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DEPARTMENT : Mechatronics

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Solution

$$\frac{dy}{dt} = k \cdot y$$

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

$$\ln y = kt + c$$

$$y = e^{(kt + c)}$$

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

$$y = ce^{kt}$$

$$\text{@ } y(0) = 20$$

$$20 = ce^{k(0)}$$

$$20 = c$$

$$\text{Therefore } y = 20e^{kt}$$

* Given that bacteria doubles after 5 hrs

$$0 \text{ hrs} = 20$$

$$5 \text{ hrs} = 40$$

$$y(5) = 40$$

$$40 = 20e^{k(5)}$$

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

$$2 = e^{5k}$$

$$\ln 2 = 5k$$

$$k = 0.1386$$

$$y = 20e^{0.1386t}$$

1 1/2 days = 24 + 12 hours = 36 hours

$$Y = 20e^{0.1386 \times 36}$$

$$Y = 2936$$

on excel

$$20 * \exp(0.1386 \times A3)$$

$$\text{for } Y_{(10)} = 10e^{0.1386t}$$

$$Y_{(30)} = 30e^{0.1386t}$$

$$Y_{(50)} = 50e^{0.1386t}$$

$$y=c*\exp(0.1386*t)$$

| c | 10 | 30 | 50 |
|------|----------|----------|----------|
| t | y(10) | y(30) | y(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 |
| 12 | 52.76168 | 158.285 | 263.8084 |
| 12.5 | 56.54773 | 169.6432 | 282.7387 |
| 13 | 60.60547 | 181.8164 | 303.0273 |
| 13.5 | 64.95437 | 194.8631 | 324.7719 |
| 14 | 69.61535 | 208.8461 | 348.0768 |
| 14.5 | 74.61079 | 223.8324 | 373.0539 |
| 15 | 79.96468 | 239.8941 | 399.8234 |
| 15.5 | 85.70277 | 257.1083 | 428.5138 |
| 16 | 91.8526 | 275.5578 | 459.263 |
| 16.5 | 98.44373 | 295.3312 | 492.2186 |
| 17 | 105.5078 | 316.5235 | 527.5391 |
| 17.5 | 113.0788 | 339.2365 | 565.3941 |
| 18 | 121.1931 | 363.5793 | 605.9655 |
| 18.5 | 129.8896 | 389.6689 | 649.4482 |
| 19 | 139.2102 | 417.6306 | 696.0511 |
| 19.5 | 149.1996 | 447.5988 | 745.9981 |
| 20 | 159.9058 | 479.7175 | 799.5292 |
| 20.5 | 171.3803 | 514.1409 | 856.9015 |

| | | | |
|------|----------|----------|----------|
| 21 | 183.6782 | 551.0345 | 918.3908 |
| 21.5 | 196.8585 | 590.5754 | 984.2924 |
| 22 | 210.9846 | 632.9538 | 1054.923 |
| 22.5 | 226.1244 | 678.3731 | 1130.622 |
| 23 | 242.3505 | 727.0515 | 1211.753 |
| 23.5 | 259.741 | 779.2231 | 1298.705 |
| 24 | 278.3794 | 835.1383 | 1391.897 |
| 24.5 | 298.3553 | 895.0659 | 1491.777 |
| 25 | 319.7646 | 959.2938 | 1598.823 |
| 25.5 | 342.7102 | 1028.13 | 1713.551 |
| 26 | 367.3023 | 1101.907 | 1836.511 |
| 26.5 | 393.659 | 1180.977 | 1968.295 |
| 27 | 421.9071 | 1265.721 | 2109.535 |
| 27.5 | 452.1822 | 1356.546 | 2260.911 |
| 28 | 484.6297 | 1453.889 | 2423.148 |
| 28.5 | 519.4056 | 1558.217 | 2597.028 |
| 29 | 556.677 | 1670.031 | 2783.385 |
| 29.5 | 596.6228 | 1789.868 | 2983.114 |
| 30 | 639.4351 | 1918.305 | 3197.175 |

BACTERIA GROWTH

3500

$$y=20 \cdot \exp(0.1386 \cdot t)$$

| 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 |
| 6 | 45.93982 |
| 6.25 | 47.55953 |
| 6.5 | 49.23636 |
| 6.75 | 50.9723 |
| 7 | 52.76944 |
| 7.25 | 54.62995 |
| 7.5 | 56.55606 |
| 7.75 | 58.55007 |
| 8 | 60.61439 |
| 8.25 | 62.75149 |
| 8.5 | 64.96394 |
| 8.75 | 67.25439 |
| 9 | 69.6256 |
| 9.25 | 72.08041 |
| 9.5 | 74.62177 |
| 9.75 | 77.25273 |
| 10 | 79.97645 |
| 10.25 | 82.79621 |
| 10.5 | 85.71538 |
| 10.75 | 88.73747 |
| 11 | 91.86612 |

| | |
|-------|----------|
| 11.25 | 95.10507 |
| 11.5 | 98.45822 |
| 11.75 | 101.9296 |
| 12 | 105.5234 |
| 12.25 | 109.2438 |
| 12.5 | 113.0955 |
| 12.75 | 117.0829 |
| 13 | 121.2109 |
| 13.25 | 125.4845 |
| 13.5 | 129.9087 |
| 13.75 | 134.489 |
| 14 | 139.2307 |
| 14.25 | 144.1396 |
| 14.5 | 149.2216 |
| 14.75 | 154.4827 |
| 15 | 159.9294 |

VARIATION OF THE NUMBER OF BACTERIA

