

SURE 452 – Geodesy 1

Sample Exam Questions

- Describe how the disagreement of an earth as an oblate spheroid or prolate spheroid was resolved. What early observational experiences were used by the Greeks to indicate that the earth was spherical? Explain why Galileo referred to the planet Jupiter as the "celestial timekeeper".
- What percentage of the earth is situated between latitudes 30° N and 50° S and longitudes 70° W and 125° W? Compute the length of the arc on the sphere between two points given their latitudes and longitudes. The length of an arc of any great circle was derived, in part, using the cosine law expressed as

$$\cos z = \sin \phi_A \sin \phi_B + \cos \phi_A \cos \phi_B \cos \delta\lambda$$

Describe the weakness of this formula.

- What is the difference between a great circle and a small circle?
- Define the following terms: principal normal section, geocentric ellipsoid, telluroid
- From the fundamental parameters of the ellipse, derive the following relationship:
$$e^2 = 2f - f^2, e^2 = \frac{e'^2}{(1 + e'^2)}$$
- What is the distance from the center of an ellipse to one of the foci if $a = 4$ cm and $b = 3$ cm?
- What quantities need to be specified in order to define an ellipsoidal reference system? What quantities are used to define the center of the ellipsoid in the locally best fitting ellipsoid and how is it achieved?
- What is the difference between the geodetic latitude, reduced latitude and geocentric latitude, Use a sketch along with your description. Convert a latitude in one system into the other system
- Compute the geodetic latitude of a point given its geocentric latitude.
- Describe the concept of a normal section. Describe the two normal sections on the ellipse. Why is the normal section from A to B different than the normal section from B to A? Describe how a normal section through A is different from the normal section at B, which lies to the north. The geodesic is the shortest surface distance between two points on an ellipse. What is the important property of the geodesic?
- What are the direct and inverse problems for the geodetic coordinates? Why do the forward and back azimuths differ by more than 180°.
- What is the importance of the Laplace azimuth? What is the cause of the deflection of the vertical and how does this affect geodetic measurements?
- Given the latitude, longitude, height, semi-major axis and flattening, compute the geocentric rectangular coordinates of a point. Given the X, Y, Z Cartesian coordinates, compute the latitude of the point.
- Given the latitude and longitude of a point and azimuth and distance to a second point, compute the latitude, longitude of the second point.
- What parameters need to be specified when defining a horizontal datum? Give an example of a horizontal datum. Describe the steps needed to define a 3D terrestrial reference system. "Scale" of any particular reference frame is somewhat less than perfect. Explain.

- Describe the parameters used to define the Geodetic Reference System 1980. NAD 83 and WGS 84 coordinate systems are identical. Explain. The WGS ellipsoid differs very slightly from the GRS 80 ellipsoid used for NAD 83. Explain. The NAD 83 datum has undergone five realizations. Describe them.
- What is the deflection of the vertical? What are its two components. How does the deflection of the vertical affect surveyors/geodesists?
- Reduce Wild T-3 notes and determine the measured angle. Reduce Polaris observations and compute the azimuth to the line?
- Define the following terms: Hour circle, almucantar, astronomic triangle, ecliptic, obliquity of the ecliptic, equinox, altitude, solar year, Greenwich mean sidereal time, Equation of Time, vernal equinox, hour angle, horizon, solstices, right ascension, autumnal equinox.
- Using Napier's Rule of Circular Parts, write an equation to solve for 'b'.
- What is the hour angle system? What is the horizon system? With a sketch, identify the important elements that help define these systems. Given the hour angle of $16^{\text{h}} 28^{\text{m}} 00^{\text{s}}$ and declination of $38^{\circ} 15' 20''$, what is the corresponding azimuth and altitude?
- Describe the phenomenon of aberration of light. What is astronomic parallax? Describe the effects refraction has on astronomic observations.
- What is the cause of precession?
- Given the local sidereal time and longitude in one area, compute the local sidereal time in another locality given its longitude. Given ephemeris data, compute the local apparent sidereal time.
- Reduce Polaris and solar observations to obtain the azimuth of a line. What are the disadvantages of the altitude method of azimuth determination?
- With a diagram, show the sidereal time relationships for MST, AS, GMST, and GAST. Explain how UT1 is determined from UTC time measurements. What is the difference between UTC, UT1, and UT2? How is the DUT1 correction determined and applied to astronomic observations? Why is a leap second necessary? How is it applied to our time systems?
- There are four conditions that can be imposed on a projection:

$$\begin{array}{ll} \sin \Omega = 0, \text{ therefore, } a = b & ab = 1 \\ l = 1 & h \text{ (or } k) = 1 \end{array}$$

Explain what each conditions means

- What are the four special properties of a map projection? Explain these properties in terms of the Tissot Indicatrix.
- What is the map projection classification scheme presented in lecture? Describe each element.
- Compute the x and y coordinates along with the relative scale factors along a meridian and along a parallel using the equidistant cylindrical projection given the latitude and longitude of a point along with the projection system parameters.
- Describe the factors that influence the selection of a suitable map projection?
- Assume a scale (S) of unity, compute the x and y coordinates along with the scale factors along a meridian and along a parallel using the conical equidistant projection.
- What map projection is considered the most suitable for world maps?

- What are the conditions for equal area and conformal projections in terms of Tissot's indicatrix? Derive the condition for conformality for equal area projections.
- Describe the Transverse Mercator Projection and its application to State Plane Coordinates.
- A fundamental tenet of map projections is that a curved surface cannot be mapped to a plane without distorting angles, distances, or area. What does this mean with respect to the selection of an appropriate map projection system? How is this accommodated within the State Plane Coordinate System?
- Earl Burkholder, in his article on local coordinate systems, discussed the advantages of local coordinates over the State Plane Coordinate System. Describe the concepts.
- What is the combined (scale) factor? Describe what makes up this factor. Describe how it is used.
- Ben Buckner, in his article "We've Missed the Point on State Plane Coordinates", states that "the real value of SPC in land surveys, as regards property corners, is as a reference tie, not as a means to express the position of a corner in a legal description." Explain.
- Show the relationship between the azimuth of a line using grid north and geodetic north, including the (t-T) correction. Define each variable.
- Given the State Plane Coordinates of a station, compute the latitude, longitude, scale factor, and convergence angle.

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