1a. We have \( P(X \geq 3) = \int_0^3 \int_y^{y+3} \frac{1}{8} \, dx \, dy = 1/4. \)

1b. We have \( P(Y \geq 1) = \int_1^2 \int_0^{y+3} \frac{1}{8} \, dx \, dy = 9/16. \)

1c. We have \( P(\text{max}(X, Y) \leq 1) = \int_0^1 \int_0^1 \frac{1}{8} \, dx \, dy = 1/8. \)

2a. We have \( P(X \leq 1) = \int_0^1 \int_0^{3-x} \frac{1}{8} \, dx \, dy = 5/9. \)

2b. We have \( P(Y \leq 2X) = \int_0^2 \int_0^{2x} \frac{2}{9} \, dy \, dx + \int_1^2 \int_0^{3-x} \frac{2}{9} \, dy \, dx = 2/9 + 4/9 = 2/3. \)

3a. We have \( P(Y \geq X) = \int_0^\infty \int_x^\infty 6e^{-3x-2y} \, dy \, dx = 3/5. \)

3b. We have \( P(X \geq 2) = \int_2^\infty \int_0^\infty 6e^{-3x-2y} \, dy \, dx = e^{-6}. \)

3c. We have \( P(Y \geq 5) = \int_0^\infty \int_5^\infty 6e^{-3x-2y} \, dy \, dx = e^{-10}. \)

4a. We have \( P(Y \geq \frac{1}{2}X + 1) = \int_{\frac{1}{2}}^2 \int_{\frac{1}{2}x+1}^{2/9} \frac{1}{16} \, dy \, dx = 1/4. \)

4b. We have \( P(|X - 1| \leq 1/2) = P(-1/2 \leq X - 1 \leq 1/2) = P(1/2 \leq X \leq 3/2) = \int_{1/2}^{3/2} \int_{1/2}^{2/9} \frac{1}{16} \, dy \, dx = 1/4. \)

5a. The density of \( X \) is \( f_X(x) = \frac{1}{8} (4 - x) \) for \( 0 < x < 4 \), and \( f_X(x) = 0 \) otherwise.

5b. The density of \( Y \) is \( f_Y(y) = \frac{2}{9} (3 - y) \) for \( 0 < y < 3 \), and \( f_Y(y) = 0 \) otherwise.

6a. We have \( P(Y \geq X) = \int_0^2 \int_0^{y} \frac{1}{8} \, dx \, dy = 1/4. \)

6b. We have \( P(Y \geq X) = \int_0^3 \int_x^3 \frac{1}{36} (4 - x)(3 - y) \, dy \, dx = 13/32. \)