

## Average Value, Center of Mass and Work

1. If a cup of coffee has temperature  $95^\circ\text{C}$  in a room where the temperature is  $20^\circ\text{C}$ , then, according to Newton's Law of Cooling, the temperature of the coffee after  $t$  minutes is  $T(t) = 20 + 75e^{-t/50}$ . What is the average temperature of the coffee during the first half hour? At what time the temperature is equal to this average temperature?
2. The linear density in a rod 8 m long is  $12/\sqrt{x^2 + 1}$  kg/m, where  $x$  is measured in meters from one end of the rod. Find the average density of the rod.
3. The masses  $m_1 = 6$  kg,  $m_2 = 5$  kg and  $m_3 = 10$  kg are located at the points  $P_1 = (1, 5)$ ,  $P_2 = (3, -2)$  and  $P_3 = (-2, -1)$ , respectively. Find the moments and the center of mass of the system.



7. A tank has the shape of an inverted circular cone with height 10 m and base radius 4 m. It is filled with water to a height of 8 m. Find the work required to empty the tank by pumping all of the water to the top of the tank. (The density of water is  $1000 \text{ kg/m}^3$ .)

8. A 100 kg cable is 50 m long and hangs vertically from the top of a tall building. How much work is required to lift the cable to the top of the building?