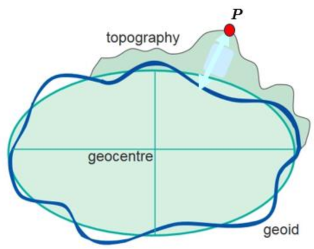
**Explain your answers with neat sketches whenever possible. If not clearly stated, assume that all computations are made on Helmert1906 (a = 6378.2 km, $f = \frac{1}{298.3}$). Also, mean radius of the earth is R = 6371 km.**

# Assignment (2)

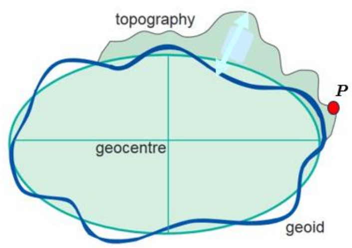
1. Define an ellipsoid and explain its essential parameters.
2. What are the size parameters of an ellipsoid? Describe each parameter and its significance.
3. How are the semi-major axis and semi-minor axis related in an ellipsoid?
4. Explain the concept of geoid and its relationship with the reference ellipsoid.
5. Explain the difference between a geocentric ellipsoid and a topocentric ellipsoid. Use sketch to illustrate your answer.
6. Describe the three components of geodetic coordinates: geodetic latitude, longitude, and ellipsoidal height.
7. Compare and contrast geodetic latitude, geocentric latitude, and reduced latitude in terms of their definitions, and calculations.
8. Discuss the mathematical relationships between geodetic, geocentric, and reduced latitudes. How can one be calculated or derived from another?
9. **Express your views with justification about the following.**
   a. A reference ellipsoid can be defined directly using its size parameters.
   b. Topocentric and geocentric ellipsoids share the same parameters.
   c. Both normal and vertical directions are straight lines.
   d. The geoid and reference ellipsoid will intersect only when the angle of deflection of the vertical becomes zero.
   e. The relation between different types of latitudes of the same point on depends on its location on the earth's surface.
   f. The value of geodetic latitude is always larger than its corresponding geocentric or reduced latitudes.
   g. The angle of deflection of the vertical has a distinct and equal value for all points on the earth's surface.
   h. There are numerous ellipsoids that are currently being used.

10. Calculate the geocentric and reduced latitudes of a station Q on the reference ellipsoid if its geodetic latitude 30° 40′ 15".

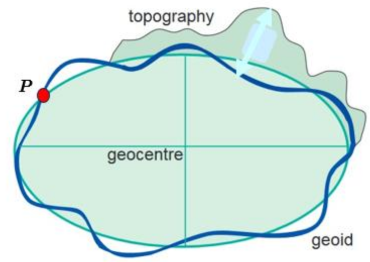
11. Utilizing the given data, provide the mathematical/numerical representation of the geoid undulation N at station **P**:




(a)




(b)




(c)

12. For any station P on the earth's surface, assume that its astronomic latitude Φ is 32° 40′ 15" and astronomic longitude Λ is 75° 42′ 18". Also, its geodetic coordinates are $\varphi = 31° \ 20'25"$, and $\lambda = 73° \ 44'27"$. Compute the components of the angle of deflection of the vertical $\theta(\xi, \eta)$. Moreover, it is found that P lies on a vessel of 3 m height above MSL, and its geodetic height is 167 m. What are the values of geoid undulation N?

13. The semi-major axis of an ellipsoid is given as a = 6371320 meters, and the linear eccentricity is ε = 1000 meters. Determine the value of the semi-minor axis b.

14. For an ellipsoid with a semi-major axis a = 6378137 meters and a semi-minor axis b = 6356752.3142 meters, compute the flattening parameter f.

15. Compute the linear eccentricity ε for an ellipsoid with a semi-major axis a = 6378137 meters and a flattening f = 1/298.257223563.

16. Given the semi-major axis a = 6371230 meters and the shape parameter flattening f = 1/298.257223563, find the value of the angular eccentricity α.

17. Calculate the second eccentricity squared $e'^2$ for an ellipsoid with a semi-major axis a = 6378137 meters and a semi-minor axis b = 6356752.3142 meters.

18. The semi-major axis of an ellipsoid is a = 6378137 meters, and the second eccentricity squared, $e'^2$, is 0.00673949674228. Find the value of the semi-minor axis b.