Primer examen parcial para la clase de sistemas de partículas

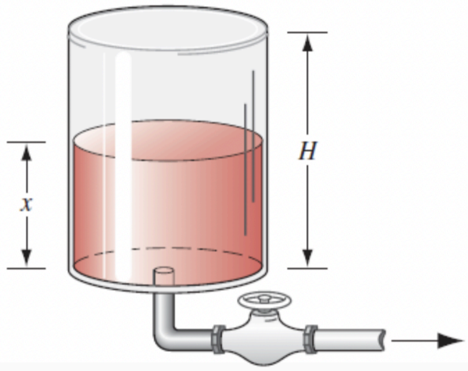
Instrucciones del examen

- **Entrega:** Martes a las 10:00 am (hora de Ensenada).
- **Formato:** El examen debe entregarse en PDF.
    - Si usan tablet, pueden responder como normalmente toman notas.
    - Si toman fotos, asegúrense de que la letra sea legible.
    - El uso de **Overleaf/LaTeX** es altamente recomendado.
- **Respuestas:** Deben ser claras, legibles y bien fundamentadas.
    - Pueden emplear resultados ya vistos en clase.
    - Si utilizan un resultado no visto, deberán **demostrarlo en una hoja aparte**.
- **Unidades:** Se hará especial énfasis en el uso correcto de las unidades.
    - Un problema correcto pero con unidades incorrectas tendrá una penalización de **–0.3 puntos sobre 1** (ejemplo: un ejercicio con valor de 1 punto quedará en 0.7 si las unidades son erróneas).

A dog weighing 10.8 lb is standing on a flatboat so that he is 21.4 ft from the shore. He walks 8.50 ft on the boat toward shore and then halts. The boat weighs 46.4 lb, and one can assume there is no friction between it and the water. How far is he from the shore at the end of this time? (Hint: The center of

Equation of Motion for Relativistic Particles and Systems with Variable Rest Mass," by Kalman B. Pomeranz, *American Journal of Physics,* December 1964, p. 955.)

A cylindrical storage tank is initially filled with aviation gasoline. The tank is then drained through a valve on the bottom. See Fig. 7-34. (*a*) As the gasoline is withdrawn, describe qualitatively the motion of the center of mass of the tank and its remaining contents. (*b*) What is the depth x to which the tank is filled when the center of mass of the tank and its remaining contents reaches its lowest point? Express your answer in terms of H, the height of the tank; M, its mass; and m, the mass of gasoline it can hold.



15. In this problem we seek to compute the rotational inertia of a disk of mass M and radius R about an axis through its center and perpendicular to its surface. Consider a mass element dm in the shape of a ring of radius r and width dr (see Fig. 9-63). (*a*) What is the mass dm of this element, expressed as a fraction of the total mass M of the disk? (*b*) What is the rotational inertia dI of this element? (*c*) Integrate the result of part (*b*) to find the rotational inertia of the entire disk.

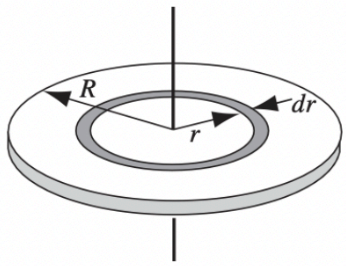


FIGURE 9-63. Problem 15.

12. Three particles are attached to a thin rod of length 1.00 m and negligible mass that pivots about the origin in the xy plane. Particle 1 (mass 52 g) is attached a distance of 27 cm from the origin, particle 2 (35 g) is at 45 cm, and particle 3 (24 g) at 65 cm. (*a*) What is the rotational inertia of the assembly? (*b*) If the rod were instead pivoted about the center of mass of the assembly, what would be the rotational inertia?

4. A pulsar is a rapidly rotating neutron star from which we receive radio pulses with precise synchronization, there being one pulse for each rotation of the star. The period T of rotation is found by measuring the time between pulses. At present, the pulsar in the central region of the Crab nebula (see Fig. 8-18) has a period of rotation of $T = 0.033$ s, and this is observed to be increasing at the rate of 1.26×10^{-5} s/y. (*a*) Show that the angular speed ω of the star is related to the period of rotation by $\omega = 2\pi/T$. (*b*) What is the value of the angular acceleration in rad/s^2? (*c*) If its angular acceleration is constant, when will the pulsar stop rotating? (*d*) The pulsar originated in a supernova explosion in the year A.D. 1054. What was the period of rotation of the pulsar when it was born? (Assume constant angular acceleration.)