

# Advanced Undergraduate Quantum Mechanics: List of corrections

October 30, 2018

1. Page 111, Problem 45 Task 1 must read
  1. Find Hermitian conjugate and inverse matrix and convince yourself that operator  $\hat{H}/\hbar\omega$  is simultaneously Hermitian and unitary.
2. Page 141 Eq. 5.74 for Legendre polynomials misses a normalization factor and contains an unnecessary Condon-Shortley phase. Eq. 5.74 and the line following it must read

$$P_l^m(x) = \frac{1}{2^l l!} (1-x^2)^{|m|/2} \frac{d^{l+|m|}}{dx^{l+|m|}} (x^2-1)^l,$$

where factor  $(-1)^m$  known as Condon-Shortley phase is excluded from the definition (it is included instead in the spherical harmonics in Eq. 5.76).

3. Page 160, Problem 70. In the sentence following the expression for the matrix, words “as a basis” must be removed.
4. Page 199, Problem 81. Numerical values for parameters  $a$  and  $b$  must be interchanged:  $a = 0.42 \text{ nm}$ ,  $b = 0.12 \text{ nm}$ .
5. Page 249, Eq.716 must read

$$\langle \hat{\mathcal{E}}_0^2(t) \rangle = -\frac{\hbar}{2} (\alpha^* e^{i\omega t} - \alpha e^{-i\omega t})^2 + \frac{\hbar}{2}$$

(the current version misses a negative sign in front of parenthesis and the negative sign in the argument of the exponential function).

6. Page 250, Problem 87. In the right-hand-side of the expression in the problem factor  $\exp(-y^2/2)$  must be replaced by

$$\exp\left(\frac{y^2}{2}\right).$$

7. Page 258, Eq. 8.7. Inside the parenthesis in the first term, the partial derivative symbol  $\partial$  must be replaced with the regular derivative symbol  $d$ .

8. Page 264, Eq. 8.19 misses a factor  $1/q!$  in the expression for Laguerre polynomials. Must read

$$L_q(x) = \frac{1}{q!} e^x \left( \frac{d}{dx} \right)^q (e^{-x} x^q).$$

9. Page 272, Problem 111. The first term in the expression for the wave function must read

$$\frac{1}{\sqrt{8\pi}} R_{1,0}(r).$$

10. Page 290, Eq. 9.31 must read

$$|\chi(t)\rangle = a \exp\left(-i \frac{\mu_B B}{\hbar} t\right) |\uparrow\rangle + b \exp\left(i \frac{\mu_B B}{\hbar} t\right) |\downarrow\rangle.$$

(the signs of the arguments of the exponential function must be exchanged). In Eq. 9.34 the time-dependent exponential factor in the first line must read  $\exp\left(-i \frac{\mu_B B}{\hbar} t\right)$  and in the second line it must be  $\exp\left(i \frac{\mu_B B}{\hbar} t\right)$ . Similar changes are needed in the subsequent equations for  $\hat{S}_x$  (signs of the argument of the time-dependent exponential factors in the first and the second lines must be swapped. In the expression for  $\langle \hat{S}_x \rangle$  the signs of the argument of the time-dependent exponential factors in the first and the second terms must be swapped and the final expression for  $\langle \hat{S}_x \rangle$  must have sign “+” before  $\varphi$  in the argument of the cosine function. The expression for  $\langle \hat{S}_y \rangle$  in the line below must read

$$\langle \hat{S}_y \rangle = -\frac{\hbar}{2} \sin \theta \sin \left( \frac{2\mu_B B}{\hbar} t + \varphi \right).$$

The same changes must be made in Eq. 9.36, which now must read

$$\begin{aligned} \langle \hat{S}_z \rangle &= \frac{\hbar}{2} \cos \theta, \\ \langle \hat{S}_x \rangle &= \frac{\hbar}{2} \sin \theta \cos \left( \frac{2\mu_B B}{\hbar} t + \varphi \right), \\ \langle \hat{S}_y \rangle &= -\frac{\hbar}{2} \sin \theta \sin \left( \frac{2\mu_B B}{\hbar} t + \varphi \right). \end{aligned}$$

11. Page 326, Problem 131. The value for  $m_J$  must be changed to  $m_J = 1/2$ .
12. Pages 494 and 495. Starting with Eq. 14.58 and till the end of the Section, parameters  $E_{2,sup,1-1/2}$  and  $E_{2,sup,1,1/2}$  must be replaced by  $\Delta E_{2,sup,1-1/2}$  and  $\Delta E_{2,sup,1,1/2}$  respectively.

13. Page 504, Eq. 15.13. In the second line of the equation factor  $e^{-iE_mt/\hbar}$  must be placed behind the summation sign  $\sum_m$  but in front of the integral symbol.
14. Page 537, Eq. 15.75. Symbol  $\varepsilon_m$  appearing in the denominators in this formula shall not be there.
15. Page 539, expression for intensity two lines above Eq. 15.78 must read  $I = (c/n_m)u$ .
16. Page 561, Problem 176. Variable  $x$  in  $V(x, t)$  must be replaced with  $z$ :  $V(z, t)$ .
17. Page 562, Problem 180. In the second sentence the phrase “in a one-dimensional potential well” must read “in an infinite one-dimensional rectangular potential well...”.
18. Page 563, Problem 182 In the last sentence the phrase that start with “find atom in the ground state” must be replaced with “find atom in the ground state as well as in one of the first excited states at  $t \rightarrow \infty$  in the first order of the perturbation theory”.
19. Page 567, Problem 198 replace formulation of the task 3 with “Find the time dependence of the number of atoms in the ground state” and remove the hint.
20. Page 568, Problem 203. The factor  $e\mathcal{E}_0/(2m_e\Omega)$  in expression for  $\hat{V}$  must be replaced with

$$\frac{ie\mathcal{E}_0\Omega}{2c}.$$

21. Page 578, Eq. 16.13. The first expression for the Hamiltonian  $\hat{H}$  (after the first “=” sign) must include the term

$$g\frac{\mu_B}{\hbar}B\hat{S}_z$$

after the first term

$$\frac{[\hat{\mathbf{p}} + e\boldsymbol{\tau}_y x B]^2}{2m_e}.$$

22. Page 602, Problem 208. In the second line of the formula for  $\hat{H}$ ,  $\hat{H}_x$  must be replaced with  $\hat{H}_y$ .
23. Page 602, Problem 211. In the first sentence the first reference to Eq. 16.39 must be replaced with reference to Eq. 16.35. In the hint to the problem the phrase starting with “but the expression for ...” and till the end of the sentence must be eliminated.

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