

VICTORIA UNIVERSITY OF WELLINGTON  
School of Mathematics, Statistics and Operations Research  
School of Geography, Environment and Earth Sciences

**MATH 321 Applied Mathematics I**  
**MATH 322 Applied Mathematics II**  
**MATH 323 Mathematics for Earth Sciences**

**Meteorology Reading Course**

**2013**  
**Assignment 2**

Complete the following problems which are taken from *An introduction to dynamical meteorology*, by J. R. Holton's, 3rd edition, Academic Press, 1992. This assignment is worth 25% towards final assessment of this module.

**Chapter 2 Problem 1**

A ship is steaming northward at a rate of  $10 \text{ km h}^{-1}$ . The surface pressure increases toward the northwest at the rate of  $5 \text{ Pa km}^{-1}$ . What is the pressure tendency recorded at a nearby island station if the pressure aboard the ship decreases at a rate of  $100 \text{ Pa (3 h)}^{-1}$ ?

**Chapter 2 Problem 2**

The temperature at a point 50 km north of a station is  $3^\circ\text{C}$  cooler than at the station. If the wind is blowing from the northeast at  $20 \text{ ms}^{-1}$  and the air is being heated by radiation at the rate of  $1^\circ\text{C h}^{-1}$ , what is the local temperature change at the station?

**Chapter 2 Problem 3**

Derive the relationship

$$\boldsymbol{\Omega} \times (\boldsymbol{\Omega} \times \mathbf{r}) = -\Omega^2 \mathbf{R}$$

which was used in Equation 2.7

**Chapter 2 Problem 5**

Compare the magnitudes of the curvature term  $u^2 \tan \phi / a$  and the Coriolis force for a ballistic missile fired eastward with a velocity of  $1000 \text{ ms}^{-1}$  at  $45^\circ$  latitude. If the missile travels 1000 km by how much is it deflected from its eastward path owing to both these terms? Can the curvature term be neglected in this case?

**Chapter 2 Problem 8**

An air parcel that has a temperature of  $20^\circ\text{C}$  at the 1000-mb level is lifted dry adiabatically. What is its density when it reaches the 500-mb level?