Physics 102.13
Quiz#3
Chapter 18

Instructor: Dr. A. Mekki

Name: Key Id:

1. What mass of steam at 100 ^{0}C must be mixed with 150 g of ice at 0 ^{0}C, in a thermally isolated container to produce liquid water at 50 ^{0}C?

$Q_1 + Q_2 = 0$

Q_1: heat lost by steam $= -mL_v + mc\Delta T$

$= -m \times 540 + m \times 1 \times (50-100)$

$= -m \times 540 - m \times 50$

Q_2: heat gained by ice $= mL_f + mc\Delta T$

$= 150 \times 80 + 150 \times 1 \times (50-0)$

$= 19500$ cal

$-m(540+50) + 19500 = 0$

$m = \frac{19500}{590} = \boxed{33.1\ g}$

2. During a certain process, 300 J of work is done on the gas, while 100 cal of heat is lost. What is the change in internal energy of the gas during this process.

$\Delta E_{int} = Q - W$

$Q = -100 \times 4.186 = -418.6$ J

$W = -300$ J

$\Delta E_{int} = -418.6 + 300 = \boxed{-118.6\ J}$

Physics 102.14
Quiz#3
Chapter 18

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Name: Key Id:

1. A rectangular copper plate of area 20.00 cm^2 is at a temperature of 30 ^{0}C. What is the final temperature if the area of the copper plate is decreased by 0.015 cm^2? Thermal expansion coefficient of copper = 17 x 10^{-6} /C^0.

$$\Delta A = A_i \, 2\alpha \, \Delta T$$

$$\Delta T = \frac{\Delta A}{A_i \, 2\alpha} = \frac{-0.015}{20 \times 2 \times 17 \times 10^{-6}}$$

$$= -22 \ ^\circ C = T_f - T_i$$

$$\Rightarrow T_f = T_i - 22 = 30 - 22$$

$$\boxed{T_f = 8 \ ^\circ C}$$

2. How much heat is needed to raise the temperature of 100 g of ice at 0 ^{0}C to 20 ^{0}C? Heat of fusion of ice = 333 kJ/kg, specific heat of water = 4190 J/kg K.

$$Q = m L_f + m c \Delta T = 0.1 \times 333 \times 10^3 + 0.1 \times 4190 \times (20 - 0)$$

$$= 333 \times 10^2 + 838 \times 10^2 = \boxed{416.8 \times 10^2 \ J}$$

Physics 102.15
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Chapter 18

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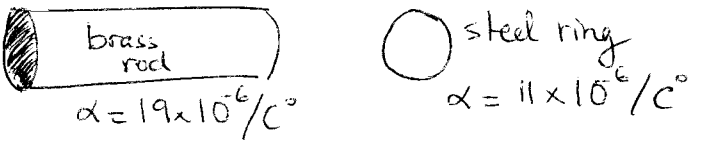
1. A brass rod is 3.000 cm in diameter at 25 ^{0}C. A steel ring has an interior diameter of 2.992 cm at 25 ^{0}C. At what common temperature if any will the ring just slide onto the rod? Thermal expansion of steel = 11 x 10^{-6} /C^0, thermal expansion of brass = 19 x 10^{-6} /C^0.



$$d_{f,rod} = d_{i,rod}\,(1 + \alpha_{brass}\,\Delta T)$$

$$d_{f,ring} = d_{i,ring}\,(1 + \alpha_{steel}\,\Delta T)$$

when $d_{f,rod} = d_{f,ring}$

$$\Rightarrow \quad d_{i,rod}\,(1 + \alpha_{brass}\,\Delta T) = d_{i,ring}\,(1 + \alpha_{steel}\,\Delta T)$$

$$3\,(1 + 19\times10^{-6}\,\Delta T) = 2.992\,(1 + 11\times10^{-6}\,\Delta T)$$

$$3 + 57\times10^{-6}\,\Delta T = 2.992 + 32.912\times10^{-6}\,\Delta T$$

$$10^{-6}\times 24.088\,\Delta T = -8\times10^{-3} \quad \Rightarrow \quad \Delta T = -322\ ^\circ C = T_f - T_i$$

$$T_f = T_i - 322 = \boxed{-307.1\ ^\circ C}$$

We have to cool below this temperature.

2. A certain substance has a mass of 20 g. When 300 J is added as heat, the temperature increases from 25.0 ^{0}C to 50 ^{0}C. What is the specific heat of this substance in J/kg K?

$$Q = m\,C\,\Delta T$$

$$C = \frac{Q}{m\,\Delta T}$$

$$= \frac{300}{0.02\times 25} = \boxed{600\ \ J/kg\,K}$$