

**Study Questions for Smith (1998) *The Science of Energy*.**

**Chapters 8-11.**

1. What are some cultural differences between Rankine and Clausius?
2. What was the "great goal" of Glasgow engineers and natural philosophers alike?
3. What was Rankine's distinction between "theoretical maximum efficiency" and "actual efficiency"?
4. What was the motivation for studying air engines as opposed to heat engines?
5. Describe the engineering project that Rankine and Napier engaged in based on air engine technology.
6. What was Clausius' "fundamental principle" of 1854?
7. What is entropy and how does it figure into Clausius' version of the two "fundamental theorems" of the mechanical theory of heat?
8. According to Smith what were the two interest groups that were contesting for scientific authority in the Tait-Tyndall controversy?
9. What was Thomson's strategy in the contest in #8?
10. According to Smith, why did Tait feel threatened by the appointment of Tyndall to the chair of natural philosophy at the Royal Institute? Why did Thomson feel less threatened?
11. What was the "calculated rhetorical move" that Tyndall made in his "On Forces" lecture against the North British energy scientists?
12. How did Thomson and Tait respond to the move in #11 in their article "Energy"? What criticism did Tyndall launch against Thomson and Tait in response?
13. According to Smith, what were some of the characteristics of Thomson and Tait's (T & T') *Treatise on Natural Philosophy* that distinguished it culturally as a work in North British energy physics?
14. How did T & T' attempt to incorporate the principle of the conservation of energy into Newtonian physics? Why was this important from a rhetorical point of view?
16. What is the basis for Smith's claim that T & T's "...construction of a dynamics centred on work and energy was radically contingent upon Scottish academic, religious and industrial culture"?
17. How was the formulation of Newtonian physics by T & T' different from Lagrange's formulation?

**Chapters 12-14**

1. According to Smith, how did the doctrine of dissipation link the natural and moral orders for its practitioners?
2. What was Clausius's notion of the mean free path of a gas molecule?
3. According to Smith, what is the difference between a dynamical theory and a molecular hypothesis?
4. What is Maxwell's Demon? What moral did Maxwell draw from his demon?
5. What do the debates between Tait and Clausius over the nature of the 2nd Law indicate about the cultures of North British and German scientists?
6. According to Maxwell's 1877 review of Tait's *Thermodynamics*, what were the two directions that foundations for the 2nd Law could take?
7. According to Smith, what was the historically contingent difference between the British approach to developing an absolute system of measurement and the German approach?
8. Explain: "The ideology of a successful cultural elite must generate space, must become inscribed in space if it is to avoid disappearing into disembodied and impotent realms of mere signs, abstract descriptions and fantasies."
9. What are some characteristics of Weber's absolute system of measurement for electric resistance?
10. According to Thomson, how are measurements of electrical phenomena similar to measurements of steam? (What do electrical phenomena have in common with water wheels and heat engines?)
11. What was the specific aim of the BAAS Committee On Standards of Electrical Resistance? How did they accomplish it?
12. How did the "Maxwellians" view energy, and how does this differ from the view of the original scientists of energy?
13. What characterizes the German "Energeticists", and how did they differ from the "Maxwellians"?
14. What characterizes Heaviside's reformulation of Maxwell's theory of electrodynamics?
15. What characterizes Hertz' interpretation of Maxwell's theory?