Quiz #5. Physical Mechanics, 2000
Total 9 points.

The vector form of the Coriolis force acting on a moving object of unit mass at the surface of the earth is

$$\vec{F}_{cor} = -2\vec{\Omega} \times \vec{V}$$

where $\vec{\Omega}$ is the angular velocity of the earth rotation and $\vec{V}$ the velocity in the earth coordinate.

(a) For an air parcel traveling east at latitude ϕ degrees north, what is the direction of the Coriolis force? Use diagram(s) to illustrate.

The vector $\vec{F}_{cor} = -2\vec{\Omega} \times \vec{V}$ points away and is perpendicular to the axis of rotation. In the northern hemisphere, it points south and upward. See the figure on page 7-13 of the Notes.

Explain *physically* (i.e., using certain physical principle(s)) why this parcel is subjecting to such a Coriolis force.

With eastward velocity, the air parcel has a larger angular velocity than the earth, it is therefore subjecting to extra centrifugal force (in addition to the one that is included in the net gravity – c.f. section 7.4.1). This centrifugal force is the Coriolis force due to eastward motion. See pages 7-12, 7-13 for more detailed explanation). The key word is **centrifugal force.**

(b) If the air parcel travels south instead, what's the direction of the Coriolis force?

As the air parcel travels south, the effective radius of rotation (the distance of the parcel from the axis of rotation) increases. To maintain it's original (it initially rotates at the same rate as the earth) angular momentum (which should be conserved in the absence of torque), it's angular velocity has to decrease (angular momentum = ΩR^2), therefore it will be spinning slower than the earth. It is therefore deflected, by the Coriolis force, to the west. – West is the right answer.

Again, explain in physical terms (again using physical principles(s)) why there is such a Coriolis force. Use diagram(s) to illustrate your point.

The explanation is given earlier. See figure in page 7-14 and the discussion following for more details. The key work is **angular momentum conservation.**