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AST 191

Activity 2

9.16.13

2a:

Given the observational data that we know to be true, we can see how much validity each of the conjectures has about what the cause is for the seasons on earth. Observational data 1 says that the seasons are flipped between north and south. This clearly disproves conjecture A because the seasons are different for different hemispheres so saying that it is summer when the earth is closest to the sun is false because only half of the earth will be in summer at this time while the other is in winter.

Observational data 4 says that the earth’s rotation axis is tilted relative to its orbital plane, which goes along with the first part of conjecture B. Observational data 1 says that the seasons are flipped between the north and south hemispheres. So we know that the northern hemisphere is in summer while the southern hemisphere is in winter as conjecture B says. However, based on the observational data, we can’t say for sure that this tilt causes the northern hemisphere to be closer to the sun in the summer than the southern hemisphere so we can’t say that conjecture B is valid.

Observational data 4 says that the earth’s rotation axis is tilted relative to its orbital plane. However, as conjecture C implies, we can’t say that this is what changes the elevation of the sun above the horizon throughout the year even though the rest of the pieces of the conjecture are sound. Therefore, we cannot confirm that conjecture C is valid.

Conjecture D says that the seasons are caused by a combination of the above effects. We know from the observational data that the earth’s rotation axis is tilted, the seasons are flipped between hemispheres, the sun’s elevation changes and is highest mid June for the northern hemisphere, and light striking from directly above is higher energy than from an angle. From these we can draw some conclusions about the reason for seasons. We know that at highest elevation, the sun is more directly above. We also know that light from directly above has more energy per unit area. We also know that the highest elevation is mid June for the northern hemisphere so we can conclude that it is hottest mid June for the northern hemisphere which would mean summer. We also know that the north and south hemispheres have flipped seasons so while it is summer in the north the south is experiencing winter. So we can conclude that the combination of axis tilt and sun elevation levels cause the seasons.

2b:

Conjecture A says that the shadow of the earth blocks the sunlight from reaching the moon, which causes a crescent moon. One observable says that the terminator changes in shape from concave to convex, however, if the earth shadow was the cause of a crescent moon, the shape would always be concave because that is the only shape that a projection of a sphere can create on a surface.

The angle of the sun and moon also can disprove conjecture A. We sometimes see both the sun and a crescent moon and this would be impossible if the earth’s shadow were to be the one causing this because if we can see the sun, then we wouldn’t be able to see the crescent moon because the sun is not behind the earth to cast the shadow.

Conjecture B says that a crescent shaped moon occurs when the sunlit side of the moon is almost completely facing away from us. This seems sound based on the observable that the terminator switches from concave to convex. When the moon’s lit side is almost completely turned away from us we see a small concave piece of the moon. As the lit side turns more towards us it becomes a larger concave piece that we see until we see a fourth of the lit side of the moon where it turns to a straight line. After it passes this point it turns to a convex piece of lit moon until the lit side turns fully towards us and we experience a full moon.

The angle of the sun and the moon can also help support conjecture B. When the angle of the sun is low compared to where the moon is in orbit, the crescent moon is thinner. This makes sense because the sun is hitting a spot of the moon that we can’t see much of so we only see a small sliver of what is being lit up by the moon. As that angle increases, we are seeing more and more of the lit side of the moon so the crescent turns into a full moon over the 28-day orbit.

Based on these observations, we can conclude that conjecture B is sound while conjecture A is not.