Question 1 cont...

using the notion of "material derivative" with our little man walk ~~&~~ having trajectory $x = vt$ (at $t=0$, $x=0$, constant velocity)

$$\frac{\partial x}{\partial t} = v$$

we have $$\frac{dP}{dt} = \frac{\partial P}{\partial t} + \frac{\partial x}{\partial t} \times \frac{\partial P}{\partial x}$$

$$= \frac{\partial P}{\partial t} + v\frac{\partial P}{\partial x}$$

$$= \frac{P_e - P_{co}}{RT}x + v\left(\frac{P_e - P_{co}}{RT}\right)(t-T)$$

$$= \frac{P_e - P_{co}}{RT}vt + v\left(\frac{P_e - P_{co}}{RT}\right)(t-T)$$

$$\boxed{\frac{dP}{dt} = \frac{v(P_e - P_{co})}{RT}(2t - T)}$$

max/min @ $\frac{dP}{dt} = 0 \Rightarrow t = T/2$

we can also see by ~~subbing in~~ $\frac{d^2P}{dt^2} = \frac{2v(P_e - P_{co})}{RT} > 0 \Rightarrow$ min

$\boxed{\text{cheapest price @ } t = T/2,\ x = \frac{vT}{2}}$

$$P = \int \frac{v(P_e - P_{co})}{RT}(2t - T)\,dt = \frac{v(P_e - P_{co})}{RT}\left[t^2 - Tt\right] + C$$

@ $t=0$, $P = P_e$

$$\rightarrow P = \frac{v(P_e - P_{co})}{RT}\left[t^2 - Tt\right] + P_e$$

@ $t = T/2$ and subbing in values $P =$ ~~[illegible]~~ 263.75 kr/kg

$\boxed{\text{with 100kr little man buys 0.3791... kg}}$