Chapter 15 Problem 49

$T_0 = 2.00000\ s$ where $g_0 = 9.80\ m/s^2$

At a new location $T_f = 1.99796\ s$

What is g at the new location?

Now assume the pendulum is a simple pendulum.

Then $\omega = \sqrt{\frac{g}{\ell}}$

Since $T = \frac{2\pi}{\omega}$, then $T = 2\pi\sqrt{\frac{\ell}{g}}$

for the original location $T_0 = 2\pi\sqrt{\frac{\ell}{g_0}}$

and for the final position $T_f = 2\pi\sqrt{\frac{\ell}{g_f}}$

$$\therefore \frac{T_0}{T_f} = \frac{2\pi\sqrt{\frac{\ell}{g_0}}}{2\pi\sqrt{\frac{\ell}{g_f}}} = \sqrt{\frac{\ell}{g_0}}\cdot\sqrt{\frac{g_f}{\ell}} = \sqrt{\frac{g_f}{g_0}}$$

Square both sides and solve for g_f.

$$\left(\frac{T_0}{T_f}\right)^2 = \frac{g_f}{g_0} \rightarrow g_f = g_0\left(\frac{T_0}{T_f}\right)^2$$

$$g_f = \left(9.80\ m/s^2\right)\left[\frac{2.00000}{1.99796}\right]^2$$

$$= \left(9.80\ m/s^2\right)\left[1.00204\right]$$

$$= 9.82002\ m/s^2$$

Since $g = 9.80\ m/s^2$ limits the answer to 3 sig. figs then

$$\boxed{g = 9.82\ m/s^2}$$