

## M05T.1 - Thermodynamics of Solid Argon

### Problem

At atmospheric pressure and low temperature the specific heat of solid argon (melting point 84K) is

$$c_p = 49.9(T/\theta)^3 \text{ kJ/kg K}$$

where  $\theta = 92 \text{ K}$  is the Debye temperature.

- a) What is the specific entropy  $s$  as a function of  $T$  and as a function of the specific energy  $u$ ? Use Nernst's third law if needed.
- b) How much energy is needed to warm 100 g of argon from 4 K to 20 K?
- c) What is the minimum energy needed to cool it back to 4 K given that the temperature of the environment is room temperature, 20°C, and that no colder body is available?