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Quiz 3

MECH3011 Fluid Mechanics

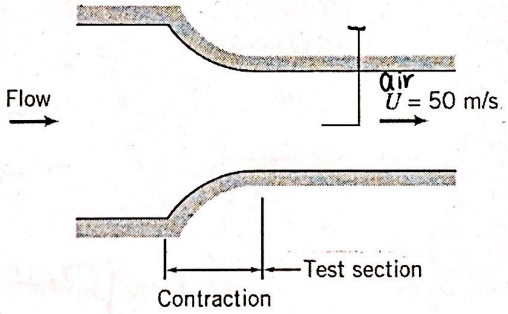
Summer 2021

- **Closed book/closed notes**
- **Show all steps to obtain full credit**

The inlet contraction and test section of a laboratory wind tunnel are shown. The air speed in the test section is U = 50m/s. A total-head tube pointed upstream indicates that the stagnation pressure on the test section centerline is 10 mm of water below atmospheric. The laboratory is maintained at atmospheric pressure and a temperature of −5°C. Evaluate:

a) the dynamic pressure on the centerline of the wind tunnel test section (gage pressure).
b) Compute the static pressure at the same point (gage pressure).

p_{atm} = 101·kPa
ρ_w = 999 kg/ m^3
Air at T = −5°C:
R = 287 J/kg·K



a) $p_{dynamic} = \frac{1}{2}\rho_{atm} U^2 = \frac{1}{2} \times 1.0 \times 10^3 \times 50^2 = 124875\ Pa$.

b) $p_{static} = \rho g h = 999 \times 9.8 \times 10 \times 10^{-3} = 97.902\ Pa$

$T = -5°C$, $R = 287\ J/kg \cdot K$

$p_1 + \frac{1}{2}\rho V_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho V_2^2 + \rho g z_2$

$p_{atm} = p_{static} + p_{dynamic} + \rho g z_2$, $z_2 = -10mm$

$\Rightarrow p_{static} = p_{atm} - p_{dynamic} - \rho g z_2$

$= 101kPa - 124875\ Pa - 9.8 \times 10 \times 10^{-3} =$