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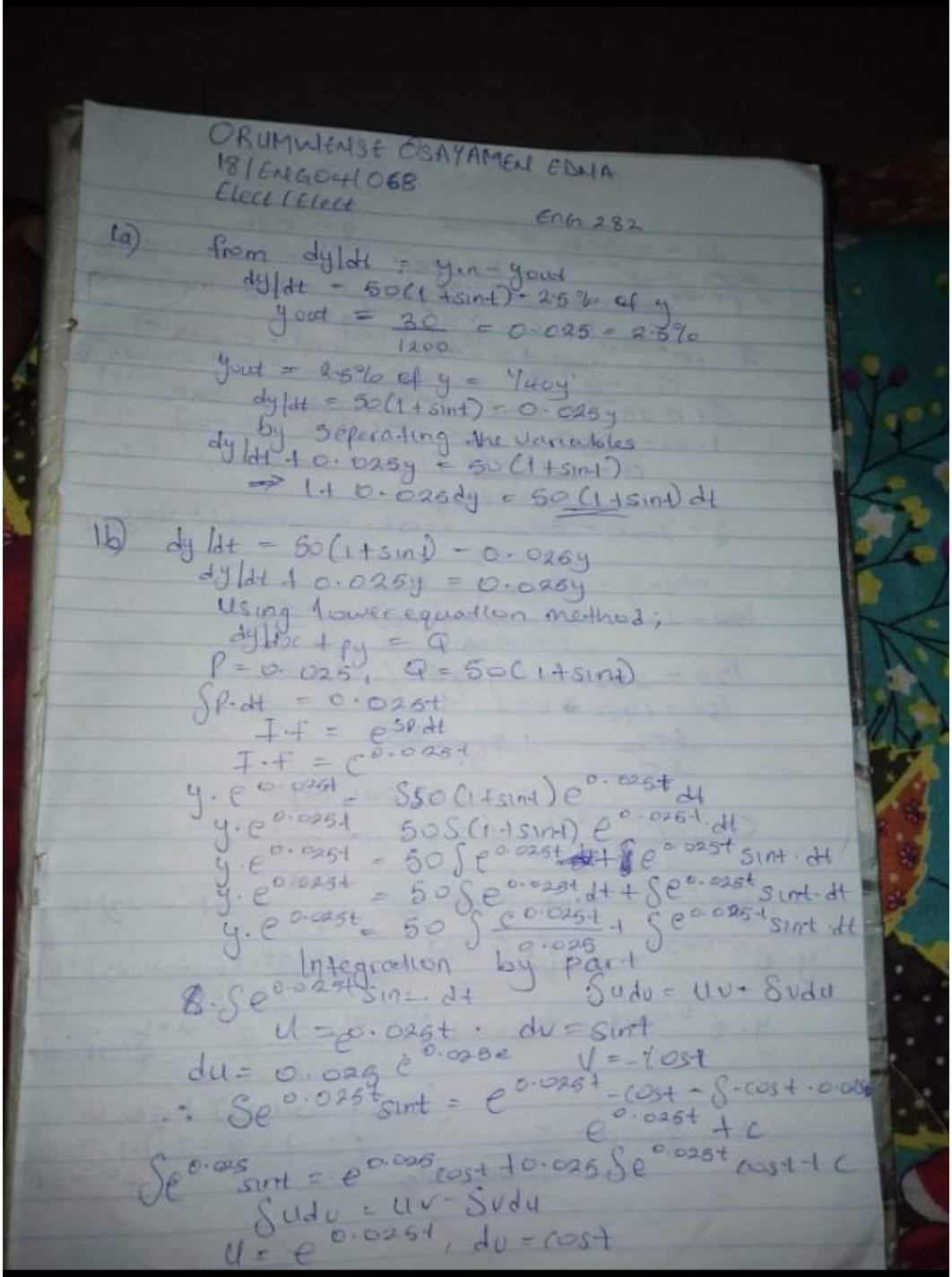

ORUMWENSE OSAYAMEN EDWIN
18/ENG04/068
Elect/Elect
ENG 282

(a) from $dy/dt = y_{in} - y_{out}$

$dy/dt = 50(1+\sin t) - 2.5\%$ of $y$

$y_{out} = \frac{30}{1200} = 0.025 = 2.5\%$

$y_{out} = 2.5\%$ of $y = \frac{1}{40}y$

$dy/dt = 50(1+\sin t) - 0.025y$

by seperating the variables

$dy/dt + 0.025y = 50(1+\sin t)$

$\Rightarrow 1 + 0.025dy = 50(1+\sin t)\,dt$

(b) $dy/dt = 50(1+\sin t) - 0.025y$

$dy/dt + 0.025y = 0.025y$

Using 1 order equation method;

$dy/dx + Py = Q$

$P = 0.025$, $Q = 50(1+\sin t)$

$\int P\,dt = 0.025t$

$I.F = e^{\int P\,dt}$

$I.F = e^{0.025t}$

$y \cdot e^{0.025t} = \int 50(1+\sin t)e^{0.025t}\,dt$

$y \cdot e^{0.025t} = 50\int (1+\sin t)e^{0.025t}\,dt$

$y \cdot e^{0.025t} = 50\int e^{0.025t}\,dt + \int e^{0.025t}\sin t\,dt$

$y \cdot e^{0.025t} = 50\int e^{0.025t}\,dt + \int e^{0.025t}\sin t\,dt$

$y \cdot e^{0.025t} = 50\left[\frac{e^{0.025t}}{0.025}\right] + \int e^{0.025t}\sin t\,dt$

Integration by part

$\int e^{0.025t}\sin t\,dt \qquad \int u\,dv = uv - \int v\,du$

$u = e^{0.025t}, \quad dv = \sin t$

$du = 0.025e^{0.025t} \qquad v = -\cos t$

$\therefore \int e^{0.025t}\sin t = e^{0.025t}(-\cos t) - \int -\cos t \cdot 0.025e^{0.025t}$

$\int e^{0.025t}\sin t = e^{0.025t}\cos t + 0.025\int e^{0.025t}\cos t + C$

$\int u\,dv = uv - \int v\,du$

$u = e^{0.025t}, \quad du = \cos t$

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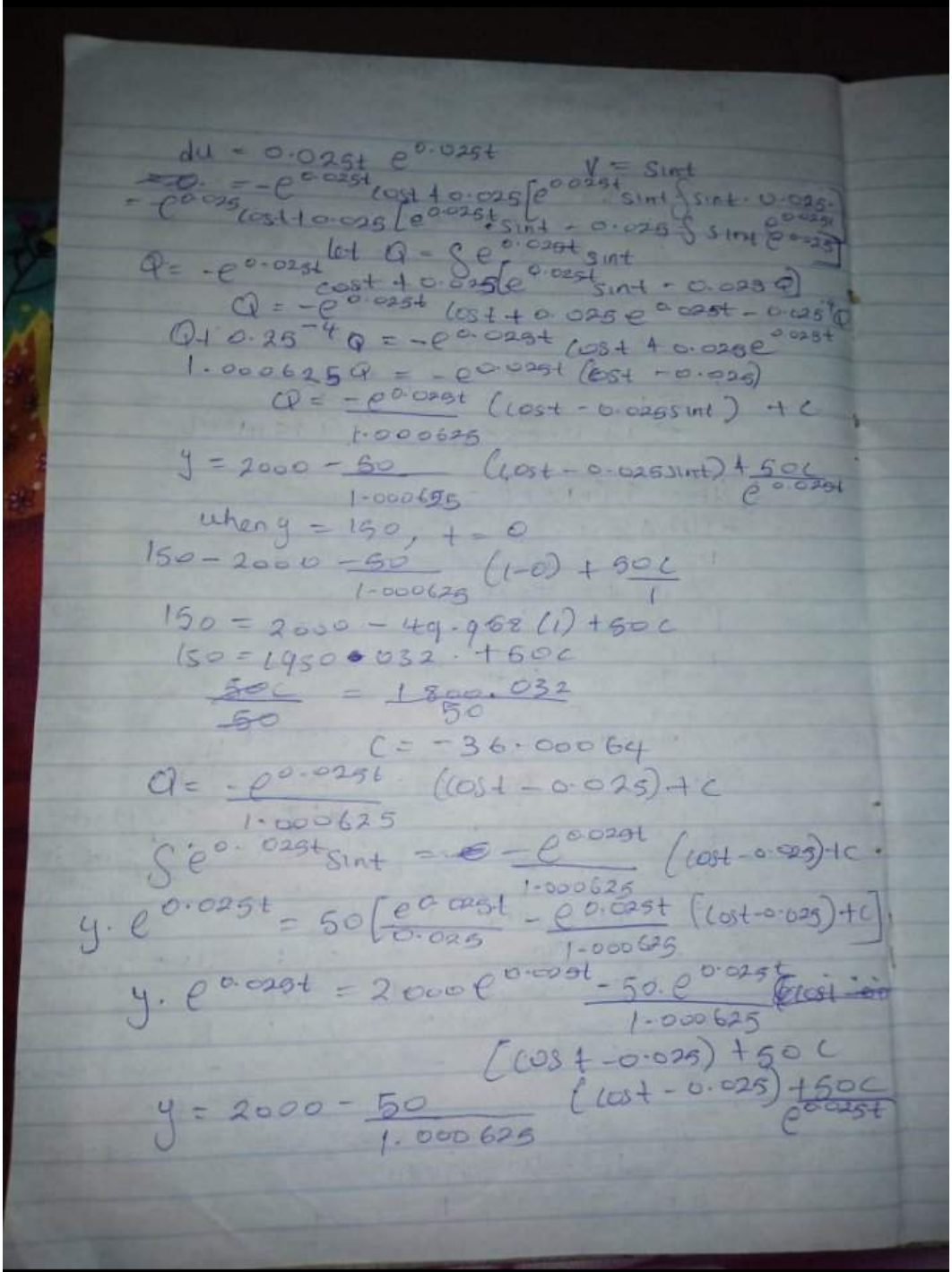

$du = 0.025t\, e^{0.025t}$

$v = \sin t$

$= -e^{0.025t}\cos t + 0.025\left[e^{0.025t}\sin t - 0.025\int \sin t\, e^{0.025t}\right]$

$= -e^{0.025t}\cos t + 0.025\left[e^{0.025t}\sin t - 0.025 Q\right]$

let $Q = \int e^{0.025t}\sin t$

$Q = -e^{0.025t}\cos t + 0.025 e^{0.025t}\sin t - 0.025^2 Q$

$Q + 0.25^{-4} Q = -e^{0.025t}\cos t + 0.025 e^{0.025t}$

$1.000625\, Q = -e^{0.025t}(\cos t - 0.025)$

$Q = \frac{-e^{0.025t}}{1.000625}(\cos t - 0.025\sin t) + c$

$y = 2000 - \frac{50}{1.000625}(\cos t - 0.025\sin t) + \frac{50c}{e^{0.025t}}$

when $y = 150$, $t = 0$

$150 = 2000 - \frac{50}{1.000625}(1-0) + \frac{50c}{1}$

$150 = 2000 - 49.968(1) + 50c$

$150 = 1950.032 + 50c$

$\frac{50c}{50} = \frac{-1800.032}{50}$

$c = -36.00064$

$Q = \frac{-e^{0.025t}}{1.000625}(\cos t - 0.025) + c$

$\int e^{0.025t}\sin t = \frac{-e^{0.025t}}{1.000625}(\cos t - 0.025) + c$

$y\cdot e^{0.025t} = 50\left[\frac{e^{0.025t}}{0.025} - \frac{e^{0.025t}}{1.000625}(\cos t - 0.025) + c\right]$

$y\cdot e^{0.025t} = 2000 e^{0.025t} - \frac{50 e^{0.025t}}{1.000625}(\cos t - 0.025) + 50c$

$y = 2000 - \frac{50}{1.000625}(\cos t - 0.025) + \frac{50c}{e^{0.025t}}$

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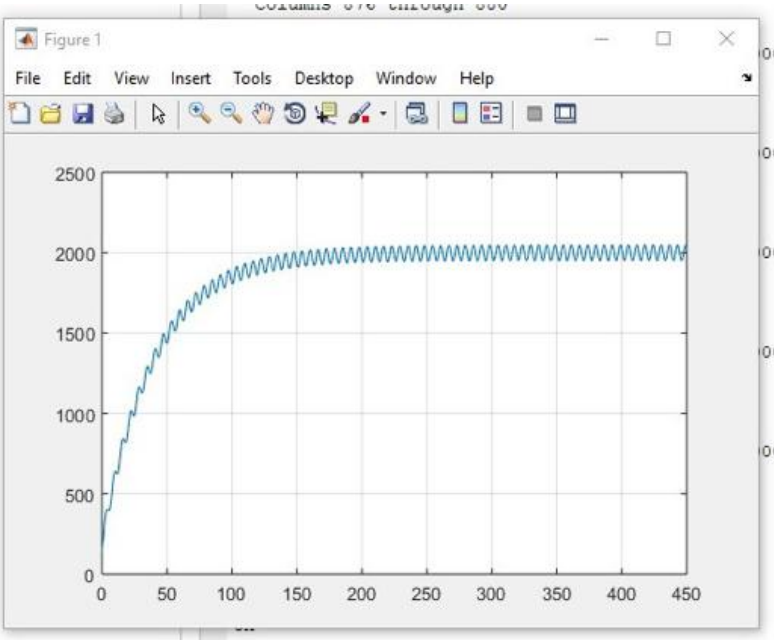
B2 279.963914100068

| t(min) | V(Litre) |
|---|---|
| 1 | 279.9639 |
| 2 | 318.1907 |
| 3 | 313.8601 |
| 4 | 303.601 |
| 5 | 327.9009 |
| 6 | 393.9593 |
| 7 | 469.1423 |
| 8 | 511.0566 |
| 9 | 506.5922 |
| 10 | 484.0395 |
| 11 | 487.1398 |
| 12 | 534.9268 |
| 13 | 604.2824 |
| 14 | 651.2431 |
| 15 | 651.4694 |
| 16 | 622.6706 |
| 17 | 608.3676 |
| 18 | 637.9229 |
| 19 | 699.585 |
| 20 | 751.3315 |
| 21 | 759.541 |
| 22 | 729.9392 |
| 23 | 702.3679 |
| 24 | 714.1865 |
| 25 | 765.9535 |
| 26 | 820.9421 |
| 27 | 838.9333 |
| 28 | 813.2194 |
| 29 | 776.7953 |

```
commandwindow
clear
clc
close all
syms m t
ans=dsolve('Dm+0.025*m=50+50*sin(t)','m(0)=150')
t=0:0.5:450
tn=subs(ans,t)
plot(t,tn)
grid on
```




```
[ 150, 2000 - (2000*1601^(1/2)*cos(atan(1/40) + 1/2))/1
>>
```