Worksheet 20: Pendulums

1. A torsional oscillator can be thought of as a torsion spring with torque constant κ and a rotor with moment of inertia I. Its kinematics follow an angular Hooke's law torque $\tau = -\kappa\theta$ and the angular Newton's second law $\tau = I\alpha$, where $\alpha = d^2\theta/dt^2$. Its angular displacement is given by the function $\theta = \cos(\omega t + \phi)$.

   What is the value of ω in this function, in terms of the characteristics of the spring and rotor?

2. The small-angle approximation models $\sin\theta \approx \theta$ in radians. How small does θ need to be for this to be a decent approximation?

θ	$\sin\theta$	$\theta - \sin\theta$	$(\theta - \sin\theta)/\sin\theta$
$1/180\ \pi$			
$2/180\ \pi$			
$5/180\ \pi$			
$10/180\ \pi$			
$20/180\ \pi$			
$45/180\ \pi$			
			1%
			5%
			10%

4. Find the length of a simple pendulum with a period of oscillation of 2.0 s.