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 1

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 1 Problem 1

Neglecting the latitudinal variation in the radius of the earth, calculate the angle between the gravitational force and gravity vectors at the surface of the earth as a function of latitude.

Chapter 1 Problem 2

Calculate the altitude at which an artificial satellite orbiting in the equatorial plane can be a synchronous satellite (i.e. can remain above the same spot on the surface of the earth).

Chapter 1 Problem 4

A train is running smoothly along a curved track at the rate of $50\,\mathrm{m\,s^{-1}}$. A passenger standing on a set of scales observes that his weight is 10% greater than when the train is at rest. The track is banked so that the force acting on the passenger is normal to the floor of the train. What is the radius of curvature of the track?

Chapter 1 Problem 9

A bullet is fired vertically upward with initial speed w_0, at latitude ϕ. Neglecting air resistance, by what distance will it be displaced horizontally when it returns to the ground? (Neglect $2\Omega u \cos\phi$ compared to g in the vertical equation.)

Chapter 1 Problem 10

A block of mass $M = 1\,\mathrm{kg}$ is suspended from the end of a weightless string. The other end of the string is passed through a small hole in a horizontal platform and a ball of mass $m = 10\,\mathrm{kg}$ is attached. At what angular velocity must the ball rotate on the horizontal platform to balance the weight of the block if the horizontal distance of the ball from the hole is 1 m? While the ball is rotating, the block is pulled down 10 cm. What is the new angular velocity of the ball? How much work is done in pulling down the block?