Registration No : Bs Tech(M)/3-19/M011

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Title of Assignment : Mid Term

Title of Course : Heat Transfer

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Submission Date : 9th September 2020

Q3(A)

ANSWER:

“THERMAL CONTACT CONDUCATANCE”:

In physics, thermal contact conductance is the study of heat conduction between solid bodies in thermal contact.The themal contact conductance coefficient,hc, is a property indicating the between two bodies in contact. The inverse of this property is termed themal contact resistance.

According to Fourier”s Law, the heat flow between the bodies is found by valuesthe relation:

$$Q= -KA\ dT/dx$$

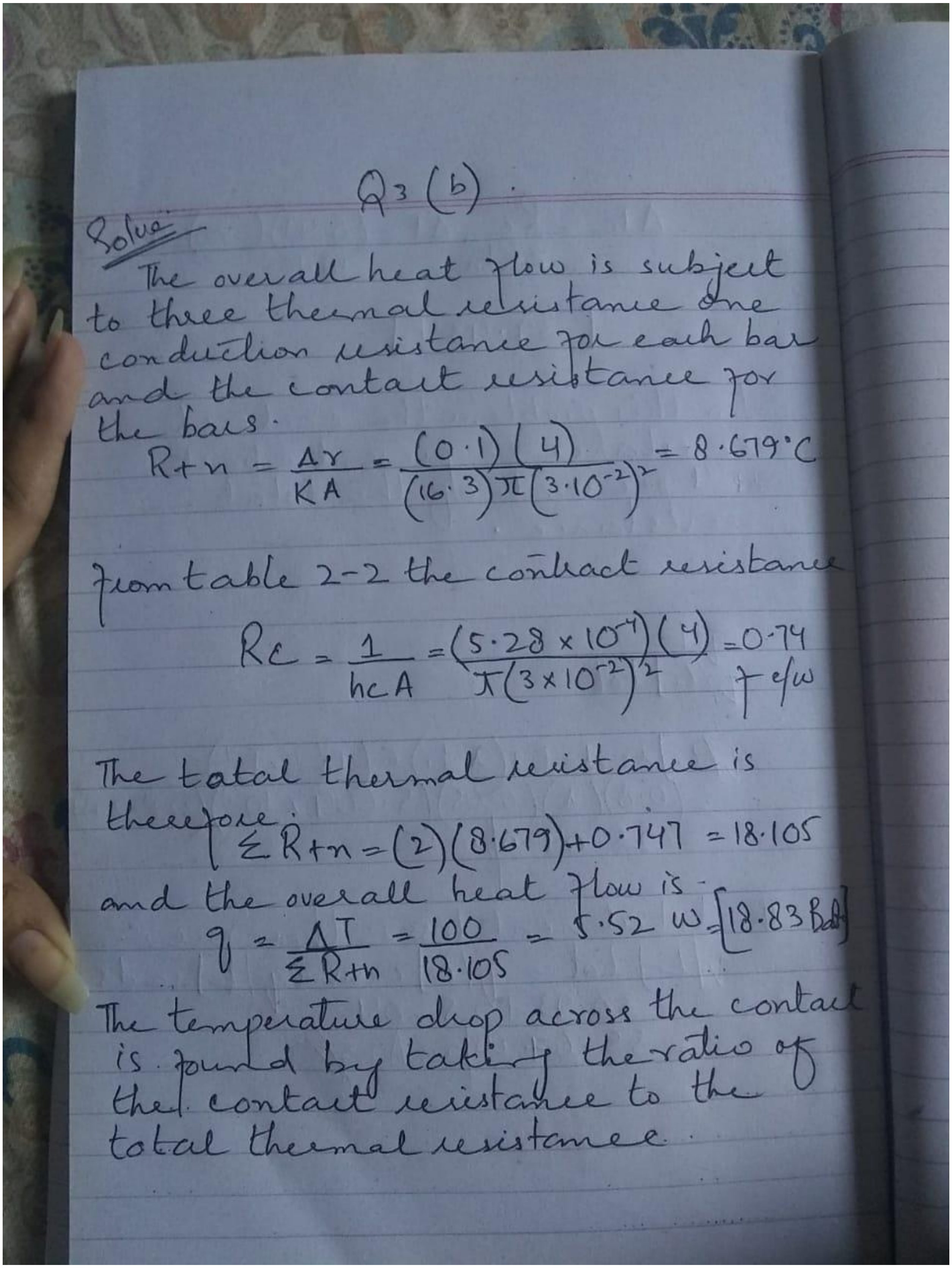
when q the heat flow , k is the thermal conductivity , A is the cross sectional area and dT /dx is the temperature gradient in the direction of floiw.

From considerations of energy conservation , the heat flow between the two bodies A and B, is found :

One may observe that the heat flow is directly related to the thermal conductivites of the bodies in contact , kA and kB , the contact area A , and the thermal contact resistance ,1/hc which as previously noted,is the inverse of the themal conductance coefficient ,hc.
Most experimentally determined values of thew thermal contact resistance fall between 0.000005 and 0.0005 msist/W (the corresponding range of thermal contact conductance is 200000 to 2000 W/m K) . to know whether the thermal contact resistance is significant or not magnitudes of the thermal resistance of the layers are compared with typical values of thermal contact resistance . thermal contact resistance is significant and may dominate for good heat conductors such

as mcetals but can be neglected for poor heat conductors such as insulators.some of the fields where contact conductances of importance are:

Q3(b)



Q3 (b).

Solve:

The overall heat flow is subject to three thermal resistance one conduction resistance for each bar and the contact resistance for the bars.

$$R_{th} = \frac{\Delta x}{KA} = \frac{(0.1)(4)}{(16.3)\pi(3.10^{-2})^2} = 8.679\,°C$$

from table 2-2 the contact resistance

$$R_C = \frac{1}{h_c A} = \frac{(5.28\times10^{-4})(4)}{\pi(3\times10^{-2})^2} = 0.74\ °C/W$$

The total thermal resistance is therefore:

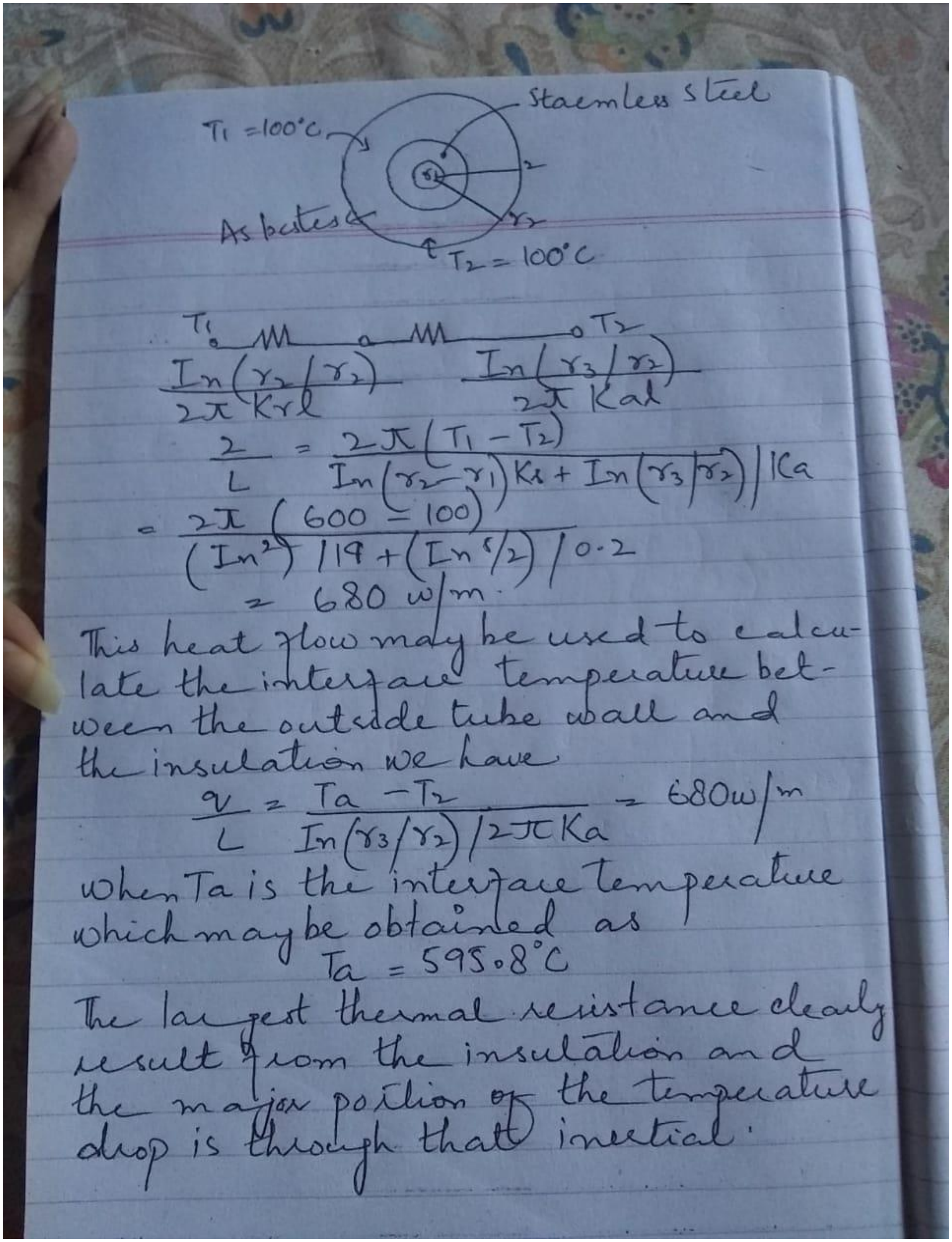
$$\Sigma R_{th} = (2)(8.679) + 0.747 = 18.105$$

and the overall heat flow is

$$q = \frac{\Delta T}{\Sigma R_{th}} = \frac{100}{18.105} = 5.52\ W = [18.83\ Btu/h]$$

The temperature drop across the contact is found by taking the ratio of the contact resistance to the total thermal resistance.

Q2(b)



Staemless steel

$T_1 = 100°C$

2

r_1

r_2

Asbastes

$T_2 = 100°C$

T_1 T_2

$$\frac{\ln(r_2/r_2)}{2\pi K r l} \qquad \frac{\ln(r_3/r_2)}{2\pi K a l}$$

$$\frac{2}{L} = \frac{2\pi(T_1 - T_2)}{\ln(r_2 - r_1) K s + \ln(r_3/r_2) / Ka}$$

$$= \frac{2\pi(600 - 100)}{(\ln 2)/19 + (\ln 5/2)/0.2}$$

$$= 680 \text{ w/m}$$

This heat flow may be used to calculate the interface temperature between the outside tube wall and the insulation we have

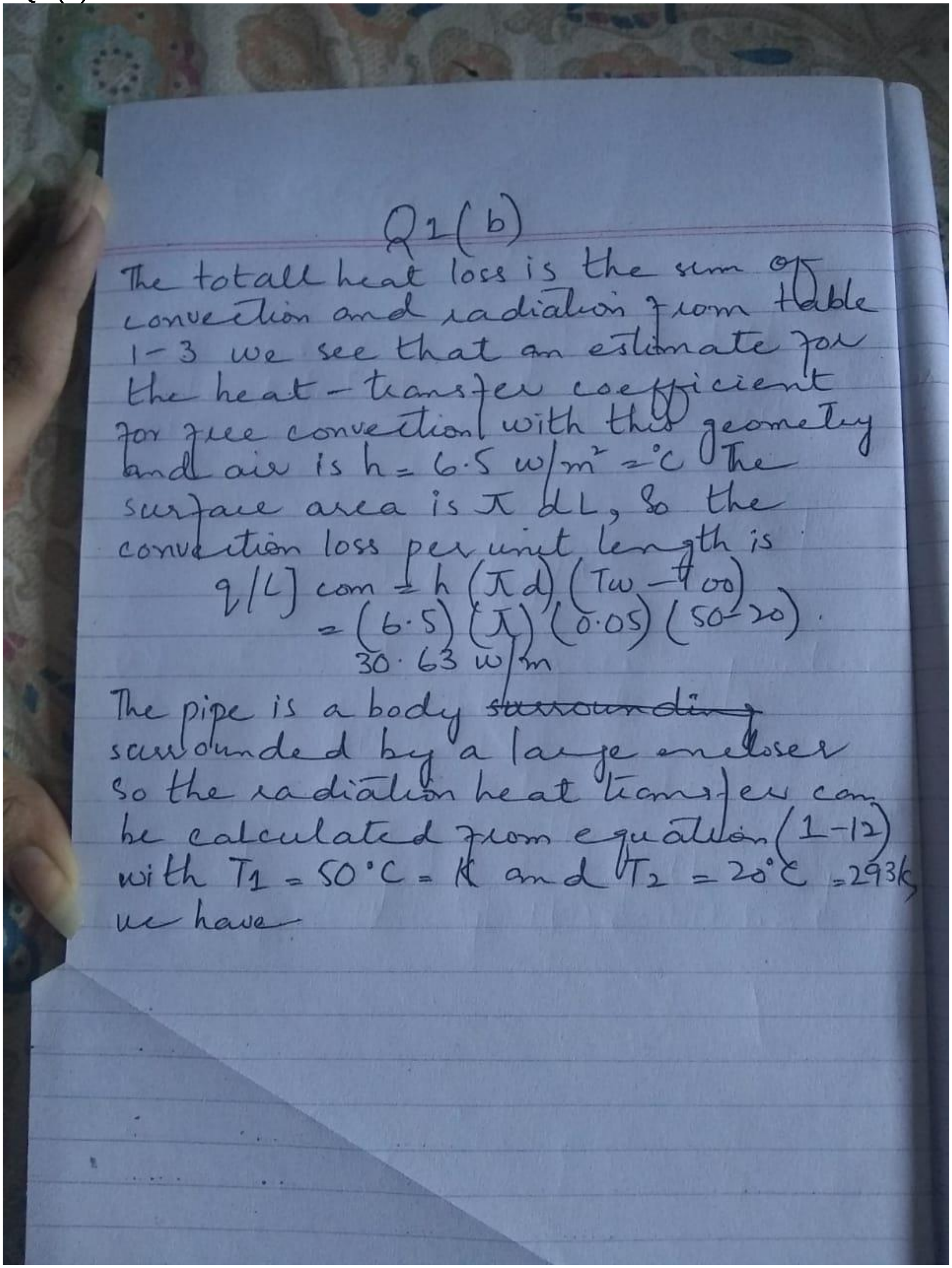
$$\frac{q}{L} = \frac{Ta - T_2}{\ln(r_3/r_2)/2\pi Ka} = 680 \text{w/m}$$

when Ta is the interface temperature which may be obtained as

$$Ta = 595.8°C$$

The largest thermal resistance clearly result from the insulation and the major portion of the temperature drop is through that inertial.

Q1(b)

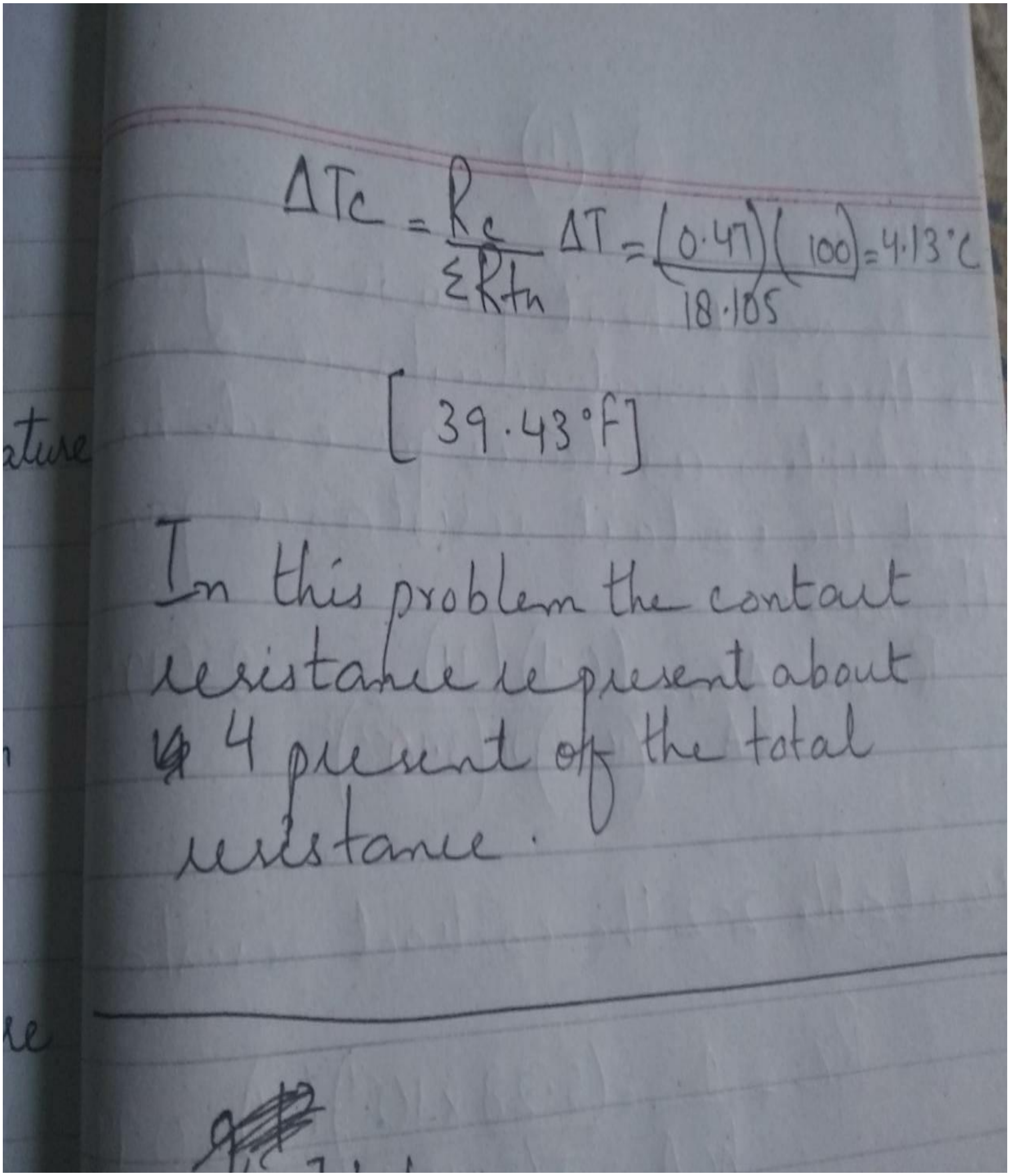


Q1(b)

The totall heat loss is the sum of convection and radiation from table 1-3 we see that an estimate for the heat-transfer coefficient for free convection with this geometry and air is $h = 6.5\ w/m^2 - {}^\circ C$ The surface area is $\pi\ dL$, So the convection loss per unit length is

$$q/L]_{com} = h(\pi d)(T_w - T_\infty)$$
$$= (6.5)(\pi)(0.05)(50-20).$$
$$30.63\ w/m$$

The pipe is a body ~~surrounding~~ surrounded by a large encloser so the radiation heat transfer can be calculated from equation (1-12) with $T_1 = 50^\circ C = K$ and $T_2 = 20^\circ C = 293K$, we have



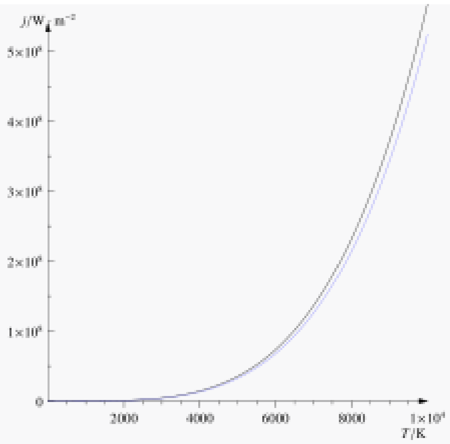
$$\Delta T_c = \frac{R_c}{\Sigma R_{th}} \Delta T = \frac{(0.47)(100)}{18.105} = 4.13°C$$

[39.43°f]

In this problem the contact resistance represent about 4 present of the total resistance.

Q1(A)

See also: Black body, Black-body radiation, Planck's law, and Thermal radiation



Graph of a function of total emitted energy of a black body proportional to its thermodynamic temperature . In blue is a total energy according to the Wien approximation, The **Stefan–Boltzmann law** describes the power radiated from a black body in terms of its temperature. Specifically, the Stefan–Boltzmann law states that the total energy radiated per

unit surface area of a black body across all wavelengths per unit time (also known as the black-body *radiant emittance*) is directly proportional to the fourth power of the black body's thermodynamic temperature *T*:

The constant of proportionality *σ*, called the Stefan–Boltzmann constant, is derived from other known physical constants. The value of the constant is

where *k* is the Boltzmann constant, *h* is Planck's constant, and *c* is the speed of light in a vacuum. The radiance (watts per square metre per steradian) is given by

A body that does not absorb all incident radiation (sometimes known as a grey body)

emits less total energy than a black body and is characterized by an emissivity, :

The radiant emittance has dimensions of energy flux (energy per unit time per unit area), and the SI units of measure are joules per second per square metre, or equivalently, watts per square metre. The SI unit for absolute temperature *T* is

the kelvin. is the emissivity of the grey body; if it is a perfect blackbody, . In the still more general (and realistic) case, the emissivity depends on the

wavelength, .

To find the total power radiated from an object, multiply by its surface area, :