Show all of your work, be clear and organized, and give exact values only.

1.   (18 pts) Evaluate each of the following integrals:

i) $$\int_{0}^{\sqrt{2}/2} \frac{x\sin^{-1} x^2}{\sqrt{1-x^4}}\, dx$$

ii) $$\int \frac{e^x}{e^x + e^{-x}}\, dx$$

2. (12 pts) The façade of an aquarium tank is a wall whose dimensions are 10 m by 30 m, as indicated by the following picture. A window is paced in this wall in the shape of an inverted equilateral triangle surmounted by a square for attendees to view what is inside. What is the force exerted on this window due to hydrostatic pressure?
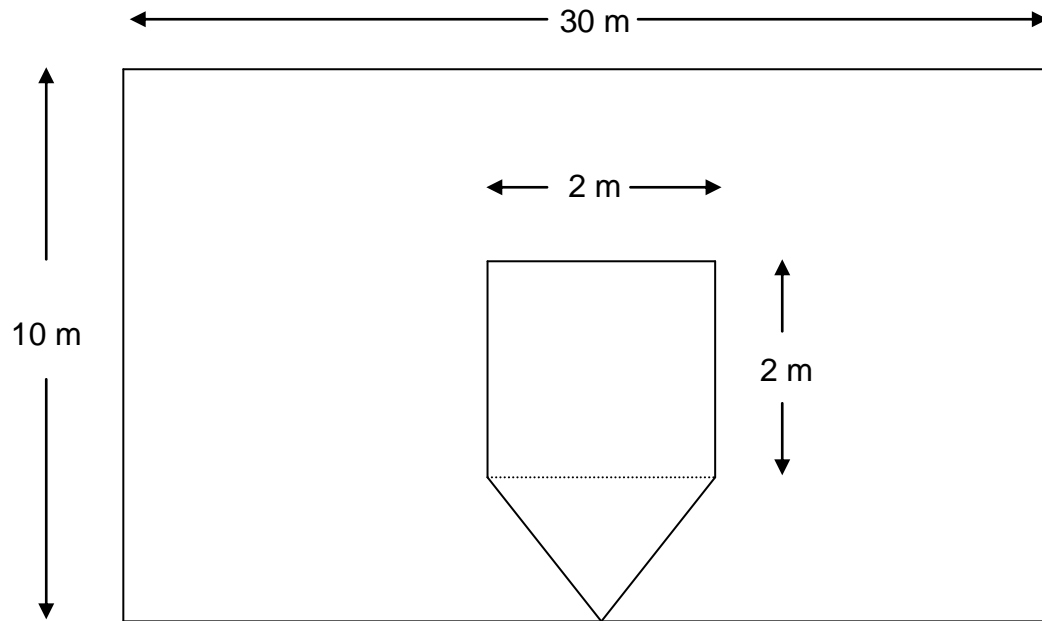
3. (12 pts) Consider the following tank which is the graph of $y = \sqrt{x}$ rotated about a central axis surmounted by a right circular cylinder whose dimensions are given in the picture provided below. There is a spout atop this tank that extends 1 meter above the tank pictured. Determine the amount of work needed to pump water out of this tank through the spout mentioned if the tank is full of water. Merely set up this integral. There is no need to evaluate it.

10 m

2 m
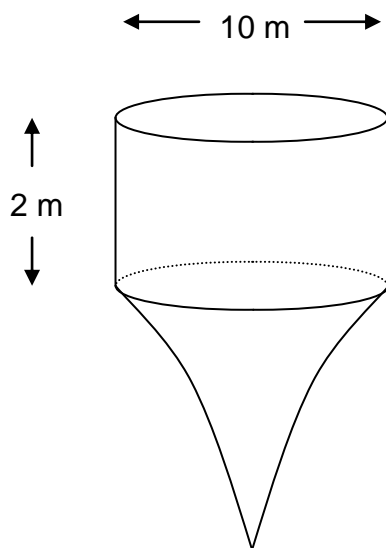
4. (12 pts) Consider the graphs of the equations $y = x^2$, $y = 2$, and $y = \dfrac{1}{x}$. There is a region in the right-hand plane that is bounded by all three of these equations. Set up an integral that would determine the volume of the solid of revolution generated by revolving this region about the line $x = -1$. Use the cylindrical shell method, and there is no need to evaluate this integral.

5.   (12 pts) Consider the region bounded by the graphs of the equations $y = \ln x$, $y = 0$, and $x = 2$. Determine the volume of the solid of revolution generated by revolving this region about the y-axis.

6.　　(12 pts) Consider the graph of the equation $y = \sin 2x$ over the interval $[0, \pi]$ and the graph of the equation $y = \sin x$ over the interval $[0, \pi]$ in the same coordinate axis system. Determine the area of the region bounded by the graphs of these two equations.

7. (12 pts) Determine the area bounded by the graphs of the equations $y = \dfrac{2x^2}{1+x^2}$

and $y = 2 - x^2$

8. (10 pts) Determine the length of the arc along the graph of the equation
$y = \dfrac{1}{3}x^3 + \dfrac{1}{4x}$ over the interval $[1,2]$