Answer on Question #73159-Physics-Mechanics-Relativity

a) What should be the angular velocity of the earth such that a person of mass 80 kg standing on the earth at the equator would actually fly off the earth?

Solution

Magnitude of the centrifugal force needs to be equal to the force of gravity:

$$m\omega^2 R = \frac{GmM}{R^2}$$

$$\omega = \sqrt{\frac{GM}{R^3}} = \sqrt{\frac{(6.67 \cdot 10^{-11})(5.97 \cdot 10^{24})}{(6378 \cdot 10^3)^3}} = 0.00124 \frac{rad}{s}.$$

b) A ball of mass 60g is moving due south with a speed of 50 ms−1 at latitude 30ºN. Calculate the magnitude and direction of the coriolis force on the ball. Compare the magnitude of this force to the weight of the ball.

Solution

$$F_c = 2m\omega v \sin\alpha = 2(0.06)(7.3 \cdot 10^{-5})(50)\sin 30 = N.$$

The direction is to the left of motion in the Southern Hemisphere: toward east.

$$\frac{F_c}{F_g} = \frac{2m\omega v \sin\alpha}{mg} = \frac{2(7.3 \cdot 10^{-5})(50)\sin 30}{9.8} = 3.7 \cdot 10^{-4}$$