1. (4 pts.) Make a graph of the following three objects’ motion on the same x vs. t plot. (As in the lab, plot t on the horizontal axis and x on the vertical one.) Please use graph paper (you can print some [here](#)). Choose the units as streets for position, and Main St. as x=0 (So E. 2nd St. is x=2, W. 2nd St. is x=-2, etc.), and minutes for time.

a) Plot curves for

   i) A car sitting still at W. 4th St.
   ii) A car moving according to \( x = -4 + 8t \)
   iii) A car moving according to \( x = -2 + 4t^2 \)

   ![Graph](#)

b) What types of motion are represented by i) - iii)? (no motion, uniform velocity, uniform acceleration?)

   i) No motion; ii) uniform velocity; iii) uniform acceleration

c) If you were sitting in car ii) blindfolded, could you tell that the car was moving? Why or why not? What about car iii)?

   Car ii): no. Car iii): yes, you could feel the acceleration.
2. (3 pts) a) Discuss two ways in which Copernicus’ solar system belonged to the modern era.

Sun was in the center; Earth and planets moved around it; no equant point

b) Discuss two ways in which Copernicus’ system retained elements of ancient philosophy.

Orbits had epicycles, deferents around sun were eccentric like Appolonius’ around Earth

c) Draw a heliocentric picture of the Earth and Sun, and indicate the Earth’s orbit and its axis, showing that it points to Polaris in the constellation Ursa Minor, or Little Dipper. Draw the same picture 5000 years ago. Was there always a pole star in these 5000 years? Discuss the implications for navigation.

Since the precession (of the Equinoxes) takes about 25,000 years, 5,000 years ago would have been 1/5 of the cycle, and from the diagram shown there would have been no true pole star. However there was a weaker star Thuban that was close to the pole in 3000BC. Without a pole star navigation is much more difficult, as Bronowski emphasized in the film.

3. (1 pt) (1 pt) In the Tychonic system, the orbits of Mars and the sun intersect. Why do they never collide?
Mars and the Sun cannot collide even though their orbital paths cross because Mars orbits the Sun and thus, although they can occupy the same point in space, they can never do so at the same time.

4. (1 pt) Name one of the important conclusions Tycho drew, either in his early or later writings, from observations of the comet of 1577.

a) The comet was beyond the orb of the moon, due to apparent lack of diurnal parallax, yet its position in the sky changed each day; therefore the heavens were not unchanging; b) its orbit took it from far away to close to the earth, crossing the orbits of several planets; therefore there were no “crystal spheres” holding the planets in their orbits.

5. (1 pt) Kepler was the first of the natural philosophers to pose the question of the cause of the planets’ motion. What cause did he identify?

Kepler identified a force emanating from the Sun that pushed planets around in their orbit. It may have been suggested by William Gilbert’s book on magnetism in 1600, which asserted that the earth behaved like a magnet.