# Homework 3

# Problem 1

- For the hot water data on the right, what would the temperature be at 1.7 seconds using linear interpolation?
- How would this change using splines?

| Time (s) | Temp (F) |
|---|---|
| 0 | 72.5 |
| 1 | 78.1 |
| 2 | 86.4 |
| 3 | 92.3 |
| 4 | 110.6 |
| 5 | 111.5 |
| 6 | 109.3 |
| 7 | 110.2 |
| 8 | 110.5 |
| 9 | 109.9 |
| 10 | 110.2 |

# Problem 2

- For the hot water data on the right, at what time would we expect the temperature to reach 100 F (use splines)

| Time (s) | Temp (F) |
|---|---|
| 0 | 72.5 |
| 1 | 78.1 |
| 2 | 86.4 |
| 3 | 92.3 |
| 4 | 110.6 |
| 5 | 111.5 |
| 6 | 109.3 |
| 7 | 110.2 |
| 8 | 110.5 |
| 9 | 109.9 |
| 10 | 110.2 |

# Problem 3

- The electric field due to a charged circular disk at a distance z along the disk axis is given below.
- Find E at z=5 cm for R=6 cm, $\sigma$=300 $\mu C/m^2$

$$E = \frac{\sigma z}{4\varepsilon_0}\int_0^R \frac{2rdr}{\left(z^2 + r^2\right)^{1.5}}$$

$$\varepsilon_0 = 8.85\times10^{-12} \quad C^2 / N - m^2$$

# Problem 4

- The temperature of the ground at a depth x for surface temperature $T_s$ and initial temperature $T_i$ is given on the next slide
- How deep should a water main be buried if we want to keep the water from freezing if the surface is at -15 C for 60 days?

# Parameters

- t=60*24*3600
- $T_s$=-15 C
- $T_i$=20 C
- T=0 C
- $\alpha$=1.38*$10^{-7}$ $m^2/s$

$$\frac{T - T_s}{T_i - T_s} = erf\left(\frac{x}{2\sqrt{\alpha t}}\right)$$