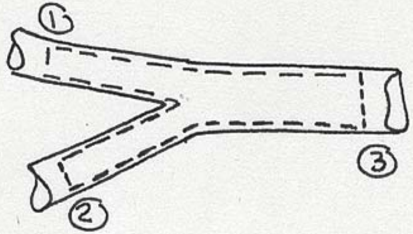
ANSWER 1.8

CHOOSE A CONTROL VOLUME (DASH) FAR ENOUGH AWAY FROM JUNCTURE SUCH THAT $\partial T/\partial n = 0$ AT EACH FLUX SURFACE.



(A) $$\frac{\partial}{\partial t}\int_{CV} C\, d\forall = -\int_{CS} C\, \vec{V}\cdot\vec{n}\, dA + \int_{CS} D_n \frac{\partial C}{\partial n}\, dA \pm S$$

THE CONCENTRATION OF HEAT ENERGY IS,

$$C\,[\mathrm{J\ m^{-3}}] = \rho\, C_p\, T$$

TEMP [°K]

FLUID DENSITY [$\mathrm{kg\ m^{-3}}$]

SPECIFIC HEAT [$\mathrm{J\ kg^{-1}\ K^{-1}}$]

$C_p = 4200\ \mathrm{J\ kg^{-1}\ K^{-1}}$ FOR WATER

FOR SIMPLICITY, ASSUME $\rho, C_p \neq f(T)$.

IF WE ASSUME STEADY STATE, THE FIRST TERM IN (A) IS ZERO.

BECAUSE WE POSITION SURFACES 1, 2, 3 WHERE $\frac{\partial T}{\partial n} = 0$, THE DIFFUSIVE FLUX TERM IS ZERO.

BECAUSE THE PIPES ARE INSULATED, $S = 0$.

SO, FINALLY (A) BECOMES,

$$0 = \rho C_p T_1 u_1 A_1 + \rho C_p T_2 u_2 A_2 - \rho C_p T_3 u_3 A_3 \tag{B}$$

DROPPING ρC_p, AND SOLVING FOR T_3,

$$T_3 = \frac{u_1 A_1 T_1 + u_2 A_2 T_2}{u_3 A_3} \tag{C}$$

NOTE FROM STATEMENT $u_1 A_1 = u_2 A_2$

AND FROM FLUID MASS CONSERVATION $(u_1 A_1 + u_2 A_2) = u_3 A_3$

$$T_3 = \frac{u_1 A_1 (T_1 + T_2)}{2 u_1 A_1} = \frac{1}{2}(T_1 + T_2) \tag{D}$$

$\therefore T_3 = 15°C \quad [288°K]$