

PHYS5701      Quantum Mechanics I      Fall 2020      HW #5  
Due at 5pm to the Grader on Thursday 29 Oct 2020

(1) Prove the Baker-Hausdorff lemma, MQM3e Equation (2.168), namely

$$e^{iG\lambda} A e^{-iG\lambda} = A + i\lambda[G, A] + \frac{i^2\lambda^2}{2!}[G, [G, A]] + \cdots + \frac{i^n\lambda^n}{n!}[[G, [G, [G, \dots [G, A]]]] + \cdots$$

and use this to prove that

$${}_R\langle\alpha|J_x|\alpha\rangle_R = \langle\alpha|J_x|\alpha\rangle \cos\phi - \langle\alpha|J_y|\alpha\rangle \sin\phi$$

where  $|\alpha\rangle_R = \mathcal{D}_z(\phi)|\alpha\rangle$  is the state  $|\alpha\rangle$  after rotation through an angle  $\phi$  about the  $z$ -axis.

(2) MQM3e Problem 3.1

(3) MQM3e Problem 3.3

(4) MQM3e Problem 3.11

(5) MQM3e Problem 3.14