Problem 1 solution:

Let \( x^2 + 2 = 3 \), we then get the two intersections \((-1, 3)\) and \((1, 3)\) of these two curve \( y = 3 \) and \( y = x^2 + 2 \). Then we have the volume of the solid of revolution as follows:

\[
V = \int_{-1}^{1} [\pi \cdot 3^2 - \pi (x^2 + 2)^2] dx \\
= 2\pi \int_{0}^{1} (9 - x^4 - 4x^2 - 4) dx \\
= 2\pi(5x - \frac{1}{5}x^5 - \frac{4}{3}x^3)|_{0}^{1} \\
= 2\pi\left(5 - \frac{1}{5} - \frac{4}{3}\right) \\
= \frac{104}{15}\pi
\]

Problem 2 solution:

Let \( 4 - x^2 = 0 \), then we can get the two intersections \((-2, 0)\) and \((2, 0)\) of the curve \( y = 4 - x^2 \) and the \( x \)-axis. There are two ways to solve this problem. The first one is to cut the solid of rotation vertically and then integral along the \( x \)-axis. The second one is to cut the solid horizontally and then integral along the \( y \)-axis.

For the first one, we will get the volume as follows:

\[
V = \int_{-2}^{2} 2\pi(3 - x)(4 - x^2) dx \\
= \int_{-2}^{2} 2\pi(x^3 - 3x^2 - 4x + 12) dx \\
= 2\pi\left(\frac{1}{4}x^4 - x^3 - 2x^2 + 12x\right)|_{-2}^{2} \\
= 64\pi
\]

For the second one,

\[
V = \int_{0}^{4} \pi(3 + \sqrt{4-y})^2 - \pi(3 - \sqrt{4-y})^2 dy \\
= \int_{0}^{4} \pi(12\sqrt{4-y}) dy \\
= (-8\pi)(4 - y)^{\frac{3}{2}}|_{0}^{4} \\
= 64\pi
\]
Problem 3 solution:

\[ W = \int_{0}^{20} 10 + \frac{1}{2} x \, dx \]
\[ = (10x + \frac{1}{4}x^2) \bigg|_{0}^{20} \]
\[ = 300 \]

Problem 4 solution:

\[ \frac{1}{4 - (-1)} \int_{-1}^{4} \frac{1}{\sqrt{3x + 4}} \, dx \]
\[ = \frac{2}{15} \sqrt{3x + 4} \bigg|_{-1}^{4} \]
\[ = \frac{2}{5} \]