

$$\begin{aligned}
 \textcircled{1} \int_1^2 \int_3^5 (y-2x) dy dx &= \int_1^2 \left[ \frac{1}{2}y^2 - 2xy \right]_3^5 dx \\
 &= \int_1^2 \left[ \left( \frac{25}{2} - 10x \right) - \left( \frac{9}{2} - 6x \right) \right] dx \\
 &= \int_1^2 (8 - 4x) dx \\
 &= \left[ 8x - 2x^2 \right]_1^2 \\
 &= 8 - 6 \\
 &= 2
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} \int_3^5 \int_1^2 (y-2x) dx dy &= \int_3^5 \left[ xy - x^2 \right]_1^2 dy \\
 &= \int_3^5 \left[ (2y - 4) - (y - 1) \right] dy \\
 &= \int_3^5 (y - 3) dy \\
 &= \left. \frac{1}{2}y^2 - 3y \right|_3^5 \\
 &= \left( \frac{25}{2} - 15 \right) - \left( \frac{9}{2} - 9 \right) \\
 &= 8 - 6 \quad \text{Note this is also} \\
 &= 2 \quad \left( \frac{25}{2} - \frac{9}{2} \right) + (-15 + 9)
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{3} \int_0^2 \int_{y^2}^{2y} (4x-y) dx dy &= \int_0^2 \left[ 2x^2 - xy \right]_{y^2}^{2y} dy \\
 &= \int_0^2 \left[ (8y^2 - 2y^2) - (2y^4 - y^3) \right] dy \\
 &= \int_0^2 \left[ -2y^4 + y^3 + 6y^2 \right] dy \\
 &= \left[ -\frac{2}{5}y^5 + \frac{1}{4}y^4 + 2y^3 \right]_0^2 \\
 &= -\frac{64}{5} + 4 + 16 = \frac{100}{5} - \frac{64}{5} = \boxed{\frac{36}{5}}
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{4} \int_1^2 \int_{1-x}^{\sqrt{x}} x^2 y dy dx &= \int_1^2 \left[ \frac{1}{2} x^2 y^2 \right]_{1-x}^{\sqrt{x}} dx \\
 &= \frac{1}{2} \int_1^2 \left[ x^3 - x^2 (1-x)^2 \right] dx \quad \begin{array}{l} (1-x)^2 = (1-x)(1-x) \\ = 1 - 2x + x^2 \end{array} \\
 &= \frac{1}{2} \int_1^2 \left[ x^3 - x^2 + 2x^3 - x^4 \right] dx \\
 &= \frac{1}{2} \int_1^2 \left( -x^4 + 3x^3 - x^2 \right) dx \\
 &= \frac{1}{2} \left[ -\frac{1}{5}x^5 + \frac{3}{4}x^4 - \frac{1}{3}x^3 \right]_1^2 \\
 &= \frac{1}{2} \left[ \left( -\frac{32}{5} + 12 - \frac{8}{3} \right) - \left( -\frac{1}{5} + \frac{3}{4} - \frac{1}{3} \right) \right] \\
 &= \frac{1}{2} \left[ -\frac{31}{5} + 12 - \frac{7}{3} - \frac{3}{4} \right] \\
 &= \frac{1}{2} \left[ -\frac{372}{60} + \frac{720}{60} - \frac{140}{60} - \frac{45}{60} \right] = \frac{1}{2} \left[ \frac{163}{60} \right] = \frac{163}{120}
 \end{aligned}$$