of the reading that go beyond what is in the text. Something in the reading that made you think of a science question you really want to know the answer to. A question that would need to be determined by a physics or astronomy experiment (or was determined by an experiment) is a good example.

While there are many interesting questions that can be asked, in this assignment we are only interested in questions that are related to the reading and about the science of the course. They need to be clearly tied to the reading, or go beyond the reading. Touching on issues outside the scope of the chapter, like in a later chapter, often produces Excellent questions. On the other hand, we are not considering questions that are only tangentially related, or interesting but not about the science. For example, questions should not be about history, philosophy, or biology/life on Earth. While those ARE interesting, they are outside the confines of this assignment and you can ask them privately or we can spend a little time on them in class. Science fiction questions are tougher to evaluate, so in principle they can be

Excellent, but in practice can be Bad. Since this is hard, we'll make it more explicit below, and give examples after that.

1.2 Assignment Overview

We next describe more about the two different types of assignments.

1.2.1 Quizzes

The bulk of the assignments are done in quizzes in eCampus. You will be given 10 questions (5 for each of the Unit 1 quizzes) to evaluate to help sharpen your skills. Perhaps the most important part of this assignment is the feedback on each question in each quiz. It is designed to both help you evaluate quality for questions in future quizzes, and provide some of the answers to the question (especially if it was interesting!) You do not need a specific score on any of the quiz assignments, however you do need to at least attempt each one in order to move on and unlock other assignments. That being said, we recommend doing your best on each quiz. You will get as many attempts as you need and your highest score will always be used. You will need to ask for more attempts if you want/need 5.

1.2.2 Unit 2 Written Assignment

The PLRQ Unit 2 Written Assignment will be pass/revise, and you will need to submit 4 Excellent questions to pass. While many submitted questions are readily described using the rubric below there are two types that we will mention that will also get a Revise and Resubmit. They are:

1. Questions about what things would be like if we changed something fundamental about our world or the universe. This is hard to define, because some of these types of questions are the best, most interesting questions, and some are just lazy thinking. Since these are harder, we will give examples below.
2. Questions based on a wrong understanding. We can't expect the reader to understand everything in the book, but one does have to have some baseline knowledge. We won't have these types of questions in the quizzes, but we will get them for the Written Assignment. In this case, we will simply give you feedback that this is a Revise and Resubmit and help you understand why. Again, examples below.

2. What makes for an Excellent PLRQ question

There are five factors you should keep in mind for evaluating these questions:

- 1) *Is it obvious the question-asker read the Unit (or rather, is it not obvious that they didn't read)?*
- 2) *Is the question relevant to this unit's reading?*
- 3) *Is the question clear and well-phrased?*
- 4) *Does it reflect critical thinking?*
- 5) *Is it relevant to the science of the reading?*

Since the way we will be learning is by taking quizzes your job will be to evaluate the quality of each question and indicate where it is between "Excellent" and "Not Acceptable" according to the standards of the course.

To try and turn the five criteria into a judgement call, we describe the criteria here, and give examples in the next Section. We note that since there is some subjectivity in assessing the question quality, we will assign partial credit for some questions. The quiz answer options are:

- **Excellent:** Question meets all the criteria
- **Good:** Question is fine overall, but doesn't fully satisfy all the requirements
- **Borderline:** Question might be ok, but it has definite flaws. Maybe it was written quickly.
- **Bad:** Question is barely acceptable. It doesn't satisfy several criteria or it's almost answered in the book except for some wording technicality.
- **Not Acceptable:** Question is nonsense or is directly answered in the reading

Excellent questions are clear, well phrased, and thoughtful. It shows that the reader was thinking critically about the material in the reading and asking for clarification about something that is unclear, or asking for more information. It is ok to ask a question that may well be answered in a later chapter. In addition, topics that are closely related to the reading, even if they are not explicitly mentioned in the reading, are fine. These are questions that scientists have found worth answering, or are currently under investigation by scientists. Said differently, if an experiment would be needed (or was needed) to answer the question, that is usually a good indication that it is an excellent question. It does not need to be about a central topic of the chapter.

Good questions indicate that the reading has been done, but are typically not excellent because of unclarities, vagueness or being too broad. To be a good question, they must still show critical thinking. Questions about definitions or simple facts that can be looked up in a dictionary are typically Bad or Borderline. However, just because it can be looked up these days, doesn't necessarily mean it is a bad question; a scientist might have had to do the experiment to learn the answer. That's an excellent question that someone else happens to already know the answer to.

Bad questions typically indicate that the reading was not done, that no thought was given to the subject material, or the student did not understand the assignment. There is sometimes the case that the question is so poorly worded that they did not make any sense.

Borderline questions still show that the reading has been done, but are not excellent (or good) questions due to lack of critical thinking or being unrelated to the science of the unit. Historical questions and questions that are not "science" questions are Borderline instead of Bad if they are clear, show critical thinking, and show that the reading has been done. Questions that are not worded clearly enough to understand what was asked, but look like there might have been a good question in there somewhere are Borderline. If the question doesn't make sense then it is Not Acceptable.

Not Acceptable questions are the worst kind of questions. For example, they are already directly answered in the textbook or show that the reader didn't read the text or just didn't understand the assignment. It is VERY important to be careful about what is *directly* answered in the book. Sometimes a related question is answered which in fact makes this an excellent question. A good check to see if a question is Not Acceptable is to be able to point to exactly where in the text, for example a page number, it is answered.

3. Example Questions and Feedback for the Quizzes

Note: In the quiz itself there will typically be feedback on both the question quality AND on the answer. Here we will just comment on the question quality to help you be prepared for the quiz itself.

- *How many known quarks are there?*
Feedback on question quality: This is a NOT ACCEPTABLE question because it is directly answered in the chapter (the answer is 6, on page 21, Table 3.1).
- *What is the difference between up quarks and the top quarks?*
Feedback on question quality: This is an EXCELLENT question because it is asking for important information that goes beyond what is in the chapter. The answer is not directly in the text itself. It takes scientists to actually determine what the differences are.
- *How many quarks are there?*
Feedback on question quality: This one is hard to evaluate. At first glance, it is similar to the first question that is not acceptable. However, this is in fact an EXCELLENT question as it asks a question that scientists are currently working on. What is the evidence that the 6 known quarks are the only quarks there are in nature? It really would have been better if it were more explicit what the reader is asking. For example, *We know of six quarks, but are there reasons to think there are others out there to be discovered?*
- *What is the mass of the Sun?*
Feedback on question quality: This is a BORDERLINE question. Superficially, this could be seen as an Excellent question, with an experiment. It's not such a good question because it does not show any real thinking, and can be easily looked up. If the question made it clear why this is interesting, that would help. For example, *If a whole bunch of new mass were to fall into the Sun, would that have an impact on the speed of the Earth around it?*
- *Do all stars have the same mass?*
Feedback on question quality: This is an EXCELLENT question because it goes beyond the simple fact, and asks about new information. While many people already know the answer to this question, that doesn't make it a bad question. It is true that this question is answered in later units (and would thus not be a good question for that unit), it is not answered directly in the text, and is a good question for the first unit.
- *What is the evidence that a big bang occurred?*
Feedback on question quality: This is an EXCELLENT question for the first unit. While it is answered in later chapters (and would thus not be a good question for them), it is not answered directly in the text.
- *Should I be worried about black holes?*
Feedback on question quality: This surely is not an excellent question since it's not really about the science, it is about you and your worries. This would get credit both as a GOOD or a BORDERLINE question for the first unit.

- *If we have only sent objects to the edges of our solar system, how can we know the true distances of stars beyond our solar system?*
Feedback on question quality: This is an EXCELLENT question because it is asking about the solar system as well as about how much we know about it using scientific methods. It is focused, easy to understand, and interesting. While one could say this is more about how we measure things rather than about the science, we would also give full credit for GOOD.
- *Why do we believe there is no edge of the universe?*
Feedback on question quality: This is an EXCELLENT question because it is clearly based on the reading, and goes beyond what is covered in Chapter 3 to something interesting. The fact that we will talk about it in a later chapter which also indicates it's likely to be an excellent question.
- *How does the universe exist?*
Feedback on question quality: It's hard to evaluate this question because it's not clear what the writer means when they use the words "exist" or "how." It is not clear if it's thoughtful or reflects critical thinking. For this reason we say this is a BAD question. A better question would be "*How was the universe created?*" or "*What made the universe come into existence?*" At the moment, it's too broad and nonspecific. Then again, since it takes a fair amount of knowledge to know just how problematic this question is we also give full credit for BORDERLINE.
- *Where did everything come from, how did it all come to be?*
Feedback on question quality: This is a BORDERLINE question in some ways, and potentially excellent in others. The question of where did everything come from IS a scientific question. It would be a better question if it were more specific, and/or more clear what the question is that is being asked.
- *Are the anti-matter guns on Star Trek real?*
Feedback on question quality: This is a BORDERLINE question as it has lots of borderline qualities. It is only barely relevant to the reading, but then again, anti-matter *is* mentioned in Chapter 3 and it is interesting to know more. The question is certainly clear, but it isn't clear if it is important or critical. It could be excellent if rephrased to not sound so frivolous.
- *What is reality as it really is?*
Feedback on question quality: There is no chapter for which this could be a relevant question. It is not really thoughtful or nor does it reflect critical thinking. It is not really asking for clarification. This is a BAD question.
- *Is there anything smaller than an atom?*
Feedback on question quality: While this could be an excellent question, since this is directly answered in Chapter 3 (the answer is both quarks and electrons, as stated on page 20, as well as Fig. 3.2, page 19), this is a NOT ACCEPTABLE question.
- *What is the difference between astronomy and cosmology?*
Feedback on question quality: This is directly answered in the book (the answer is given on page 25, in Box 4.1), and is therefore a NOT ACCEPTABLE question.

4. PLRQ Unit 2 Written Assignment

For the Written Assignment you will submit four questions relating to Unit 2 following the same format as the questions you have been reviewing. Each question must be Excellent to pass this assignment.

Before starting, we note that multi-part questions should be avoided. Questions submitted with multiple question marks cannot be Excellent, so a good check is to see if you have multiple question marks in a single question. Similarly, you should not submit more than four. The goal here is **not** to create enough questions such that four of them are Excellent, the goal of the assignment is for **you** to create the questions AND only submit them ONLY if you think they are Excellent. Similarly, you are not creating quiz questions for others to evaluate, but rather questions you want to know the answer to. They should all be Excellent.

4.1 Instructions

You should write four separate questions, and they should only be over the reading for Unit 2 (Chapters 5-9). You should submit the four questions to the **PLRQ Unit 2 Written Assignment** found in eCampus under **Home > Quizzes > PLRQs** These should be submitted by the due date specified in class.

Please number and format your questions as follows:

1. *First question*
2. *Second question*
3. *Third question*
4. *Fourth question*

While eCampus allows you to type in your questions directly into the quiz, this spoils the text formatting which makes grading them difficult. You should submit your questions as a file, preferably a .pdf file. For example you can use your preferred word processor (including Word, Pages, and GoogleDocs) and use the “Save As” option under the File menu to put it into PDF format. You can then upload this file to the PLRQ Unit 2 Written Assignment quiz on eCampus. A second reason we ask for .pdf files is that eCampus is known to remove the file extension of some formats (especially .docx files) when they are uploaded, making it difficult to even open the file after downloading. While this is not an irreversible loss of data, it does make grading significantly more difficult. Again, this is why we ask you to turn it into a .pdf and submit that.

4.2 How you will be graded

Your set of four questions will be reviewed on a Pass/Revise basis by hand and your score will be recorded in the eCampus Gradebook as a score out 10. If all of your questions are considered Excellent you will receive full credit (pass) and get a score of 10/10, and you may get no feedback. Any other score is considered not passing (you see a 5 in the gradebook) and will be accompanied by feedback in the original assignment¹, specifically identifying the non-Excellent questions. Examples of questions that will get a Revise and Resubmit for being other than Excellent are given below. Extra questions submitted in the same assignment will be ignored.

¹ Feedback can be found in the same assignment you submitted to in eCampus and you will only get comments on questions that are not excellent. Simply click the original assignment to view the feedback. See http://tobackgroup.physics.tamu.edu/toback/109/ECampus_Quiz_Instructions_and_Help.pdf#page=4 or email 109GeneralHelp@physics.tamu.edu if you need help.

Note that since there are many students in the course, and each needs to be graded by hand, it may take a few days to get you Feedback and a grade. It will be announced either in class or by Announcement/email when all the grades have been posted.

4.3 First Revision (if needed)

If you do not Pass on your first attempt your score will be marked as a 5/10 (this will be true even if 3 of the 4 questions are excellent), and you will need to submit a second attempt to the same quiz. Note that while you will need to revise as many times as you need to pass, you are given two attempts directly in eCampus, but if you need more than two you will need to ask for them explicitly.

The due dates for Revisions will either be announced in class or in an eCampus Announcement/email. All revision submissions will be done in the same assignment you submitted to originally.

Before resubmitting we will again point out that there will be comments on any question that is not excellent. You should use this feedback as part of your revision process. **You may re-use any questions that were already Excellent.** When you have four excellent questions simply submit them as your second attempt to the same quiz.

4.4 Additional Revisions (if needed)

If you do not pass on your second attempt, you will need to send an email to request more. Before sending this email you should use the feedback so that you have four Excellent questions. When you are done, send the following to 109QuizHelp@physics.tamu.edu.

- Your name
- Which assignment you need more attempts for
- Your four Excellent questions, exactly as you would submit as a revision

If your request shows that you have used the feedback and understood the assignment, then another attempt will be opened for you on the original assignment to submit those questions.

4.5 Example questions which will get a Revise and Resubmit

- *Since there are no objects of mass between space or galaxies, is that area still considered dark matter?*

Feedback on question quality: While this question has most of the elements of an Excellent question, it is based on a misunderstanding of space and dark matter. The submitter has clearly read, asked for clarification about a crucial idea in a clear, and comprehensive manner, and picked a topic that is extremely relevant to the reading and the science behind it. However, there is no “between” space. Dark matter as far as we know IS mass (of course we could be wrong).

- *When the gluon between two quarks is destroyed, how does a new gluon bond form, if one does at all?*

Feedback on question quality: The student has clearly read and asked for clarification about a crucial idea in a clear, and comprehensive manner. It is also extremely relevant to the reading and the science behind it. On the other hand, it is difficult to grade because it misunderstands what the book says about the role of gluons and how they interact. They do NOT bond.

- *Why does dark matter have gravity but space doesn't?*
Feedback on question quality: This question is clear and concise, and it addresses a relevant topic in the unit. However, it is based on a misunderstanding of dark matter, space *and* gravity. Gravity describes how things are “attracted” due to their mass, and general relativity describes this as a curving of space time. If dark matter has mass it also curves space-time.
- *If quarks didn't exist, what would the Universe be like?*
Feedback on question quality: This question is clear, concise and asking something interesting. In some sense, it is asking what looks like a critical question. However, it is so general that one could ask this type of question for ANY topic, so it just needs to be revised so it achieves the goals of the assignment. When it is revised, it needs to be clear that this question is relevant to Unit 2.
- *True/False, the higher the speed of a particle in motion, the more energy it has?*
Excellent
Good
Borderline
Bad
Not acceptable
Feedback on question quality: This question has not followed the instructions. In particular, it has asked a question where the answer is NOT ACCEPTABLE, and it seems to be asking it as if it were meant to be submitted as an example PLRQ quiz question, which is not what we are looking for. We are looking for the submitter to write down Excellent questions.
- *How many particles have we discovered? Are there more particles out there and how would we go about finding them?*
Feedback on question quality: This question is a good example of a multi-part question that needs to be avoided. It is easily identified because you can see two question marks. It is always hard to grade these because some parts of a question may be better than others, and ultimately the goal of the assignment is to get you to ask a single specific question which is Excellent. While the two question marks are a dead giveaway, the second question is an example of the kind which is harder to spot. That is a compound question in that it asks if there are more particles that we haven't discovered yet AND how we would attempt to discover those currently unknown particles. A simple solution to this would be to separate the questions into 3 different ones, and then ask which are excellent. The first one is clearly Not Acceptable as that is directly answered in the text. The last two are Excellent, albeit simple.
- *Could there be other electrons we haven't discovered yet?*
Feedback on question quality: This one is hard to evaluate. In some sense it is an EXCELLENT question in general as it asks a question that scientists are currently working on. On the other hand, the first Rubric question (see Section 2 above) is about whether it is clear they have read the Unit. While this would be an excellent Chapter 3 question (and be perfect for Unit 1), it's not immediately clear whether the question is relevant to Unit 2, or that the student read the unit at all. This would get a Revise and Resubmit.