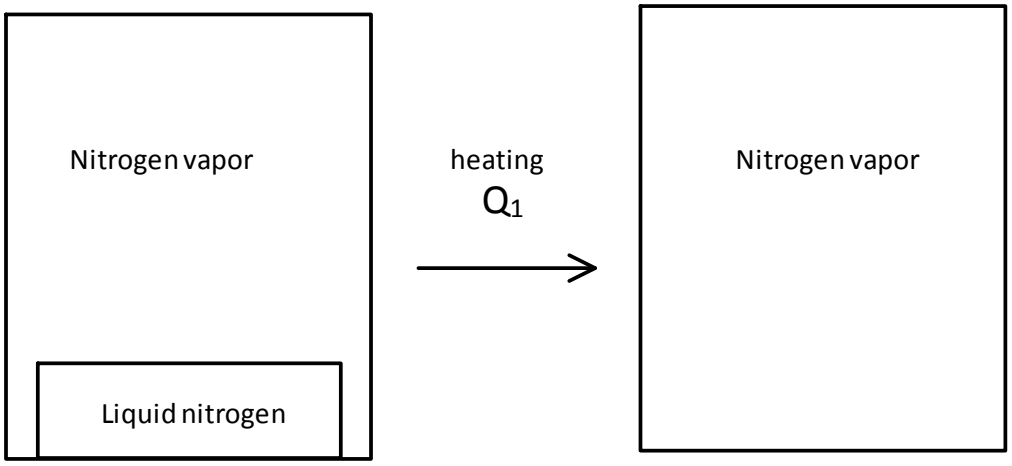
Question 1.

Estimate how much energy input by heating was transferred into the nitrogen.

Phase change liquid to vapor (constant volume)

Neglect air in container for energy calculations

Mostly vapor by volume
Mostly liquid by mass



Temperature = 77K
Pressure = 1 atm
Volume = 2L

Temperature increases
Pressure increases
Volume = 2L

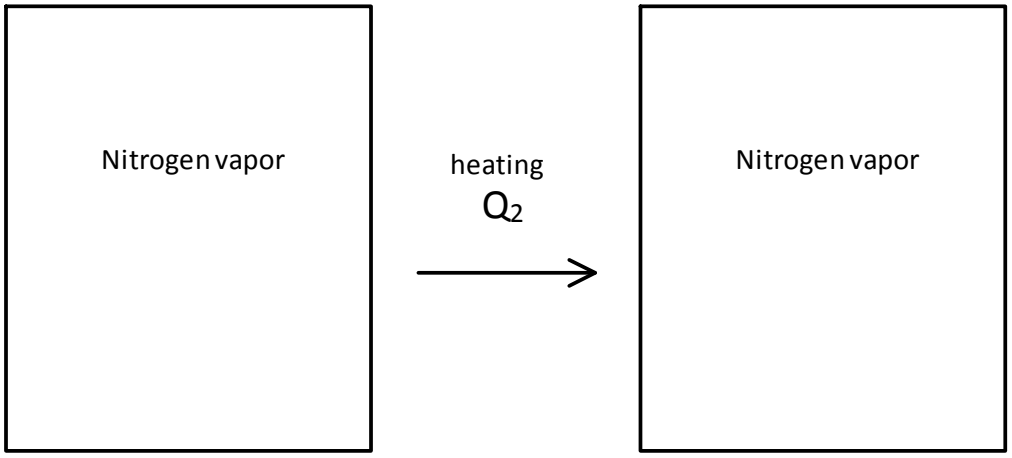
Mass of 50 ml of liquid nitrogen

$m = \rho V = (0.808 g/ml)(50 ml) = 40.4$ grams

*Energy input by heating

$Q_1 = mL_v = (40.4g)(199 J/g) = 8040$ J

Heating nitrogen vapor to 300K (80^{o}F)



Temperature = T, assume about 77K
Pressure = P
Volume = 2L

Temperature = 300K
Pressure increases
Volume = 2L + a little (container expands)

*Energy input by heating (constant volume)

$Q_2 = mc_v\Delta T = (40.4g)(0.743J/gK)(300K\text{-}77K) = 6700\ J$

Estimate for total amount of energy input by heating

$Q = Q_1 + Q_2 = 14{,}740\ J$

About 15,000 J

*Approximations where made to simplify the calculations. The phase change did not occur under constant temperature or pressure. The heating of the nitrogen vapor starts at a higher temperature then 77K. Also the specific heat at constant volume changes a bit with temperature The air in the contain was not considered in these energy calculations. Even with these approximations, I think the result of several thousand Joules is a good estimate.