Q- 240 g mass on a 0.8 m long string is pulled 8.4° to one side and released. How long does it take for the pendulum to reach 6.0° on the opposite side?

For small angles the motion of a pendulum bob is simple harmonic with time period T given by

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Here L is the length of the pendulum.

The angular frequency for this motion is given by

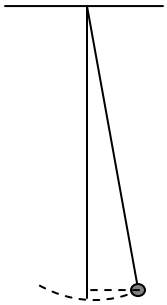
$$\omega = \frac{2\pi}{T} = \sqrt{\frac{g}{L}} = 3.5\,\text{rad/s} = 200.5^0/\text{s}$$

The displacement from equilibrium position as a function of time is given by

$$x = A \sin (\omega t + \phi)$$

As initially, at t =0, the bob is released from extreme position x = A, the initial phase ϕ is 90^0 and hence the equation can be written as

$$x = A \sin (\omega t + 90^0)$$
$$x = A \cos (\omega t) \qquad \text{---------- (1)}$$



Now here $A = L \sin 8.4^0 = 0.8*0.146 = 0.117$ m

And $x = - L \sin 6.0^0 = - 0.8*0.1045 = - 0.084$ m

Substituting in equation 1 we get

$$- \quad 0.084 = 0.117 \cos[(3.5\text{rad/s})*t]$$

Or $\cos[(3.5\text{rad/s})*t] = - 0.084/0.117 = - 0.718$

Gives $3.5\ \text{rad/s}*t = [135.88^0] = 2.37$ rad

Gives $t = 2.37/3.5 = 0.677$ s