

**ESCI 342 – Atmospheric Dynamics I**  
**Answers to Selected Exercises for Lesson 11**

2. a. A chain of fluid parcels in your bathtub lies in the horizontal plane. The chain is circular with a radius of 5 cm. The chain is rotating clockwise (as viewed from above) with a tangential velocity of 0.5 cm/s. As the chain moves over the drain, horizontal convergence causes the radius of the chain to shrink to 1 cm. What is the new tangential velocity? (Hint: Your bathwater is barotropic.)

**Answer: 2.5 cm/s**

- b. Repeat part a., only assume that initially the chain is rotating counter-clockwise.

**Answer: Same as a., only in opposite direction**

3. Show that  $\beta = \frac{2\Omega}{a} \cos \phi$  where  $a$  is the radius of the Earth.

**Hint:**  $\frac{df}{dy} = \frac{df}{d\phi} \frac{d\phi}{dy}$

4. A circular chain of fluid parcels with a radius of 300 km is centered at latitude 30N. Its circulation is initially zero. The entire chain of fluid parcels begins moving northward at 5 m/s.

- a. What is the rate of change of the circulation?

**Answer:  $-28 \text{ m}^2 \text{ s}^{-2}$**

- b. Assuming  $\beta$  remains nearly constant with small changes in latitude, what will the circulation be after 24 hours?

**Answer:  $-2.4 \times 10^6 \text{ m}^2 \text{ s}^{-1}$**

- c. How strong will the tangential winds be after 24 hours?

**Answer: 1.3 m/s**