• **Theme Music:** Linkin Park

  *High Voltage*

• **Cartoon:** Wiley Miller

  *Non-Sequitur*

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**Quiz 3**

<table>
<thead>
<tr>
<th></th>
<th>3.1</th>
<th>3.3.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>55%</td>
<td>20%</td>
</tr>
<tr>
<td>B</td>
<td>25%</td>
<td>55%</td>
</tr>
<tr>
<td>C</td>
<td>85%</td>
<td>25%</td>
</tr>
<tr>
<td>D</td>
<td>30%</td>
<td></td>
</tr>
</tbody>
</table>

3.2

\[ \Delta S = \frac{Q_A}{T_A} - \frac{Q_B}{T_B} = \frac{-0.5 \text{ J}}{350 \text{ K}} + \frac{0.5 \text{ J}}{250 \text{ K}} = -1.4 \times 10^{-3} \text{ J/K} + 2.0 \times 10^{-3} \text{ J/K} = +0.6 \times 10^{-3} \text{ J/K} \]

3.3.1

\[
\frac{p(E_f)}{p(E_i)} = \frac{e^{\Delta S/k_B T}}{e^{\Delta S/k_B T}} = e^{\Delta S/k_B T} = e^{0.015/0.025} = e^{0.6} = 0.55
\]
Foothold idea:
Fields

- **Test particle**
  - We pay attention to what force it feels.
  - We assume it does not have any effect on the source particles.

- **Source particles**
  - We pay attention to the forces they exert and assume they do not move.

- **Physical field**
  - We consider what force a test particle would feel if it were at a particular point in space and divide by its coupling strength to the force. This gives a vector at each point in space.

\[
\vec{g} = \frac{1}{m} \vec{W}_{E\rightarrow m} \quad \vec{E} = \frac{1}{q} \vec{F}_{\text{all charges } \rightarrow q} \quad V = \frac{1}{q} U_{\text{all charges } \rightarrow q}
\]

Foothold ideas:
Electric potential energy and potential

- The potential energy between two charges is \( U_{12}^{\text{elec}} = \frac{k_c Q_1 Q_2}{r_{12}} \)
- The potential energy of many charges is \( U_{12...N}^{\text{elec}} = \sum_{i<j=1}^{N} \frac{k_c Q_i Q_j}{r_{ij}} \)
- The potential energy added by adding a test charge \( q \) is \( \Delta U_q^{\text{elec}} = \sum_{i=1}^{N} \frac{k_c q Q_i}{r_{iq}} = qV \)
Positive test charge near a single (+) source charge

Potential energy of a positive test charge near a positive source.

\[ U = \frac{kqQ}{r} \]

Electric Potential of a positive test charge near a positive source.

\[ V = \frac{kQ}{r} \]

Negative test charge near a single (+) source charge

Potential energy of a negative test charge near a positive source.

\[ U = \frac{kqQ}{r} \]

Electric Potential of a negative test charge near a positive source.

\[ V = \frac{kQ}{r} \]