List of problems (from the textbook):

4.6
4.7
4.8
4.9 (solve for bound state only)

Hints:

For problem 4.6, the trick is to integrate by-part $l$ times in order to bring all the derivation terms in one same term. You should get $l$ boundary terms plus on final integral. You can show that all the boundary terms are zero because they all contain at least one factor $(x^2-1)$ which becomes zero when you take the value at $x = -1$ and $x = 1$. You then need to take care of the final integral. Discuss the three cases $l > l'$, $l < l'$ (same result by symmetry) and $l = l'$. Remember that deriving an $n$th order polynomial more than $n$ times gives zero. For $l = l'$, we will need to calculate the integral. Use a change of variable $x = \cos \theta$ useful formulae:

$$
\frac{d^n}{dx^n}(x^n) = n! \quad \text{and} \quad \int_0^\pi \sin^{2l+1}\theta d\theta = 2 \frac{2 \cdot 4 \cdot 6 \cdots (2l)}{1 \cdot 3 \cdot 5 \cdots (2l+1)} = 2 \frac{(2l)!}{(2l+1)!}
$$

For problem 4.9: solve for a bound state only, write the solution inside and outside the spherical well. Use the continuity of $u$ and $du/dr$ at the boundary $r = a$. Show that these conditions are equivalent to solving an equation like $\sqrt{\left(\frac{z_0}{z}\right)^2 - 1} = -\tan^{-1}(z)$ . Discuss in which case there is a solution.