Physics 109 Midterm Review

The Midterm will be Eight of the Questions Below.

Michael Fowler, Fall 2007

When asked for approximate times, the right century is enough.

Important note: almost any answer to a question involving geometry or astronomy would probably be better (and earn more credit) with a diagram!

1. Explain briefly what features of the Babylonian numbering and measuring systems were superior to ours: sketch the way they represented 1, 2, 10, 25, 60, 75 . . . . What was not so good about their system?

2. Approximately when and where was Thales? What did he contribute to the development of science? How did he measure the height of a pyramid? How did he measure the distance away of a ship? How did his explanations of thunder, for example, differ from what had been believed before?

3. According to the historical record, who first did geometry? And why? And when? What evidence do we have of this?

4. Approximately when and where was Pythagoras? Briefly, what did his followers believe? How did music play a role in their beliefs? Why did they think the stars moved across the sky daily?

5. Draw a couple of diagrams to prove Pythagoras’ Theorem, that is, draw two equal squares each containing four identical triangles, as in the flashlet, and identify the relevant areas.

6. Reproduce the Pythagoreans proof that the square root of two is irrational, that is, it isn’t a fraction.

7. Approximately when and where was Plato? What institution did he found? What was its purpose? What did it say above the doorway? Plato made a specific suggestion to the astronomers as to how they should try to account for the motion of the planets. What was it?

8. Describe with sketches Plato’s Five Regular Solids. Prove that there can only be five.

9. Approximately when and where was Aristotle? What was his school called? What were the four elements? Why did things move? What’s the difference between what he called “natural motion” and “violent motion”? What were his quantitative rules of falling motion?
10. Approximately when and where was Eratosthenes? Describe how he figured out the size of the earth.

11. Approximately when and where was Aristarchus? Explain how he figured out the distance to the moon.

12. How did Aristarchus try to find the distance to the sun? How accurate was he? What important conclusion could he reach anyway?

13. How did Ptolemy account for the retrograde motion of Mars? How is it accounted for now?

14. Write a paragraph on how the Nestorians were an important link in the chain of transmission of Greek knowledge to the West. Give a couple of dates and places.

15. Approximately when was Baghdad built? When was the House of Wisdom founded? What was the contribution of Hunayn? Where was he from?

What were the important contributions of Indian mathematics and science to Baghdad?


17. Explain how al-Khwarismi would solve, say, \( x^2 + 10x = 56 \). (Numbers may vary!)

18. Approximately when and where was al-Tusi? How did he explain back-and-forth motion in terms of combined circular motions?

19. When did Copernicus live, approximately? What was his main contribution to science? What reasons did he give for introducing a new model?

20. Sketch Ptolemy’s picture of the motion of Venus. Does it correctly account for the observed phases of Venus? Does Copernicus’s picture predict different phases of Venus than Ptolemy’s?

21. How did Galileo estimate the height of mountains on the moon? Explain fully, with a diagram and how to work out the answer.

22. Explain how a sundial like the one (sometimes!) behind Pavilion IV works (or would if the trees weren’t there). Explain clearly how it differs from an Australian sundial.

23. The next “new moon” will be November 7. Immediately after that, the moon will be a thin crescent, visible just after sunset. Draw a diagram showing the relative positioning of the earth, the sun and the moon at this phase.

24. If you looked through a telescope at Venus, would you see phases? If you did, what would be, very approximately, the apparent size of Venus at “full” as opposed to “crescent”?
25. If you looked through a telescope at Mars, would you see phases? If you did, what would be the apparent size of Mars at “full” as opposed to “crescent”?

26. If you lived on the moon and watched the earth, would you see phases? Would you ever see the earth eclipse the sun? Would you ever see the earth set?

27. At this moment in time, is there anywhere on earth where the sun is directly overhead? Is there more than one place? Can you guess, very approximately, what the latitude(s) of the place(s) might be?

28. Explain why we have seasons, with diagrams. What days mark the beginning of each season? Show where the Earth is on your diagram at the beginning of each season.

29. At the north pole, the Pole Star, Polaris, is always directly overhead. Is there anywhere where it is always on the horizon? (At night, of course!) If there is such a place, does it move around the horizon, or stay in the same spot?

30. Why didn’t Galileo believe in giants? Why can a cat fall through a greater distance safely than a horse can, even though the cat is a lot smaller? Explain your answer.

31. Why are ants several feet long, as seen in movies like “Them” never going to bother us? Explain your answer. Why are lungs so complicated, instead of being like the inside of a balloon, for example?

32. Galileo claimed that Aristotle’s assertion that a brick weighing twice as much as another similar one would fall twice as fast led to a contradiction if the two were tied together. Explain.

33. Galileo used a pendulum to argue that something rolling down a ramp would pick up the same speed as if it fell the same distance. Recount his argument.

34. If something falls from rest for two seconds, what is its speed at the end of the two seconds? What was its average speed during the two seconds? How far did it fall? (Note: this question could appear with a different time interval.)

35. Galileo gave a simple rule for the ratios of the distance fallen in the first second, the second second, the third second, etc. What was it? What does it tell us about the average velocities in these successive periods?

36. A cannonball is shot horizontally from a cliff top at 100* meters per second (this number could change). Show on a diagram where the cannonball is after 1, 2, and 3 seconds.

37. A cannonball is shot horizontally from a cliff top at 100* meters per second. Show on a diagram vectors representing the velocity of the cannonball after 1, 2, and 3 seconds. Explain with a drawing how these vectors relate to each other and to the acceleration.