1.1 Differentiate and collect terms and the results follows.

1.2 Perform the Gaussian integration by completing the square, and the stated result follows.

1.3 Solution in text.

1.4 Apply Eq.(1.11) to an energy eigenfunction.

1.5 Multiply the Schrodinger equation by the complex conjugate wave function and intregate the equation over space. Perform a partial integration on the kinetic energy term and the result follows.

1.6 Multiply the time-independent Schrodinger equation by the complex conjugate energy eigenfunction. Multiply the time-independent Schrodinger equation for the complex conjugate energy eigenfunction by the energy eigenfunction. Note that the right hand side of these two equations are the same. The required result results from subtracting the two equations.

2.1 Evaluate the Gaussian integrals.

2.2 Solution in text.

2.3 Direct calculation of the corresponding probability currents gives the stated results.

2.4 Repeat the analysis of Section 2.3 for the asymmetric case, and the stated results follows.

2.5 Insert the expressions from Eq.(2.69) and Eq.(2.70) into Eq.(2.71) and note that cancellations leads to the stated result.

2.6 Performing the limiting processes give the stated result.

2.7 Performing the limiting proces in Eq.(2.69) gives the stated result.

2.8 Inserting the explicit expressions gives the stated result.

2.9 The substitution gives

$|T_{12}|^{2}=m^2V^2/k^2k_B^2\hbar^4 (\sin(k_Ba_B))^2$

which is to be inserted into the expression for the reflection coefficient

$R= |T_{12}|^{2} / (1+|T_{12}|^{2})$.

2.10 Insert the expression in Eq.(2.75) into Eq.(2.78) to obtain the stated result for the transmission probability.

2.11 Follow the instructions to obtain the stated result.

3.1 Inser the spin-lees version of Eq.(3.7) into Eq.(3.8) and perform the integrations to obtain the stated result (perhaps try first the case of a few-particle state).