國立中央大學九十學年度碩士班研究生入學試題卷

所別: 地球物理研究所　不分組　科目: _____普通物理學_____　共 1 頁　第 1 頁

所別: 應用地質研究所　不分組

（每題 20 分;總分 100 分）

1. As shown in Figure 1, what horizontal force F must be applied to the cart (mass M) so that the blocks (mass m_1 and m_2) remain stationary relative to the cart? Assume all surfaces, wheels, and pulley are frictionless.
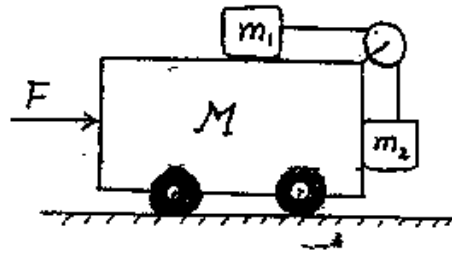

Figure 1.

2. As shown in Figure 2, a pendulum of length L and mass M is connected to a spring of force constant k. What is the frequency of the vibration of the system for small values of the amplitude (small θ). Assume the pendulum rod is rigid and neglect its mass.
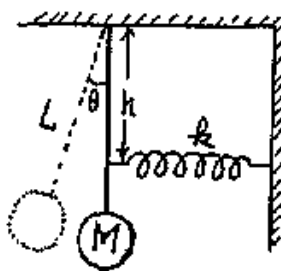

Figure 2.

3. A sinusoidal wave on a string is described by the equation

$$y = A\sin(kx - wt)$$

where A=0.51cm, k=3.1rad/cm and w=9.3rad/s. How far does a wave crest move in 10 seconds? Does the wave move in the positive or negative direction?

4. A sphere of radius $2a$ is made of a non-conducting material that has a uniform volume charge density ρ (Assume that the material does not affect the electric field.) A spherical cavity of radius a is now removed from the sphere, as shown in the following figure. Find the electric field within the cavity.
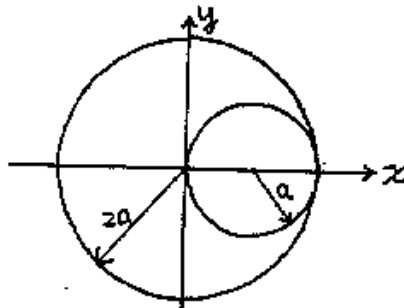
5. A power plant, having a Carnot efficiency, produces 2×10^9 W of electrical power from turbines that take in steam at temperature 500 K and discharge water at 300 K into a flowing river. The water downstream is warmer by 6 K due to the output of the power plant. What is the flow rate of the river? (PS.: The Carnot cycle contains two isothermal and two adiabatic processes.)