Activity 1.3.3 Thermodynamics

Introduction

Think back to the last time someone complained about a door being left open. What did you notice about the temperature within the room as a result of the open door? In Activity 1.3.3 you will investigate the effects of work, thermo energy, and energy on a system, as in the case of the room with the door left open.

Procedure

Answer the following questions as your teacher discusses the Introduction to Thermodynamics presentation.

1. Define thermodynamics.

2. List three examples of a thermodynamic system.
   a.
   b.
   c.
3. Define thermal energy.

4. Define temperature.

5. Fill in the table below with the correct scale and unit.

Scale	Freezing point of water	Boiling point of water
Celsius		
Fahrenheit		
Kelvin		

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6. Define absolute zero.

7. Define thermal equilibrium.

8. Define the Zeroth Law of Thermodynamics.

9. Define the 1st Law of Thermodynamics.

10. List two ways thermo energy can be increased in a system.
    a.
    b.
11. Define the 2nd Law of Thermodynamics.

12. Define entropy.

13. Define convection.

14. List two examples of convection.
    a.
    b.
15. Define conduction.

16. List two examples of conduction.
    a.
    b.

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Conduction Equations:

$$P = kA\frac{\Delta T}{L} \qquad k = \frac{PL}{A\Delta T} \qquad P = \frac{Q}{\Delta t}$$

17. Define the following variables.

P =

Q =

t =

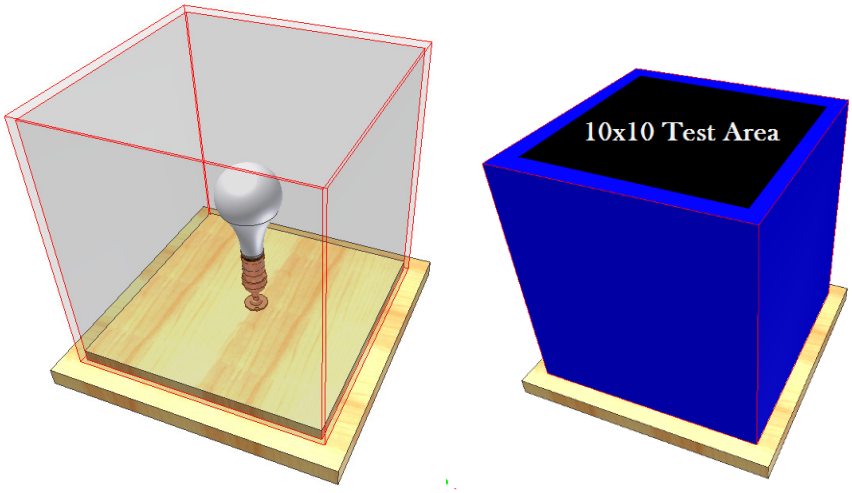
k =

A =

L =

ΔT =

(18-22) A 3/16 in. thick acrylic testing box with dimensions of 10 in. x 10 in. is covered with an unknown ½ in. insulation material. Determine the thermal conductivity for the insulating material if a 25W bulb is used to heat the box. The bulb maintains the inside temperature at 10ºC higher than the outside temperature.



18. List all known values.

19. List all unknown values.

20. Select equations.

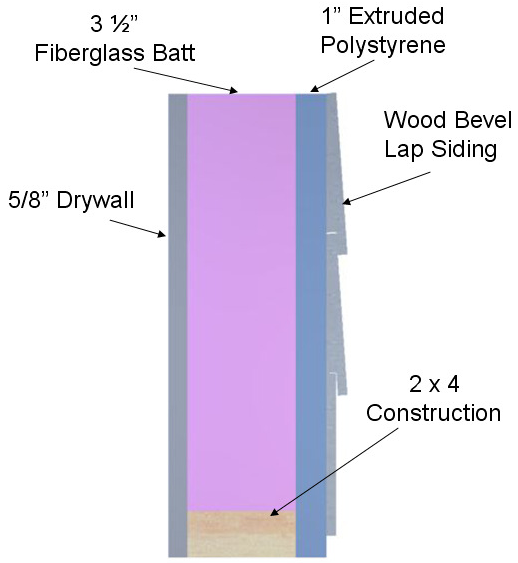
21. Apply known values.

22. Solve.

23. Define U-value.

24. Define R-value.

(25-26) Using the provided R-value chart and illustration below, calculate the R-value of the wall cavity and the R-value at the stud location.



25. Wall cavity R-value

26. R-value at stud location

27. Define radiation.

28. List two examples of radiation.
    a.
    b.

29. Define Stefan's Law.

(30-34) A student travels on a school bus in the middle of winter from home to school. The school bus temperature is 58° F. The student's skin temperature is 91.4° F. Determine the net energy transfer from the student's body during the 20 min ride to school. Note: Skin emissivity is 0.90, and the surface area of the student is $1.50m^2$.

30. List all known values.

31. List all unknown values.

32. Select equations.

33. Apply known values to equations.

34. Solve.

35. Define geothermal energy.

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R-Value Chart	
Construction Material	**R-Value**
½ in. Drywall	0.45
5/8 in. Drywall	0.56
Particle Board – ½ in.	0.63
Particle Board – ¾ in.	0.94
Fiberboard ½ in.	1.32
Extruded Polystyrene 1 in.	4.00
Extruded Polystyrene 1 ½ in.	6.00
Foil-faced Polyisocyanurate 1 in.	7.20
2 x 4	4.38
2 x 6	6.88
Hardwood	0.90
Masonry Systems	**R-Value**
Brick 4 in. common	0.80
Brick 4 in. face	0.44
Concrete Block – Normal wt. 12 in. empty core	1.23
Concrete Block – Light wt. 12 in. empty core	2.60 - 2.30
Cement Mortar	0.20
Sand and Gravel	0.60
Stucco	0.20
Roofing	**R-Value**
Asphalt Roll	0.15
Asphalt Shingle	0.44
Slate	0.05
Wood	0.94
Siding	**R-Value**
Wood Shingles	0.87
Wood Drop	0.79
Wood Bevel Lapped	0.80
Aluminum/Steel – Hollow	0.61
Aluminum/Steel – with 3/8 in. Backer	1.82
Insulation	**R-Value per in.**
Fiberglass Batt	3.0 - 3.8
Blankets – Rock Wool	3.0 - 3.8
Loose Fill – Cellulose	2.8 - 3.7
Loose Fill – Fiberglass 0.7 lb/cu.ft	2.2 - 4.0
Loose Fill – Rock Wool	3.1
Loose Fill – Vermiculite	2.2
Extruded Polystyrene	5.00

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