# AQM - SHEET 2

1) CONSIDER 1D-FUNCTIONS, $f(x) \in L^2(-\infty, \infty)$ (i.e. $\int_{-\infty}^{\infty} |f(x)|^2 dx < \infty$).

THE OPERATOR $P_x$ IS DEFINDED AS.

$\hat{P}_x f(x) = -i \frac{\partial f(x)}{\partial x}$ $[\hbar = 1]$.

SHOW THAT $\hat{P}_x$ IS HERMITIAN: $\hat{P}_x^+ = \hat{P}_x$.

SHOW EXPLICITELY THAT: $[\hat{X}, \hat{P}_x] = i$.

2) A SYSTEM IS DESCRIBED BY THE ONC BASIS $\{|E_1\rangle, |E_2\rangle\}$

WHERE $\hat{H}|E_1\rangle = E_1|E_1\rangle$, $\hat{H}|E_2\rangle = E_2|E_2\rangle$, $\hat{H}$ BEING THE HAMILTON-OPERATOR OF THE SYSTEM.

2 a) SHOW THAT $H = E_1|E_1\rangle\langle E_1| + E_2|E_2\rangle\langle E_2|$ IS THE HAMILTONIAN.

2 b) CONSIDER THE INITIAL STATE $|\psi(0)\rangle = a_1|E_1\rangle + a_2|E_2\rangle$

(with $|a_1|^2 + |a_2|^2 = 1$) DETERMINE $|\psi(t)\rangle$ $\forall t$.

2 c) WHICH IS THE PROB. TO FIND THE ENERGY $E_1$ IF WE PERFORM A MEASUREMENT OF THE ENERGY AT THE INSTANT $t$?

3) $\hat{A}$ LINEAR OPERATOR, $\hat{A} = |f_1\rangle\langle f_2|$ VERIFY THAT IT LINEAR AND DETERMINE $\hat{A}^+$.

4) $\hat{A}, \hat{B}$ HERMITIAN OPERATORS. SHOW THAT $[\hat{A}, \hat{B}]$ IS ANTIHERMITIAN.

(RECALL: $\hat{O}$ IS ANTIHERMITIAN IF $\hat{O}^+ = -\hat{O}$).