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

Integrating both sides, we have

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

$$\ln(F_A - 20{,}000) = -0.03t + c$$

Taking (exp) of both sides

$$F_A - 20{,}000 = Ce^{-0.03t}$$

where $C = e^c$

$$F_A = 20{,}000 + Ce^{-0.03t}$$

Initially there were no fresh air

Hence,

$$F_A(0) = 0$$

$$F_A = 20{,}000 + Ce^{-0.03t}$$

when $t = 0$, $F_A = 0$

$$0 = 20{,}000 + C \times e^{-0.03 \times 0}$$

$$C = -20{,}000$$

Substitute for C

$$\cancel{F_A}\ F_A(t) = 20{,}000 - 20{,}000\, e^{-0.03t}$$

(particular solution)

b) Time at which 90% of the air will become fresh

$$\frac{90}{100} \times \frac{20{,}000}{1} = 20{,}000 - 20{,}000e^{-0.03t}$$

$$18000 = 20{,}000 - 20{,}000\,e^{-0.03t}$$

$$-2000 = -20{,}000\,e^{-0.03t}$$

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

$$\ln 0.1 = -0.03t$$