

Thermodynamics Homework 5

The higher the temperature a substance is, the more kinetic energy its molecules have. The kinetic energy of a molecule can be calculated with the following equation:

$$E = \frac{3}{2}kT$$

Where "E" is the kinetic energy of the molecule measure in Joules."k" is a constant, $k=1.38 \times 10^{-23}$ J/K . And "T" is the temperature of the substance measured in Kelvin (NOT $^{\circ}\text{F}$ or $^{\circ}\text{C}$).

1. Calculate the kinetic energy of a molecule at the following temperatures:
 - a. 600K
 - b. 373K
 - c. 273K
 - d. 100K
 - e. 10,000K
 - f. 0K (absolute zero)
2. There are two substances both at a temperature of 300K. Helium Gas (HE) and liquid Mercury (Hg). What is the kinetic energy of a molecule in each of the substances? Which substance has its molecules moving faster?
3. A rock is thrown up into the air at 16m/s. How long will it take to get back down to where it was thrown?
4. A car accelerates from 10m/s to 22m/s while traveling a distance of 1400m. What is the acceleration of the car?
5. A machine does 4500J of work in 30s. What is the power output of the machine?
6. The kinetic energy of a molecule is 4.0×10^{-18} J. What is the temperature of the substance where the molecule is found?
7. A 2.0kg weight is twirling in circles. The radius of the circle is 1.30m and it goes around the circle 3 times per second. What is the centripetal force needed to stay in a circle?
8. What is the momentum of a 10,000kg train traveling at 3.0m/s?
9. A train is traveling at 125 km/hr for 3.0 hours. How far will the train travel?
10. If a person falls off a building and onto cement, they will die, but if they landed on a giant pile of pillows they might live. Explain why this is true in terms of Impulse, change in momentum, force and time.