In-class problem linked to lecture pages 128-137

Consider a chemical reaction $2A+B \rightarrow C$. Suppose we produce 1 mole of C at 500K and atmospheric pressure. The molar heat capacities of these substances at atmospheric pressure are all zero between 0 and 10K, and above 10K are given by:

$c_A = 93$ cal/mole-K

$c_B = 86$ cal/mole-K

$c_C = 262$ cal/mole-K

(*a*) Will this reaction absorb or release heat?

(*b*) How much, in Joules?

$dQ = T\,dS$

$$S_A(500K) = \int_0^{500} \frac{c_A\,dT}{T} = 93\int_{10}^{500} \frac{dT}{T} = 93\ln 50$$

$S_B = 86 \ln 50$

$S_C = 262 \ln 50$

$\Delta S = [262 - 86 - 2(93)]\ln 50$

$= -39.12$

$\Delta Q = T\Delta S = 500(-39.12) = -19560 \text{ cal} = -81840 \text{ J}$

negative ... integral