PHYS4520 Physics in Meteorology

Problem Set 9

1. (a) Calculate the horizontal and vertical air-parcel displacement X(t) and Z(t) associated with an internal gravity wave, defined by

$$\frac{dX}{dt} = u, \qquad \frac{dZ}{dt} = w.$$

- (b) For simplicity, take the initial condition to be X = Z = 0 at t = 0, find the trajectory of such air parcel. Hence, show that the air parcel oscillates in straight lines perpendicular to the wave vector (k, 0, m).
- 2. (a) Find the period (in minutes) of an internal gravity wave of horizontal wavelength 100 km and vertical wavelength 5 km in the Earth's mesosphere, where $N^2 = 3 \times 10^{-4} \,\mathrm{s}^{-2}$.
 - (b) How long (in minutes) does the energy associated with this wave take to propagate through a vertical distance of 20 km?
 - (c) If the maximum horizontal wind fluctuation (peak-to-peak) due to the wave is 2 ms^{-1} , find the maximum horizontal and vertical distances traversed by an air parcel. (You may use the results from Problem 1).