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663 $\theta'' = U \cos \theta - (M + m)g \sin \theta + ml(\cos \theta \sin \theta) \theta'^2$

$Ml \cos^2 \theta - (M + m)l$. (7) Fig.2 Vector Diagram For

Force Components In Torque Balance Equations(6)

And(7)represent 2th, 2024Derivation Of Equations Of

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inition The Energy Which An Object Possesses Due To

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As Well As Possibly Derive An Alternative Functionality

Of An Inverted Pendulum System. First Let Us Consider

The Lagrangian Equation For The Inverted Pendulum.

This Is Setup By Looking At The Difference Of Kinetic

And Potential Energy In The System Defined By Fig 2.1:

Fig 2.1 1th, 202421 The Inverted PendulumWhere The

Lagrangian $L = T - U$ is the difference between the kinetic and potential energies of the bob. The kinetic energy of the bob is given by $\frac{1}{2}mv^2$, where v is the velocity of the bob. In terms of θ , the kinetic energy becomes $T = \frac{1}{2}mL^2\dot{\theta}^2$. The potential energy becomes $U = mgh = mgL(1 - \cos\theta)$. The Lagrangian is $L = \frac{1}{2}mL^2\dot{\theta}^2 - mgL(1 - \cos\theta)$. The Euler-Lagrange equation is $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = \frac{\partial L}{\partial \theta}$. This gives $mL\ddot{\theta} = -mg\sin\theta$. For small angles, $\sin\theta \approx \theta$, so $\ddot{\theta} + \frac{g}{L}\theta = 0$. The solution is $\theta(t) = A\cos(\omega t) + B\sin(\omega t)$, where $\omega = \sqrt{\frac{g}{L}}$. The period is $T = 2\pi\sqrt{\frac{L}{g}}$.

1. 2 Lab 21. The Inverted Pendulum Figure 21.1: The Frame Of Reference For The Simple Pendulum Problem. Of , The Kinetic Energy Becomes $T = \frac{1}{2}M\dot{\theta}^2 + \frac{1}{2}mL^2\dot{\theta}^2 = \frac{1}{2}(M + mL)\dot{\theta}^2$. The potential energy becomes $U = mgh = mgL(1 - \cos\theta)$. The Lagrangian is $L = \frac{1}{2}(M + mL)\dot{\theta}^2 - mgL(1 - \cos\theta)$. The Euler-Lagrange equation is $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = \frac{\partial L}{\partial \theta}$. This gives $(M + mL)\ddot{\theta} = -mg\sin\theta$. For small angles, $\sin\theta \approx \theta$, so $\ddot{\theta} + \frac{g}{L}\theta = 0$. The solution is $\theta(t) = A\cos(\omega t) + B\sin(\omega t)$, where $\omega = \sqrt{\frac{g}{L}}$. The period is $T = 2\pi\sqrt{\frac{L}{g}}$.

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