IBE AMARACHI SHEILA

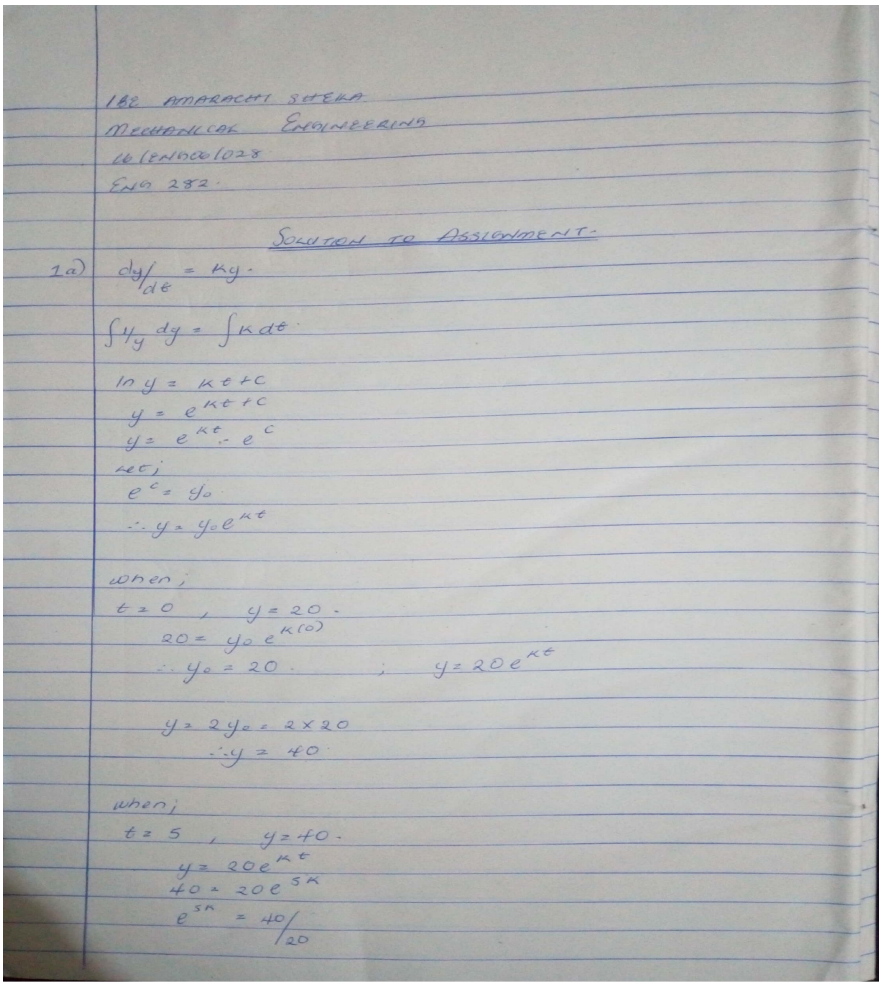
MECHANICAL ENGINEERING

16/ENG06/028

ENG 282

ANSWERS TO ASSIGNMENT

NO 1A and B



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MECHANICAL ENGINEERING
16/ENG06/028
ENG 282.

SOLUTION TO ASSIGNMENT.

1a) $\frac{dy}{dt} = ky.$

$\int \frac{1}{y}\, dy = \int k\, dt$

$\ln y = kt + c$

$y = e^{kt+c}$

$y = e^{kt} \cdot e^{c}$

Let;

$e^{c} = y_0$

$\therefore y = y_0 e^{kt}$

when;

$t = 0, \quad y = 20.$

$20 = y_0 e^{k(0)}$

$\therefore y_0 = 20. \quad ; \quad y = 20e^{kt}$

$y = 2y_0 = 2 \times 20$

$\therefore y = 40$

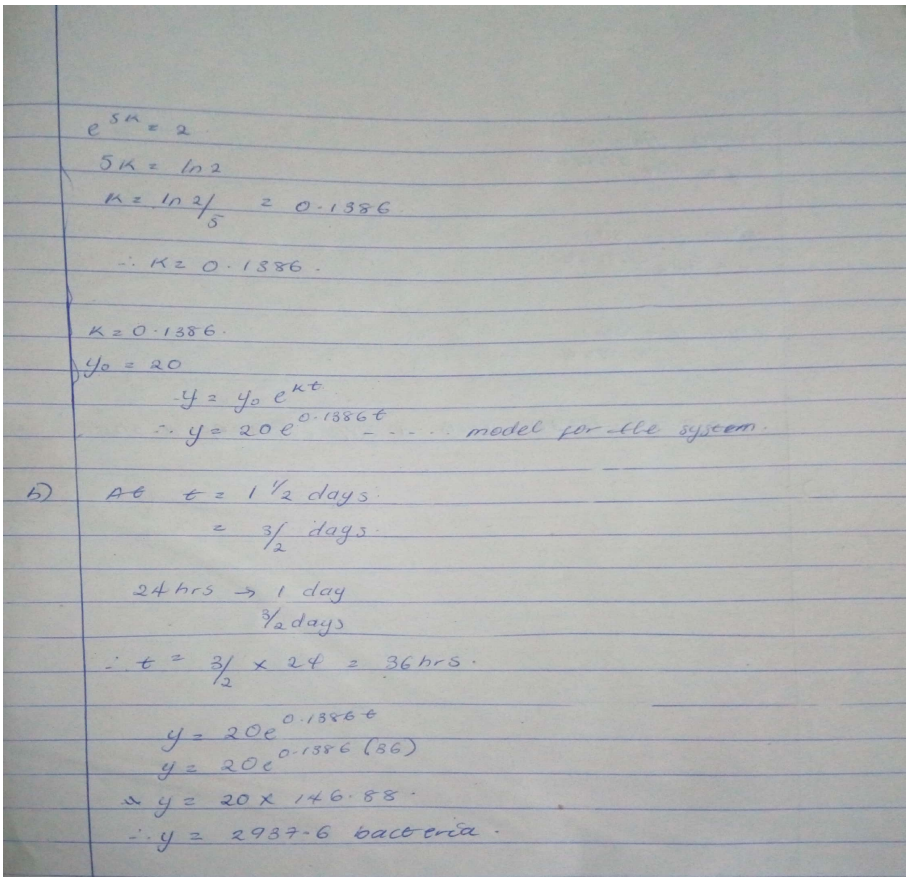
when;

$t = 5, \quad y = 40.$

$y = 20e^{kt}$

$40 = 20e^{5k}$

$e^{5k} = \frac{40}{20}$



$e^{5k} = 2$

$5k = \ln 2$

$k = \ln 2/5 = 0.1386$

$\therefore k = 0.1386$.

$k = 0.1386$.

$y_0 = 20$

$y = y_0 e^{kt}$

$\therefore y = 20e^{0.1386t}$ ..... model for the system.

b) At $t = 1\frac{1}{2}$ days.

$= \frac{3}{2}$ days.

24 hrs → 1 day

$\frac{3}{2}$ days

$\therefore t = \frac{3}{2} \times 24 = 36$ hrs.

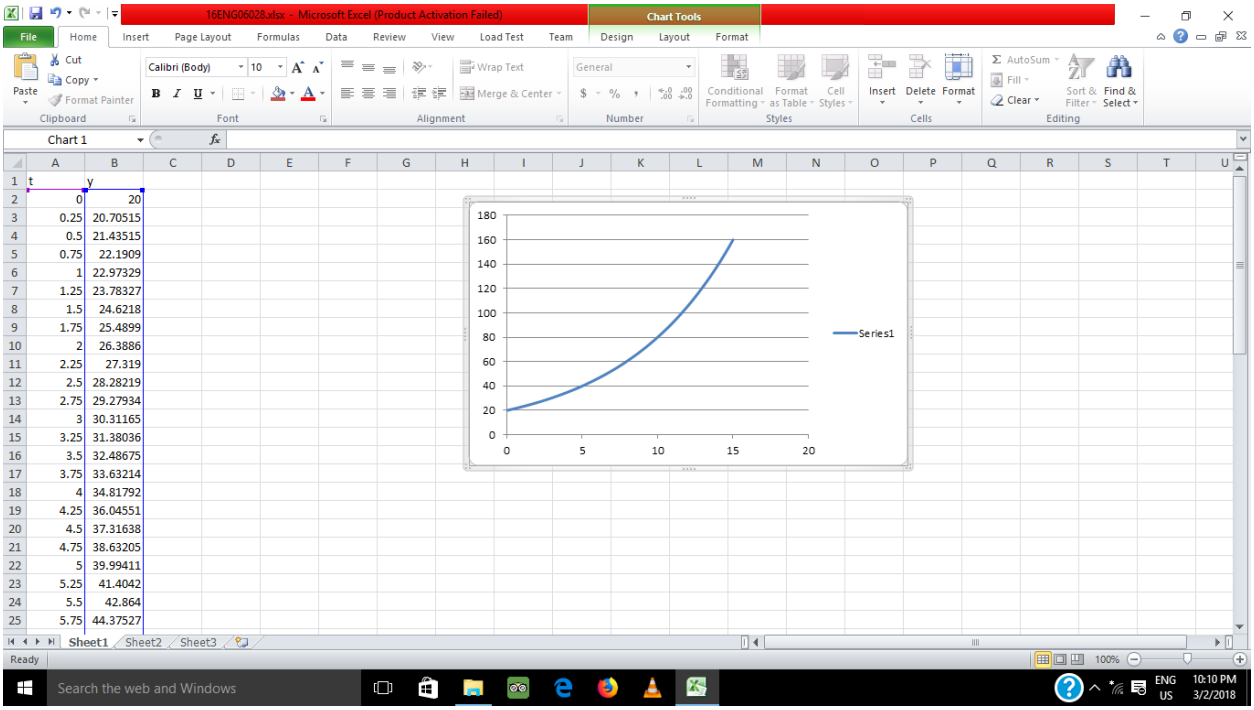
$y = 20e^{0.1386t}$

$y = 20e^{0.1386(36)}$

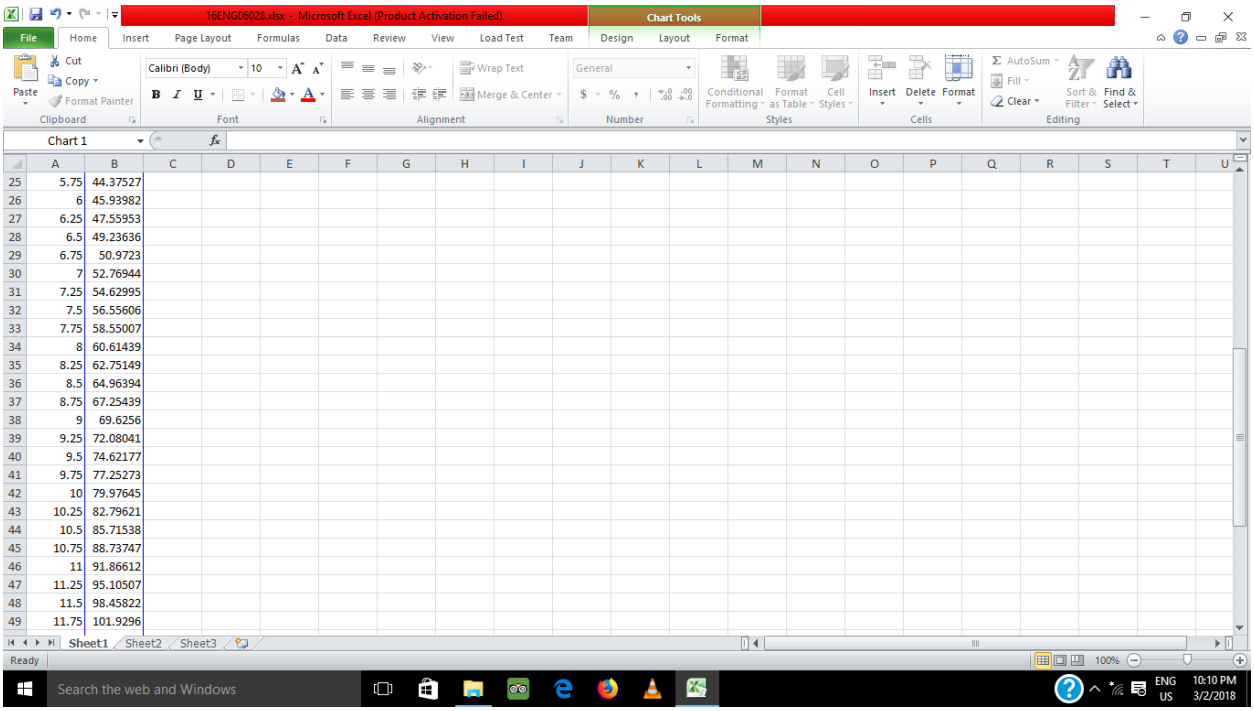
$\therefore y = 20 \times 146.88$.

$\therefore y = 2937.6$ bacteria.

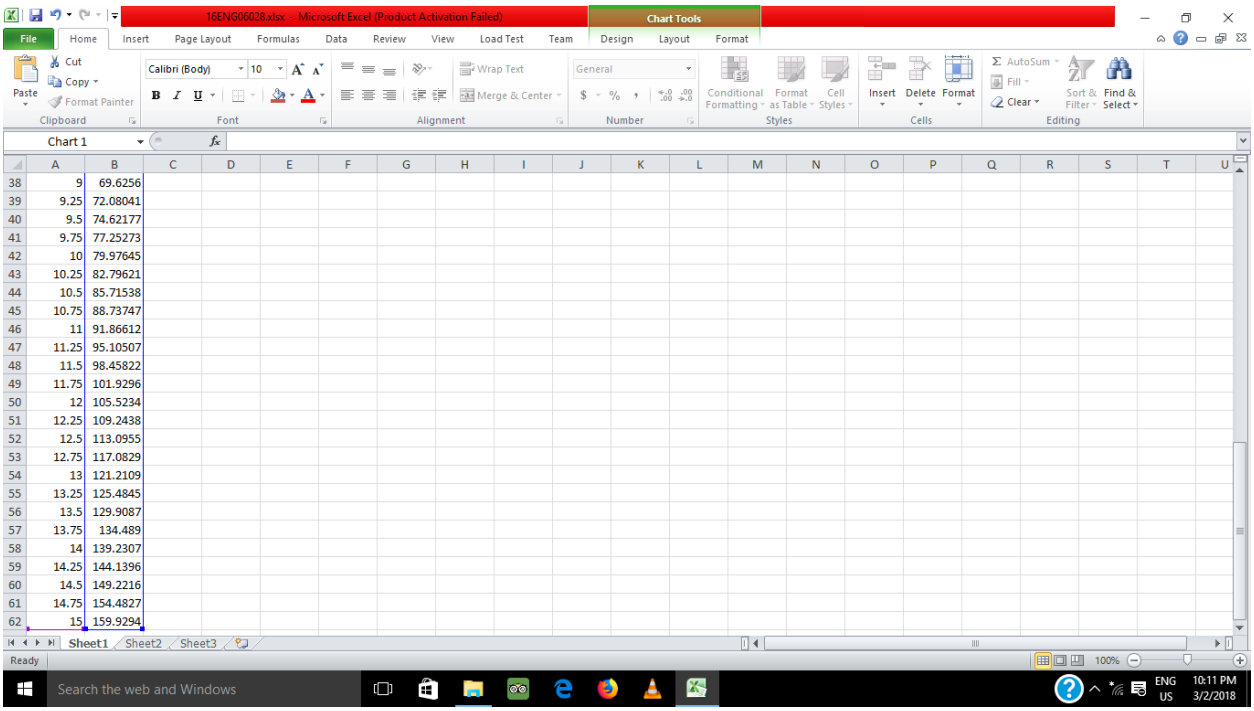
NO 1(C)



t	y
0	20
0.25	20.70515
0.5	21.43515
0.75	22.1909
1	22.97329
1.25	23.78327
1.5	24.6218
1.75	25.4899
2	26.3886
2.25	27.319
2.5	28.28219
2.75	29.27934
3	30.31165
3.25	31.38036
3.5	32.48675
3.75	33.63214
4	34.81792
4.25	36.04551
4.5	37.31638
4.75	38.63205
5	39.99411
5.25	41.4042
5.5	42.864
5.75	44.37527

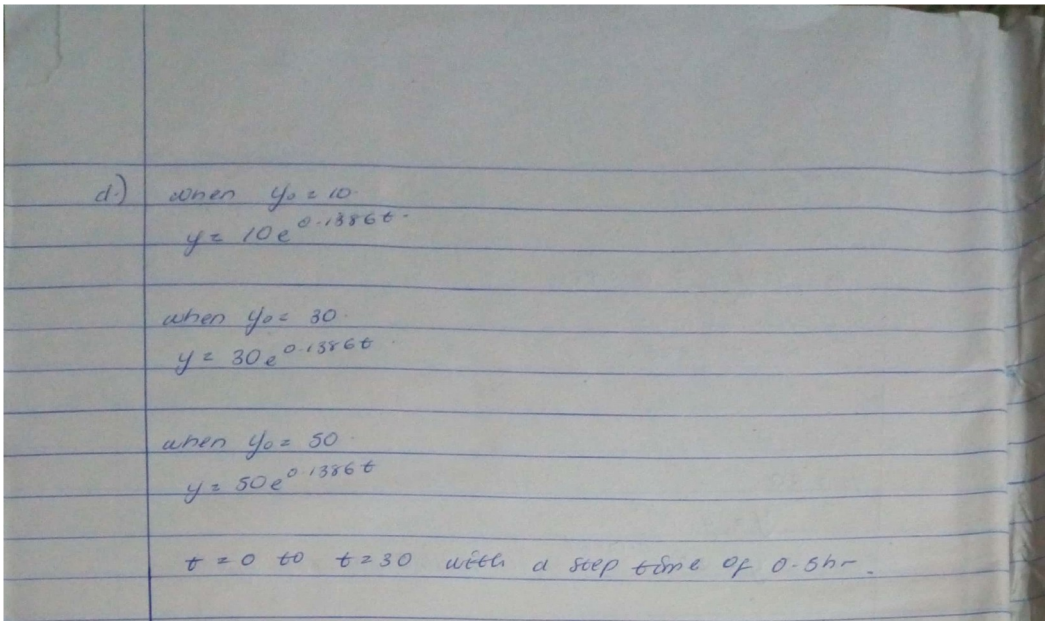


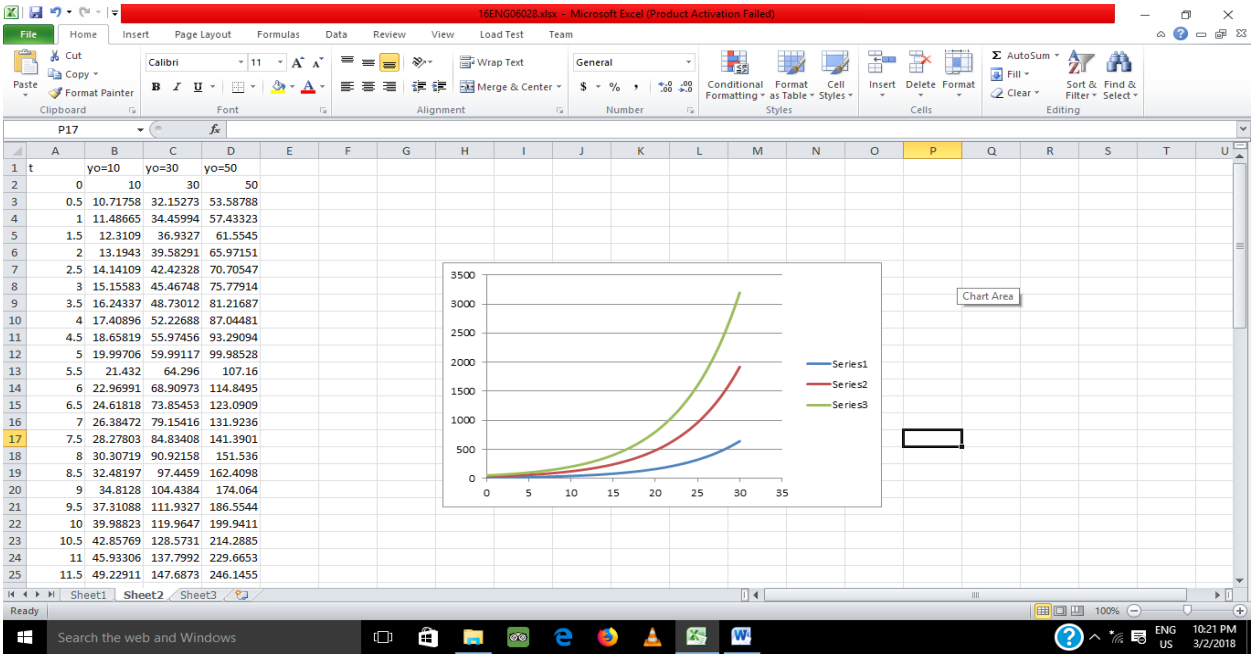
	A	B
25	5.75	44.37527
26	6	45.93982
27	6.25	47.55953
28	6.5	49.23636
29	6.75	50.9723
30	7	52.76944
31	7.25	54.62995
32	7.5	56.55606
33	7.75	58.55007
34	8	60.61439
35	8.25	62.75149
36	8.5	64.96394
37	8.75	67.25439
38	9	69.6256
39	9.25	72.08041
40	9.5	74.62177
41	9.75	77.25273
42	10	79.97645
43	10.25	82.79621
44	10.5	85.71538
45	10.75	88.73747
46	11	91.86612
47	11.25	95.10507
48	11.5	98.45822
49	11.75	101.9296



	A	B
38	9	69.6256
39	9.25	72.08041
40	9.5	74.62177
41	9.75	77.25273
42	10	79.97645
43	10.25	82.79621
44	10.5	85.71538
45	10.75	88.73747
46	11	91.86612
47	11.25	95.10507
48	11.5	98.45822
49	11.75	101.9296
50	12	105.5234
51	12.25	109.2438
52	12.5	113.0955
53	12.75	117.0829
54	13	121.2109
55	13.25	125.4845
56	13.5	129.9087
57	13.75	134.489
58	14	139.2307
59	14.25	144.1396
60	14.5	149.2216
61	14.75	154.4827
62	15	159.9294

NO1(D)


d.) when $y_0 = 10$
$y = 10e^{0.1386t}$
when $y_0 = 30$
$y = 30e^{0.1386t}$
when $y_0 = 50$
$y = 50e^{0.1386t}$
$t = 0$ to $t = 30$ with a step time of 0.5hr.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P17
t yo=10 yo=30 yo=50
0 10 30 50
0.5 10.71758 32.15273 53.58788
1 11.48665 34.45994 57.43323
1.5 12.3109 36.9327 61.5545
2 13.1943 39.58291 65.97151
2.5 14.14109 42.42328 70.70547
3 15.15583 45.46748 75.77914
3.5 16.24337 48.73012 81.21687
4 17.40896 52.22688 87.04481
4.5 18.65819 55.97456 93.29094
5 19.99706 59.99117 99.98528
5.5 21.432 64.296 107.16
6 22.96991 68.90973 114.8495
6.5 24.61818 73.85453 123.0909
7 26.38472 79.15416 131.9236
7.5 28.27803 84.83408 141.3901
8 30.30719 90.92158 151.536
8.5 32.48197 97.4459 162.4098
9 34.8128 104.4384 174.064
9.5 37.31088 111.9327 186.5544
10 39.98823 119.9647 199.9411
10.5 42.85769 128.5731 214.2885
11 45.93306 137.7992 229.6653
11.5 49.22911 147.6873 246.1455
Chart Area
Series1
Series2
Series3
Sheet1 Sheet2 Sheet3
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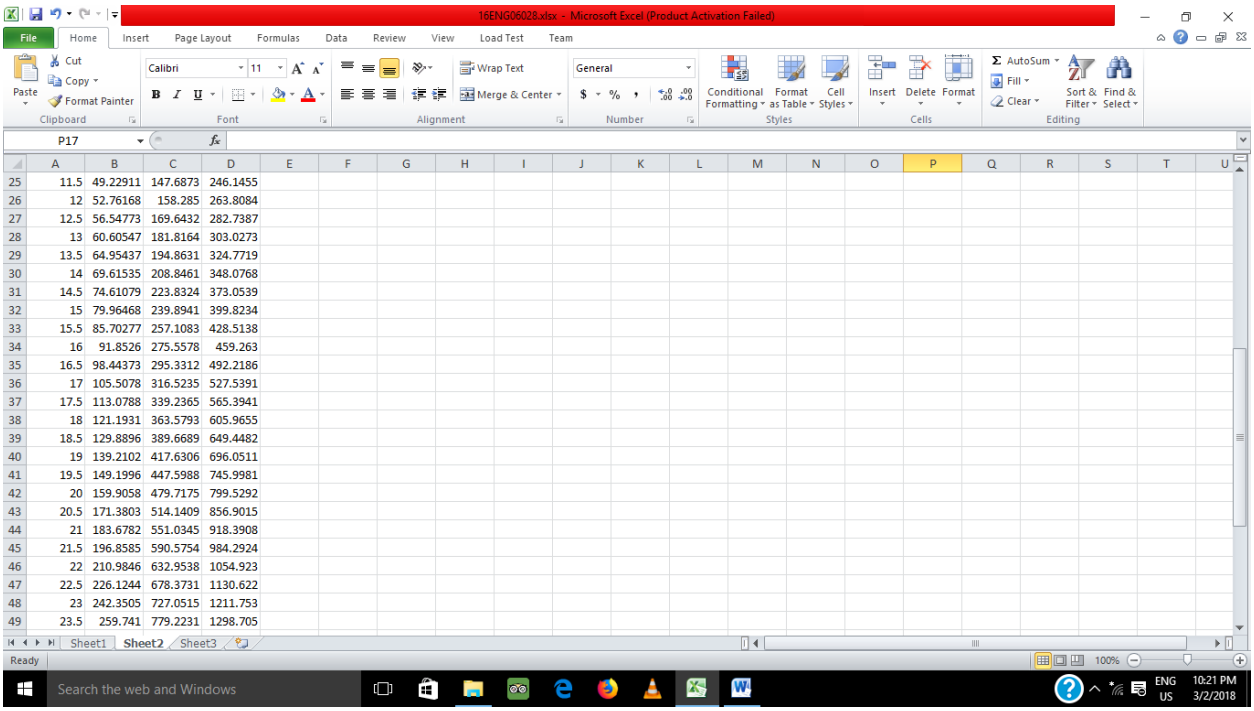
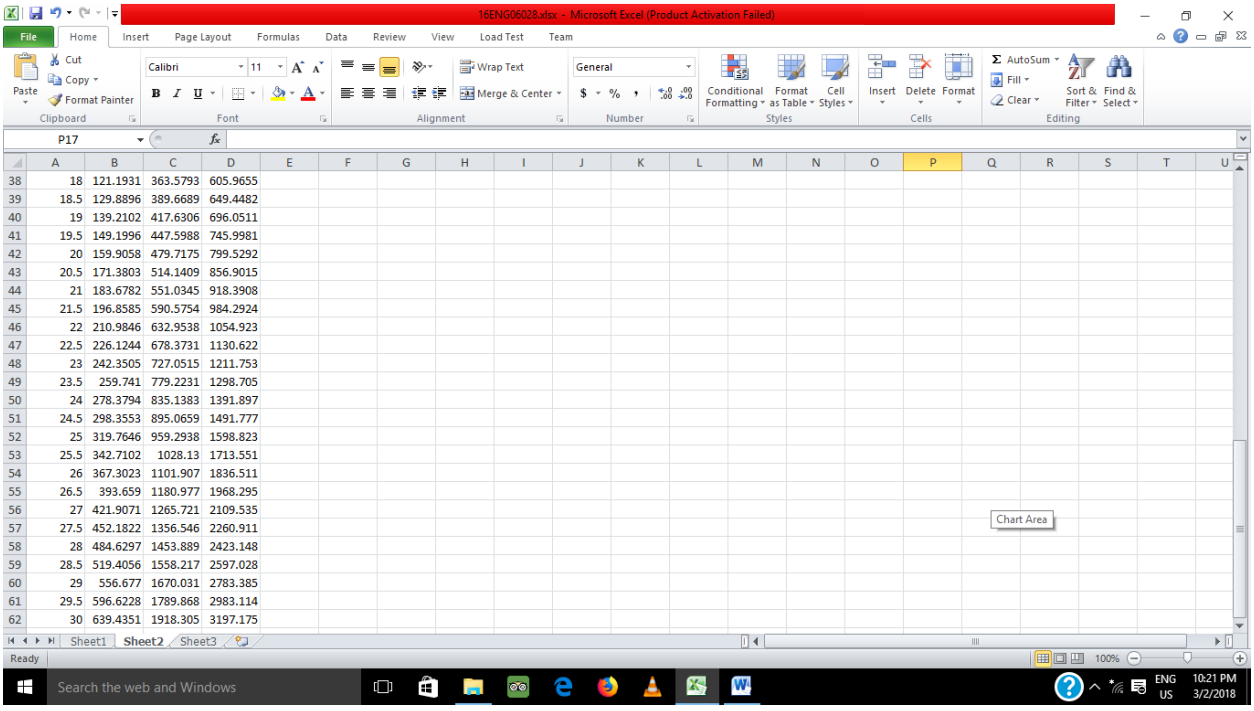


	A	B	C	D
25	11.5	49.22911	147.6873	246.1455
26	12	52.76168	158.285	263.8084
27	12.5	56.54773	169.6432	282.7387
28	13	60.60547	181.8164	303.0273
29	13.5	64.95437	194.8631	324.7719
30	14	69.61535	208.8461	348.0768
31	14.5	74.61079	223.8324	373.0539
32	15	79.96468	239.8941	399.8234
33	15.5	85.70277	257.1083	428.5138
34	16	91.8526	275.5578	459.263
35	16.5	98.44373	295.3312	492.2186
36	17	105.5078	316.5235	527.5391
37	17.5	113.0788	339.2365	565.3941
38	18	121.1931	363.5793	605.9655
39	18.5	129.8896	389.6689	649.4482
40	19	139.2102	417.6306	696.0511
41	19.5	149.1996	447.5988	745.9981
42	20	159.9058	479.7175	799.5292
43	20.5	171.3803	514.1409	856.9015
44	21	183.6782	551.0345	918.3908
45	21.5	196.8585	590.5754	984.2924
46	22	210.9846	632.9538	1054.923
47	22.5	226.1244	678.3731	1130.622
48	23	242.3505	727.0515	1211.753
49	23.5	259.741	779.2231	1298.705



	A	B	C	D
38	18	121.1931	363.5793	605.9655
39	18.5	129.8896	389.6689	649.4482
40	19	139.2102	417.6306	696.0511
41	19.5	149.1996	447.5988	745.9981
42	20	159.9058	479.7175	799.5292
43	20.5	171.3803	514.1409	856.9015
44	21	183.6782	551.0345	918.3908
45	21.5	196.8585	590.5754	984.2924
46	22	210.9846	632.9538	1054.923
47	22.5	226.1244	678.3731	1130.622
48	23	242.3505	727.0515	1211.753
49	23.5	259.741	779.2231	1298.705
50	24	278.3794	835.1383	1391.897
51	24.5	298.3553	895.0659	1491.777
52	25	319.7646	959.2938	1598.823
53	25.5	342.7102	1028.13	1713.551
54	26	367.3023	1101.907	1836.511
55	26.5	393.659	1180.977	1968.295
56	27	421.9071	1265.721	2109.535
57	27.5	452.1822	1356.546	2260.911
58	28	484.6297	1453.889	2423.148
59	28.5	519.4056	1558.217	2597.028
60	29	556.677	1670.031	2783.385
61	29.5	596.6228	1789.868	2983.114
62	30	639.4351	1918.305	3197.175

NO 1(E)

e) Increase in time led to an exponential growth (increase) in the population of the bacteria in the growth medium.