Phy100: Heat transport

1) Three basic forms of thermal heat transport

i) Conduction;

ii) Convection;

iii) Radiation.

Conduction and collisions

Microscopically, heat conduction occurs by means of collisions between molecules or atoms in crystals or diffusions of electrons in metals.



Fast (hot) aroms

Slow (cold) atoms



The following pictures Illustrate such processes.

Common temperature

Examples of heat conduction





Heat conduction rate or power

$$P = \frac{Q}{t} = \frac{\kappa A(T_{hot} - T_{cold})}{d}$$



- 2 = heat transferred in time t
- K = thermal conductivity of the barrier
 - A= area
 - **T**= temperature
 - **d** = thickness of barrier

SI units

- Q/t: J/s or Watts
- A: m^2
- d: m
- T: Kelvin
- k: W/mK

Temperature units: ^oC, K, ^oF

Absolute temperature (in units of Kelvin) is a measure of thermal energy – energy of vibrating molecules, atoms.

Kelvin Scale, Celsius scale or centigrade scale, Fahrenheit scale



Q1

Last July, temperatures in Death Valley,Nevada/California reached a record of 131 F.In centigrade scale or Celsius degree, or centi degree, this corresponds to

- 1) 38C;
- 2) 45C;
- 3) 50C;
- 4) 55C.



Thermal conductivity table

Copper Gold Iron Steel	385 314 79.5 50.2	(in units of W/m K)
Glass Concrete Brick, insulating Brick, red Wood	0.8 0.8 0.15 0.6 0.12-0.04	
Fiberglass Styrofoam Polyurethane Air (0c)	0.04 0.033 0.02 0.024	

Which of the following reduces the heat conduction of a house in winters?

- 1) Increases the surface area;
- 2) Decreases the thickness of walls;
- 3) Use double pane windows instead of single pane ones.
- 4) Keep house temperatures a few degrees higher.



R value

- This is a quantity usually used to specify house insulation properties in construction bussiness.
- R = d / k $Q/t = A (T_2 - T_1)/R$
- R is defined in US units: (ft². °F.hr/BTU)
- BTU A British Thermal Unit (BTU) is the amount of heat energy needed to raise the temperature of one pound of water by one degree F.
- I BTU=1055 Joules
- 1 R = 0.093 m²·0.55 °C·3600s/1055J = 0.17 m²·°K ·s/J

Etext, tutorial problems and resource center

http://www.phas.ubc.ca/~phys100

1) We are going to use etext materials next week.

2) You can get help for MP problems at Resource center (Henning 208).