

PHYSICS 109: MIDTERM I EXAM PROBLEMS

The midterm will be eight of these, to be answered in the class period.

It will be pledged: you must not use any source of information during the exam. You will not need calculators, as you can see.

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

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, 5400.
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?
3. According to the historical record, who first did geometry? And why? And approximately when? Who first approached geometry as a purely *intellectual* exercise?
4. Approximately when and where was Pythagoras? Briefly, what did his followers believe? Why did they think the stars moved across the sky daily? Why did they think numbers related to music?
5. Draw a couple of diagrams to prove Pythagoras' Theorem, that is, reproduce two equal squares containing four identical triangles, as in the flashlet, and explain your proof.
6. Reproduce the Pythagoreans proof that the square root of two is irrational, that is, it isn't a fraction: but do it for 3. Explain why the argument doesn't hold for 9.
7. Approximately when and where was Plato? What institution did he found? What was its purpose? What did it say above the doorway?
8. Describe with sketches Plato's Five Regular Solids. Prove with diagrams that there can only be five. 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?
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 Strato? What two arguments did he give against Aristotle's description of natural falling motion?
11. Approximately when and where was Eratosthenes? Describe how he figured out the size of the earth.

12. Approximately when and where was Aristarchus? Explain how he figured out the distance to the moon.
13. How did Aristarchus try to find the distance to the sun? How accurate was he? What important conclusion could he reach anyway?
14. How (according to Archimedes) did Aristarchus account for the fact that the stars don't seem to change over the course of a year in the way you'd expect if the Earth is really circling around the sun?
15. How did Archimedes prove the crown wasn't pure gold?
16. Describe how Archimedes found upper and lower bounds to the value of π , and prove it must be greater than 3.
17. Explain Zeno's paradox of Achilles and the tortoise: Achilles runs ten times faster, gives the tortoise a 100 yards start in a 200 yards race—how does he catch up?
18. Explain Zeno's paradox of the arrow: if the smallest time is an instant, an arrow can't move in an instant. But time must be made up of instants, so how can an arrow ever move?
19. Describe with a diagram Ptolemy's basic model for the motion of the inner planets. Does it give a good account of how they are observed to move through the sky? In Ptolemy's time, the phases (shadowing) of the planets could not be observed, but Galileo saw it with his telescope. Do you think that would change Ptolemy's mind if he could have observed it?
20. How did Ptolemy account for the retrograde motion of Mars? How is it accounted for now? If you could see Mars through a telescope, and observe its phases, would they appear any different in Ptolemy's model and Copernicus' model?
21. There was a "New Moon" September 18th. Immediately after that, the Moon was 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.
22. Venus is called the evening star sometimes. Does that mean you can never see Venus in the early morning (before sunrise, of course)? Could you ever see Venus at midnight? Explain your answer with a diagram.
23. 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?
24. Draw a diagram making clear how an eclipse of the moon happens, and explain why there isn't one every month.
25. 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.
26. 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?