1. let y represent fresh air

rate of accumulator = rate of in flow − rate of outflow

$$\frac{dy}{dt} = 600 - 0.03y$$

rate of income = 600 ft^3/min

rate of outcome = $\frac{600}{20000} \times y = 0.03y$

$$\frac{dy}{dt} = -0.03(y - 20000)$$

$$\frac{dy}{(y-20000)} = -0.03dt$$

$$\ln(y - 20000) = -0.03t + C$$

$$y - 20000 = e^{-0.03t + C}$$

$$y - 20000 = y_0 e^{-0.03t}$$

$$y = 20000 + y_0 e^{-0.03t}$$

If the room contained no fresh air

$y = 0$, $t = 0$

$$0 = 20000 + y$$

$$y_0 = -20000$$

$$y = 20000 - 20000 e^{-0.03t}$$

$$y = 20000(1 - e^{-0.03t})$$

This is the model for the amount of oil at any time t.

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b. room contains 20000 ft^3 of oil

90% of 20000

$= 18000\ ft^3/min$

from the model:

$$y = 20000(1 - e^{-0.03t})$$

$$18000 = 20000(1 - e^{-0.03t})$$

$$e^{-0.03t} = -\left(\frac{18000}{20000} - 1\right)$$

$$e^{-0.03t} = +0.1$$

$$-0.03t = \ln 0.1$$

$$-0.03t = -2.303$$

$$t = \frac{2.303}{0.03}$$

$$t = 76.77\ min$$

c. 6 hours to ultimate becomes

60 minute = 1 hour

x = 6

$6 \times 60 = x \times 1$

$x = 360$ minute

d. The steady state value of the fresh amount of air in the room gives 20 000 ft^3 of air.

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e The graph gave a straight line which entails that the steady rate value of the amount of fresh air in the room does not change even with the expense of increase in time

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