MATH 221A   Multivariate Calculus   Spring 2003

The surface temperature is measured (in °C) at the grid points of a 10 m by 10 m region of a plane. The following table gives the measured data. Values in the gray region are the x and y coordinates and values in the white region are temperatures.

10.0	100.0	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	0.0
9.5	95.0	91.5	88.0	84.3	80.6	76.6	72.5	68.2	63.9	59.4	55.0	50.6	46.4	42.3	38.4	34.7	31.3	28.4	25.9	24.2	23.8
9.0	90.0	88.1	86.1	83.8	81.3	78.4	75.2	71.6	67.8	63.9	59.9	56.2	52.6	49.3	46.5	44.1	42.3	41.2	41.1	42.2	45.0
8.5	85.0	84.8	84.4	83.6	82.4	80.6	78.1	75.1	71.8	68.3	64.8	61.5	58.5	56.0	54.1	52.9	52.5	53.1	55.0	58.4	63.8
8.0	80.0	81.6	83.0	83.9	84.1	83.4	81.7	79.1	76.0	72.6	69.4	66.4	64.0	62.1	61.1	60.9	61.7	63.8	67.3	72.6	80.0
7.5	75.0	78.7	82.1	84.9	86.8	87.2	86.0	83.6	80.4	77.0	73.7	70.9	68.8	67.5	67.1	67.8	69.7	73.0	78.0	84.8	93.8
7.0	70.0	76.0	81.7	86.9	90.8	92.6	91.7	88.8	85.0	81.1	77.6	74.8	72.8	71.9	72.1	73.5	76.3	80.6	86.7	94.7	105.0
6.5	65.0	73.5	82.0	90.1	97.0	100.7	99.3	94.9	89.7	84.8	80.8	77.7	75.9	75.2	75.8	77.8	81.3	86.5	93.5	102.5	113.8
6.0	60.0	71.1	82.6	94.6	106.3	114.1	109.8	101.9	94.1	87.7	82.9	79.6	77.7	77.2	78.2	80.7	84.7	90.5	98.2	108.0	120.0
5.5	55.0	68.3	82.7	99.5	119.5	139.4	124.0	108.6	97.2	89.1	83.5	80.0	78.1	77.8	79.1	81.9	86.4	92.7	100.9	111.2	123.8
5.0	50.0	64.4	80.4	101.0	133.0	150.0	138.1	111.4	97.0	88.0	82.2	78.6	76.9	76.8	78.4	81.5	86.3	92.9	101.4	112.1	125.0
4.5	45.0	58.8	73.7	91.0	111.5	131.9	117.0	102.1	91.2	83.6	78.5	75.5	74.1	74.3	76.1	79.4	84.4	91.2	99.9	110.7	123.8
4.0	40.0	52.1	64.6	77.6	90.3	99.1	95.8	88.9	82.1	76.7	72.9	70.6	69.7	70.2	72.2	75.7	80.7	87.5	96.2	107.0	120.0
3.5	35.0	45.0	55.0	64.6	73.0	78.2	78.3	75.4	71.7	68.3	65.8	64.2	63.9	64.7	66.8	70.3	75.3	82.0	90.5	101.0	113.8
3.0	30.0	38.0	45.7	52.9	58.8	62.6	63.7	62.8	61.0	59.1	57.6	56.8	56.8	57.9	60.1	63.5	68.3	74.6	82.7	92.7	105.0
2.5	25.0	31.2	37.1	42.4	46.8	49.7	51.0	51.1	50.4	49.5	48.7	48.4	48.8	50.0	52.1	55.3	59.7	65.5	73.0	82.3	93.8
2.0	20.0	24.6	29.0	32.9	36.1	38.4	39.7	40.1	40.0	39.6	39.4	39.4	40.0	41.1	43.1	45.9	49.7	54.8	61.3	69.6	80.0
1.5	15.0	18.3	21.4	24.1	26.4	28.1	29.1	29.6	29.8	29.8	29.8	30.0	30.5	31.5	33.1	35.4	38.5	42.6	48.0	54.9	63.8
1.0	10.0	12.1	14.1	15.8	17.3	18.4	19.2	19.6	19.8	19.9	19.9	20.2	20.6	21.3	22.5	24.1	26.3	29.2	33.1	38.2	45.0
0.5	5.0	6.0	7.0	7.8	8.6	9.1	9.5	9.7	9.9	9.9	10.0	10.1	10.4	10.8	11.4	12.2	13.3	14.9	16.9	19.7	23.8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0

1. On graph paper, set up a coordinate axes for the region $[0, 10] \times [0, 10]$ using a scale so that the distance between grid lines represents 0.5 m.

2. Determine the lowest temperature and the highest temperature in the data.

3. Locate the points at which the temperature is 0 °C. On your plot, sketch the curve or curves along which the temperature is 0 °C.

4. Locate the points at which the temperature is 15 °C. This will require you to interpolate the measured data. You can do this informally. On your plot, sketch the curve or curves along which the temperature is 15 °C.

5. Repeat the process of sketching "curves of constant temperature" for temperatures from 30 °C to 150 °C every 15 °C.