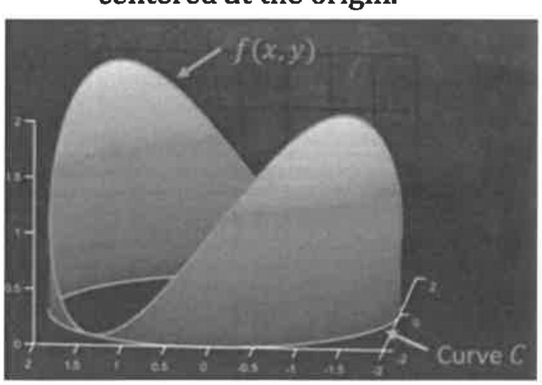
https://www.youtube.com/watch?v=WA5_a3C2iqY&list=PLHXZ9OQGMqxfW0GMqeUE1bLKaYor6kbHa&index=3&t=612s

$$\int_C f(x,y)\,ds = \int_a^b f(h(t),g(t))\sqrt{\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2}\,dt$$

Curve	Parametric Equations	
	Counter-Clockwise	Clockwise
$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ (Ellipse)	$x=a\cos(t)$ $y=b\sin(t)$ $0\le t\le 2\pi$	$x=a\cos(t)$ $y=-b\sin(t)$ $0\le t\le 2\pi$
	Counter-Clockwise	Clockwise
$x^2+y^2=r^2$ (Circle)	$x=r\cos(t)$ $y=r\sin(t)$ $0\le t\le 2\pi$	$x=r\cos(t)$ $y=-r\sin(t)$ $0\le t\le 2\pi$
$y=f(x)$	$x=t$ $y=f(t)$	
$x=g(y)$	$x=g(t)$ $y=t$	
Line Segment From (x_0,y_0,z_0) to (x_1,y_1,z_1)	$\vec{r}(t)=(1-t)\langle x_0,y_0,z_0\rangle+t\langle x_1,y_1,z_1\rangle$, $0\le t\le 1$ or $x=(1-t)x_0+t\,x_1$ $y=(1-t)y_0+t\,y_1$, $0\le t\le 1$ $z=(1-t)z_0+t\,z_1$	

1. Calculate the line integral of $f(x,y) = \frac{x^2+y^2}{4} + \frac{xy}{2}$ above the circle of radius 2 centered at the origin.

$x^2+y^2=2^2$



$x = 2\cos t \quad y = 2\sin t$

$\vec{r}(t) = 2\,\text{cot}\,\vec{i} + 2\sin t\,\vec{j} \qquad t\in[0,2\pi]$

$f(2\cos t, 2\sin t) = \frac{(2\cos t)^2+(2\sin t)^2}{4} + \frac{(2\cos t)(2\sin t)}{2}$

*double angle $\sin 2\theta = 2\sin\theta\cos\theta$

$= \frac{4}{4} + \frac{2\sin 2t}{2}$

$= 1+\sin 2t$

$\int_0^{2\pi} (1+\sin 2t)\sqrt{(-2\sin t)^2+(2\cos t)^2}\,dt$

$= \boxed{4\pi}$

2. Evaluate $\int_C xy^4 ds$ where C is the right half of the circle $x^2 + y^2 = 16$ traced out in a counter-clockwise direction.

$x = 4\cos t \quad y = 4\sin t \qquad t \in [-\pi/2, \pi/2]$

$\vec{r}(t) = 4\cos t\, \vec{i} + 4\sin t\, \vec{j}$

$f(x,y) = xy^4$

$f(4\cos t, 4\sin t) = 4\cos t\,(4\sin t)^4$

$= 1024\cos t \sin^4 t$

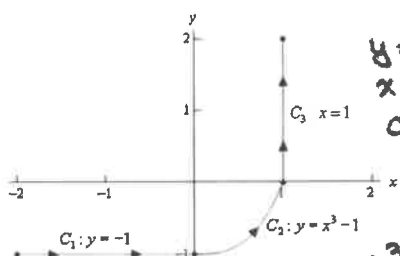
$\int_{-\pi/2}^{\pi/2} 1024\cos t \sin^4 t \sqrt{(-4\sin t)^2 + (4\cos t)^2}\, dt$

$\int_{-\pi/2}^{\pi/2} 1024\cos t \sin^4 t\,(4)\, dt$

$= \boxed{\frac{8192}{5}} \approx 1638.4$

3. Evaluate $\int_C 4x^3 ds$ where C is the curve shown below.

Need to split into 3 integrals



$y = t$
$x = 1$
$0 \le t \le 2$ * 0 to 2 *
b/c t in terms of y not x

$f(1,t) = 4$

$y = -1$
$x = t$
$-2 \le t \le 0$

$f(t,-1) = 4t^3$

$y = t^3 - 1$
$x = t$
$0 \le t \le 1$

$f(t, t^3-1) = 4t^3$

$\int_C 4x^3 ds = \int_{-2}^{0} 4t^3 \sqrt{(1)^2 + (0)^2}\, dt + \int_0^1 4t^3 \sqrt{1^2 + (3t^2)^2}\, dt + \int_0^2 4\sqrt{0+1^2}\, dt$

$= -16 + 2.268 + 8$

$= \boxed{-5.732}$

4. Evaluate $\int_C 4x^3 ds$ where C is the line segment from $(-2, -1)$ to $(1, 2)$

$\vec{r}(t) = (1-t)\langle -2,-1\rangle + t\langle 1,2\rangle \quad 0 \le t \le 1$

$= \langle -2+3t, -1+3t\rangle$

$x = -2+3t \quad y = -1+3t$

$f(-2+3t, -1+3t) = 4(-2+3t)^3$

$\int_C 4x^3 ds = \int_0^1 4(-2+3t)^3 \sqrt{(3)^2+(3)^2}\, dt$

$= \boxed{-21.213}$

5. Evaluate $\int_C 4x^3 ds$ where C is the line segment from $(1, 2)$ to $(-2, -1)$

$\vec{r}(t) = (1-t)\langle 1,2\rangle + t\langle -2,-1\rangle$

$= \langle 1-3t, 2-3t\rangle \quad 0 \le t \le 1$

$x = 1-3t \quad y = 2-3t$

$f(1-3t, 2-3t) = 4(1-3t)^3$

$\int_0^1 4(1-3t)^3 \sqrt{(-3)^2+(-3)^2}\, dt$

$= \boxed{-21.213}$