Phy100: Heat transport

Three basic forms of thermal heat transport

1) Conduction (summary);

2) Convection;

3) Radiation.

Three steps for house heating problem

A) Calculate the heat conduction rate, or power

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

B) The input energy power is equal to **P**. Calculate the energy consumed per month (Q = t P).

C) Given the unit price for energy consumed, calculate Monthly bill M :

 $M = m \times Q / 1GJ;$ m: Price for 1GJ



A=200m², T inside – T outside = 24K, d=0.3m, Q/t = 9600 W.

Terasen Gas uses GJ (=billion J) as units. 1GJ charge is about 15CAD.

The monthly gas bill should be closest to 1) 50 CAD; 2) 100 CAD; 3) 350 CAD; 4) 1000 CAD.

<u>Q per day is 829,440 KJ, for one month is 24,883,200 KJ</u> = 24.9 GJ

Q2 (previous lecture)

For instance is inside T=20C, Q/t decreases from 9.6KW to 8KW. Assume that there are 200,000 houses in a city like Vancouver, for one month about how much energy and money are saved:

- 1) 10,000 GJ, and 150,000 dollars a month;
- 2) 0.1 million GJ and 1.5 million dollars a month;
- 3) 1 million GJ and 15 million dollars a month;
- 4) 10 million GJ and 150 million Dollars a month.

For instance inside T=20C, Q/t decreases from 9.6KW to 8KW. For one month, Q decreases from 24.9GJ to 20.7 GJ.

You are saving 4.2 GJ, emitting less heat into the air and saving about 60CAD per house.

Q1

A new house with total surface area 200m²; the thickness of the wall (and roof) is 30cm. Kappa for the wall material is assumed to be 0.15 W/m. K. Inside temperature is kept at 20C and outside is zero. What is the approximate heat conduction power P in this case?

- 1) 800W;
- 2) 2000W;
- 3) 10000W;
- 4) None of above.



Q2

The input power is equal to the heat conduction power (we assume no other heat loss). Using the previous result, estimate how much is the monthly heating bill? (For 1GJ or one billion Joules, charge is 15 CAD.)

- 1) 400 CAD
- 2) 240 CAD
- 3) 180 CAD
- 4) 80CAD



What have been neglected in our estimate?

- Haven't taken into account heat conduction through windows, doors;
- No convection or radiation losses.
- Input power efficiency is assumed to be 100%.

>>>><u>Physics 100 study guide</u>

Q0

My lectures are

Too fast;
Too slow;
Mostly ok.



Midterm

 Open book exam (textbooks, lecture notes and formula sheets)

2) No communications/No Laptops/No Cell phones

3) No PRS-clicker-based questions;

 Problems are similar to the ones discussed during lectures or related textbooks, MP problems or tutorial problems or problems in study guide..