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Course: ENGR 282 (MATHS)
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Solution

Step 1: Setting up a model

Let $F_A(t)$ denote the amount of fresh air in the room at time t

$$\frac{dF_A}{dt} = \text{Fresh air in flow rate} - \text{Fresh air out flow rate}$$

Input of fresh air = $600 \text{ ft}^3/\text{min}$

Initially there was no fresh air

Hence, $F_A(0) = 0$

Also

Output of mixture = $600 \text{ ft}^3/\text{min}$

Mixture of fresh air and Normal Air

$$= 20,000 \text{ ft}^3/\text{min}$$

$$\frac{dF_A}{dt} = 600 - \frac{600}{20,000} \times F_A(t)$$

$$\frac{dF_A}{dt} = 600 - 0.03 F_A$$

$$\frac{dF_A}{dt} = -0.03 (F_A - 20,000)$$

Step 2: Solution of the Model

$$\frac{dF_A}{dt} = -0.03 (F_A - 20,000)$$

dt