PROBLEM 6.36

Known: A closed system undergoes a process in which $Q$ occurs at $T_b$.
Find: For each of several cases, determine whether the entropy change is positive, negative, zero, or indeterminate.

**Schematic & Given Data:**

```
  \[ T_b \]
```

**Analysis:** In two cases, Eq. 6.24 takes the form $\Delta S = \frac{Q}{T_b} + \theta$.

(a) $Q > 0$, $T > 0$ \quad \Delta S = \frac{Q}{T_b} + \theta > 0$

(b) $Q = 0$, $Q = 0$ \quad \Delta S = \frac{Q}{T_b} + \theta > 0$

(c) $Q < 0$, $Q < 0$ \quad \Delta S = \frac{Q}{T_b} + \theta < 0$

(d) $Q > 0$, $Q > 0$ \quad \Delta S = \frac{Q}{T_b} + \theta > 0$

(e) $Q < 0$, $Q < 0$ \quad \Delta S = \frac{Q}{T_b} + \theta < 0$

(f) $Q > 0$, $Q < 0$ \quad \Delta S = \frac{Q}{T_b} + \theta$

In indeterminate: $\Delta S$ may be positive or negative depending on the relative magnitudes of the two terms on the right side.

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(a) False. See discussion of Sec. 5.1

(b) False. For any process of a closed system, internally reversible or otherwise, $\Delta E = Q - W$. Accordingly, the magnitude and direction of $Q$ is not determined by $W$ alone unless $\Delta E = 0$.

(c) False. See discussion of Sec. 6.7.1

(d) False. See discussion of Sec. 6.7.1

(e) False. See discussion of Sec. 6.7.1

(f) True. See Eq. 6.24

(g) False. See Sec. 6.8.1.