4. (a) A well-lagged uniform cylindrical rod is 20.0 cm long and has a diameter of 2.00 cm. One end of it is in thermal contact with a hot reservoir maintained at a temperature of $150°C$ while the other end is in thermal contact with a very large block of ice at temperature $0°C$.

(i) It is found that the ice block is melting at a rate of $0.1683 \text{ kg min}^{-1}$. What is the thermal conductivity of the material of the rod?

[$400 \text{ W m}^{-1} \text{K}^{-1}$]

(ii) Calculate the rate of change of the entropy of the system comprising the hot and cold reservoirs and the rod.

[0.1224 J K^{-1}]

[5 marks]

[Latent heat of fusion of ice $= 3.36 \times 10^4 \text{ J kg}^{-1}$]