ชื่อ.....รหัส.....

มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบกลางภาค ประจำภาคการศึกษาที่ 1 ประจำปีการศึกษา 2552

วันที่ : 27 กรกฎาคม 2552 เวลา : 9:00 – 12:00

วิชา : Momentum and Heat Transfer (231-311) ห้องสอบ : R300

- อนุญาตให้นำหนังสือและเอกสารอื่นๆ เข้าห้องสอบได้
- อนุญาตให้นำเครื่องคิดเลขทุกรุ่นเข้าห้องสอบได้
- ข้อสอบมีทั้งหมด 7 ข้อ (8 หน้า) ให้ทำทุกข้อ
- กระดาษไม่พอให้ทำต่อด้านหลัง
- ใช้ดินสอทำข้อสอบได้

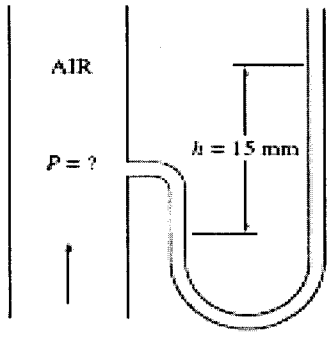
ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

หน้าที่	ข้อที่	คะแนนเต็ม	คะแนนที่ได้
2	1	5	
3	2	10	
4	3	10	
5	4	10	
6	5	15	
7	6	20	
8	7	20	
รวมคะแนน		90	

อ. ผกามาศ เจษฎ์พัฒนานนท์

14 กรกฎาคม 2552

1. A mercury manometer (ρ = 13,600 kg/m^3) is connected to an air duct to measure the pressure inside. The difference in the manometer levels is 15 mm, and the atmospheric pressure is 100 kPa. (a) Judging from the Figure below, determine if the pressure in the duct is above or below the atmospheric pressure. (b) Determine the absolute pressure in the duct. (5 points)

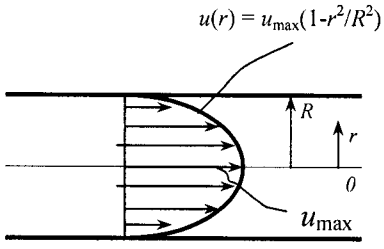


2. Answer these questions (10 points)

2.1 What is the no-slip condition? What causes it? (2 points)

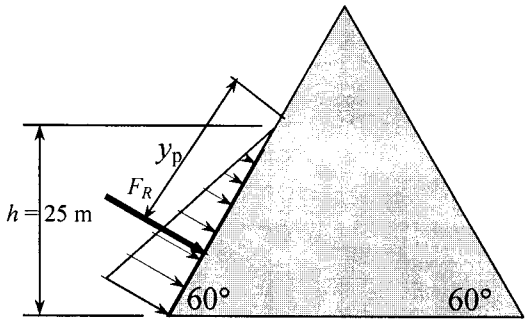
2.2 In a piping system, the water temperature remains under 40°C. Determine the minimum pressure allowed in the system to avoid cavitation. (2 points)

2.3 In regions far from the entrance, fluid flow through a circular pipe is one-dimensional, and the velocity profile for laminar flow is given by $u(r) = u_{max}(1-r^2/R^2)$, where R is the radius of the pipe, r is the radial distance from the center of the pipe, and u_{max} is the maximum flow velocity, which occurs at the center. Obtain (a) a relation for the drag force applied by the fluid on a section of the pipe of length L and (b) the value of the drag force for water at 20°C with R = 0.08 m, L = 15 m, u_{max} = 3 m/s, and μ = 0.0010 kg/m.s. (6 points)



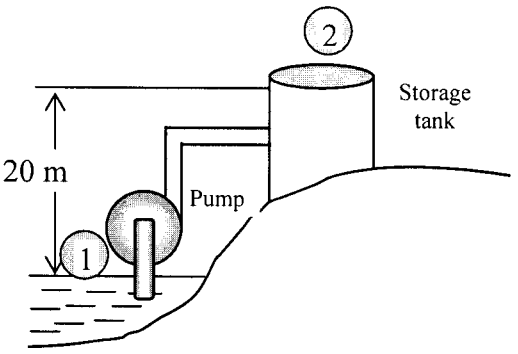
3. The water in a 25-m-deep reservoir is kept inside by a 150-m-wide wall whose cross section is an equilateral triangle, as shown in Figure below. Determine (a) the total force (hydrostatic + atmospheric) acting on the inner surface of the wall and its line of action and (b) the magnitude of the horizontal component of this force. Take P_{atm} = 100 kPa.

(10 points)

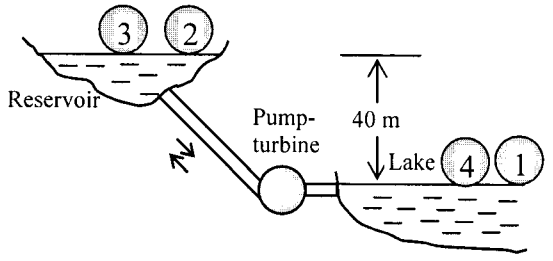


4. Water is pumped from a lake to a storage tank 20 m above at a rate of 70 L/s while consuming 20.4 kW of electric power. Disregarding any frictional losses in the pipes and any changes in kinetic energy, determine (a) the overall efficiency of the pump-motor unit and (b) the pressure difference between the inlet and the exit of the pump.

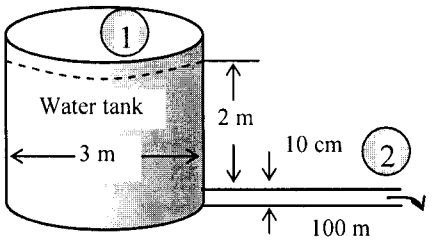
(10 points)



5. An entrepreneur is considering building a large reservoir 40 m above the lake level, pumping water from the lake to the reservoir at night using cheap power, and letting the water flow from the reservoir back to the lake during the day, producing power as the pump-motor operates as a turbine-generator during reverse flow. Preliminary analysis shows that a water flow rate of 2 m^3/s can be used in either direction, and the irreversible head loss of the piping system is 4 m. The combined pump-motor and turbine-generator efficiencies are expected to be 75 percent each. Assuming the system operates for 10 h each in the pump and turbine modes during a typical day, determine the potential revenue this pump-turbine system can generate per year if a utility company is selling electric power for $0.03/kWh at night and is welling to pay $0.08/kWh for power produced during the day. (15 points)



6. A 3-m-diameter tank is initially filled with water 2 m above the center of a sharp-edged 10-cm-diameter orifice. The tank water surface is open to the atmosphere, and the orifice drains to the atmosphere through a 100-m-long pipe. The friction coefficient of the pipe can be taken to be 0.015 and the effect of the kinetic energy correction factor can be neglected. Determine (a) the initial velocity from the tank and (b) the time required to empty the tank. (20 points)



7. During a winter day, wind at 55 km/h, 5°C, and 1 atm is blowing parallel to a 4-m-high and 10-m-long wall of a house. Assuming the wall surfaces to be smooth, determine the friction drag force acting on the wall. What would your answer be if the wind velocity has doubled? How realistic is it to treat the flow over side wall surfaces as flow over a flat plate? (20 points)