1) In a double-slit experiment with electrons, the detector is located along a vertical screen parallel to the y-axis as in the figure. The amplitude of the electrons detected on the screen is given by

$$\psi_1(y,t)=A_1 e^{-i(kx-wt)}/\sqrt{1+y^2}$$

when only the first slit is open and given by

$$\psi_2(y,t)=A_2 e^{-i(kx-wt+\pi y)}/\sqrt{1+y^2}$$

when only the second slit is open.
Find the intensity of the electrons;
a) When they both slots are open and with presence of light source
b) When both slots are open without light source.
c) Draw the intensity of electron on the screen as a function of y for (a) and (b) condition.

2) In the double-slit experiment shown in the figure, the plate with the slits is moved vertically. The momentum transmitted from the photons to the plate can be measured. Suppose a photon hits the M point. Find the uncertainty of the F1 and F2 $\triangle X$.

3) **a)** $|0\rangle$ is unique.
b) $0\,|V\rangle = |0\rangle$
c) $|-V\rangle = -\,|V\rangle$

Verify these claims given above by considering;

$|0\rangle + |0'\rangle$ and use the advertised properties of the two null vectors in turn,
$|0\rangle = (0+1)|V\rangle + |-V\rangle$ and
$|V\rangle + |-V\rangle = 0\,|V\rangle = |0\rangle$.

4) **a)** Find the eigenvalues and normalized eigenvectors of the matrix

$$\Omega=\begin{bmatrix} 1 & 3 & 1 \\ 0 & 2 & 0 \\ 0 & 1 & 4 \end{bmatrix}$$

b) Is the matrix Hermitian? Are the eigenvectors orthogonal?

5) Home work

Exercise 1.6.6. Verify that the following matrices are unitary:

$$\frac{1}{2^{1/2}}\begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix}, \quad \frac{1}{2}\begin{bmatrix} 1+i & 1-i \\ 1-i & 1+i \end{bmatrix}$$

Verify that the determinant is of the form $e^{i\theta}$ in each case. Are any of the above matrices Hermitian?

6) Home work

*Exercise 1.8.3.** Consider the Hermitian matrix

$$\Omega = \frac{1}{2}\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & -1 \\ 0 & -1 & 3 \end{bmatrix}$$

(1) Show that $\omega_1 = \omega_2 = 1$; $\omega_3 = 2$.
(2) Show that $|\omega = 2\rangle$ is any vector of the form

$$\frac{1}{(2a^2)^{1/2}}\begin{bmatrix} 0 \\ a \\ -a \end{bmatrix}$$

(3) Show that the $\omega = 1$ eigenspace contains all vectors of the form

$$\frac{1}{(b^2 + 2c^2)^{1/2}}\begin{bmatrix} b \\ c \\ c \end{bmatrix}$$

either by feeding $\omega = 1$ into the equations or by requiring that the $\omega = 1$ eigenspace be orthogonal to $|\omega = 2\rangle$.