Phys 511 — Prof. P. Berman
Quantum Mechanics I — Fall, 2003

Problem Set 12
Due Friday, December 5
Final Exam – Tuesday, Dec. 16   1:00-4:00 Room 340 West Hall
A list of equations will be provided.

Do as many of these problems as time permits. Most of them are simple and short. The grade will be based on 40, but, as a bonus, anyone answering at least *seven* questions will receive full credit. (of course, the more you answer, the smarter you'll get). In any event, at least *read* all the questions. Any grade over 40 will be counted as extra credit.

There will be a review session on Thursday, Dec. 11 from 4-5:30 in room 4246 Randall.

1. Obtain an expression for the differential cross section in first Born approximation for scattering by a potential well. Plot the differential cross section (in units of $\beta^4 a^2$) as a function θ for $ka = 1, 10, 100$. Plot the total cross section (in units of $4\pi\beta^4 a^2$) as a function of ka. What are the validity limits for your results?
2. Calculate the differential scattering cross section in first Born approximation for a potential $V(r) = V_0 e^{-r^2/a^2}$. Plot your results as a function of θ for $(2\mu V_0/\hbar^2)^{1/2} a = 0.5$ and $(2\mu E/\hbar^2)^{1/2} a = 2.$ In general, when would you expect the Born approximation to be a good approximation for this potential?
3. Problem 57.
4. Problem 63. Check using Mathematica or some other program.
5. Problem 64. Check using Mathematica (MatrixExp) or some other program.
6. Problem 65.
7. Problem 66.
8. Problems 68 and 69. What is the significance of these results?
9. Problem 73.
10. Problem 74.
11. Problem 75a.
12. For $\ell = 1$, write eigenkets $|\ell_x\rangle$ and $|\ell_y\rangle$ in terms of the $|\ell_z\rangle$ basis.
13. Problem 79.