Question 1

A particle with energy E is incident on a barrier with width L and height U_0. In the region around the right edge,

$$\psi_{II}(x) = Ce^{\alpha x} + De^{-\alpha x}$$

$$\psi_{III}(x) = Fe^{ikx}$$

where

$$k = \sqrt{2mE/\hbar^2}$$

$$\alpha = \sqrt{2m(U_0 - E)/\hbar^2}$$

Which of the following results from boundary conditions at $x = L$?

1. $C + D = F$
2. $C - D = F$
3. $Ce^L + De^L = Fe^{iL}$
4. $Ce^L - De^L = Fe^{iL}$
5. $Ce^{\alpha L} + De^{-\alpha L} = Fe^{ikL}$
6. $Ce^{\alpha L} - De^{-\alpha L} = Fe^{ikL}$

Question 2

Consider a particle tunneling through a barrier. Assume that $E = U_0/2$ and that the wide barrier approximation holds and that for a particular width the transmission coefficient is

$$T = \frac{1}{10}.$$

Now suppose that with the various energies held fixed, the width of the barrier is doubled. Which of the following gives the transmission coefficient for the new width?

1. $T = \frac{1}{10}$
2. $\frac{1}{20} < T < \frac{1}{10}$
3. $\frac{1}{100} < T \leqslant \frac{1}{20}$
4. $T = \frac{1}{100}$
5. $T < \frac{1}{100}$