1 Newtonian or Lagrangian

A block of mass $m$ is held at rest on a frictionless plane of mass $M$, angle of incline $\theta$. The plane rests on a frictionless horizontal surface. Find the acceleration of $m$ and $M$ after the block is released.

![Diagram of block on inclined plane](image)

2 Small oscillations

A bead is free to move without friction along a circular wire hoop of radius $R$, which rotates with constant angular speed $\omega$ about a vertical diameter. What is the minimum value of $\omega$ for which the bead will remain at a fixed $\theta_0$? For a sufficiently large $\omega$, what is $\theta_0$ (as a function of $\omega$)? What is the frequency of small oscillations about $\theta_0$?

![Diagram of bead on rotating hoop](image)

3 Coupled oscillations

Two masses are connected to each other by a massless spring of spring constant $k_{12}$ and to fixed walls by springs of spring constant $k$. Find the characteristic frequencies of longitudinal modes.

![Diagram of coupled oscillations](image)