Name _____ Section _____

ES205
Examination I
April 25, 1997

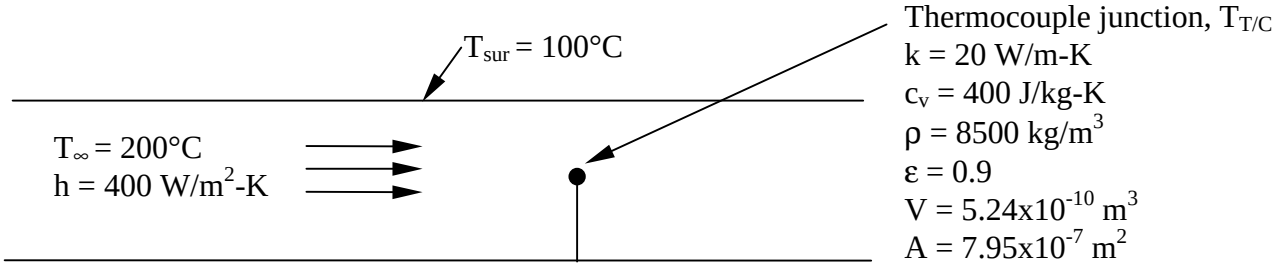
Problem	Score
1	/25
2	/25
3	/25
4	/25
Total	/100

Show all work for credit
AND
Turn in your signed help sheet

Name _____ 25 pts

ES205 Examination II **Problem 1** April 25, 1997

A thermocouple is used to measure the temperature of the fluid in a pipe as shown below. Assume conduction can be neglected. Note: $\sigma = 5.67 \times 10^{-8}$ W/(m^2-K^4)



a) Determine the differential equation for the temperature of the thermocouple junction $T_{T/C}$ in terms of general parameters, that is, do not substitute in the numerical values given. (17 pts)

b) How do you check your assumption that the junction temperature is uniform at any instant in time? (3 pts)

c) Using the numerical values given, determine the steady state temperature of the thermocouple bead. (5 pts)

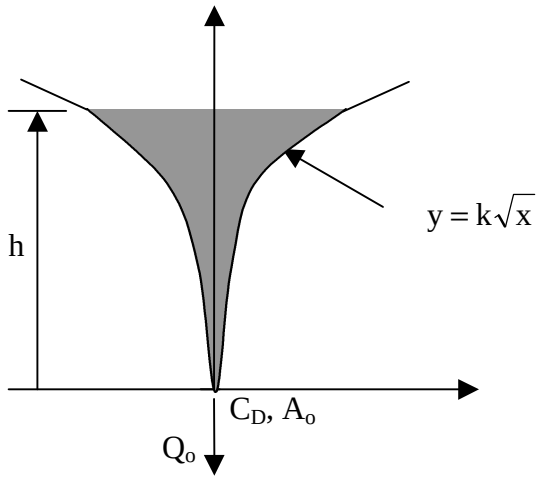
Name _____ 25 pts

ES205 Examination II **Problem 2** April 25, 1997

A uniquely designed tank has a circular cross-section and wall that are described by the equation $y = k\sqrt{x}$. A drain plug located in the tank bottom has a discharge coefficient C_D and a cross-sectional area A_0.

a) Determine the differential equation of motion (EOM) describing the change in water height h as the water empties from the tank. The initial height of water in the tank when t = 0 is h = h_0. (20 pts)

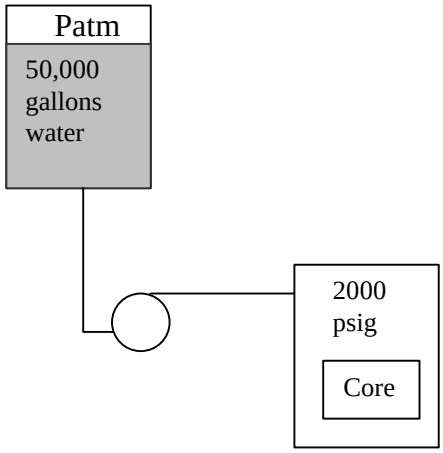
b) Solve the EOM for h as a function of time (5 pts)



Name _____ 25 pts

ES205 Examination II **Problem 3** April 25, 1997

An emergency flooding system for a nuclear reactor core is shown. Find the **input power to the fluid** required to flood the core at a rate of 5000 gal/min (11.14 ft^3/s). The piping system contains 750 ft of 8 inch commerical steel pipe with three gate valves and seven 90° standard elbows. Assume a square-edged entrance (Kent = 0.45), 60dF water, and flanged connections. If the pump efficiency is 60%, determine the **horsepower required from the electric motor** that drives the pump. You may need some of these: ρ=1.94slug/ft^3, μ=7.761x10^{-4} lbm/(ft-s), ν=1.243x10^{-5} ft^2/s, D_{pipe}=7.625 in, 1 hp = 550 ft-lbf/sec.



Name _____ 25 pts

ES205 Examination II **Problem 4** April 25, 1997

Determine the EOM relating the input x to the output y for the hydraulic amplifier. Assume small displacements, K_v = valve constant, A = area of the piston.