Two cylinders each contain n moles of the same ideal gas. Each cylinder has a piston of mass M that is free to move without friction. No gas can enter or leave either cylinder. Initially, both gas samples are at room temperature, have the same volume, and are at the same pressure.

A. Is the pressure in the cylinders *greater than, less than,* or *equal to* atmospheric pressure? Explain.

Greater. $p = p_{atm} + \dfrac{Mg}{A}$ ← weight of piston / area

The piston in cylinder A is now locked into place while that in cylinder B is left free. Each cylinder is placed in an identical, closed, thermally insulated box containing identical amounts of an ice and water mixture at 0°C, as shown at right. After the contents of each box have come to equilibrium amongst themselves, it is observed that some ice remains in each mixture.

(You may find it helpful to draw P-V diagrams in answering the following questions.)
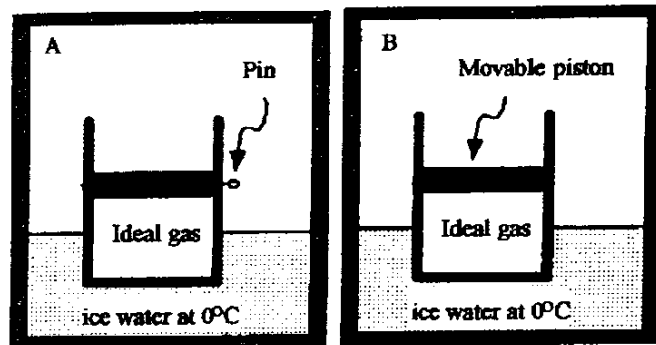
cylinders when *initially* placed in insulating containers

B. Is the final temperature of the gas in cylinder A *greater than, less than,* or *equal to* the final temperature of the gas in cylinder B? Explain your answer briefly.

Equal. Both are in thermal equilibrium with the ice/water/vapor mixture at T_2.
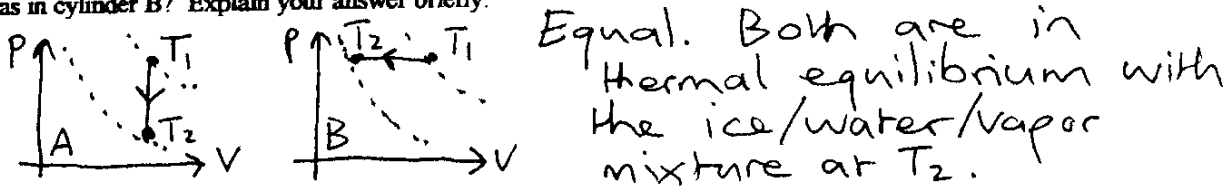
C. Is the final pressure of the gas in cylinder A *greater than, less than,* or *equal to* the final pressure of the gas in cylinder B? Explain your answer briefly.

Less than. See p-V diagrams.

Isovolumetric   vs   isobaric
(isochoric) A   B

D. Is the final volume of the gas in cylinder A *greater than, less than,* or *equal to* the final volume of the gas in cylinder B? Explain your answer briefly.

Greater than. See p-V diagrams.

E. Is the amount of ice left in the box containing cylinder A *greater than, less than,* or *equal to* the amount of ice left in the box containing cylinder B? Explain your answer briefly.

Let Q = heat flowed from gas to ice.

$Q_A = c_V m(T_1 - T_2)$ and $Q_B = c_p m(T_1 - T_2)$

$c_p = c_V + R$ ∴ $Q_B > Q_A$ ∴ more ice melts in B

∴ more ice is left in A!