Massachusetts Institute of Technology - Physics Department

Physics - 8.01 **Assignment #10** December 1, 1999.

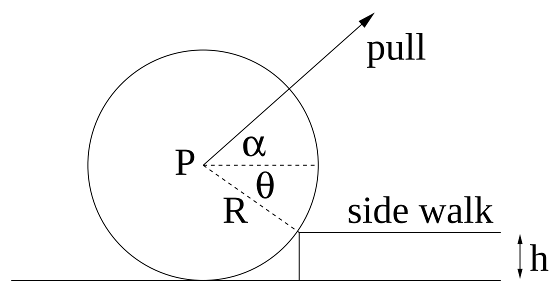
It is strongly recommended *that you read about a subject* **before** *it is covered in lectures.*

Lecture Date	Material Covered	Reading
#33 Fri 12/3	Kinetic Gas Theory - Ideal Gas Law ***PIVoT***	Page 494 – 504
	Isothermal Atmosphere	***Take Notes!***
	Phase Diagrams - Phase Transitions	
#34 Mon 12/6	The Wonderful Quantum World	***Take Notes!***
	Breakdown of Classical Mechanics	
#35 Wed 12/8		*Bring a Friend*

There is no due date for this assignment, and it will not be graded.
Solutions will be posted on Dec 10.

10.1 *Lifting a Drum up the Sidewalk*

A cylinder of mass M and radius R is lying on the street against the sidewalk. The height of the sidewalk is h. A rope is attached to the axis at each end (point P and Q) of the cylinder (we only show point P in the figure). We pull on the ropes (with equal force) perpendicular to the axis at an angle α with a horizontal plane so as to just lift the cylinder off the street.



a) What is the ratio of this force (2 ropes combined) to the weight of the cylinder? Express your answer in terms of α, θ, M, and g.

b) At what angle of α is the ratio as described under a) a minimum, and at what angle is it a maximum? Use $\theta = 30°$.

10.2 *Strain, Stress and Oscillations*

A mass of 400 kg is hanging from a nylon rope of length 5 m and diameter 1 cm. We pull the mass down from its equilibrium position over a distance of 3 cm. (The stress is proportional to the strain.) Since the mass of the rope is much less than 400 kg you may neglect it.

a) Calculate the force needed to do this.

b) The mass is now released and it starts to oscillate vertically. Is the motion a SHO? What is the period of one oscillation?

c) We now pull the mass down 10 cm from equilibrium and we release it. The stress is still proportional to the strain. Is the motion now a SHO?

d) How much mass can we hang on the rope before it breaks? Any idea how long the rope then is?

10.3 *Archimede's Principle*

A uniform block of wood floats in water with two-thirds of its volume submerged. In oil it has 90% of its volume submerged. What is the density of the wood and of the oil?

10.4 *Archimede's Principle and Oscillations*
A cylindrical wooden rod is weighted at one end so that it floats upright in water. The length of the submerged portion of the rod is 3 m. The rod is displaced vertically from its equilibrium position and released. What is the period of oscillation? If the atmospheric pressure increases by 5%, by what fraction will the period change?

10.5 *Ultimate Tensile Strength* – page 378, problem 63

10.6 *Beam Dump - Heat Power* – page 537, problem 13

10.7 *Density of Atoms* – page 512, problem 17

10.8 *Diving Bell - Ideal gas Law* – page 513, problem 24

10.9 *Scuba Diving* – page 512, problem 16

10.10 *High Altitude Balloons* – page 512, problem 21

10.11 *The Earth Atmosphere* – page 513, problem 28

10.12 *Oil Pipeline* – page 535, problem 5