

2018-2019 Term 2

PHYS1001 Essential Physics

Assignment 5

Due date: 12th March, 2019 by 6:00 pm

(Please leave your homework in the box with the label “PHYS 1001” outside room 213 in Science Centre North Block)

Please answer all six questions

1. A small immersion heater rated at 500 W is used to heat a cup of water with mass M .
 - (a) The temperature of the water raised from 20°C to 80°C in 6 minutes. Given the specific heat capacity of water is 4186 J/kg/°C, estimate the mass M .
 - (b) List two assumptions made in above estimation. Do you think your value of M in part (a) is overestimated or underestimated? Explain your answer.
2. Steam with a mass of 20 g and at a temperature of 100 °C is added to 100 g of ice at 0 °C. Calculate the final temperature of the mixture when equilibrium is reached. The specific heat capacity of water is 4186 J/kg/°C. The latent heat of fusion and vaporization of water are 3.33×10^5 J/kg and 22.6×10^5 J/kg respectively.
3. A 50 g bullet is initially moving at 200 m/s. It is embedded into a block of ice at 0°C before stopping. Assuming the temperature of the bullet does not have any significant change, calculate how much ice is melted as a result of this collision. Given the latent heat of fusion of ice is 334 kJ/kg.
4. A car is parked in an outdoor carpark in a sunny day. It is found that the temperature in the car is higher than the outside temperature (i.e. the car behaves like a greenhouse). Applying the concepts of heat transfer (e.g. conduction, convection, radiation) you have learnt in lectures, explain why the temperature in the car is higher than the outside temperature.
5. Dry sand and water with mass m_{sand} and m_{water} respectively are mixed together. The specific heat capacity of the mixture $c_{mixture}$ is measured to be 1200 J/kg/°C. It is known that the specific heat capacity of dry sand c_{sand} and the specific heat capacity of water c_{water} are 900 J/kg/°C and 4186 J/kg/°C respectively.
 - (a) Show that the mass ratio between water and dry sand is given by:
$$\frac{m_{sand}}{m_{water}} = \frac{c_{mixture} - c_{water}}{c_{sand} - c_{mixture}}$$
 - (b) What is the mass ratio $m_{sand} : m_{water}$?
6. It is known that the specific heat capacity of water is higher than that of ethanol. If a glass of water at 100°C of mass m is mixed with a glass of ethanol at 0°C of the same mass, will the temperature of the final solution be higher or lower than 50°C? Explain your answer.