

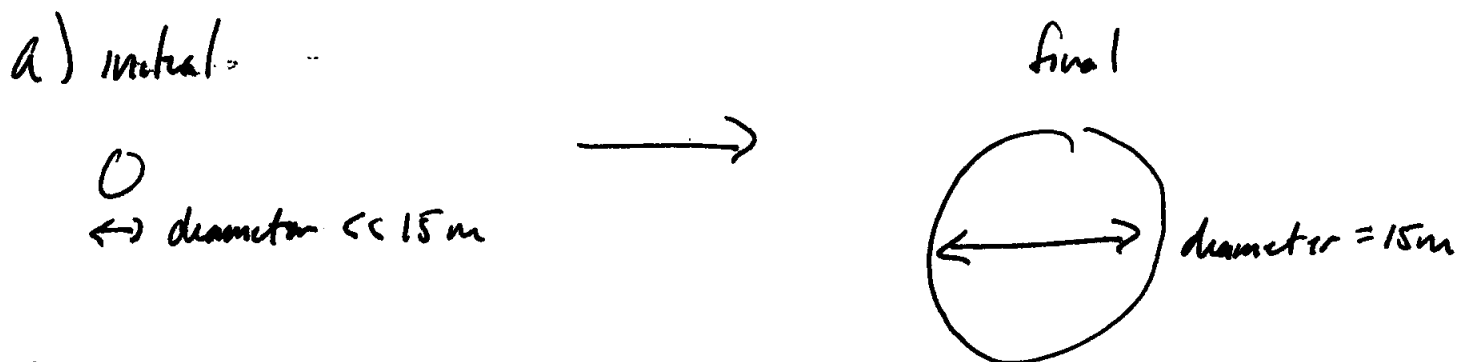
CH353 – Physical Chemistry I
Spring 2015, Unique 51170

Quiz 3, 24 February 2015

Let's think again about our weather balloon from Quiz 1. To remind you, this weather balloon is filled with hydrogen gas and released from a ground-based weather station, then slowly rises through the atmosphere recording and relaying weather conditions. It eventually achieves an altitude of 60,000 ft (~18 km); at this altitude, the weather balloon is 15 m in diameter. Assume the balloon is spherical and that it is a closed system.

a) Draw the initial and final states of this system.

b) Determine whether the following quantities are greater than zero, equal to zero, or less than zero, or if there is not enough information to determine: ΔT , ΔV , ΔP , ΔU , ΔH , ΔS_{sys} , ΔS_{surr} , and ΔS_{tot} .



b)

$\Delta T < 0$	$\Delta U < 0$	(because $\Delta T < 0$)
$\Delta V > 0$	$\Delta H < 0$	
$\Delta P < 0$		

b) continued:

ΔS_{sys} is being influenced by two competing considerations:

$$V_f > V_i \text{ (so } \Delta S_{\text{sys}} \uparrow)$$

$$T_f < T_i \text{ (so } \Delta S_{\text{sys}} \downarrow)$$

Which one is more important? You know the balloon rises, so this process does happen spontaneously. You also know that this process is not reversible (in fact it is expansion against constant pressure). So $\Delta S_{\text{TOT}} > 0$. $\therefore \Delta S_{\text{sys}} > 0$ as well.

$$\Delta S_{\text{surr}} = \frac{q_{\text{surr}}}{T_{\text{surr}}}, \quad q_{\text{surr}} > 0 \text{ (from heat transfer from}$$

System to surroundings), so $\Delta S_{\text{surr}} > 0$ also (although this

is probably very small)