Question 5 (25 marks)

G: Germinate, NG: Not germinate
$P(G) = 0.6$, $P(NG) = 0.4$

Question 5 (a) (i)

$$P(G, G, G, G) = (0.6)(0.6)(0.6)(0.6) = (0.6)^4 = \frac{81}{625}$$

Question 5 (a) (ii)

$$P(G, NG, NG, NG) = (0.6)(0.4)(0.4)(0.4) \times \frac{4!}{3!} = \frac{96}{625}$$

Question 5 (a) (iii)

$$P(NG, NG, NG, NG) = (0.4)(0.4)(0.4)(0.4) = (0.4)^4 = \frac{16}{625}$$

Question 5 (b)

Independence is necessary to do the calculation in **(a)** as the probability would change depending on whether or not the other seeds germinate. Independence may not be valid as the growing conditions (temperature, moisture and soil type) may vary from seed to seed.

Question 5 (c)

Expected value $= xP(x) = 4(0.6) = 2.4$

Question 5 (d)

Null hypothesis H_0: $P = 0.9$
Alternative hypothesis H_1: $P < 0.9$

Sample proportion $= p = \frac{97}{120}$

True population proportion = Sample proportion ± 1.96(Standard error of the proportion)

$$\text{Standard error of the proportion} = \sqrt{\frac{p(1-p)}{n}}$$

$$\text{True population proportion} = \frac{97}{120} \pm 1.96\sqrt{\frac{\frac{97}{120}\left(1-\frac{97}{120}\right)}{120}} = 0.738,\ 0.879$$

Confidence interval: $0.738 \leftrightarrow 0.879$
There is evidence to support the gardener's claim that less than 90% of the seeds germinate because, based on the sample data, any values in the range 73.8% – 87.9% are possible value for the proportion of seeds in the sample that germinate.
$P = 0.9$ is not in the confidence interval. At the 5% significance level, we accept the alternati hypothesis and agree that the gardener's suspicions are well-founded.