Problem set 1-solutions  
PHY1033C HIS 3931 IDH 3931  
Discovering Physics: The Universe and Humanity’s Place In It  
Fall 2016

(all problems 2 points)

1. (see, e.g. http://astro.unl.edu/classaction/animations/coordsmotion/zodiac.html) How high does the Sun get in the sky at midday now? (The high point is close to 1 pm since we’re on EDT.) By “how high” I mean an angle, which you should measure, by finding an upright object (like holding a pencil vertical) and marking off its shadow (easier to do with two of you!), then drawing a triangle. Or, you could angle a pencil towards the Sun so it has no shadow, then measure the angle. (be clear whether you mean with respect to vertical or horizontal when writing this up). Either way, draw a picture of your triangle, and label the sides and the angle you mean. Given that Gainesville is 29.6 degrees from the Equator, what should that angle be on Midsummer’s day? (Hint 1: try to find a globe to look at and imagine the sun shining on it: if not, make a picture. Hint 2: if this question completely flummoxes you, or you need help with trig, please come to me and I’ll elaborate.)

You should have gotten an “altitude” close to 65 degrees from horizontal for the maximum elevation angle (“height”) of the sun in September in central Florida.

For midsummer in the northern hemisphere, the Earth’s axis is tilted maximally towards the sun (see below). The sun’s rays are so far away that they come in essentially parallel to one another. As you can see from the diagram, $\alpha$ is the latitude minus the axis tilt, or 29.6-23.5=6.1 degrees (from vertical). So even at local noon, the sun is a lot closer to the horizon now (early September) than in summer.
2. Explain with your own diagram and an accompanying explanation why the summer is in the months of June-August in the northern hemisphere of Earth, and in the months November-February in the southern hemisphere. Make sure your diagram shows the axis of the rotating Earth at various positions its orbit around the Sun, and that the orbit is elliptical with the Sun at one focus. Why are we in Florida actually further away from the Sun in summer?

For hints, consult
http://astro.unl.edu/naap/motion1/animations/seasons_ecliptic.html
The Earth’s axis is always oriented towards Polaris, the north star, as it rotates around the sun (see sketch). While the amount of solar radiation reaching the earth does depend a bit on how far away the Earth is, the orbit is very nearly circular, so this is not a big effect. More important is whether the northern or southern hemisphere receives direct rays. In Florida’s summer, the northern hemisphere is oriented so as to receive more direct radiation, but is actually further from the Sun, as shown.

(Problems 3 and 4 are based on the reading from the text, Fred Gregory, *Natural Science in Western History*, and from the preface to Stephen Weinberg’s book, *To Explain the World*, read online at Amazon, [http://www.amazon.com/To-Explain-World-Discovery-Science/dp/0062346652](http://www.amazon.com/To-Explain-World-Discovery-Science/dp/0062346652))
3. Name 3 things that the ancient Greeks knew about the cosmos that agree with modern science. Name one that disagrees.

For things that agree, you could have mentioned

a) Earth is a sphere
b) Moon goes around the Earth
c) There are several “planets” that move against the background of the fixed stars
d) Sun’s apparent motion through the zodiac takes about 365 days
e) Ratio of distances of Earth to Sun and Moon (Hipparchus)
f) Radius of the Earth (Eratosthenes)

For things that disagree, you could have mentioned

a) Earth is stationary, doesn’t spin
b) Earth is stationary, doesn’t move around sun
c) Earth is at center, planets (including Sun and Moon), stars revolve around Earth
d) Heavenly objects only moved in perfect circles at uniform speed

4. What would you say is the primary conflict that Weinberg identifies between a physicist’s view of history of science (at least, his own) and a historian’s? Where do you find yourself standing in this conflict – which “side’s” position appeals to you more? (No “right” answer to this last part).

Weinberg believes that nature corresponds to an objective reality, and that science, whose goal should be to “explain”, not just describe this reality, is itself a kind of objective reality, to be “discovered”, rather than invented. Historians, at least according to him, often insist on the cultural basis of science and how it is practiced, but also even in some cases on the cultural basis of its results.
5. (2 pts.) What essentially distinguished a) Milesian (6th cent. B.C.) and b) the Pythagorean approach to the understanding of nature in (early 5th century B.C.) from the mythopoeic approach that earlier civilizations had adopted?

Earlier, mythopoeic societies in Greece and elsewhere in the ancient world ascribed natural phenomena to divine agency. Without denying the existence of the divine, the Milesians identified the study of nature as an enterprise that could be pursued separately, claiming that powers of human reason could be used to uncover patterns in the natural world. The Pythagoreans were inspired by mathematics to identify regularities and patterns in nature, but never removed divine agency from their discussions completely.