1. Let \( X \) denote the number of raindrops that fall during the next one minute. Then \( X \) is Poisson with \( \lambda = 6 \).

1a. We have \( P(X = 5) = e^{-6}6^5/5! = 0.1606 \).

1b. We have \( P(X = 0) = e^{-6}6^0/0! = 0.002479 \).

1c. We have \( P(X \geq 4) = 1 - P(X \leq 3) = 1 - e^{-6}6^0/0! - e^{-6}6^1/1! - e^{-6}6^2/2! - e^{-6}6^3/3! = 1 - 61e^{-6} = 0.8488 \).

2. Let \( Y \) denote the number of raindrops that fall during the next 15 seconds. Then \( Y \) is Poisson with \( \lambda = 1.5 \).

2a. We have \( P(Y = 1) = e^{-1.5}(1.5)^1/1! = 0.3347 \).

2b. We have \( P(Y = 0) = e^{-1.5}(1.5)^0/0! = 0.2231 \).

2c. We have \( P(Y \geq 3) = 1 - P(Y \leq 2) = 1 - e^{-1.5}(1.5)^0/0! - e^{-1.5}(1.5)^1/1! - e^{-1.5}(1.5)^2/2! = 1 - (29/8)e^{-3/2} = 0.1912 \).

3. We have \( P(X \geq 4) = 1 - P(X \leq 3) = 1 - e^{-\lambda}\lambda^0/0! - e^{-\lambda}\lambda^1/1! - e^{-\lambda}\lambda^2/2! - e^{-\lambda}\lambda^3/3! = 1 - \frac{1}{6}e^{-\lambda}(6 + 6\lambda + 3\lambda^2 + \lambda^3) \).

4a. The random variable \( X \) is a Binomial with \( n = 10000 \) and \( p = 1/1000. \) So the mass is \( P(X = x) = p_X(x) = \binom{n}{x}(1/1000)^x(999/1000)^{10000-x} \) for \( 0 \leq x \leq 10000 \).

4b. We have \( \mathbb{E}(X) = np = (10000)(1/1000) = 10 \).

4c. We have \( \text{Var}(X) = npq = (10000)(1/1000)(999/1000) = 999/100. \)

4d. Since the distribution of \( X \) is approximately Poisson with \( \lambda = np = 10 \), we have \( P(X = 9) \approx e^{-10}10^9/9! = 0.125 \).

5a. Since the distribution of \( X \) is approximately Poisson with \( \lambda = (10000)(3/10000) = 3 \), then \( P(X \geq 5) = 1 - P(X \leq 4) \approx 1 - e^{-3}3^0/0! - e^{-3}3^1/1! - e^{-3}3^2/2! - e^{-3}3^3/3! - e^{-3}3^4/4! = 1 - (131/8)e^{-3} = 0.1847 \).

5b. Since the distribution of \( Y \) is approximately Poisson with \( \lambda = (10000)(5/10000) = 5 \), and since \( X \) and \( Y \) are independent, the distribution of \( X + Y \) is roughly Poisson with \( \lambda = 8 \). Thus \( P(8 \leq X + Y \leq 9) = P(X + Y = 8) + P(X + Y = 9) = e^{-88}/8! + e^{-89}/9! = 0.2637 \).

6. We have \( P(Y > X) = \sum_{x=0}^{\infty} \sum_{y=x+1}^{\infty} (e^{-\lambda}\lambda^x/x!)(q^{y-1}p) = \sum_{x=0}^{\infty} (e^{-\lambda}\lambda^x/x!)p \sum_{y=x+1}^{\infty} q^{y-1} = e^{-\lambda} \sum_{x=0}^{\infty}(\lambda^x/x!pq^x/(1-q)) = e^{-\lambda} \sum_{x=6}^{\infty}(\lambda q)^x/x! = e^{-\lambda} e^{\lambda q} = e^{\lambda(q-1)} = e^{-\lambda p} \).