1. Let the metric for a gravitational wave be

$$ds^2 = -dt^2 + dx^2 + dy^2 + [1 + f(t-z)]dz^2 - f(t-z)dtdz,$$

where $f(t-z)$ is an arbitrary function of $(t-z)$. Consider long-wavelength gravity waves. At a given time t_0, over the size of your gravity wave detector, $f(t_0 - z)$ is nearly constant.

   (a) (1 pt.) In which direction is the wave moving?

   (b) (7 pts.) Compute the distance between two parts of your gravity-wave detector at $(0, 0, 0, 0)$ and $(0, 0, 0, 1)$ with and without the wave. Hint: This metric is not the same as the metric that we introduced in class on April 6.

2. Consider the Römer, Einstein, and Shapiro time delays, equations 8–10 in Taylor, J, and Weisberg, J, 1989, ApJ, 345, 434. (There is a link on the syllabus.)

   (a) Explain each time delay at a level appropriate for your little sister, who is enrolled in PHY183.

   (b) For the binary pulsar 1913+16, estimate the magnitude of each time delay for the radio waves passing in the pulsar system and in the solar system. Your estimate need only be good to a factor of 10.

3. Hartle problem 23.9

4. Hartle problem 23.13