

## Spherical Geometry

- 1) What are the basic objects of spherical geometry? Compare with Question 2 on the previous handout.
- 2) What are the straight lines on a sphere? How did you construct this definition? What properties of straight lines of the plane also hold for the sphere? Can you give both an *extrinsic* and an *intrinsic* definition of straight lines on the sphere? For an intrinsic definition, you can only consider the information from the surface itself; think of a bug walking on the sphere (or a person on the Earth!). Could you use your intrinsic definition of a straight line to determine the straight lines on the Earth if you're in an empty field?
- 3) Describe all the ways that three distinct straight lines on the sphere can intersect.
- 4) Do Euclid's Postulates hold on the sphere?
- 5) How do you measure distance on the sphere? How do you measure angles?
- 6) Use the Lénárt sphere to model the following question: Consider that the Earth is a sphere with radius 6371 km. What is the shortest distance between each pair of cities listed below? Is this path along the straight line connecting them?
  - a. from Quito, Ecuador ( $0^{\circ}\text{N}$ ,  $78^{\circ}\text{W}$ ) to Kampala, Uganda ( $0^{\circ}\text{N}$ ,  $32^{\circ}\text{E}$ )?
  - b. from Saint Petersburg, Russia ( $60^{\circ}\text{N}$ ,  $30^{\circ}\text{E}$ ) to Anchorage, Alaska ( $60^{\circ}\text{N}$ ,  $150^{\circ}\text{W}$ ). What is the shortest path? Can you directly calculate this distance?
  - c. from Seattle ( $48^{\circ}\text{N}$ ,  $2^{\circ}\text{E}$ ) to Paris ( $48^{\circ}\text{N}$ ,  $122^{\circ}\text{W}$ ). What is the distance if traveling due east?
  - d. from Lincoln, NE ( $40^{\circ}\text{N}$ ,  $96^{\circ}\text{W}$ ) to Sidney, Australia ( $34^{\circ}\text{S}$ ,  $151^{\circ}\text{E}$ )?