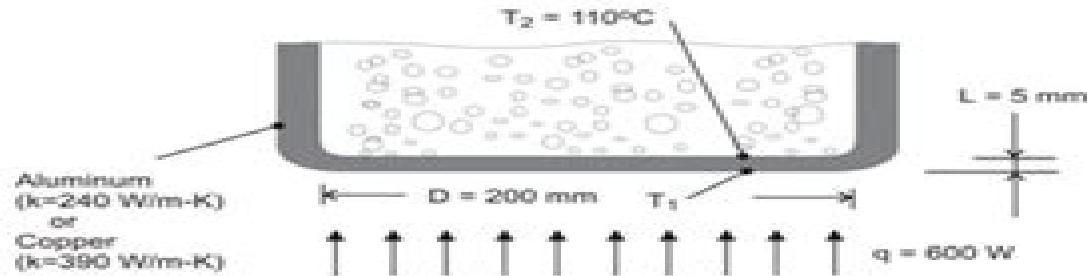


PROBLEM 1.10

KNOWN: Thickness, diameter and inner surface temperature of bottom of pan used to boil water. Rate of heat transfer to the pan.

FIND: Outer surface temperature of pan for an aluminum and a copper bottom.

SCHEMATIC:



ASSUMPTIONS: (1) One-dimensional, steady-state conduction through bottom of pan.

ANALYSIS: From Fourier's law, the rate of heat transfer by conduction through the bottom of the pan is

$$q = kA \frac{T_1 - T_2}{L}$$

Hence,

$$T_1 = T_2 + \frac{qL}{kA}$$

where $A = \pi D^2 / 4 = \pi (0.2\text{ m})^2 / 4 = 0.0314\text{ m}^2$.

$$\text{Aluminum: } T_1 = 110^\circ\text{C} + \frac{600\text{ W} (0.005\text{ m})}{240\text{ W/m}\cdot\text{K} (0.0314\text{ m}^2)} = 110.40^\circ\text{C}$$

$$\text{Copper: } T_1 = 110^\circ\text{C} + \frac{600\text{ W} (0.005\text{ m})}{390\text{ W/m}\cdot\text{K} (0.0314\text{ m}^2)} = 110.25^\circ\text{C}$$

COMMENTS: Although the temperature drop across the bottom is slightly larger for aluminum (due to its smaller thermal conductivity), it is sufficiently small to be negligible for both materials. To a good approximation, the bottom may be considered *isothermal* at $T = 110^\circ\text{C}$, which is a desirable feature of pots and pans.

Heat Transfer Incropera 5th Edition Solution Manual

James Sucec



Heat Transfer Incropera 5th Edition Solution Manual:

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1. Understanding the eBook Heat Transfer Incropera 5th Edition Solution Manual
 - The Rise of Digital Reading Heat Transfer Incropera 5th Edition Solution Manual
 - Advantages of eBooks Over Traditional Books
2. Identifying Heat Transfer Incropera 5th Edition Solution Manual
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Heat Transfer Incropera 5th Edition Solution Manual
 - User-Friendly Interface
4. Exploring eBook Recommendations from Heat Transfer Incropera 5th Edition Solution Manual
 - Personalized Recommendations
 - Heat Transfer Incropera 5th Edition Solution Manual User Reviews and Ratings
 - Heat Transfer Incropera 5th Edition Solution Manual and Bestseller Lists
5. Accessing Heat Transfer Incropera 5th Edition Solution Manual Free and Paid eBooks
 - Heat Transfer Incropera 5th Edition Solution Manual Public Domain eBooks
 - Heat Transfer Incropera 5th Edition Solution Manual eBook Subscription Services
 - Heat Transfer Incropera 5th Edition Solution Manual Budget-Friendly Options
6. Navigating Heat Transfer Incropera 5th Edition Solution Manual eBook Formats

- ePub, PDF, MOBI, and More
- Heat Transfer Incropera 5th Edition Solution Manual Compatibility with Devices
- Heat Transfer Incropera 5th Edition Solution Manual Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Heat Transfer Incropera 5th Edition Solution Manual
 - Highlighting and Note-Taking Heat Transfer Incropera 5th Edition Solution Manual
 - Interactive Elements Heat Transfer Incropera 5th Edition Solution Manual
- 8. Staying Engaged with Heat Transfer Incropera 5th Edition Solution Manual
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Heat Transfer Incropera 5th Edition Solution Manual
- 9. Balancing eBooks and Physical Books Heat Transfer Incropera 5th Edition Solution Manual
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Heat Transfer Incropera 5th Edition Solution Manual
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Heat Transfer Incropera 5th Edition Solution Manual
 - Setting Reading Goals Heat Transfer Incropera 5th Edition Solution Manual
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Heat Transfer Incropera 5th Edition Solution Manual
 - Fact-Checking eBook Content of Heat Transfer Incropera 5th Edition Solution Manual
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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