Matt Wardynski
ENGR 115
2:00-5:00pm
10/20/2016

| Input Parameters | |
|---|---|
| Outdoor $CO_2$, ppm | 388 |
| Assumed $CO_2$, ppm | 400 |
| Correction Factor, ppm | 12 |
| Volume of Room, $ft^3$ | 1287 |
| Room Capacity, ppl | 2 |

## Mason and Pedro's Dorm Room Analysis

| Minutes | Date Time, GMT-07:00 | Hobo $CO_2$, ppm | Actual $CO_2$, ppm |
|---|---|---|---|
| 1 | 10/20/2016 14:46 | 799.8 | 811.8 |
| 2 | 10/20/2016 14:47 | 634.9 | 646.9 |
| 3 | 10/20/2016 14:48 | 459.1 | 471.1 |
| 4 | 10/20/2016 14:49 | 398.7 | 410.7 |
| 5 | 10/20/2016 14:50 | 406.6 | 418.6 |
| 6 | 10/20/2016 14:51 | 398.7 | 410.7 |
| 7 | 10/20/2016 14:52 | 393.8 | 405.8 |
| 8 | 10/20/2016 14:53 | 386.4 | 398.4 |
| 9 | 10/20/2016 14:54 | 818.1 | 830.1 |
| 10 | 10/20/2016 14:55 | 710 | 722 |
| 11 | 10/20/2016 14:56 | 740.5 | 752.5 |
| 12 | 10/20/2016 14:57 | 734.4 | 746.4 |
| 13 | 10/20/2016 14:58 | 771.7 | 783.7 |
| 14 | 10/20/2016 14:59 | 812.6 | 824.6 |
| 15 | 10/20/2016 15:00 | 884 | 896 |
| 16 | 10/20/2016 15:01 | 950.5 | 962.5 |
| 17 | 10/20/2016 15:02 | 1102.6 | 1114.6 |
| 18 | 10/20/2016 15:03 | 1105.6 | 1117.6 |
| 19 | 10/20/2016 15:04 | 1129.4 | 1141.4 |
| 20 | 10/20/2016 15:05 | 1179.5 | 1191.5 |
| 21 | 10/20/2016 15:06 | 1219.8 | 1231.8 |
| 22 | 10/20/2016 15:07 | 1239.9 | 1251.9 |
| 23 | 10/20/2016 15:08 | 1278.4 | 1290.4 |
| 24 | 10/20/2016 15:09 | 1299.8 | 1311.8 |
| 25 | 10/20/2016 15:10 | 1366.3 | 1378.3 |
| 26 | 10/20/2016 15:11 | 1462.8 | 1474.8 |
| 27 | 10/20/2016 15:12 | 1504.3 | 1516.3 |
| 28 | 10/20/2016 15:13 | 1570.8 | 1582.8 |
| 29 | 10/20/2016 15:14 | 1611.1 | 1623.1 |
| 30 | 10/20/2016 15:15 | 1631.9 | 1643.9 |
| 31 | 10/20/2016 15:16 | 1656.9 | 1668.9 |
| 32 | 10/20/2016 15:17 | 1655.7 | 1667.7 |
| 33 | 10/20/2016 15:18 | 1653.8 | 1665.8 |
| 34 | 10/20/2016 15:19 | 1647.7 | 1659.7 |
| 35 | 10/20/2016 15:20 | 1622.7 | 1634.7 |
| 36 | 10/20/2016 15:21 | 1616 | 1628 |

| 37 | 10/20/2016 15:22 | 1611.7 | 1623.7 |
| 38 | 10/20/2016 15:23 | 1613.6 | 1625.6 |
| 39 | 10/20/2016 15:24 | 1602 | 1614 |
| 40 | 10/20/2016 15:25 | 1578.1 | 1590.1 |
| 41 | 10/20/2016 15:26 | 1565.9 | 1577.9 |
| 42 | 10/20/2016 15:27 | 1586.1 | 1598.1 |
| 43 | 10/20/2016 15:28 | 1582.4 | 1594.4 |
| 44 | 10/20/2016 15:29 | 1579.4 | 1591.4 |
| 45 | 10/20/2016 15:30 | 1591 | 1603 |
| 46 | 10/20/2016 15:31 | 1594.6 | 1606.6 |
| 47 | 10/20/2016 15:32 | 1581.2 | 1593.2 |
| 48 | 10/20/2016 15:33 | 1586.7 | 1598.7 |
| 49 | 10/20/2016 15:34 | 1590.4 | 1602.4 |
| 50 | 10/20/2016 15:35 | 1592.2 | 1604.2 |
| 51 | 10/20/2016 15:36 | 1594.6 | 1606.6 |
| 52 | 10/20/2016 15:37 | 1603.2 | 1615.2 |
| 53 | 10/20/2016 15:38 | 1599.5 | 1611.5 |
| 54 | 10/20/2016 15:39 | 1591.6 | 1603.6 |
| 55 | 10/20/2016 15:40 | 1553.1 | 1565.1 |
| 56 | 10/20/2016 15:41 | 1565.9 | 1577.9 |
| 57 | 10/20/2016 15:42 | 1565.9 | 1577.9 |
| 58 | 10/20/2016 15:43 | 1561.7 | 1573.7 |
| 59 | 10/20/2016 15:44 | 1562.9 | 1574.9 |
| 60 | 10/20/2016 15:45 | 1551.3 | 1563.3 |
| 61 | 10/20/2016 15:46 | 1500 | 1512 |
| 62 | 10/20/2016 15:47 | 1500.6 | 1512.6 |
| 63 | 10/20/2016 15:48 | 1503.1 | 1515.1 |
| 64 | 10/20/2016 15:49 | 1496.9 | 1508.9 |
| 65 | 10/20/2016 15:50 | 1106.2 | 1118.2 |
| 66 | 10/20/2016 15:51 | 494.5 | 506.5 |
| 67 | 10/20/2016 15:52 | 420 | 432 |
| 68 | 10/20/2016 15:53 | 441.4 | 453.4 |
| 69 | 10/20/2016 15:54 | 437.1 | 449.1 |
| 70 | 10/20/2016 15:55 | 426.7 | 438.7 |
| 71 | 10/20/2016 15:56 | 401.7 | 413.7 |
| 72 | 10/20/2016 15:57 | 418.2 | 430.2 |
| 73 | 10/20/2016 15:58 | 556.2 | 568.2 |
| 74 | 10/20/2016 15:59 | 523.2 | 535.2 |
| 75 | 10/20/2016 15:59 | | |
| 76 | 10/20/2016 15:59 | | |

Actual Concentration Plot
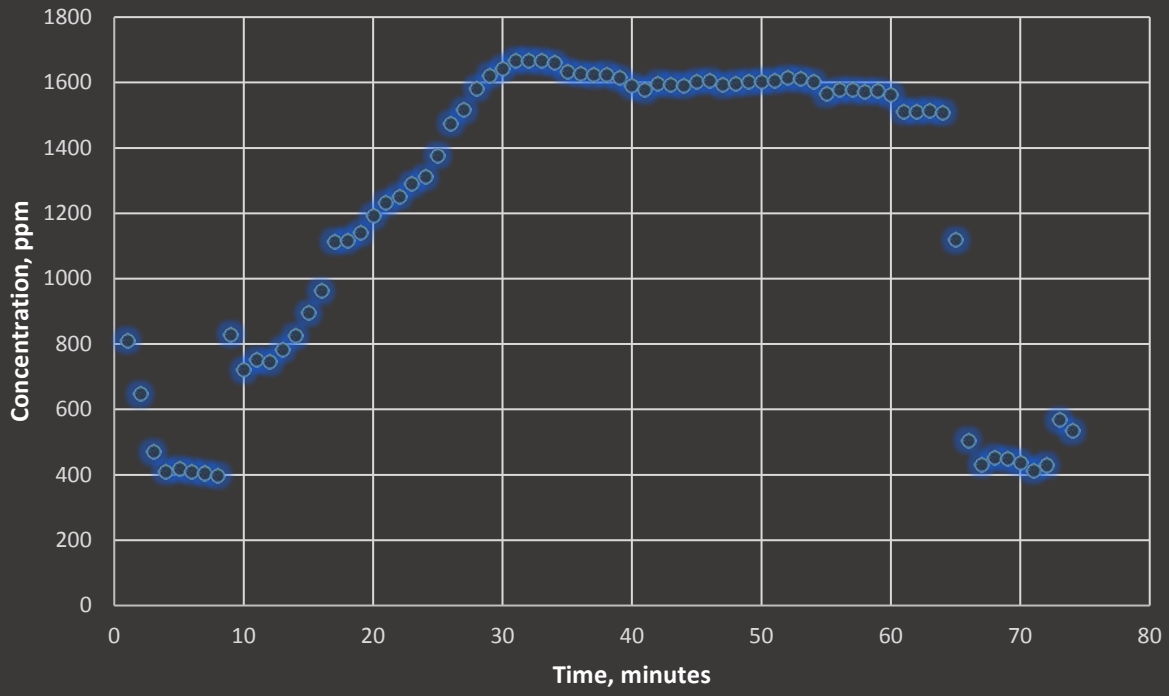
# Ventilation Rate Analysis

| Date and Time | Minutes | Hours | $CO_2$, ppm | Y-axis |
|---|---|---|---|---|
| 10/20/2016 15:16 | 0 | 0.000 | 1669 | 0 |
| 10/20/2016 15:17 | 1 | 0.017 | 1668 | 0.0009461 |
| 10/20/2016 15:18 | 2 | 0.033 | 1666 | 0.0024461 |
| 10/20/2016 15:19 | 3 | 0.050 | 1660 | 0.0072768 |
| 10/20/2016 15:20 | 4 | 0.067 | 1635 | 0.0273224 |
| 10/20/2016 15:21 | 5 | 0.083 | 1628 | 0.0327636 |
| 10/20/2016 15:22 | 6 | 0.100 | 1624 | 0.0362713 |
| 10/20/2016 15:23 | 7 | 0.117 | 1626 | 0.0347199 |
| 10/20/2016 15:24 | 8 | 0.133 | 1614 | 0.0442297 |
| 10/20/2016 15:25 | 9 | 0.150 | 1590 | 0.0641130 |
| 10/20/2016 15:26 | 10 | 0.167 | 1578 | 0.0744172 |
| 10/20/2016 15:27 | 11 | 0.183 | 1598 | 0.0574134 |
| 10/20/2016 15:28 | 12 | 0.200 | 1594 | 0.0605064 |
| 10/20/2016 15:29 | 13 | 0.217 | 1591 | 0.0630213 |
| 10/20/2016 15:30 | 14 | 0.233 | 1603 | 0.0533319 |
| 10/20/2016 15:31 | 15 | 0.250 | 1607 | 0.0503439 |
| 10/20/2016 15:32 | 16 | 0.267 | 1593 | 0.0615116 |
| 10/20/2016 15:33 | 17 | 0.283 | 1599 | 0.0569127 |
| 10/20/2016 15:34 | 18 | 0.300 | 1602 | 0.0538308 |
| 10/20/2016 15:35 | 19 | 0.317 | 1604 | 0.0523349 |
| 10/20/2016 15:36 | 20 | 0.333 | 1607 | 0.0503439 |
| 10/20/2016 15:37 | 21 | 0.350 | 1615 | 0.0432417 |
| 10/20/2016 15:38 | 22 | 0.367 | 1612 | 0.0462911 |
| 10/20/2016 15:39 | 23 | 0.383 | 1604 | 0.0528333 |
| 10/20/2016 15:40 | 24 | 0.400 | 1565 | 0.0853435 |
| 10/20/2016 15:41 | 25 | 0.417 | 1578 | 0.0744172 |
| 10/20/2016 15:42 | 26 | 0.433 | 1578 | 0.0744172 |
| 10/20/2016 15:43 | 27 | 0.450 | 1574 | 0.0779892 |
| 10/20/2016 15:44 | 28 | 0.467 | 1575 | 0.0769673 |
| 10/20/2016 15:45 | 29 | 0.483 | 1563 | 0.0868896 |
| 10/20/2016 15:46 | 30 | 0.500 | 1512 | 0.1319902 |
| 10/20/2016 15:47 | 31 | 0.517 | 1513 | 0.1314508 |
| 10/20/2016 15:48 | 32 | 0.533 | 1515 | 0.1292063 |
| 10/20/2016 15:49 | 33 | 0.550 | 1509 | 0.1347819 |

| Input Parameters | |
|---|---|
| Outdoor $CO_2$, ppm | 388 |
| Assumed $CO_2$, ppm | 400 |
| Correction Factor, ppm | 12 |
| Volume of Room, $ft^3$ | 1287 |
| Room Capacity, ppl | 2 |

Ventilation Rate Analysis for Mason and Pedro's Dorm Room

$y = 0.2079x$
$R^2 = 0.7213$

Concentration Log Function

Time, hr
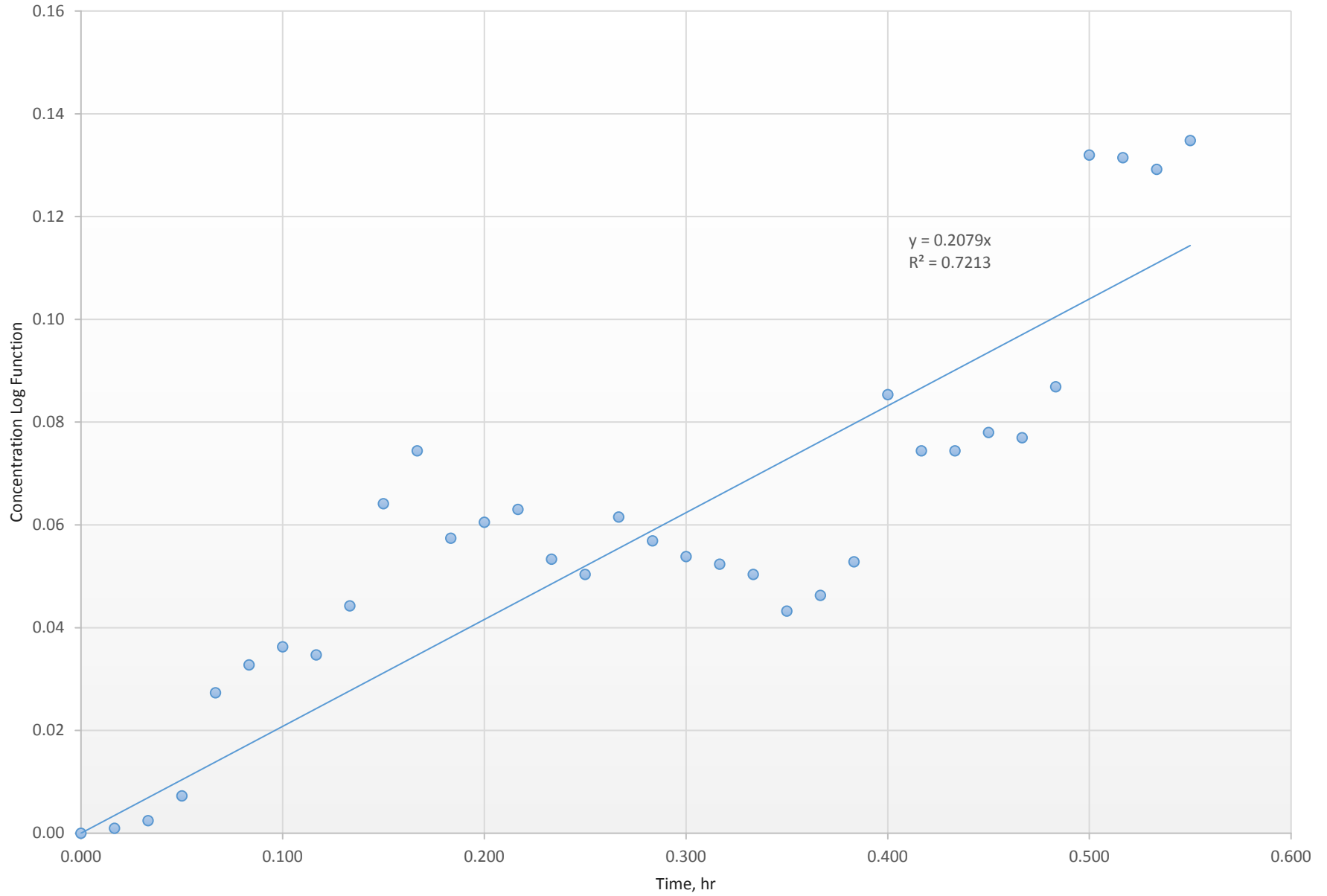
1. What is the air exchange rate ($\lambda$) of the room you tested?  Be sure to include the units for the air exchange rate in your answer.

The exchange rate was 0.2079 hr$^{-1}$

2. In general it takes 3/$\lambda$ hours to remove a non-reactive chemical from indoor air. Based on this time, what recommendations would you make to the occupants of the room?

My value for 3/$\lambda$ is about 14 hours. Because of the poor ventilation, it will take a long time for the non-reactive chemical to be removed, so I would recomend that the occupants of the room should either open as many windows as possible, or just get out of the room.

3. Compare your ventilation rate for a typical number of occupants to the ASHRAE recommended ventilation rate. Based on this comparison, are the occupants wasting energy heating and cooling the air or are the occupants being too cheap and not supplying enough air? Justify your answer.

My ventilation rate is 2.2 scfm/person while the ASHRAE recommended ventilation rate is about 15 scfm/person. That is a problem. The room occupants are being too cheap by not supplying enough air because the ventilation rate is much lower than the ASHRAE recommended ventilation rate. If they were trying to heat the room, they would have no trouble getting it warm because of the poor ventilation. Therefore, they are saving money on heating, but at the cost of poor indoor air quality.

4. Given the ASHRAE standard ventilation standard, what is the maximum number of people you would recommend having in this room at one time?  Use your model to determine this number.

If there was 0.3 people in the room, then there would be a ventilation rate of 14.9 scfm/person. However, it isn't really possible to have a third of a person living in a dorm room, so that's not good.

**Input Parameters**

| | |
|---|---|
| Outdoor $CO_2$, ppm | 388 |
| Assumed $CO_2$, ppm | 400 |
| Correction Factor, ppm | 12 |
| Volume of Room, ft$^3$ | 1287 |
| Room Capacity, ppl | 0.3 |

**Calculations**

| | |
|---|---|
| Air Exchange Rate, 1/hr | 0.2079 |
| Time to remove non-reactive chemical, hr | 14 |
| Ventilation Rate, ft$^3$/min/person | 15 |