Philosophy of Modern Physics III/IV

1st Assignment

Dr Adrian Heathcote

September 1st 2004

All assignments are due **Thursday 7th October**. Late assignments will be accepted up to 24th October without excuse, but marks will be deducted at the rate of 5 marks per day. Assignments WILL NOT BE ACCEPTED after 24th October unless a satisfactory excuse is submitted. The only satisfactory excuses are illness or misadventure. Pressure of other work, or computer equipment failure, does not normally count as misadventure—and note that it is not necessary to type up your answers at all. For further information contact the II/III Coordinator, Dr M. McDermott. Work may be placed in the box at the SOPHI office, with the proper cover sheet attached—or handed to me in class. (Please make sure you keep a copy of your assignment.)

Answer all Questions

1. Answer all eight questions on pp. 37–8 of Hughes. SYW. When reasons are asked for, make them brief.

2. Square each of the Pauli spin operators. What do you notice? Now square $\frac{1}{2}I$, where I is the identity operator on $\mathbb{C}^2$. Add this to the sum of the squares of the Pauli spin operators. What is the result?

3. Suppose a system is in a mixed state (as on p. 139—marked with a star). Show that there can be no 'Ignorance Interpretation' of this state, by using what you have learned of the Pauli spin operators and their eigenvectors.

4. Give the definition of an Idempotent operator. Is the identity operator idempotent? Are the Pauli Spin matrices idempotent? Is the sum of two projection operators necessarily idempotent?

5. What real number is the trace of a quantum mechanical mixed state?

6. See p. 107. Calculate $U^{-1}S_xU$. SYW.

7. Say what the *spectral decomposition* of a Hermitian operator with non-degenerate eigenvalues is. Brief answer.

8. Is an eigenvalue a) a probability of an experimental outcome; or b) the possible value of an experimental outcome?

9. Incompatible observables can be represented by a) commuting operators; b) non-commuting operators; c) operators that project onto a single one-dimensional subspace?

10. Are the eigenvalues of a Hermitian operator real or complex?

SYW = show your working

Note that scores for this will be ranked and the final score arrived at by normalising for the class.