

Closed book. Clearly circle your choice. No work needs to be shown for multiple-choice questions. No partial credit is given for multiple-choice questions.

1. A 1.0 cm^2 cross-sectional area steel bar is heated up such that its length extends by 0.1 mm . To extend a 2.0 cm^2 cross-sectional area steel bar by 0.1 mm , it must experience a temperature change _____ the temperature change of the 1.0 cm^2 cross-sectional area steel bar. (The bars have the same length.)
- (A) smaller than.
 (B) the same as.
 (C) larger than.
 (D) (Not enough information is given.)



2. [3.0 points.] A metal container is filled to the brim with a liquid. If the temperature decreases, under which conditions would the liquid overflow? (There are no changes in phase.)
- (A) $3\alpha_{\text{metal}} > \beta_{\text{liquid}}$.
 (B) $3\alpha_{\text{metal}} = \beta_{\text{liquid}}$.
 (C) $3\alpha_{\text{metal}} < \beta_{\text{liquid}}$.
 (D) (Two of the above choices.)
 (E) (All of the above choices.)
 (F) (None of the above choices.)

For questions (3)-(5), a 0.50 kg iron sample is at a temperature of 15° C , and 1.00 kg of water is at 35° C .

Specific heat of iron is $440 \frac{\text{J}}{\text{kg} \cdot \text{K}}$. Specific heat of water is $4,190 \frac{\text{J}}{\text{kg} \cdot \text{K}}$.

3. [3.0 points.] If the 0.50 kg iron sample at 15° C is placed into the 1.00 kg of water at 35° C to reach thermal equilibrium in an insulated container, heat will be transferred:
- (A) from the 0.50 kg iron sample to the 1.00 kg of water.
 (B) from the 1.00 kg of water to the 0.50 kg iron sample.
 (C) (No heat is exchanged.)
 (D) (Not enough information is given.)
4. [3.0 points.] After reaching thermal equilibrium, the _____ had the greatest change in internal energy.
- (A) 0.50 kg iron sample.
 (B) 1.00 kg of water.
 (C) (There is a tie.)
 (D) (Not enough information is given.)
5. [3.0 points.] After reaching thermal equilibrium, the _____ had the greatest change in temperature.
- (A) 0.50 kg iron sample.
 (B) 1.00 kg of water.
 (C) (There is a tie.)
 (D) (Not enough information is given.)

Questions (6)-(10) are continued on the back of this page.

Equations and constants:

$$T_c = T - 273.15.$$

$$\alpha \Delta T = \frac{\Delta L}{L}; \quad 3\alpha \Delta T = \beta \Delta T = \frac{\Delta(\text{Volume})}{\text{Volume}}.$$

$$Q = mc\Delta T.$$

11.11.29