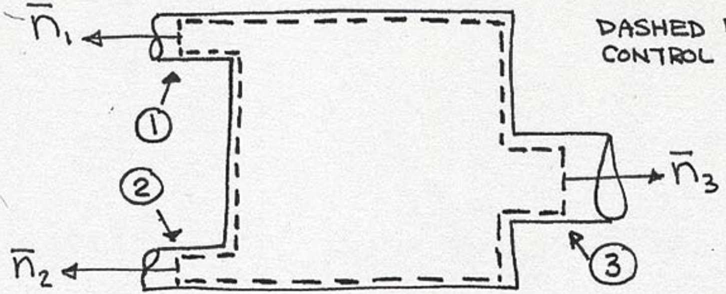
ANSWER 1.6

A CONVENIENT CONTROL VOLUME CAN BE DRAWN AROUND THE INTERIOR VOLUME OF THE TANK, AND EXTENDING INTO PIPES 1 & 2 TO POSITIONS OF UNIFORM CONCENTRATION, i.e. $\partial C/\partial n = 0$ ALONG PIPE.



NOW EVALUATE EQ A FOR THIS CONTROL VOLUME

$$(A) \quad \underset{1}{\frac{\partial}{\partial t}\int_{C\forall} C\, d\forall} = \underset{2}{-\int_{CS} C\vec{V}\cdot\vec{n}\, dA} + \underset{3}{\int_{CS} D_n \frac{\partial C}{\partial n} dA} \underset{4}{\pm S}$$

BECAUSE WE ASSUME STEADY STATE, $\partial/\partial t = 0$, THE FIRST TERM IS ZERO

NO SOURCE OR SINK IS MENTIONED, ∴ SET $S = 0$

WE EVALUATE THE TWO SURFACE INTEGRALS, $\int_{CS}$, AT THE THREE INDICATED AREAS OF FLUX

NOTE THAT WE PLACED THE SURFACE 1, 2, 3 FAR ENOUGH INTO THE PIPES THAT $\partial C/\partial n = 0$ AT EACH SURFACE ∴ THERE IS NO DIFFUSIVE FLUX, TERM 3 = 0

EVALUATING TERM 2 AT EACH FLUX AREA

$$(B) \quad 0 = +u_1 A_1 C_1 + u_2 A_2 C_2 - u_3 A_3 C_3$$

FROM CONSERVATION OF FLUID MASS (CONTINUITY) WE ALSO HAVE $u_1 A_1 + u_2 A_2 = u_3 A_3$ FOR INCOMPRESSIBLE FLOW. USING THIS TO REPLACE $u_3 A_3$ IN (B) AND SOLVING FOR C_3

$$(C) \quad C_3 = \frac{u_1 A_1 C_1 + u_2 A_2 C_2}{(u_1 A_1 + u_2 A_2)}$$

OR,

$$C_3 = \frac{(20 \tfrac{cm}{s})(10 cm^2)(9 \,mg/\ell) + (10 \tfrac{cm}{s})(10 cm^2)(0 \,mg/\ell)}{(20 \tfrac{cm}{s})(10 cm^2) + (10 \tfrac{cm}{s})(10 cm^2)}$$

$$C_3 = \frac{20}{30} * 9 \,mg/\ell = 6 \,mg/\ell$$