Q- A 3.00-g lead bullet at 30.0 degrees C is fired at a speed of 240 m/s into a large block of ice at 0 degrees C, in which it embeds itself. What quantity of ice melts? (Specific heat capacity of lead is 128 J/kg/^{0}C and latent heat of melting of ice is $333*10^3$ J/kg)

Answer:

The Amount of energy given to the ice is the kinetic energy of the bullet and the heat released by the bullet in cooling down to 0^oC.

The kinetic energy of the bullet = (1/2) $mv^2 = 0.5*3*10^{-3}*240^2 = 86.4$ J

The energy released by the bullet in cooling down to 0^0C

$m\ s\ \Delta t = 3*10^{-3}*128*(30 - 0) = 11.52$ J

Here s = 128 J/kg/^{0}C is the specific heat capacity of lead.

Hence the total heat given to the ice = 86.4 + 11.52 =97.92 J

The latent heat of melting of ice is $L = 333*10^3$ J/kg

Hence mass of the ice melted is given by m' = heat absorbed/latent heat
= $97.92/(333*10^3) = 0.294*10^{-3}$ kg.
= 0.294 g