Study Questions for Chang (2004) *Inventing Temperature*.

Chapter 1.
1. What do "most severe winter cold", "greatest summer heat", "first night frost", "deep caves", "boiling spirit", "melting butter", and "Paris Observatory cellars" all have in common?
2. What were two causes of variation in the boiling point of water identified by the Royal Society committee?
3. What is "superheating"?
4. How many types of boiling were identified by De Luc in 1772?
5. What was the significance of Marcet's 1842 experiments with glass vessels that had contained sulphuric acid?
6. Given that water displayed superheating, what were three factors that allowed the boiling point of water to still be used as a fixed point?
7. What was Cavendish's 1777 explanation for using steam to measure the boiling point of water?
8. What was De Luc's 1777 criticism of Cavendish's explanation?
9. What was the pressure-balance theory of boiling? What was a major problem it faced? What were two responses to this problem?
10. What was Gay-Lussac's 1818 modification of the pressure-balance theory? What was Marcet's 1842 role in this modification?
11. What was Gernez's 1866 & 1875 contribution to the pressure-balance theory?
12. What was Tomlinson's 1868-69 criticism of Gernez's contribution?
13. What was Aitken's 1880-81 discovery about steam?
14. According to Aitken, in addition to the right temperature, what is needed to bring about a change of state?
15. According to Aitken, is there a difference between boiling and evaporation?
16. How does a thermoscope differ from a thermometer? On what is the reliability of thermoscopes based?
17. What is Chang's "principle of respect"? What is the example of hands placed in cold and hot water, and then placed in lukewarm water supposed to illustrate?
18. According to Chang, does sensation have stronger justification than other standards? If not, why do we accept sensation as a prior standard?
19. What is "epistemic iteration"?
20. Describe the three stages of Chang's iterative development of temperature standards.
21. What are three epistemic strategies in defense of the fixity of the boiling point of water?
22. What is the most important serendipitous factor for the fixity of the boiling point of water? Why is it serendipitous?
23. According to Chang, fixed points (like the steam point) are a type of robust middle-level regularity. How are they different from observational claims based directly on sense-data? How are they different from high-level theoretical claims?
24. What are some overt parallels between the histories of the boiling point and the freezing point of water?
25. What is the theoretical understanding of supercooling, based on Black's concept of latent heat?

Chapter 2.

1. Explain how the following positions could have addressed the discrepancies between thermometers filled with different liquids: an operationalist, a simple-minded conventionalist, a sophisticated conventionalist. Why were these discrepancies a problem for a realist?
2. What is Chang's "Problem of Nomic Measurement"?
3. What were the three contenders for the claim of indicating true temperature?
4. What was the method of mixtures? What did De Luc conclude from this method?
5. What was De Luc's critical assumption?
6. What is "heat capacity", according to Irvinist caloric theories of heat? What is "latent heat"?
7. How did chemical caloric theories of heat differ from Irvinist caloric theories?
8. Why did Dalton claim that the mixtures De Luc used to justify his conclusion had *higher* temperatures than De Luc assumed?
9. Why did Haüy claim that the mixtures De Luc used had *lower* temperatures than De Luc assumed?
10. Why did caloric theory teach that the action of heat was most purely manifested in gases?
11. What observation by Gay-Lussac and Dalton strengthened the faith in the simplicity of the thermal behavior of gases?
12. What was Laplace's distinction between latent/combined caloric, free/sensible caloric, and the free caloric of space?
13. How did Laplace argue for the air thermometer as "the true thermometer of nature"? What was a major problem in this argument?
14. What was Regnault's idea of "comparability"? According to Chang, what was the basic assumption underlying this idea?
15. Which type of thermometer passed Regnault's criterion of comparability? According to Chang, why must this conclusion be qualified?
16. What is the claim of constructive empiricism? What is problematic about this claim?
17. What is Chang's "new concept of observability"? How does this relate to Regnault's contribution to thermometry?
18. How does Chang justify Regnault's use of mercury thermometers in establishing the reliabiilty of the air thermometer?
19. What is Chang's "Principle of Single Value"?
20. What is the hypothetico-deductive method of theory testing? Why does it face the problem of holism?
21. How did Regnault's work on thermometry avoid the problem of holism?