(1) (a) We solve this by parts, let \( u = x \Rightarrow du = dx \), \( dv = \sinh 2x \Rightarrow v = \frac{1}{2} \cosh 2x \). The integral becomes, \( I = \frac{x}{2} \cosh 2x - \frac{1}{2} \int \cosh 2xdx = \frac{x}{2} \cosh 2x - \frac{1}{4} \sinh 2x + C \).

(b) We solve this by parts, let \( u = \sin^{-1}3x \Rightarrow du = 3dx/\sqrt{1-9x^2}, dv = dx \Rightarrow v = x \). The integral becomes, \( I = x \sin^{-1}3x - \int 3xdx/\sqrt{1-9x^2} \). We solve the new integral via u-sub where \( u = 1 - 9x^2 \Rightarrow du = -18xdx \), \( I = x \sin^{-1}3x + \frac{1}{2} \int du/\sqrt{u} = x \sin^{-1}3x + \sqrt{u}/3 + C = x \sin^{-1}3x + \sqrt{1-9x^2}/3 + C \).

(2) We get the work for the bucket for free: \( W_B = 5 * 50 = 250ft - lb \). We derive the force function for the water, \( F = 40 - x/10 \), then we integrate to get the work, \( W_w = \int_0^{50} (40 - x/10)dx = 40x - x^2/20 \bigg|_0^5 = 1875ft - lb \), so the total work is \( W = 2125ft - lb \).

(3) If we use the coordinate where the bottom of the box is \( 11ft \) and the top of the box is \( 1ft \), we have an infinitesimal volume of \( V_i = 300\Delta x_i \), then the weight is \( F_i = 12000\Delta x_i \), hence the work to move the infinitesimal volume to our height is \( W_i = 12000x\Delta x_i \). Finally, we integrate to get \( W = \int_1^{11} 12000xdx = 6000x^2 \bigg|_{11}^1 = 720,000ft - lb \).

(4) The derivative is \( dy/dx = -1/2\sqrt{2-x} \Rightarrow (dy/dx)^2 = 1/(8 - 4x) \), then the surface area is, \( SA = 2\pi \int_0^{5/4} \sqrt{2-x}\sqrt{1+1/4(2-x)}dx = \pi \int_0^{5/4} \sqrt{9 - 4x} = -\frac{\pi}{6} (9 - 4x)^{3/2} \bigg|_0^{5/4} = 19\pi/6 \).

(5) The derivative is \( dy/dx = \tan x \), then the arc length is, \( L = \int_0^{\pi/4} \sqrt{1 + \tan^2x} \ dx = \int_0^{\pi/4} \sec x \ dx = \ln |\tan x + \sec x| \bigg|_0^{\pi/4} = \ln(1 + \sqrt{2}) \).

(6) Here we have a gap, so we need a big radius and a little radius: \( R = 2/(x + 1) \), \( r = x \), then the volume is \( V = \pi \int_0(4/(x + 1)^2 - x^2)dx = \pi [-4/(x + 1) - x^3/3] \bigg|_0^1 = 5\pi/3 \).

(7) Here there is no gap, so \( R = 1 - e^{-x} \), then the volume is, \( V = \pi \int_0^1 (1-e^{-x})^2dx = \pi \int_0^1 (1-2e^{-x}+e^{-2x})dx = \pi [x+2e^{-x}-e^{-2x}/2] \bigg|_0^1 = \pi [-1/2 + 2/e - 1/2e^2] \).

(8) Here \( r = x \) and \( h = \ln x \), then the volume is, \( V = 2\pi \int_1^e x\ln x \ dx \). We solve this by parts, \( u = \ln x \Rightarrow du = dx/x, dv = xdx \Rightarrow v = x^2/2 \). Then the integral becomes, \( V = \pi x^2 \ln x \bigg|_1^e - 2\pi \int_1^e (x/2)dx = \pi e^2 - \pi x^2/2 \bigg|_1^e = \pi e^2/2 + \pi/2 \).

(9) Here the area of each rectangle is \( A = 4y^2 = 4\sin^2x \), then the volume is \( V = \int_0^\pi 4\sin^2xdx = \int_0^\pi 2(1 - \cos 2x)dx = 2x - \sin 2x \bigg|_0^\pi = 2\pi \).