CH. 5 EXAMPLES:

• A block of mass m is sliding down a ramp making an angle θ with the horizontal. Friction is unimportant. Show that the acceleration of the block is $a = g \sin\theta$.

• Masses m_1 and m_2 are attached by a string of negligible mass and are hanging straight down from a string attached to the upper mass, m_1. If the system of two masses is accelerating vertically downward at $a = g/4$ with both strings taut, show that the tension in the upper string is $(3/4)(m_1 + m_2)g$.

• A conical pendulum hangs from a string of length ℓ that makes an angle θ with the vertical. If the pendulum bob moves in a circle at constant speed v show that this speed must be $v = \sqrt{g\ell \sin\theta \tan\theta}$.

• A rock rests on the bottom of a bucket which is attached to a long string. The whole system is swung in a vertical circle of radius ℓ as in class. What force does the bottom of the bucket exert on the rock of mass m at the instant the bucket is precisely upside down at the top of the circle, travelling at speed v? What is the minimum value of v such that the rock

will just maintain contact with the bottom of the bucket at the top of the circle.

Answer: $n = m((v^2/\ell) - g),\ v = \sqrt{g\ell}$.

• A block slides down a ramp making an angle θ with the horizontal. The coefficient of kinetic friction between block and ramp is μ_k. Show the acceleration of the block is $a = g(\sin\theta - \mu_k \cos\theta)$. Find μ_k if the block slides at constant velocity with ramp angle $\theta = 30°$. Answer: $\mu_k = 0.58$.

• A block of mass m_1 can slide (frictional coefficient μ_k) on a horizontal tabletop. A string of negligible mass attaches it over a frictionless peg to a hanging mass m_2 which is attached to another mass m_3 by another short string. If the hanging masses are allowed to fall vertically, what is the tension in the string joining these two masses? Answer: $T = (m_1 m_3(1 + \mu_k)g)/(m_1 + m_2 + m_3)$.

• Show that the greatest speed with which a car can travel without skidding around an unbanked curve of radius 1000 m, if the coefficient of static friction between tires and road is $\mu_s = 1.0$, is 100 m/s.