SUMMARY - EXAM I- MAT 102/202 **PREPARED BY: HIBA OTHMAN**

Method	When to Use	Formula
Volumes by slicing	When the cross section is specified	$V=\int_{x_1}^{x_2} A(x)dx$ or $V=\int_{y_1}^{y_2} A(y)dy$, where • $A=\pi R^2$ or $A=\pi \frac{D^2}{4}$ when the cross-section is a circle (*R:* radius, *D*: diameter) • $A=s^2$ or $A=\frac{d^2}{2}$ when the cross-section is a square (*s:* side or base, *d*: diagonal) • $A=\frac{b^2}{4}\sqrt{3}$ or $A=\frac{h^2}{\sqrt{3}}$ when the cross-section is an equilateral triangle (*b:* side or base, *h*: height)
Volumes by Disks	When two functions are revolved about an axis to constitute one region running between both functions (the disk method gives a solid with no empty space inside)	• $V=\int_{x_1}^{x_2} \pi\left(f(x)-g(x)\right)^2 dx$ to get the volume about the x-axis • $V=\int_{y_1}^{y_2} \pi\left(f(y)-g(y)\right)^2 dy$ to get the volume about the y-axis
Volumes by Washers	When two functions are revolved about an axis and the volume between them is required (the washer method gives a solid with some empty space inside) **<u>Note:</u>** Rather than drawing to determine which of the functions is above the second, we use absolute value.	• $V=\left\|\int_{x_1}^{x_2} \pi\left(f^2(x)-g^2(x)\right)dx\right\|$ to get the volume about the x-axis • $V=\left\|\int_{y_1}^{y_2} \pi\left(f^2(y)-g^2(y)\right)dy\right\|$ to get the volume about the y-axis
Volumes by Cylindrical Shell	When two functions are revolved about an axis and there are points of intersection between the graphs of the functions and the axis.	• $V=\left\|\int_{x_1}^{x_2} 2\pi x\left(f(x)-g(x)\right)dx\right\|$ to get the volume about the y-axis

	Note: Rather than drawing to determine which of the functions is above the second, we use absolute value.	• $V=\left\lvert\int_{y_1}^{y_2} 2\pi\, y\big(f(y)-g(y)\big)dy\right\rvert$ to get the volume about the x-axis • $V=\left\lvert\int_{x_1}^{x_2} 2\pi(x-k)\big(f(x)-g(x)\big)dx\right\rvert$ to get the volume about the line *x*=k • $V=\left\lvert\int_{y_1}^{y_2} 2\pi(y-k)\big(f(y)-g(y)\big)dy\right\rvert$ to get the volume about the *y*=k
Length	To calculate the length of functions	• $L=\int_{x_1}^{x_2}\sqrt{1+(y')^2}\,dx$ when $y=f(x)$ • $L=\int_{y_1}^{y_2}\sqrt{1+(x')^2}\,dy$ when $x=f(y)$ • $L=\int_{t_1}^{t_2}\sqrt{(x'_t)^2+(y'_t)^2}\,dt$ when parametric equations are given $x=f(t)$ & $y=g(t)$