Plan:

Exam: Feb. 10/11

warm-up FRI - week 2

$$\int \frac{\ln(x)}{\sqrt{x}}\,dx$$

FRI - week 2

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warm-up FRI - week 2

$$\int \frac{\ln(x)}{\sqrt{x}}\,dx = 2\sqrt{x}\cdot\ln(x) - \int \frac{1}{x}\cdot 2x^{\frac{1}{2}}\,dx =$$

$\int u\,dv = uv - \int v\,du$ IBP

LIPET

$u = \ln(x)$ | $dv = \frac{1}{\sqrt{x}}\,dx$

$du = \frac{1}{x}\,dx$ | $\int x^{-1/2}\,dx = 2x^{\frac{1}{2}}$

$$= 2\sqrt{x}\ln(x) - 2\int x^{-\frac{1}{2}}\,dx$$

$$= 2\sqrt{x}\ln(x) - 2\cdot 2x^{\frac{1}{2}} + C$$

$$= 2\sqrt{x}\ln(x) - 4\sqrt{x} + C$$

$$= 2\sqrt{x}(\ln(x) - 2)$$

$$\frac{1}{dx}(\text{ans}) = x^{-\frac{1}{2}}(\ln(x) - 2) + 2\sqrt{x}\left(\frac{1}{x}\right) = \frac{\ln(x)}{\sqrt{x}} - 2x^{-1/2} + 2x^{-1/2} = \frac{\ln(x)}{\sqrt{x}}$$

EX:

$$\int \sin(\ln(x))\,dx$$

$u = \sin(\ln(x))$	$dv = dx$
$du = \frac{\cos(\ln(x))}{x}$	$v = x$

Hint: LIPET

$\int \ln(x)\,dx = x\cdot\ln x - \int 1\,dx$ (since $x\cdot\frac{1}{x}$)

$u = \ln(x)$	$dv = dx$
$du = \frac{1}{x}dx$	$v = x$

$$\int \sin(\ln(x))\,dx = x\cdot\sin(\ln(x)) - \int x\cdot\frac{\cos(\ln(x))}{x}\,dx$$

$$= x\cdot\sin(\ln(x)) - \int \cos(\ln(x))\,dx =$$

$u = \cos(\ln(x))$	$dv = dx$
$du = -\frac{\sin(\ln(x))}{x}dx$	$v = x$

$$= x\cdot\sin(\ln(x)) - \left[x\cdot\cos(\ln(x)) - \int x\left(\frac{-\sin(\ln(x))}{x}\right)dx\right]$$

$$= x\cdot\sin(\ln(x)) - x\cdot\cos(\ln(x)) \int \sin(\ln(x))\,dx$$

$A = \text{stuff} - A$

$2A = \text{stuff}$

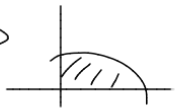
$A = \frac{\text{stuff}}{2}$

adding $\int \sin(\ln(x))\,dx$:

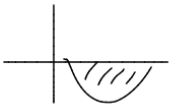
$$2\int \sin(\ln(x))\,dx = x(\sin(\ln(x)) - \cos(\ln(x))$$

$$\boxed{\int \sin(\ln(x))\,dx = \frac{x(\sin(\ln(x)) - \cos(\ln(x))}{2}}$$

$\int_a^b f(x)\,dx$ = #, the signed area under the curve

+ ⇒ 

https://www.desmos.com/calculator/qi8o1rdjpu

− ⇒ 

set $a=0$, $b=x$ $(u=x)$

$\int_0^x f(u)\,du$ = Area so-far function | start @ 0 move right to x — this is the (signed) area.

$$\int_0^x \sin(\ln(u))\,du = \frac{x}{2}\left(\sin(\ln(x)) - \cos(\ln(x))\right)$$

the area so far ... up to x

To see where the area above = area below set $= 0$

$$\frac{x}{2}\left(\sin(\ln(x)) - \cos(\ln(x))\right) = 0$$

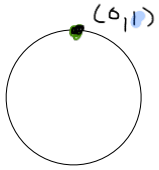
$\sin(\ln(x)) = \cos(\ln(x)) = \sin(\ln(x) + \frac{\pi}{2})$

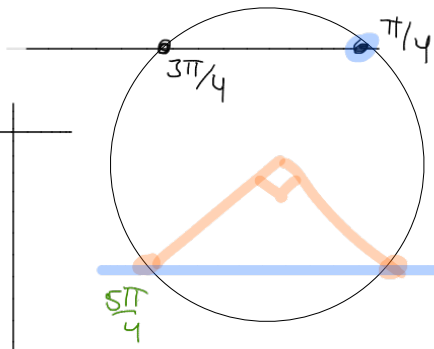
$x = 0$

$\sin(a+b) = \sin(a)\cos(b) + \sin(b)\cos(a)$

set $b = \frac{\pi}{2}$

$$\sin(a+\tfrac{\pi}{2}) = \sin(a)\cdot\underbrace{\cos(\tfrac{\pi}{2})}_{0} + \underbrace{\sin(\tfrac{\pi}{2})}_{1}\cdot\cos(a) = \cos(a)$$





If $\ln(x) = \frac{\pi}{4}$ ← same sin

then $\ln(x) + \frac{\pi}{2} = \frac{3\pi}{4}$

Next $\ln(x) = \frac{5\pi}{4}$

$x = e^{5\pi/4}$

$\ln(x) = \frac{\pi}{4}$

$e^{\ln(x)} = e^{\pi/4}$

$x = e^{\pi/4} \approx 2$