1. Consider a volume of air that has horizontal surfaces extending from 30˚E to 33˚E longitude, and from 22˚S to 20˚S latitude. The top of the volume is the 800 hPa surface, and the bottom is the 900 hPa surface. Along the entire southern edge of the volume, the meridional wind is measured to be a uniform 13 m/s, and it is 8 m/s along the northern edge. The zonal velocity is zero everywhere in the volume. The vertical p-velocity at 900 hPa is $1 \times 10^{-3}$ hPa/s. What must the vertical p-velocity at the 800 hPa level be? Is the air rising or sinking at this level?

2. Do Problem 3.1 in Holton. Hint: The “ground speed” is the velocity relative to map coordinates. It is the wind velocity plus the “air speed.”

3. Do Problem 3.2 in Holton. Hint: Make a sketch in natural coordinates. Find $\nabla \Phi$, find $\partial \Phi / \partial s$, use Equation (3.9). Does the answer depend on any assumption about the magnitude of the velocity, $V$?


5. Do Problem 3.9 in Holton. Hints: Normal and anomalous anticyclones are called regular and anomalous highs in Table 3.1. Use the binomial expansion to approximate the square root of something close to unity. That is,

$$(1 + x)^{1/2} = 1 + \frac{1}{2} x - \frac{1}{8} x^2 \pm \cdots \approx 1 + \frac{1}{2} x \quad \text{if} \quad x \ll 1$$