3. Let $a$ be the origin, then it satisfies the following system of two equations in two unknowns:
\[ \begin{align*}
0 &= x - a_1 = \frac{6}{\sqrt{2}} + a_1 \\
0 &= y - a_2 = \frac{6}{\sqrt{2}} + a_2
\end{align*} \]
Solving this system, we obtain $a_1 = -\sqrt{2}$ and $a_2 = -\sqrt{2}$. So the bus arrives at a random time between 1:54 a.m. and 2:06 a.m.

4. If $P(Y < 2 + \alpha) = 0$ for $\alpha > 0$ then $E[Y]$ is undefined.

5. The probability is equivalent to choosing a random number $X$ from $0$ to $1$. The desired probability is
\[ P(\frac{1}{3} \leq X \leq \frac{2}{3}) = \int_{\frac{1}{3}}^{\frac{2}{3}} f_X(x) \, dx = \frac{1}{2} \int_{\frac{1}{3}}^{\frac{2}{3}} 3x^2 \, dx = \frac{1}{2} \left[ x^3 \right]_{\frac{1}{3}}^{\frac{2}{3}} = \frac{1}{2} \left( \left( \frac{2}{3} \right)^3 - \left( \frac{1}{3} \right)^3 \right) = \frac{1}{2} \left( \frac{8}{27} - \frac{1}{27} \right) = \frac{1}{2} \left( \frac{7}{27} \right) = \frac{7}{54}. \]

6. (a) $P[Y < 4] = 0.85$ is given by
\[ P[Y < 4] = \int_{-\infty}^{4} f_Y(y) \, dy = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{4} e^{-\frac{y^2}{2}} \, dy = 0.85. \]
(b) $P[Y < 4]$ is given by
\[ P[Y < 4] = \int_{-\infty}^{4} f_Y(y) \, dy = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{4} e^{-\frac{y^2}{2}} \, dy = 0.85. \]
(c) The desired probability is
\[ P[Y < 4] = \int_{-\infty}^{4} f_Y(y) \, dy = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{4} e^{-\frac{y^2}{2}} \, dy = 0.85. \]

7. Let $X$ be the random variable representing the number of people in a sample. Then $P(X = x)$ is given by
\[ P(X = x) = \binom{500}{x} \left( \frac{1}{2} \right)^x \left( \frac{1}{2} \right)^{500-x} = \binom{500}{x} \left( \frac{1}{2} \right)^{500}. \]

8. The number of documents generated by the secretary on a given eight-hour working day is Poisson with parameter $\lambda = 8$. So the answer is
\[ \sum_{x=0}^{\infty} e^{-\lambda} \frac{\lambda^x}{x!} = 1 - e^{-\lambda} = 0.9882 = 1. \]

9. Let $X$ be the time between the first and second heart attacks. We are given that $P(X \leq 5) = 1/2$. Since the probability of memorylessness, the probability that a person who had one heart attack five years ago will not have another one during the next five years is still $P(X > 5)$, it follows that $P(X > 5) = 1/2$.

10. The probability mass function of $X$ is given by
\[ P(X = n) = \left( \frac{1}{2} \right)^n \left( \frac{1}{2} \right)^{n-1} = \left( \frac{1}{2} \right)^n, \quad n = 0, 1, 2, \ldots. \]

11. We know that $P(X \geq 2) = 2/3$. Hence, by Markov's inequality,
\[ \frac{1}{2} \leq P(X \geq 2) = \frac{1}{P(X < 2)} \leq \frac{1}{2}. \]

12. Let $X_1, \ldots, X_n$ be the random sample, $\alpha$ be the expected value of the distribution, and $\sigma^2$ be the variance of the distribution. We want to find $n$ so that
\[ P(\mu - 2\sigma < X < \mu + 2\sigma) = 0.98. \]

13. If $X$ is normally distributed, then
\[ P(X \leq 5) = \frac{1}{2} P(X \leq 5) = \frac{1}{2} P(X \leq 5) = \frac{1}{2} \int_{-\infty}^{5} f_X(x) \, dx = 0.445. \]

14. Let $X$ be the lifetime of the randomly selected light bulb. We have
\[ P(X \leq 700) = 0.25. \]

15. If $X$ is uniformly distributed on $\alpha$ to $\beta$, then
\[ P(X < \alpha) = P(X > \beta) = \frac{1}{\beta - \alpha}. \]

16. If $X$ is normally distributed, then
\[ P(X \leq 5) = \frac{1}{2} P(X \leq 5) = \frac{1}{2} \int_{-\infty}^{5} f_X(x) \, dx = 0.25. \]