1. (i) Sample space contains \( \binom{20}{5} \) events which are equally likely.

\[
P(5 \text{ blue chips}) = \frac{\binom{7}{5}}{\binom{20}{5}}
\]

You can choose 5 blue chips in \( \binom{20}{5} \) ways.

(ii) \( P(1 \text{ blue, 2 white, 2 red}) = \frac{\binom{7}{1} \binom{8}{2} \binom{5}{2}}{\binom{20}{5}} \)

\( \text{All events} \)

(iii) \( P(\text{no blue chips}) = \frac{\binom{12}{5}}{\binom{20}{5}} \)

You can choose 5 chips out of 13 possible ways.

(iv) \( P(\text{at least one blue chip}) = 1 - P(\text{no blue chips}) = 1 - \frac{\binom{12}{5}}{\binom{20}{5}} \)

2. (i) \( P(3 \text{ defective bulbs in 3 draws}) = \frac{\binom{3}{2}}{\binom{12}{2}} \cdot \frac{2}{11} \cdot \frac{1}{10} = \frac{1}{220} \)

(ii) \( P(5 \text{ white bulbs}) = P(2 \text{ defective bulbs in 4 draws}) \cdot \frac{1}{\binom{12}{4}} \cdot \frac{2}{11} \cdot \frac{1}{10} = \frac{1}{8} \) since only one defective bulb is left among 8 bulbs.

(iii) \( P(10 \text{ black bulbs}) = P(2 \text{ defective bulbs in 9 draws}) \cdot \frac{1}{\binom{12}{9}} \cdot \frac{2}{11} \cdot \frac{1}{10} = \frac{1}{55} \)

3. Denote by \( A_1, A_2, A_3 \) the events of East, Midwest, West, respectively, and by \( B_1, B_2 \) the events of Passivate, Optimize, respectively.

(i) 300 respondents out of 500 are Passivate.

\[ P(B_1) = \frac{3}{5} \]

(ii) 160 respondents out of 500 are for Midwest.

\[ P(A_2) = \frac{16}{50} = \frac{8}{25} \]

\[ P(B_2|A_2) = \frac{P(A_2 \cap B_2)}{P(A_2)} = \frac{70/500}{160/500} = \frac{7}{16} \]
The respondents who are optimistic are 200. \[ P(B_2) = \frac{200}{500} \]

\[
P(A_2 | B_2) = \frac{P(A_2 \cap B_2)}{P(B_2)} = \frac{70}{500} = \frac{7}{50}
\]

But \[ P(A_2) = \frac{160}{500} \]

Since \[ P(d_2 | NB_2) \neq P(d_2 | P(B_2)) \], the rules \( A_2, B_2 \) are not independent.

Similarly,

\[
P(A_3 | NB_1) = \frac{110}{500} \neq P(A_3)P(B_1) = \frac{200}{500} \cdot \frac{300}{500} = \frac{60}{500}
\]

We have \[ P(A_3 | B_1) = \frac{120}{500} \]

\[
P(A_3 | B_2) = P(d_3 | P(B_2)) = \frac{200}{500} = \frac{200}{500} = \frac{80}{500}
\]

\[
D: \text{disease}; \quad TP: \text{test positive}; \quad TN: \text{test negative}
\]

We have \[ P(D) = 0.04, \quad P(TN | D) = 0.20, \quad P(TP | D) = 0.80 \]

\[ \Rightarrow \text{We define} \quad P(D') = 0.96, \quad P(TP | D') = 0.80 \]

Thus, by Bayes' Theorem:

\[
T(D | TP) = \frac{P(TP | D) \cdot P(D)}{P(TP | D) \cdot P(D) + P(TP | D') \cdot P(D')} = \frac{(0.80)(0.04)}{(0.80)(0.04) + (0.80)(0.96)}
\]

\[ = \frac{5}{17} \]