Sample Format for Homework Assignments

The following pages will show how a typical assignment should be completed, whether solving the problem by hand or using Mathcad. Always show the formulas when applicable and highlight the answer. Briefly identify the steps involved in the solution.

Drawings should be used when appropriate. Use a straight edge, compass and/or template when drawing figures. Label all pertinent elements of the drawing.

The question that is answered in the next two pages is:[1]

1. Assuming that a = 6,378,300. m and b = 6,356,860. m, compute the mean radius of the earth at a point in latitude 50^{o}N.

The first page is the hand solution while the second is the Mathcad solution.

[1] Clark, D., 1961. Plane and Geodetic Surveying for Engineers, Vol. 2, Higher Surveying, 4th edition, Constable & Company Ltd., London.

1) GIVEN: $a = 6,378,300.\text{m}$, $b = 6,356,860.\text{m}$, $\phi = 50°\text{N}$

FIND THE MEAN RADIUS OF EARTH AT 50° N LATITUDE

SOLUTION:

FIRST ECCENTRICITY SQUARED

$$e^2 = \frac{a^2 - b^2}{a^2} = \frac{(6,378,300.\text{m})^2 - (6,356,860.\text{m})^2}{(6,378,300.\text{m})^2}$$

$$= 0.00671114955$$

RADIUS OF CURVATURE IN THE MERIDIAN

$$M = \frac{a(1-e^2)}{(1-e^2\sin^2\phi)^{3/2}} = \frac{(6,378,300.\text{m})(1-0.00671114955)}{(1-0.00671114955\sin^2 50°)^{3/2}}$$

$$= 6,373,105.373\,\text{M}$$

RADIUS OF CURVATURE IN THE PRIME VERTICAL

$$N = \frac{a}{(1-e^2\sin^2\phi)^{1/2}} = \frac{6,378,300.\text{M}}{(1-0.00671114955\sin^2 50°)^{1/2}}$$

$$= 6,390,897.586\,\text{M}$$

MEAN RADIUS

$$R_{MEAN} = \sqrt{MN} = \left[(6,373,105.373\text{m})(6,390,897.586)\right]^{1/2}$$

$$= 6,381,995.279 \quad \text{OR} \quad \underline{6,381,995\,\text{M}}$$

Example Homework Assignment Format

1. Find the mean radius of the earth at 50ºN latitude.

Given:

$a := 6378300\,m$ $b := 6356860\,m$ Semi-major and semi-minor axes of the earth.

$\phi := 50$

Solution:

$\phi_r := \phi \cdot \frac{\pi}{180}$ Convert degrees into radians for Mathcad

$e2 := \frac{a^2 - b^2}{a^2}$ e2 is the first eccentricity, e, squared

$e2 = 0.0067114955$

$M := \frac{a \cdot (1 - e2)}{\left[1 - e2 \cdot \left(\sin\left(\phi_r\right)\right)^2\right]^{\frac{3}{2}}}$ M - Radius of curvature in the meridian

$M = 6373105.373\,m$

$N := \frac{a}{\sqrt{1 - e2 \cdot \left(\sin\left(\phi_r\right)\right)^2}}$ N - Radius of curvature in the prime vertical

$N = 6390897.586\,m$

The mean radius of the earth at 50ºN latitude:

$R_{mean} := \sqrt{M \cdot N}$ $R_{mean} = 6381995.279\,m$