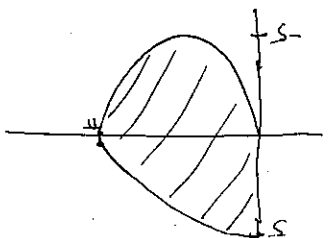


1. Find the area bounded by the graphs of $y = -5 \sin(x)$, $y = \frac{1}{2}x^2 + 5$, $x = 0$, and $x = \pi$.



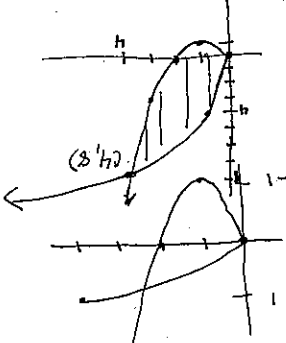
$$A = \int_0^{\pi} \left(-\frac{1}{2}x^2 + 5 + 5 \sin(x) \right) dx$$

$$= -\frac{1}{6}x^3 + 5x - 5 \cos(x) \Big|_0^{\pi}$$

$$= -\frac{1}{6}\pi^3 + 5\pi - 5(-1) - (-5)$$

$$= -\frac{1}{6}\pi^3 + 5\pi + 10$$

2. Find the area of the bounded region between the curves $y = 4\sqrt{x}$ and $y = (x-1)^2 - 1$.



$$A = \int_4^6 \left(4\sqrt{x} - (x-1)^2 + 1 \right) dx$$

$$= 4 \cdot \frac{2}{3} x^{3/2} - \frac{1}{3} (x-1)^3 + x \Big|_4^6$$

$$= \frac{8}{3} \cdot 4 \cdot 2 - \frac{1}{3} \cdot 8 \cdot 7 + 4 - 0 + \frac{1}{3}(-1) - 0$$

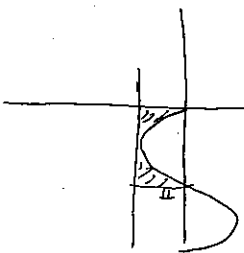
$$= \frac{64}{3} - 9 + 4 - \frac{1}{3} = \frac{63}{3} - 5 = 18$$

3. Find the area of the region bounded by $x = \sin(y)$, $x = 1$, $y = 0$, and $y = \pi$.

$$A = \int_0^{\pi} (1 - \sin(y)) dy$$

$$= y + \cos(y) \Big|_0^{\pi}$$

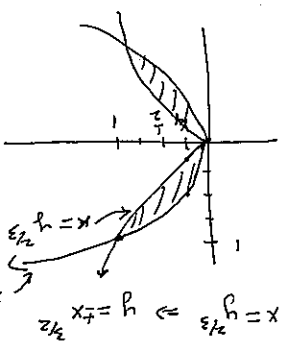
$$= \pi + (-1) - 0 - (1) = \pi - 2$$



30

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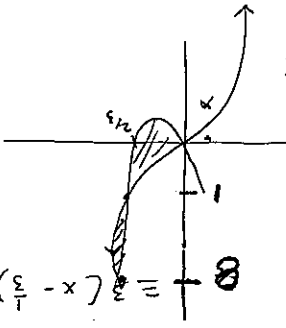
4. Set up BUT DO NOT EVALUATE an integral that can be used to find the area of region bounded by $x = y^{2/3}$ and $x = y^2$ by integrating with respect to the following axis.



(a) the x-axis
(b) the y-axis

a) $\int_0^1 (y^{2/3} - y^2) dx$ (+2 order)
b) $\int_0^1 (y^{2/3} - y^2) dy$ (+1 solve for y^2)

5. Set up BUT DO NOT EVALUATE an integral that can be used to find the area bounded between $x = \sqrt[3]{y}$ and $y = 3x^2 - 2x$.



$$y = 3x^2 - 2x$$

$$= 3(x^2 - \frac{2}{3}x + \frac{1}{9}) - \frac{1}{3}$$

$$= 3(x - \frac{1}{3})^2 - \frac{1}{3}$$

$$x = \sqrt[3]{y} \Rightarrow y = x^3$$

$$A = \int_0^1 (x^3 - 3x^2 + 2x) dx + \int_2^3 (3x^2 - 2x - x^3) dx$$

$$y + \frac{1}{3} = 3(x - \frac{1}{3})^2$$

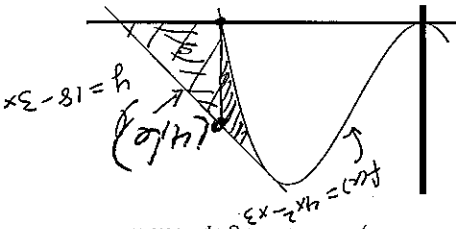
$$x = \frac{1}{3} \pm \sqrt{\frac{y + \frac{1}{3}}{3}}$$

un. ts² issue

12

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6. (From the 2003 AP Calculus AB exam) Consider the graph below.



Let f be the function given by $f(x) = 4x^2 - x^3$, and let ℓ be the line $y = 18 - 3x$, where ℓ is tangent to the graph of f in the first quadrant. Let S be the region bounded by the graph of f , the line ℓ , and the y -axis, as shown above.

(a) Find the x -coordinate of the point where ℓ is tangent to the graph of f .

Handwritten solution for (a):
 $f'(x) = 8x - 3x^2 = 0$
 $3x^2 - 8x + 3 = 0$
 $(3x + 1)(x - 3) = 0$
 $x = -\frac{1}{3}$ or $x = 3$
 Since $x = 3$ is in the first quadrant, the answer is $x = 3$.

Handwritten notes for (a):
 bold ans $\rightarrow 3$
 set-up $y_1 = y_2$
 8 pts

(b) Find the area of S . Give the exact answer.

Handwritten solution for (b):
 $f(x) = 4x^2 - x^3$
 $\ell(x) = 18 - 3x$
 x -int at $x = 4$
 x -int at $x = 3$
 $A = \int_0^4 (18 - 3x - (4x^2 - x^3)) dx$
 $A = \int_0^4 (18 - 3x - 4x^2 + x^3) dx$
 $A = [18x - \frac{3}{2}x^2 - \frac{4}{3}x^3 + \frac{1}{4}x^4]_0^4$
 $A = 18(4) - \frac{3}{2}(16) - \frac{4}{3}(64) + \frac{1}{4}(256)$
 $A = 72 - 24 - \frac{256}{3} + 64$
 $A = 112 - \frac{256}{3} = \frac{336 - 256}{3} = \frac{80}{3}$

Handwritten numbers: 12, 20