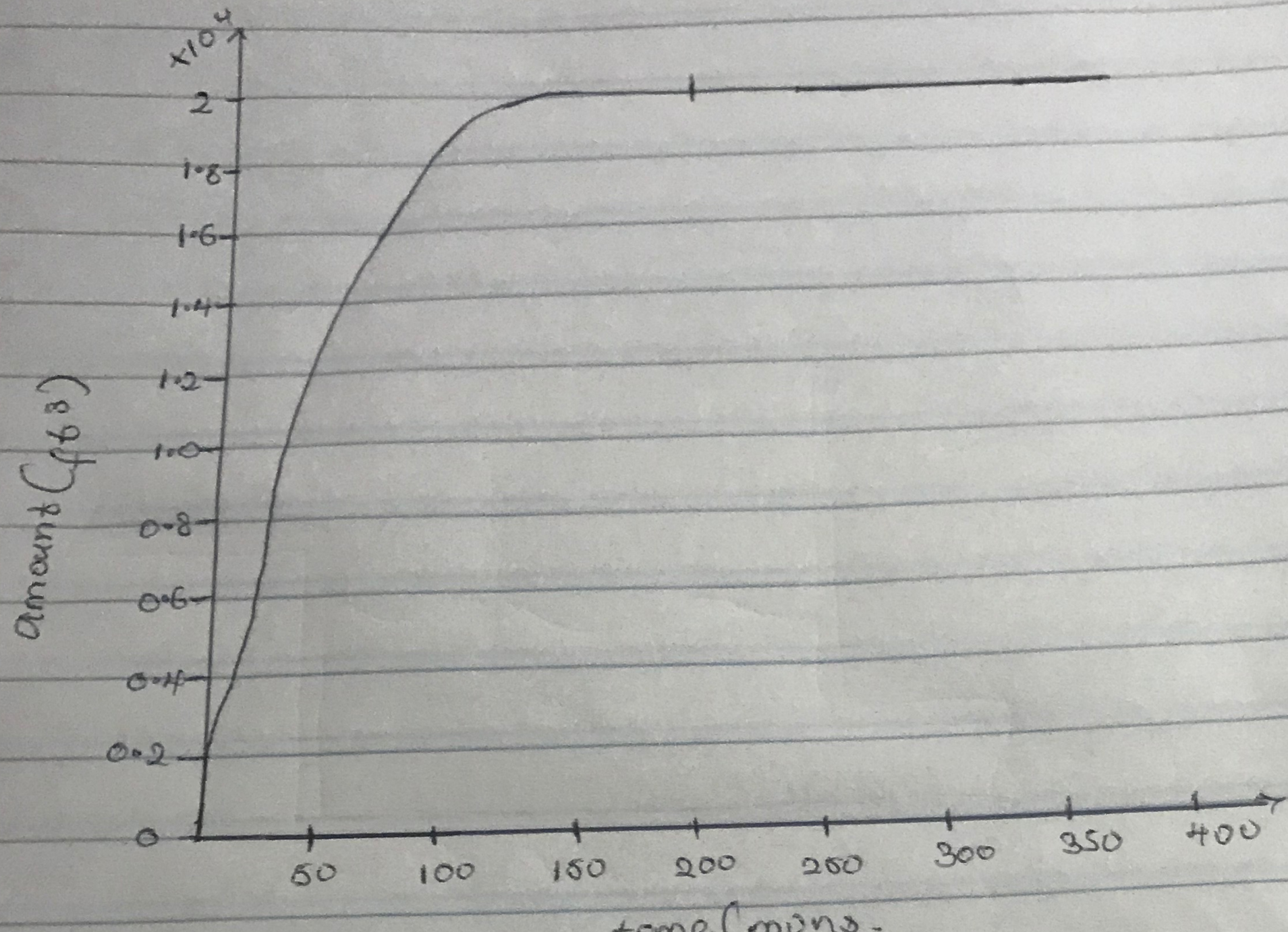
x10⁴
2
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
0
Amount of CO2
50
100
150
200
250
300
350
400
time (mins.

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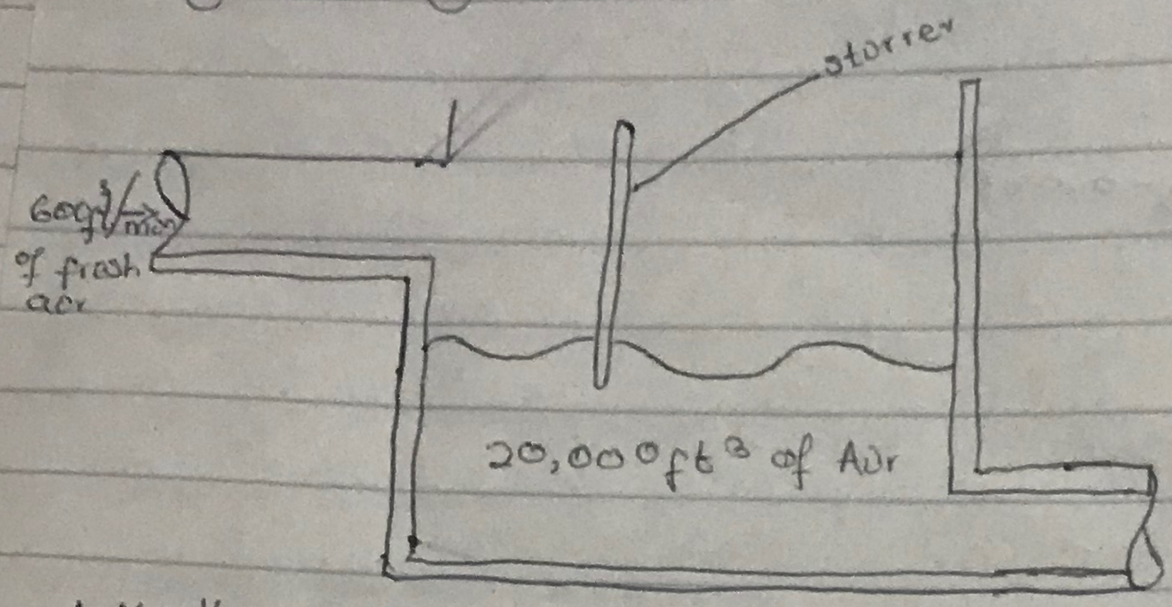
Chemical Engineering
017/eng01/080

Eng 282 Assignment.



Initially, no fresh air = 0ft³ of air

Let $y(t)$ be the amount of fresh air present in ft³

$$\frac{dy}{dt} = \text{Air in} - \text{Air out}$$

$$\text{Air in} = 600 ft^3/min$$

$$\text{Air out} = \frac{y}{20000} \times 600 \ ft^3/min$$

$$\text{Air out} = 0.03y ft^3/min.$$

$$dy/dt = 600 - 0.03y$$

$$dy/dt = -0.03(-20,000 + y)$$

$$dy/dt = -0.03(y - 20,000)$$

$$\frac{1}{(y-20,000)} dy = -0.03dt$$

Integrating; $\int \frac{1}{(y-20,000)} dy = \int -0.03dt$

$$\ln(y - 30,000) = -0.03t + c$$

$$y - 20,000 = e^{-0.03t + c}$$

$$y - 20,000 = e^{-0.03t} \cdot e^c$$

where $e^0 = y_0$

$$y - 20,000 = y_0 e^{-0.03t}$$

at initial point $y = 0$ and $t = 0$

$$0 - 20,000 = y_0 e^{-0.03(0)}$$

$\therefore y_0 = -20,000$

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

b. When will 90% of air will become fresh

$y = \frac{90}{100} \times 20,000 = 18,000$

$\Rightarrow 18,000 - 20,000 = -20,000\, e^{-0.03t}$

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

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

$e^{-0.03t} = 0.1$

$-0.03t = \ln 0.1$

$t = \frac{-2.3026}{-0.03}$ $\quad t = 76.75 \approx 77$ minutes.

c) Command window

```
clear
clc
close all
t = 0: 50: 360
y = 20,000 - 20000 * exp(-0.03 * t)
plot(t, y)
xlabel ('time (mins)')
ylabel ('amount (ft^3)')
grid on
grid minor
axis tight
```