1. Fill in the blank.

a. The difference in travel time for a given reflection at two geophones is known as _________________.

b. Head waves are generated when the angle of refraction equals _____________.

c. The proportionality constant for Hooke’s law for hydrostatic stress is known as the ________________________.

d. Seismic reflection data define a _________________ on a time distance plot.

e. The most common method of collecting seismic reflection data to increase the fold coverage on the subsurface is known as ____________________________.

f. A geophone whose natural frequency is 30 Hz would be ideal for recording seismic waves whose frequency are between (a) 4 and 30 Hz; (b) 50 and 100 Hz. ____________.

g. The acoustic impedance of a layer of rock is determine by the layer’s ________________ and ________________.

h. The ____________ velocity accounts for the disproportionate time spent by reflected waves in higher velocity layers.

i. The ________________ distance is that distance at which the reflected arrival is coincident with the first critically refracted arrival.

j. The total time a seismic wave takes traveling from one shot point to other shot point and vice versa in a refraction survey is known as the ________________ time.

k. ____________________________ is an elastic modulus that relates transverse thinning to paralleling lengthening when the object is subjected to normal stress.

l. This seismic wave alternately compresses and dilates the rock it passes through: ________________

m. This velocity best corrects an event on a CMP gather for normal moveout: ________________
n. In seismic reflection processing, a statics correction corrects for ______________.

o. The amplitude of a reflected wave is described by its ____________________.

2. A seismic wave whose velocity is 1500 m/sec intersects the $V_1 - V_2$ interface as shown below. Label the various reflected and refracted rays (waves) and determine their velocities.
3. The reflection and refraction data shown on the next page were collected in an area where a hidden layer is suspected. Calculations indicate that the RMS velocity of the second layer is 755 m/sec with a zero-offset time of 0.0492 sec. The zero-offset time for the first reflector is 0.0448 sec. The refraction data form two straight line segments with slopes of 1/670 and 1/3200 sec/m, respectively, with a time intercept of 0.0477 sec. What are the velocities of the various layers and their thickness?
4. The time distance plot shown below indicates 3 layers with dips on the second and third interfaces. Determine the first and second layer velocities, the dip of the $V_1 - V_2$ interface, and the vertical depth directly below the geophone located at $x = 60$ m.
5. Questions pertain to Table 1 below.

a. What is the drift corrected reading for station 2+00 N with respect to the nine o’clock base reading?

b. What is the drift corrected reading for station 4+00 S with respect to the nine o’clock base reading?

c. Assuming that the value of the IGRF field in the survey area is 60110 nT, calculate the total field anomaly for station 2+00 N.

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<th>Station</th>
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<th>Time</th>
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<td>Base</td>
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<td>9:00</td>
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</tr>
<tr>
<td>Base</td>
<td>60080</td>
<td>11:00</td>
</tr>
</tbody>
</table>
6. Each of the following magnetometers measures a different component of Earth's magnetic field. What is the most common component measured by each?

   a. fluxgate magnetometer;

   b. proton precession magnetometer;

   c. alkali vapor magnetometer;

   d. gradiometer;

7. The diagram below depicts a buried sphere magnetized by induction in the Northern Hemisphere. Inclination of the field is 70°. Indicate clearly on the figure below along horizontal black line the following:

   (a) The location where the vertical field ($\Delta Z$) anomaly is a maximum and where the anomaly would be zero.

   (b) The location where the horizontal field ($\Delta H$) anomaly would be zero and where the anomaly’s positive and negative maximums would be.

   (c) Which anomaly ($\Delta Z$ or $\Delta H$) would look most like the total field anomaly at this location?

   (d) Is North to the right or left on this diagram?

   (e) If this body were located in the Southern Hemisphere would the anomaly (total field) maximum be located south of the body’s center or north?
8. Draw three different geologic scenarios (subsurface configurations) that would give rise to the time-distance graph shown below. Do not use hidden or low velocity layers as part of your scenario.
Equations for Exam #2

\[ Z_1 = \frac{X_c}{2} \sqrt{\frac{V_2-U_1}{V_2+U_1}} \]

\[ Z_2 = \frac{X_c}{2} \sqrt{\frac{V_3-U_2}{V_2+U_3}} \]

\[ Z_3 = \frac{t_1 v_1}{2} \frac{U_3 v_3}{v_2^2 - v_3^2} \]

\[ Z_2 = \frac{1}{2} \left( t_{i_3} - 2 t_1 \frac{V_3^2 - v_1^2}{V_3 v_3} \right) \frac{v_0 v_3}{V_4 - v_2^2} \]

\[ = \frac{1}{2} \left( t_{i_3} - t_{i_2} \right) \frac{V_3 v_3}{v_2^2 - v_3^2} \]

\[ \Delta T_0 = \frac{\left( T_{o_1} + T_{o_2} - T_e \right)}{2} \]

\[ Z_p = \frac{\Delta T_0 v_1}{\cos \theta_c} \]

\[ \cos \theta_c = \left( \frac{v_2^2 - v_3^2}{v_2^2} \right)^{1/2} \]

\[ \sin \theta_c = \frac{v_1}{v_2} \]

\[ \theta_c = \frac{1}{2} \left( \sin^{-1} \frac{v_1}{v_2} + \sin^{-1} \frac{v_1}{v_3} \right) \]

\[ \gamma = \frac{1}{2} \left( \sin^{-1} \frac{v_1}{v_2} - \sin^{-1} \frac{v_1}{v_3} \right) \]

\[ Z_a = \frac{V_1 t_{i_1}}{2 \cos \theta_c} \]

\[ Z_b = \frac{V_1 t_{i_1}}{2 \cos \theta_c} \]

\[ \Delta t = \frac{\Delta Z \cos \theta_c}{V_1} \]

\[ h_a = \frac{Z_a}{\cos \gamma} \]

\[ h_b = \frac{Z_b}{\cos \gamma} \]

\[ \sin \theta_1 = \frac{\sin \theta}{V_1} \]

\[ \sin \theta_2 = \frac{v_0}{V_1} \sin \theta \]

\[ \sin \theta_p = \frac{V_0}{V_1} \sin \theta \]

\[ \sin \theta_r = \frac{V_0}{V_1} \sin \theta \]

\[ \sin \theta_t = \frac{V_0}{V_1} \sin \theta \]

\[ t_{\text{radial}} = \frac{2 Z_c \cos \theta_c + X \sin (\theta + \delta)}{V_1} \]

\[ t_{\text{radial}} = \frac{2 Z_c \cos \theta_c + X \sin (\theta - \delta)}{V_1} \]

\[ V_p = \sqrt{\frac{K}{1 - \rho}} \]

\[ V_S = \frac{\sqrt{-\rho}}{1 - \rho} \]

\[ V_R = q U_S \]

\[ V_p / V_3 = \sqrt{\frac{2 \pi}{1 - \sigma}} \]

\[ \tan I = 2 \tan \lambda \]

\[ \tan I = 2 \cot \theta \]

\[ B_T = \sqrt{B_r^2 + B_b^2} \]

\[ B_r = \frac{\mu_0}{4 \pi r_1} \frac{2 m_1}{r_1} \sin \lambda \]

\[ B_r = \frac{\mu_0}{4 \pi r_1} \frac{2 m_1}{r_1} \cos \lambda \]

\[ B_b = \frac{\mu_0}{4 \pi r_1} \frac{2 m_1}{r_1} \sin \lambda \]

\[ B_b = \frac{\mu_0}{4 \pi r_1} \frac{2 m_1}{r_1} \sin \lambda \]

\[ AT = \Delta N e \cos I_0 + \Delta Z \sin I_0 \]