

1. PRESSURE

Consider an air parcel that is subject to a pressure force equivalent to a 10 hPa pressure difference per 2000 km.

- (a) What would be the acceleration of this air parcel?
- (b) Examine the velocity of the air parcel after 1 hour.

2. CORIOLIS FORCE

- (a) A snooker or billiards player gives a ball a velocity of 1 ms^{-1} in an attempt to hit “dead centre” a second ball that is at a distance of 3 m. How far off-centre will the collision be if the player makes no allowance of the Coriolis force?
- (b) Is it easier to break athletic track records in Melbourne as opposed to Zurich? Give reasons for your answer.

3. “FUN-FAIR” RIDE

A circular shaped “fun-fair” ride of diameter 12 m is rotating about a horizontal axis. How rapidly must it rotate to enable people to stand freely on the inside of the apparatus?

4. ADIABATIC TEMPERATURE CHANGE

A fluid parcel descends adiabatically from the height of the St. Gotthard Pass to the elevation of Altdorf. What temperature change will the fluid parcel experience? Make assumptions for the pressure at the two elevations.

5. LAPLACE EQUATION

- (a) Write down the Laplace’s equation in cartesian coordinates (C) and show that

$$\Phi = (x^2 + y^2 + z^2)^{-1/2}$$

is a solution of the C form of the equation.

- (b) Laplace’s equation can be written in cylindrical polar (CP) coordinates. Derive this equation on looking up in a reference book and show that

$$\Phi = \ln(r)$$

is a solution of the CP form of the equation.