Conceprual Questions

5. Higher energy e's correspond to lower wavelenth. According to Bragg formula \( \cos \theta_m = \frac{m}{2d} \) will correspondingly be smaller for a given d and hence \( \theta_m \) will be larger for each m in diffraction plate and hence better resolved.

6. \( E_0 = \frac{1}{8}mL^2 \propto \frac{1}{m^2} \). As because we are increasing the mean \( \theta \) limited and decreasing this length by a factor of half they can be same and ground state energy remains the same.
Exercises and Problems

7. Angle for $m^{th}$ order line is given by

$$\text{Path difference} = 2d \cos \theta_m = m \lambda$$

(Bragg condition). As we go to higher and higher orders, cosine of $\theta$ also increases (i.e. value of $\theta$ goes on decreasing). However you can't decrease it beyond zero (see left) whence you can't make the path difference more than $2d$. Hence the path difference lies between $0 (\theta=90^\circ)$ to $2d (\theta=0^\circ)$.

For intermediate angle the path difference is in between these two values. But you get the lines when

path difference is an integer multiple of $\lambda$, i.e. $2\lambda$...

Clearly we can go up to $\pm 2d/\lambda$ order [and of course

the order has to be an integer]. So it's highest integer $\leq 2d/\lambda$. 
(Aside remark) From problem 7 you can really see the highest order observable \( \leq 2/d \times 2d/(hc/E) \approx 3.17 \), i.e. \( m_{\text{MAX}} = 3 \).

\[ \lambda_e = \frac{h}{p_e} = \frac{h}{mc} = 3.6 \times 10^{-10} \text{m} \]

\[ d = 1.5 \text{mm} \gg \lambda_e \]

Hence we can apply the small angle approx. for fringe width:

\[ i.e. \quad \alpha \approx \frac{\lambda}{L/d} \]

\[ \lambda \propto \frac{1}{m} \implies \lambda_e / \lambda_e = me/m_n \quad \text{or} \quad \lambda_n = \frac{me}{m_n} \cdot \lambda_e < \lambda_e. \]

Hence, no problem with the earlier assumption even in time.

 Clarification (b): We want some width of fringes as of the electron.

\[ \text{Detector} \]

Geometry of the set up of Davisson Germer exp.

Bragg condn: \( 2d \sin \Theta_m = m \lambda \)

or, (in terms of \( \phi, D \)): \( 2D \cos \phi/2 \cdot \sin \phi/2 = m \lambda \)

or, \( D \sin \phi = m \lambda \)

or, \( D = D \cos \phi \)

\[ \Rightarrow \phi = 2\theta \]

\[ \phi = \theta/2 \]

Sample

Atomic spacing \( d \) = distance between planes
So Davison-Germer exp. is nothing but Bragg diffraction with different variables. Here $\phi = 60^\circ$ (scattering angle).