



CRAWFORD UNIVERSITY  
COLLEGE OF NATURAL AND APPLIED SCIENCES  
INDUSTRIAL CHEMISTRY PROGRAMME  
HARMATTAN SEMESTER EXAMINATION 2016/2017 SESSION

COURSE CODE: ICH 323

COURSE TITLE: HEAT TRANSFER

UNIT 3

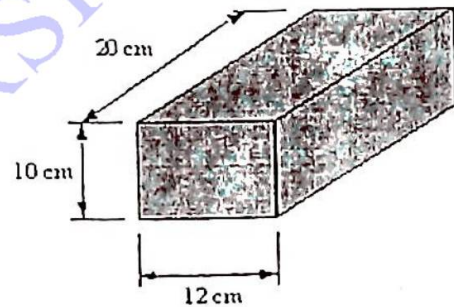
TIME ALLOWED: 3 Hours

DATE: February, 2017.

INSTRUCTION: Answer three (3) Questions only

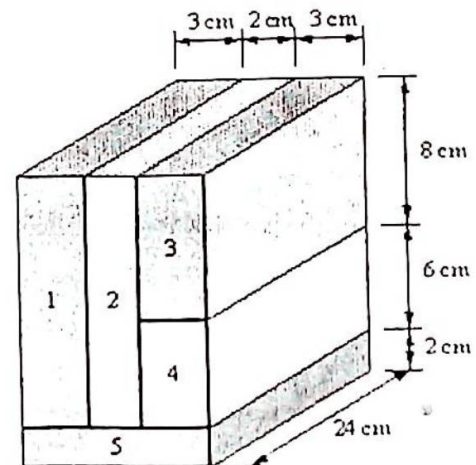
- What is heat transfer?
  - List and explain the three modes of heat transfer illustrating your answer with examples.
- A rectangular slab, 2 cm thick, is measured to be 100 °C on one side and 96.2 °C on the other side. The slab is 20 cm by 20 cm. Calculate the rate of heat transfer through the slab if the conductivity of the slab is 170 W/mK.

ii. A loaf of freshly baked bread is left to cool on a cooling rack. The dimension of the loaf is as described in the figure, and its surface temperature is 120 °C. The temperature of the air is 20 °C, and the convection coefficient from the loaf to air is 10 W/m<sup>2</sup>K. Emissivity of the bread is 0.76, and its conductivity is 0.121.

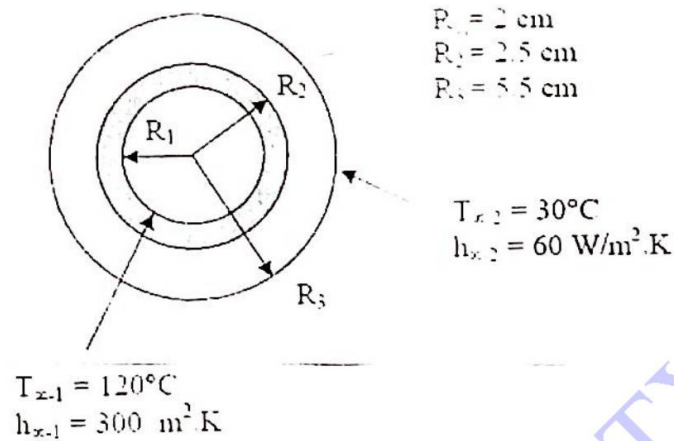


Based on these information, calculate the total heat loss from the bread.

- For a composite shown on the right, construct the thermal circuit model. Find the total thermal resistance of the composite. The thermal conductivities are:  $k_1 = k_3 = 80$  W/mK,  $k_2 = 120$  W/mK,  $k_4 = 100$  W/mK, and  $k_5 = 150$  W/mK.



4. A steel pipe with 5 cm OD and 4 cm ID carries hot steam at temperature of  $120^{\circ}\text{C}$ . The pipe is insulated with 3 cm thick of glass wool. The convective heat transfer coefficient between the steam and the pipe is  $300 \text{ W/m}^2\cdot\text{K}$  and  $60 \text{ W/m}^2\cdot\text{K}$  for the insulation and the air. Determine the overall heat transfer coefficient for this system and the heat transfer coefficient for this system and the heat loss for 1 meter if the air temp is  $30^{\circ}\text{C}$ .



5. A 5 cm, 60 cm long aluminum cylinder initially at  $50^{\circ}\text{C}$  is submerged in an ice-water bath at  $2^{\circ}\text{C}$ . The unit surface conductance between the metal and the bath is  $550 \text{ W/m}^2\cdot\text{K}$ . Determine the temperature of the aluminum after 1 minute. Also calculate the cumulative heat transfer for 1 minute.