Honors Physics – P221

Exam III

Monday – November 25 2002

Guidelines:

(1) This exam consists of four problems, each worth 25 points. Please show all your work in the blue books provided.

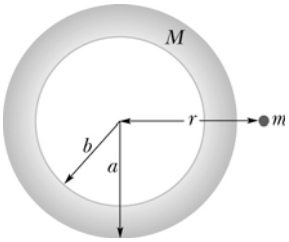
(1) This is a closed book exam – you may use your one page of formulae.

(1) Please take the time to write your solutions neatly and clearly. Be sure to specify units.

Thank you,

Alex R. Dzierba

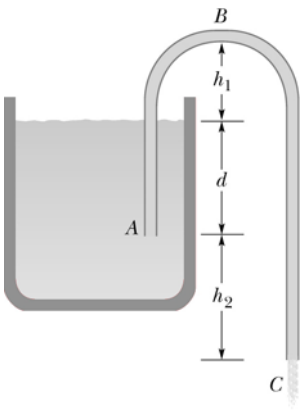
Problem 1 (25 points)



The figure shows a spherical shell of mass M with inner radius b and outer radius a. What is the gravitational force this shell exerts on a mass m when the smaller mass is located at distance r from the center of the spherical shell when:

(a) $r < b$?
(b) $b < r < a$?
(c) $r > a$?

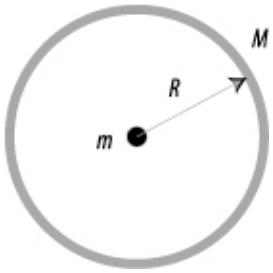
Problem 2 (25 points)



The figure shows a siphon in action. The liquid in the vessel pours out through the tube ABC. For the siphon to work the tube must be initially filled with liquid. The density of the liquid is ρ.

(a) What is the velocity of the fluid at point C?
(b) What is the pressure in the fluid at point B?

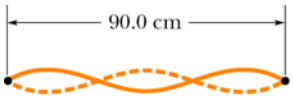
Problem 3 (25 points)



In the figure above a ring of radius *R* and mass *M* lies in the plane of the paper and is fixed in space. At the center of the ring is a small mass *m*. When the mass is moved a small distance *z* perpendicular to the paper the mass will execute simple harmonic motion about the center of the ring along a line perpendicular to the plane of the ring.

(a) What is the gravitational force on the small mass due to the ring when the mass is at the center of the ring?
(b) What is the gravitational force on the small mass due to the ring when the mass is located a small distance *z* along a line perpendicular to the ring and through the center?
(c) For the case described in (b) what is the frequency (*f*) of small oscillations after the mass is released?

Problem 4 (25 points)



A standing wave (shown above) is set up in a 90-cm long string that is fixed at the ends. The mass of the string is 7 gm and tension in the string is 150 N. If the string is oscillating as shown, find:

(a) the wavelength of the standing wave
(b) the frequency of the wave
(c) the frequency if the same pattern is obtained with the tension doubled.