CH365 Chemical Engineering Thermodynamics

Lesson 3
Review

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Lesson 3 Problems

Problem 1.20

Verify that the SI unit of kinetic and potential energy is the joule.

Problem 1.22

The turbines in a hydroelectric plant are fed by water falling from a 50-m height. Assuming 91% efficiency for conversion of potential to electrical energy, and 8% loss of the resulting power in transmission, what is the mass flow rate of water required to power a 200-watt light bulb?

Problem 1.27

Energy costs vary greatly with energy source: coal @ $35.00/ton, gasoline @ a pump price of $2.75/gallon, and electricity @ $0.1000/kWhr. Conventional practice is to put these on a common basis by expressing them in $/GJ. For this purpose, assume gross heating values of 29 MJ/kg for coal and 37 GJ / m^3 for gasoline.

(a) Rank order the three energy sources with respect to energy cost in $/GJ.

(b) Explain the large disparity in the numerical results of Part 9a). Discuss the advantages and disadvantages of the three energy sources.

Problem 1.29

A laboratory reports the following vapor-pressure (P^{sat}) data for a particular organic chemical:

t/ °C	P^{sat} / kPa
-18.5	3.18
-9.5	5.48
0.2	9.45
11.8	16.9
23.1	28.2
32.7	41.9
44.4	66.6
52.1	89.5
63.3	129
75.5	187

Correlate the data by fitting them to the Antoine equation:

$$\ln P^{sat} / \text{kPa} = A - \frac{B}{T / K + C}$$

That is, find numerical values of parameters A, B, and C by an appropriate regression procedure. Discuss the comparison of correlated and experimental values. What is the predicted normal boiling point of this chemical (i.e., the temperature at which the vapor pressure is 1 atm).