Mechanical Engineering 252: Convective Heat and Mass Transfer
Midterm Exam: March 16, 2010, Professor Ralph Grief
(Exam Average = 116 out of 165)

1. There is a boundary layer flow past a plate aligned with the flow. For $U_\infty = 1\frac{m}{s}, \nu = 10^{-5}\frac{m^2}{s}$
(15 points)(a) What is the value of the velocity at an axial distance x = .1m, at a location .002m away (perpendicularly) from the plate?
(20 points)(b) For $\alpha = \nu = 10^{-5}\frac{m^2}{s}$ what is the value of the temperature at the same location? Take T_w =400K and $T_\infty = 300K$.

2. There is steady flow in a channel (or duct). Neglect axial conduction. Determine the mean (average or bulk) temperature for
(25 points)(a) a constant heat flux
(25 points)(b) a heat flux varying according to Be^{-Cx} with specified constants B and C
Note superposition principles are NOT needed for this problem

Indicate specifically (give equation) how you would proceed to obtain the mean (avg or bulk) temperature for
(15 point)(c) a heat flux varying according to Bte^{-Cx} with t = time. ** Do NOT actually carry out the solution.

3. Consider the thermal inlet region for fully developed flow in a channel so that u = (const)y and v= 0. For the wall temperature variation give below give the explicit relations for the heat flux at the wall y=0 for x>1.
Do NOT evaluate the "final" integrals but write the results in terms of the actual functions (and not in terms of the influence function "f")

Cases (15 points each)	Location	$t_{wall} - t_i$	Wall heat flux = ?
(a)	0 < x	const = A	
(b)	0 < x	Ax	
(c)	0 < x < 1 x > 1	Ax A	