Two masses $m_1$ and $m_2$ ($m_1 \neq m_2$) are connected by a rigid rod of length $d$ and of negligible mass. An extensionless string of length $l_1$ is attached to $m_1$ and connected to a fixed point of support $P$. Similarly, a string of length $l_2$ ($l_1 \neq l_2$) connects $m_2$ and $P$. The assembly is subject to a uniform gravitational field of magnitude $g$ directed as shown in the figure, and is able to move only within the plane of the figure.

(a) Using the Lagrangian or otherwise, obtain the equation of motion for the angle $\phi$ defined in the accompanying figure. Do not assume $\phi$ is small.

(b) Find the frequency of small oscillations around the equilibrium position of the assembly $\phi_0$. You do not need to find $\phi_0$ explicitly but you must write down an equation that it satisfies.