① a) $x<0$ $\quad -\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} = +i\hbar\frac{\partial\psi}{\partial t} \rightarrow \psi(x,t) = \varphi(x)\,\tau(t)$

$\tau(t) = e^{-iEt/\hbar t}$

$-\frac{\hbar^2}{2m}\frac{d^2\varphi}{dx^2} = E \rightarrow \varphi_1(x) = A e^{ikx} + B e^{-ikx} \quad / \quad k = \frac{\sqrt{2mE}}{\hbar}$

$x>0 \qquad \varphi_2(x) = C e^{ikx}$

b) $\varphi_1(x=0) = \varphi_2(x=0) \rightarrow A+B = C \rightarrow B = C-A$

$\left.\frac{d\varphi}{dx}\right|_{x=0^-} = ik(A-B) \qquad \left.\frac{d\varphi_2}{dx}\right|_{x=0^+} = ikC$

$ik(C-A+B) = -\frac{2mS}{\hbar^2}C \rightarrow 2ik(C-A) = -\frac{2mS}{\hbar^2}C \rightarrow C = \frac{ikA}{mS/\hbar + ik}$

Llamamos $\alpha = \frac{mS}{\hbar^2} \rightarrow C = \frac{ikA(\alpha - ik)}{\alpha^2+k^2} = \frac{Ak(k-i\alpha)}{\alpha^2+k^2}$

$$T(E) = \frac{C^* C}{A^* A} = \frac{k^2(k^2+\alpha^2)}{(\alpha^2+k^2)^2} = \frac{k^2}{\alpha^2+k^2} = \frac{1}{\alpha^2/k^2+1} \quad / \quad \frac{\alpha^2}{k^2} = \frac{m^2S^2}{\hbar^4}\frac{\hbar^2}{2mE}$$

$$\boxed{T(E) = \left(1+\frac{mS^2}{2\hbar^2 E}\right)^{-1}}$$

② $\gamma = 1{,}25$. $\qquad \Delta t' = 2h$

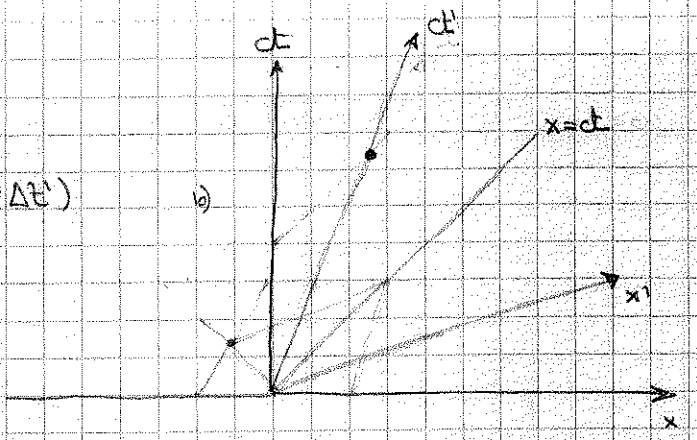
a) $\Delta t = \gamma\left(\Delta t' + \frac{v}{c^2}\Delta x'\right) \; ; \; \Delta x = \gamma(\Delta x' + v\Delta t')$

$\Delta t_p = \gamma\Delta t' - \frac{\Delta x}{c}$

$\Delta t_p = \gamma\Delta t' - \frac{\gamma}{c}(\Delta x' + v\Delta t')$

$\Delta t_p = \gamma(1-v/c)\Delta t' = \frac{(1-v/c)}{(1-v/c)^{1/2}(1+v/c)^{1/2}}\Delta t' = \sqrt{\frac{1-v/c}{1+v/c}}\Delta t' = 1\text{ hora}$

b)



c) Trayecto recorrido por la nave durante el examen. $\Delta x_A = v\Delta t = \gamma v\Delta t' = 1{,}5c$

Trayecto recorrido por la nave mientras llega señal a Tierra $\Delta t_B = \frac{\Delta x_A}{c} = 1{,}5h$

$\Delta x_B = v\Delta t_B = 0{,}9c$

Trayecto recorrido por la nave mientras corrige ($\Delta t = 2h$) : $\Delta x_C = v\Delta t = 1{,}2c$

Trayecto recorrido por la nave mientras llega a resultados : $\Delta x_D = v\Delta t_D$

$\Delta t_D = \frac{\Delta x_A + \Delta x_B + \Delta x_C + \Delta x_D}{c} \Rightarrow (\Delta t_D = 9h \quad \Delta t_T = 12{,}5h)$ $\boxed{\Delta t_T = 10\text{ horas}}$