1. Give a clear, concise, and readable definition for each of the following: (20 pts)

   a. International Gravity Standardized Network 1971

   b. Nettleton's method of gravity profiling

   c. Forward modeling

   d. Theoretical gravity

   e. Unstable gravimeter
2. Gravity survey south of Nowhere, USA (25 pts)

<table>
<thead>
<tr>
<th>Station</th>
<th>Time</th>
<th>Dial Rdg</th>
<th>Elev. (m)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0800</td>
<td>347.8</td>
<td>2469.8</td>
<td>45.00°N</td>
</tr>
<tr>
<td>A2</td>
<td>0830</td>
<td>98.5</td>
<td>2926.8</td>
<td>46.00°N</td>
</tr>
<tr>
<td>A3</td>
<td>0900</td>
<td>375.9</td>
<td>2531.1</td>
<td>46.50°N</td>
</tr>
<tr>
<td>A1</td>
<td>0930</td>
<td>344.8</td>
<td>2469.8</td>
<td>45.00°N</td>
</tr>
</tbody>
</table>

Day 2: (dial reset at station A2)

<table>
<thead>
<tr>
<th>Station</th>
<th>Time</th>
<th>Dial Rdg</th>
<th>Elev. (m)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>0800</td>
<td>747.5</td>
<td>2926.8</td>
<td>46.00°N</td>
</tr>
<tr>
<td>A4</td>
<td>0830</td>
<td>647.2</td>
<td>3079.3</td>
<td>200m N of A2</td>
</tr>
<tr>
<td>A2</td>
<td>0900</td>
<td>743.5</td>
<td>2926.8</td>
<td>46.00°N</td>
</tr>
<tr>
<td>A5</td>
<td>0930</td>
<td>547.2</td>
<td>3232.0</td>
<td>200m S of A2</td>
</tr>
<tr>
<td>A2</td>
<td>1000</td>
<td>749.5</td>
<td>2926.8</td>
<td>46.00°N</td>
</tr>
</tbody>
</table>

Gravimeter Scale constant = 0.872 gu/du
Bouguer reduction density = 2.67 Mg/m³
Observed gravity at A1 = 9,797,094.0 gu
\( g_{th} \) at A2 = 9807095.5 gu

a. For stations A2 and A5, what is the drift correction in dial units (include sign) with respect to the initial 0800 reading for each day?
   A2 __________________________
   A5 __________________________

b. What is the observed gravity at these two stations?
   A2 __________________________
   A5 __________________________

c. What is theoretical gravity at A5?

d. What is the simple Bouguer anomaly at A2, referenced to the geoidal surface?

e. What is the difference in gravity between stations A1 and A4 due to elevation and at which station would gravity be greater?

f. What is the difference in gravity between stations A4 and A5 due to latitude only?
3. A salt dome has physical properties that are different from the surrounding sediments that enable its detection by geophysical methods. What are these physical properties, how are they different from the surrounding sediments, and which geophysical methods are used to detect the salt? (10 pts)

4. Bouguer anomalies are large and negative over mountain ranges, large and positive over ocean basins, and near zero near sea-level. Using the Pratt and Airy models for isostatic compensation explain why this is so? (10 pts)
5. The Bouguer anomaly map shown below is from a gravity survey designed to evaluate the economic potential of a sedimentary basin east of Perth, Australia. Two gravity features are readily apparent on the map: a long wavelength regional trend representing increasing thickness of the basin and a short wavelength feature in the center of the map. (12 pts)

b. In what direction is the basin thickening?

c. Draw in the 735 mgal regional contour on the map.

d. Does the gravity anomaly in the center result from a positive or negative contrast?

e. Speculate on the possible source of the anomaly?
6. In the diagram below, simple Bouguer anomalies are calculated at stations A and B. Which of the following statements is correct: (a) the value calculated at A is too low while that at B is too high; (b) both values would be too high; (c) both values would be too low. Explain. (7 pts)

7. Salt domes on the Gulf coast of the United States form structures which are favorable for the occurrence of oil and natural gas. These structures are easily modeled assuming a spherical source. What are the maximum gravity anomaly and the half-width of the anomaly if the salt dome has a radius of 4 km and a depth to center of 6 km? The salt is 200 kg/m$^3$ less dense than the surrounding sediment. (6 pts)
Equation Sheet

\[ F = Gm_1m_2/r^2; \quad g = Gm/r^2; \]

\[ G = 6.67 \times 10^{-11} \text{ m}^3/\text{kg-sec}^2; \quad GM = 3.986005 \times 10^{14} \text{ m}^3/\text{sec}^2; \quad \omega = 2\pi/T \]

\[ g_{th} = 9780318.46(1+0.005278895 \sin^2\lambda +0.000023462 \sin^4\lambda) \text{ gu} \]

Free Air correction: \[ C_{FA} (\text{gu}) = 3.086 \text{ h (m)} \]

Bouguer slab correction: \[ C_{BS} (\text{gu}) = 0.4191 \rho \text{h (m)} \text{ where } \rho \text{ is in Mg/m}^3 \]

Theoretical gravity gradient: \[ \Delta g_{th} (\text{gu}) = 8.11 \times 10^{-3} \sin 2\lambda \Delta s \text{ (m)} \]

Terrain correction: \[ C_T (\text{gu}) = 0.4191 \rho/n (r_2 - r_1 + \sqrt{r_1^2 + z^2} + \sqrt{r_2^2 + z^2}) \]

where \( C_T = \text{terrain correction of a sector} \); \( \rho = \text{Bouguer reduction density (Mg/m}^3\); \( n = \text{number of sectors in a zone} \); \( r_1 = \text{inner radius of zone (m)} \); \( r_2 = \text{outer radius of zone (m)} \); and \( z = \text{modulus of elevation difference between observation point and mean elevation of the sector (m)} \).

\[ g = 4\pi^2 I / T^2 \quad g_1T_1^2 = g_2T_2^2; \quad g = 2(s_1t_1 - s_1t_2)/t_2t_1 \]

\[ R = R_e (1 - f \sin^2\lambda); \quad f = 1/298.247; \quad R_e = 6,378,139 \text{ m}; \quad R_{ave} = 6.371,000 \text{ m} \]

\[ \Delta g_x = (4/3)\pi G\Delta \rho R^3 z/(x^2 + z^2)^{3/2} \]

\[ \Delta g_x = 2\pi G\Delta \rho R^2 z/(x^2 + z^2) \]

\[ \Delta g_x = 2\pi G\Delta \rho t \]

\[ z = 1.305x_{1/2} = 0.65w_{1/2} \]

\[ z = x_{1/2} = 0.5w_{1/2} \]