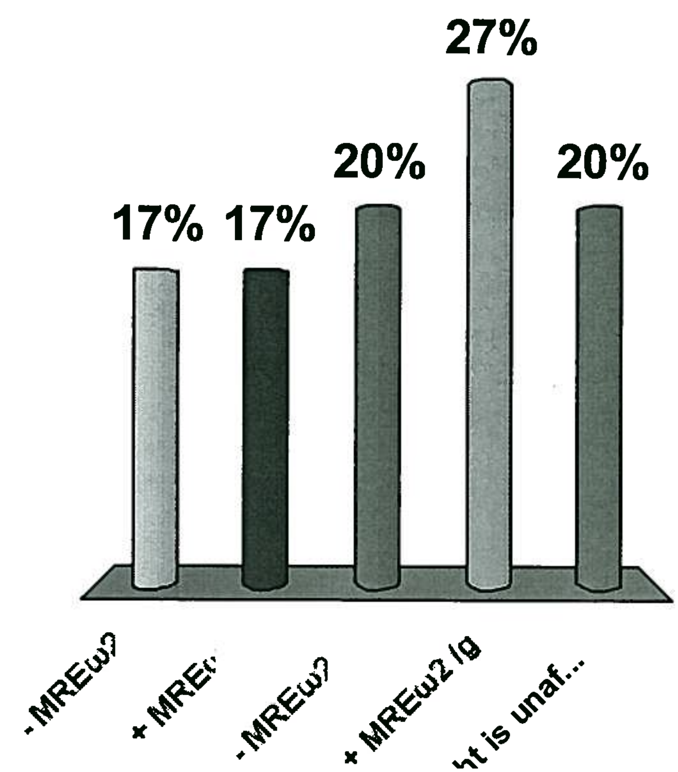
J. GRIFFIN 4/4/08 (a)

A mass, M, sets on a scale located on the equator in Ecuador. Because of the rotation of the earth, the scale is at rest in an accelerated frame, and the mass' weight, Mg, will be altered by an amount (where $R_E = 6.4 \times 10^6$ m is the radius of the earth):

a) $- MR_E\omega^2$
b) $+ MR_E\omega^2$
c) $- MR_E\omega^2 /g$
d) $+ MR_E\omega^2 /g$
e) 0: The weight is unaffected.



J. GRIFFIN 4/4/08 (b)

The correct answer is a): the weight changes by an amount, $-MR_E\omega^2$; i.e., it decreases slightly; as follows,

- The pseudo-force acting on an object at rest in a rotating frame is $|F_{Pseudo}| = MR_E\omega^2$, and is directed outward from the axis of rotation, - which means upward at the equator. Thus, this pseudo-force opposes the gravitational force, Mg, on the mass, and reduces the force, Mg, (which the scale must exert to keep the mass, M, at rest) by the amount $\Delta W = -MR_E\omega^2$.
- In magnitude, $MR_E\omega^2 = (3.4 \times 10^{-3})$ Mg, since $(6.4 \times 10^6)*(2\pi/24*60*60)^2 = 3.38 \times 10$-2 m/s^2 and g = 10 m/s^2, so the effect is small, (1/3)%.
- (Q: What would the effect be at the north pole? A: zero, because R = 0 at North Pole.)