1. The probability density function (PDF) of the observations, viewed as a function of the unknown parameter h is termed as the Likelihood Function
   Ans d
2. As shown in class lectures

$$p(\bar{\mathbf{y}};h) = \left(\frac{1}{2\pi\sigma^2}\right)^{\frac{N}{2}} e^{-\frac{1}{2\sigma^2}\sum_{k=1}^{N}(y(k)-h)^2}$$

   Ans c

3. As the number of samples N increases, the variance of the estimate and hence the spread of estimate around the true parameter decreases
   Ans a
4. The observations are given as $y(1) = -2, y(2) = 1, y(3) = -1, y(4) = -2$. The ML estimate is given by the sample mean

$$\hat{h} = \frac{1}{N}\sum_{k=1}^{N} y(k) = \frac{-2+1-1-2}{4} = -\frac{4}{4} = -1$$

   Ans d
5. Given $\sigma^2 = 1$. The variance of the sample mean is $\frac{\sigma^2}{N}$. Given $N = 4$, the variance of the sample mean is $\frac{\sigma^2}{N} = \frac{1}{4} = \frac{1}{4}$
   Ans b
6. Given the fading channel estimation with pilot vector $\bar{\mathbf{x}} = [-1 \quad 1 \quad 1 \quad -1]^T$ and received symbol vector $\bar{\mathbf{y}} = [-1 \quad -1 \quad 2 \quad 3]^T$. Hence, the channel estimate is,

$$\hat{h} = \frac{\bar{\mathbf{x}}^T\bar{\mathbf{y}}}{\bar{\mathbf{x}}^T\bar{\mathbf{x}}} = \frac{-1}{4} = -\frac{1}{4}$$

   Ans a
7. Given $v(k)$ is IID Gaussian noise with zero-mean and variance $\sigma^2 = 1$. Also given $\bar{\mathbf{x}} = [-1 \quad 1 \quad 1 \quad -1]^T$. The variance of the maximum likelihood $\hat{h}$ is,

$$\frac{\sigma^2}{||\bar{\mathbf{x}}||^2} = \frac{1}{4} = \frac{1}{4}$$

   Ans c
8. The variance of the maximum likelihood estimate $\hat{h}$ is

$$\frac{\sigma^2}{\bar{\mathbf{x}}^H\bar{\mathbf{x}}}$$

   Ans c
9. Given the fading channel estimation problem with pilot vector $\bar{\mathbf{x}} = [1+j \quad -1+j \quad -1-j \quad -1+j]^T$ and received vector $\bar{\mathbf{y}} = [-j \quad 1 \quad -j \quad 1]^T$. The estimate of the channel coefficient h is

$$\frac{\bar{\mathbf{x}}^H\bar{\mathbf{y}}}{\bar{\mathbf{x}}^H\bar{\mathbf{x}}} = -\frac{1}{4} - \frac{1}{4}j$$

   Ans b

10. The Fisher information $I(h)$ for estimation of a parameter h given the likelihood $p(\bar{\mathbf{y}}; h)$ is

$$E\left\{\left(\frac{\partial}{\partial h} \ln p(\bar{\mathbf{y}}; h)\right)^2\right\}$$

Ans b