

Philosophy 1103: Introduction to Philosophy of Science

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Solutions to Practice Quiz #1

[Total: 40 marks]

1. Identify each of the four claims underlined in the passage below as either *hypothetical* or *empirical*. [1 mark each.]

In 1966, as a young faculty member at Boston University, biologist Lynn Margulis proposed that (1) complex (eukaryotic) cells evolved from symbiotic combinations of simple (prokaryotic) cells. In other words, (2) at some time long ago, one simple cell engulfed another, yet both survived. The idea was supported by the fact that (3) mitochondria, which are the “power plants” of animal cells, have their own DNA which resembles that of bacteria, and is separate from the animal’s own DNA. Margulis claimed (4) mitochondria are actually descended from bacteria! The paper was initially rejected, quite fiercely, as symbiosis theories had been dismissed by mainstream biology at the time. Weathering constant criticism of her ideas for decades, Margulis is famous for her tenacity in pushing her theory forward, despite the opposition she faced.

1. *Hypothetical*
2. *Hypothetical*
3. *Empirical*
4. *Hypothetical*

2. Sometimes an empirical statement can be ‘infected’ with theoretical claims. For example, you may say, “When I released the ball, it naturally gravitated downwards, to its natural place”, but this is infected with Aristotelian physics. If you say, “When I released the ball, the force of gravity pulled it down to the ground”, this is infected with Newtonian physics. A pure empirical statement would say, “When I released the ball, it moved downwards”. It describes only what is observed, and nothing invisible, like forces or natures.

Each of the following empirical statements is similarly infected with theoretical ideas. Replace each statement with a purely empirical one that expresses only the observational content, and is as theoretically neutral as possible. [2 marks each]

- (i) The guy coughed all over me, spraying me with viruses, and sure enough some of those viruses got past my immune system and made me sick 3 days later.

The guy coughed all over me, and I got sick 3 days later.

- (ii) When a barometer is carried to the top of a mountain, the reduction in air pressure causes the column of mercury to drop a few inches.

When a barometer is carried to the top of a mountain, the column of mercury drops a few inches.

3. Read the following argument.

It is a little-known fact that the theory of a spherical earth was refuted back in 1904, in the village of Welney that sits at one end of a 6-mile straight section of a canal. On May 11th that year Lady Elizabeth Anne Blount hired a commercial photographer to use a telephoto lens camera to take a picture from Welney of a large white sheet she had placed, touching the surface of the canal, six miles away. The photographer mounted his camera two feet above the water at Welney and was surprised to be able to obtain a picture of the target, which should have been invisible to him given the low mounting point of the camera. If the earth were a sphere with a radius of 4,000 miles, then the top of the sheet would have been 10 feet below the horizon! Lady Blount published the pictures far and wide, but rather than accept the truth of a flat earth, the “scientific community” claimed that the light from the sheet was being curved somehow.

- (i) What hypothesis is being argued for in this passage? [2 mark]

The earth is flat (not a sphere).

(ii) What data are used in the argument? (Summarise) [2 mark]

A photo was taken of a white sheet, from 6 miles away. Both the sheet and camera were just above the surface of a canal.

(iii) Is the hypothesis strongly supported by the data? If not, offer an alternative explanation of the data. [2 marks]

The data fits the prediction of the flat earth theory, assuming that the light travelled in a straight line. But we know that light can bend, so the round earth theory might also explain this, in which case there isn't strong support.

(iv) Was your judgment in part (iii) influenced by your background knowledge? If so, write down one or two of your background beliefs that are relevant. [2 mark]

Yes, I'm influenced by my certainty that the earth is a sphere. Any apparent evidence for a flat earth must have another explanation.

4. Francis Bacon urges scientists to "...lay their notions by and begin to familiarize themselves with facts". For each scientific claim below give *two* "notions" (prior commitments, intuitions, prejudices, etc.) that would affect someone's view concerning that claim: one that would incline someone to support it, and another that would to incline someone to reject it. [2 marks each]

Do not cite data or scientific theories here. Do not argue for or against the claim! Refer instead to cultural, religious, moral, political, or philosophical 'worldview' ideas, or personal circumstances, that might be influential. E.g. for the hypothesis, "Spanking is harmful to the child, causing depression and violent outbursts as an adult", you might write:

Support: Pacifism, which says that violence never solves anything.

Reject: Someone in a traditional culture, where spanking children is the norm.

- (i) The universe had an absolute beginning, where space, time, matter, energy and the laws of physics appeared all at once.

Support: Someone who believes that God created the universe from nothing

Reject: Someone who believes that the material universe is all that exists

- (iii) Statistically speaking, women have an innate preference to work with people, and men innately prefer to work with things.

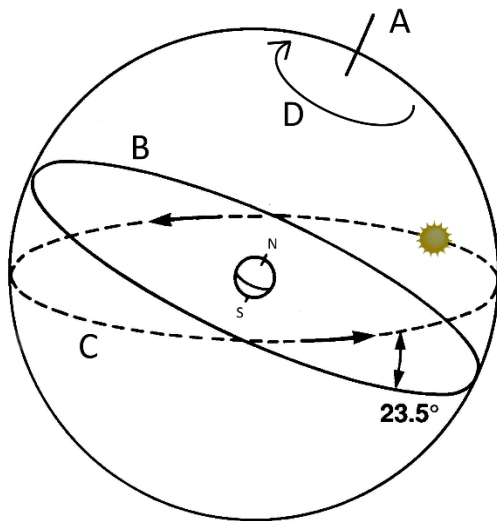
Support: Someone from a traditional culture, with clear gender roles

Reject: A feminist who thinks that sex differences are socially constructed

5. Which of the following best expresses Aristotle's definition of a 'planet' [1 mark]

- A celestial body that orbits the sun
- A celestial body that orbits the earth
- A celestial body that orbits the earth *and* moves relative to the fixed stars
- A celestial body with at least one moon

6. Identify the objects labelled A, B, C and D on the Ptolemaic diagram below. [1 mark each]



A. *Celestial North Pole*

B. *Celestial Equator*

C. *Ecliptic*

D. *Diurnal rotation*

7. (i) In the diagram shown below, give the standard names for the planets labelled as A, B and C. [3 marks]

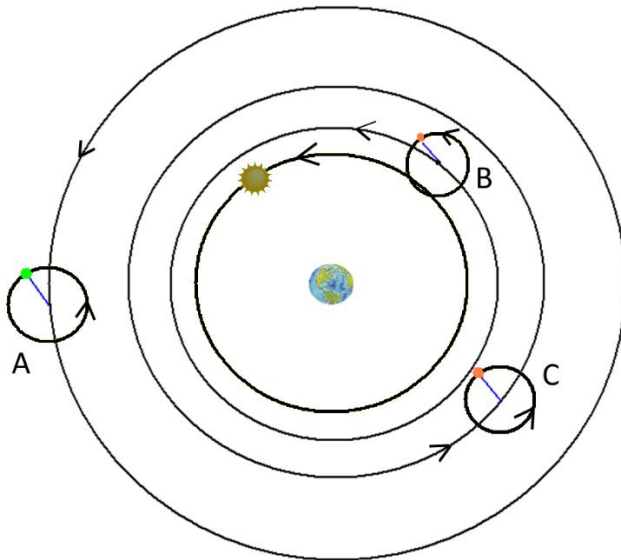
A is *Saturn*

B is *Mars*

C is *Jupiter*

- (ii) Are these three planets inferior or superior? *Superior* [1]

- (iii) In the diagram, planet *C* is undergoing retrograde motion. [1]



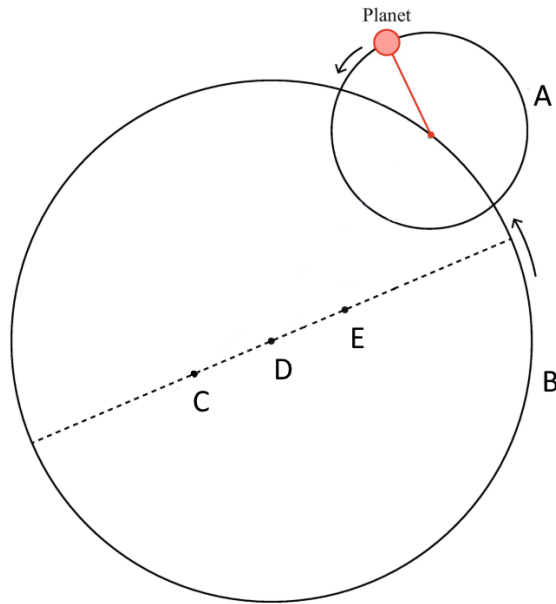
8. (i) Define what is meant by the ‘annual stellar parallax’ [2 marks]

The annual stellar parallax is a change in how the stars appear, viewed from the earth, over the course of 6 months.

- (ii) How did Aristotle use this concept to argue that the earth was stationary? [3 marks]

No annual stellar parallax was visible, at the time of Aristotle. The most natural explanation of this (as judged by Aristotle) is that the earth is stationary.

9. Identify the components of Ptolemy's theory that are shown in the diagram. [4]



- A. *epicycle*
- B. *deferent*
- C. *earth*
- D. *centre of the orbit*
- E. *equant*

[N.B. The points C and E can be swapped, i.e. the earth can be at E, in which case C is the equant.]

10. Assuming that the planet shown is *Mars*, draw the approximate position of the sun on the diagram below. [1 mark]

