Midterm Exam - 11AM Mar 2 2018
Atoms to Universe– Phys 340
Time 50min

Do as many problems as you can in the time. After I have marked the exam, you will be given a chance to hand in revised answers to the questions you got wrong. Your midterm mark will be the average of the total marks obtained the first and second time. Note that the questions will be marked somewhat more strictly the second time, but you cannot get less than you got the first time.

The exam will be marked out of 20. There are 24 marks altogether on this exam. The marks for each question are given in square brackets at the beginning of the question. There are seven questions.

Answer the questions in the Answer booklets, but if you do any work on the exam sheets, make sure you include them with the booklets.

There are two(2) pages altogether.

Calculators (unprogrammed) are allowed in the exam room.

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1. [4] List at least 4 of the major contributions Galileo made to the development of physics. Why were they important?

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   1)Observation of Jupiter's moons, Venus' phases, Moon's mountains, Sunspots

   This was important in showing that the Aristotilian model of the skys was problematic. Jupiter's moons showed that that the there were things that did not obit the earth. Venus' phases showed that Venus must both be nearer the earth than the sun and further, at different times in its orbit. It must penetrate the crystiline sphere of the sun if that existed. The Moon's mountains showed that the moon was far more similar to the earth than was ever suspected by Aristotle. The sun's sunspots showed that the sun was not perfect, that it also suffered change. (Any one of those would have been sufficient)

2) He argued that all bodies fall at the same rate in the absence of air. This contradicted Aristotle who believed heavy bodies fell faster.

3) He showed that the rate of fall near the earth obeyed the Merton rule (The average velocity in fall was proportional to the time over which the fall took place if it started from rest. Ie, the distance fallen went as the square of the time of fall.

4) The oscillation of a pendulum had a time which is independent of the amplitude for small amplitudes. This was almost immediately used by Huygens to create clocks which were far more accurate than anything made previously.

5)The compounding of motion– the horizonal movement of a projectile in vacuum was independent of the vertical motion. Vertically it would fall while horizontally it would keep moving uniformly.

2. [3] What did Pythagoras consider his greatest discovery in music? What is the current thinking about what the mechanism is behind his discovery.

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   He discovered that the harmonious sounds had ratios of small whole numbers, showing that the nature and mathematics were closely related. The key seems to be the existence of beats. If two of the harmonics of a note are near to each other in frequency but not identical, the sound will have louder and quiter oscillations proportional to the difference in frequency of the two notes. The mind seems to regard such oscillations as displeasing. If note have an exact whole number ration some of the harmonics of one will be the same frequencies of harmonics of other note, which makes the mind seem to want to merge the two sounds into one sound experience, and we consider this harmonious. Why is still unknown.

3. [4] List 5 similarities and differences between Ptolemy and Kepler's view of the planetary motion.

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   (This is directly from the notes on Kepler— Greek Astronomy-¿ Kepler's Orbits)

1) Kepler– planets around sun, Ptolomy, orbits around earth

2)Kepler– ellipses, Ptolomy circles.

3) Kepler and Ptolomey both had two points equidistant from the center of the orbit – Kepler foci of the ellipse, Ptolomey–earth and equant.

4) Kepler– equal areas in equal time by radius line from sun to the planet. Ptolomey, equal angles in equal times around the equant (a vacant point in space)

5) Kepler – distance of planets known and definite if earth's distance from sun known. Ptolomey– distance of planets complely unknown. Planets ordered by some sort of aesthetic desires (and perhaps by changes of brightness of the planets), except for moon which had parallax on changing position on earth, so it must be closer.

4. [4]What was natural motion (motion which did not need an explanation) and how did it change from Aristotle to Huygens.

There were forms of motion which did not need explanation– planet just moving naturally. Aristotle– superlunary– motion is in circles with uniform motion along the circle. sublunary– natural motion is at rest– for example falling to the surface of the earth. (or for air and fire rising into the heavens). For Galileo, motion to the earth obeyed a law (Merton law– distance goes as the square of the time elapsed.) and horizontally, uniform motion along a circle horizontally around the earth. For Huygens, natural motion always was motion along a straight line with uniform motion. Anything else needed explanation. Forces, especially forces of contact needed to change that motion.

5. [3] a) What is parallax? Give some examples of its use?

Parallax is the change in the direction of view on motion of he observer in a direction perpendicular to the view direction. Its main use is to find the distance to something. The parallax due to the two views from the two eyes is used to figure out how far away nearby objects are. It was used astronomically to determine how far away celestial objects are from earth. The epicycles can be explained as the parallas due to the earth's motion around the sun.

b) How did Eratosthenes' measure the size of the earth?

He knew that on the summer soltice the sun shone directly down a well in Syene sourth of Aleandria. In Alexandria he erectes a tall pole and measured the minimum length of the shadow of the pole.Knowing the height of the pole, and the length of the shadow, he knew that the sun on the summer solstice was 7.2 degrees from vertical. He also knew how far it was from Alexandria to Syene. and this mean that he knew that that distance was 7.2 degrees/360 degrees =1/50 of the circumference of the earth. His result was close to the current known value (depending on what the length of the stadia is which was how he reported the distance)

6. [4]a) How did Aristarchus measure the distance to the sun? What were the limitations to this technique?

   He argued that if he measured the angle between the perpendicular to the line to the sun and the direction to the moon when the moon was exactly half lit by the sun, then that angle would represent the parallax angle to the sun due to the moon's distance from the earth. He knew that the moon was about 60 times the earth diameter from earth (from eclipse measurements). He got a parallax angle of about 3 degrees, which meant that the sun was about 20 times as far away as the moon (instead of about 400 times). Seeing when the moon is exactly half lit it extremely difficult especially without telescopes.

   b) Why did Tycho Brahe reject Copernicus model of the solar system, and what was his model?

   He said that he had never observed any parallax in the positions of any stars, which either meant that they were horrendously far away or the earth did not move. For him the stationary earth was more reasonable than such absurd distances. (Since he could see angles of about 2 min of arc, the stars would have to be about 57*60/2 equals approx 1700 times as far away as the sun.) He accepted Copernicus's arguments, so he had everything orbit the sun, and then the sun orbiting the earth.

7. [2] What will be the topic of your term paper for this course? Why? (Note that you do not have to stick by this topic if you think of a better one before you write it, but I want some indication that you have thought about it.)
