TOPIC
Thermodynamics – Section 12 – Question 2

QUESTION
The specific heat of graphite over a temperature range of 200K to 800K is given by

$$C = 0.05749T^2 - 31.25T + 4370$$

where C is given in J/kg-K and temperature T is given in K. The amount of heat required in Joules to raise the temperature of 5 grams of graphite in an inert atmosphere from 400 K to 600K most nearly is

(A) 420
(B) 3309
(C) 3692
(D) 6316

HINTS
Note that the specific heat is not a constant but a function of temperature.

SOLUTION
The heat required, W is

$$W = m\int_{T_0}^{T_f} cdT$$

where

m = mass,
T_0 = initial temperature,
T_f =final temperature,
c =specific heat as a function of temperature, T.

Given

$m = 0.005\text{kg}$
$T_0 = 400K$
$T_f = 600K$

$$W = m\int_{T_0}^{T_f} cdt$$

$$W = 0.005\int_{400}^{600}(0.05749T^2 - 31.25T + 4370)dT$$

$$= 0.005\left[0.05749\frac{T^2}{3} - 31.25\frac{T^2}{2} + 4370T\right]_{400}^{600}$$

$$= 3309J$$

ANSWER
(B)

CONTRIBUTOR

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