① b) i) Systematic error.

→ These errors shifts or elongates the distribution by a constant factor.

→ That is, $X_{measured}$ could be of form $aX + b$ where

X is the true value of the realisation of x taken and X_m is the measured value of X.

→ This error affects the mean and variance of the distribution. However the distribution of X_m is likely to be same as distribution of X.

→ a: multiplication / scaling factor.
b: offset / zero-setting error.

ii) Random error.

→ These errors occur independent of the random variable X.

$$X_{measured} = X + \varepsilon.$$

→ Since they are random & they tend to have zero mean and they can be averaged out by increasing the sample size.

→ the distribution of $X_{measured}$ depends on the Signal to Noise Ratio. If SNR is very high, $X_{measured}$ essentially follows distribution of X. If it is very low (near 0), $X_{measured}$ is distributed as determined by ε.

→ In most cases, SNR can be increased by increasing sample size.

However, systematic errors are difficult to detect.
unless we have some prior information on the true value.