

### POE Practice Test - Thermodynamics

#### Multiple Choice

Identify the choice that best completes the statement or answers the question.

1. Heat is the transfer of energy from one place to another. It naturally occurs by one of three methods. Which one is not a natural heat transfer method?
  - a. Conduction
  - b. Convection
  - c. Radiation
  - d. Refrigeration
2. Radiation is the chief method of energy transfer
  - a. from the sun to an earth satellite.
  - b. from a gas flame to the top layer of water in a teakettle..
  - c. from a soldering iron to metals being soldered.
  - d. from the bottom of a glass of water to an ice cube floating in it.
3. Of the processes below, the one in which practically all the heat transfer is by conduction is:
  - a. from the sun to an earth satellite.
  - b. from a gas flame to the top layer of water in a teakettle.
  - c. from a stovetop to a pot of water above it.
  - d. from the bottom of a glass of water to an ice cube floating in it.
4. Plastic handles are often used on kitchen utensils because
  - a. the plastic is a good radiator
  - b. the plastic is a good insulator
  - c. the plastic is a good conductor
  - d. the plastic softens gradually with excessive heat
5. To increase the insulating qualities of a house, a homeowner should:
  - a. Increase the R-value
  - b. Increase the U-value
  - c. Increase radiation
  - d. Increase conduction
6. The law stating that heat energy always goes toward entropy, or moves from hot to cold and from order to disorder, is known as:
  - a. 1<sup>st</sup> law of thermodynamics
  - b. 2<sup>nd</sup> law of thermodynamics
  - c. Newton's first law
  - d. Newton's second law
7. Which of the following methods of heat transfer explains why air near the ceiling is warmer than the air near the floor in an enclosed room?
  - a. Convection
  - b. Conduction
  - c. Radiation
  - d. R-value

POE Practice Problems

A team of students tests a material for its thermal conductivity (k). After 20 minutes in a heat box, the temperature is 48° C inside the box and 28° C on top of the material. The following data is true about this test:

Area of material = .0225 m<sup>2</sup>

Thickness of material = .0127 m

Light bulb = 25 W

1. Calculate the thermal conductivity constant (k) for the material.

Formula	Substitute / Solve	Final Answer
$P = \frac{kA\Delta T}{L}$ $k = \frac{PL}{A\Delta T}$	$k = \frac{(25W)(.0127m)}{(.0225m^2) 20K}$ $k = .706 \frac{W}{mK}$	.706 W/mK

2. Calculate the amount of energy transferred through the material.

Formula	Substitute / Solve	Final Answer
$Q = Pt$	$Q = 25W (1200s)$ $Q = 30,000 J$	30,000 Joules

3. A piece of copper steel (specific heat = 490 J/kg·K) has a mass of 300 g. If it is heated to 150°C, then plunged into 4.00 kg water (specific heat = 4180 J/kg·K) at 20°C, what will be the final temperature at equilibrium?

Formula	Substitute / Solve	Final Answer
$Q_c = Q_w$ $m\Delta T_c = m\Delta T_w$	$[13kg(490 \frac{J}{kg\cdot K}) T_f - 423K] =$ $4kg(4180 \frac{J}{kg\cdot K}) T_f - 293K$ <p>Solve for T<sub>f</sub></p>	294.1K

$$-147T_f + 62181 = 16720T_f - 4898960$$

$$4961141 = 16867T_f$$

$$294.1K = T_f$$