

- $f(x) = (x+2)(x+3)(x+4)$. $f'(x) = (x+2)(x+3) + (x+2)(x+4) + (x+3)(x+4)$
 $f'(1) = 3 \cdot 4 + 3 \cdot 5 + 4 \cdot 5 = 12 + 15 + 20 = 47$
 $f'(4) = 6 \cdot 7 + 6 \cdot 8 + 7 \cdot 8 = 42 + 48 + 56 = 146$
 $146 - 47 = 99$
- $\int_0^2 (2x^3 - kx^2 + 2k) dx = 12 \Rightarrow \left[\frac{1}{2}x^4 - \frac{k}{3}x^3 + 2kx \right]_0^2 = 12 \Rightarrow 8 - \frac{8}{3}k + 4k = 12 \Rightarrow k = 3$.
 $\int_{-3}^3 \frac{dx}{x^2+9} = \frac{1}{3} \arctan \frac{x}{3} \Big|_{-3}^3 = \frac{1}{3} \arctan 1 - \frac{1}{3} \arctan(-1) = \frac{1}{3} \cdot \frac{\pi}{4} - \frac{1}{3} \cdot \frac{-\pi}{4} = \frac{\pi}{6}$.
- $A_{circle} = \pi r^2$; $\frac{dA_{circle}}{dt} = 2\pi r \frac{dr}{dt} = 3\pi \Rightarrow r \frac{dr}{dt} = \frac{3}{2}$. $A_{sq} = 2r^2$; $\frac{dA_{sq}}{dt} = 4r \frac{dr}{dt} = 4 \cdot \frac{3}{2} = 6$
- $A = \int_1^3 (3x^2 + 3) dx = (x^3 + 3x) \Big|_1^3 = 27 + 9 - 4 = 32$. $\int_0^{32} |x-1| dx = \frac{1}{2} + \frac{961}{2} = 481$.
- $A = \int_0^1 \frac{x dx}{x^2+1} = \frac{1}{2} \ln(x^2+1) \Big|_0^1 = \frac{1}{2} \ln 2$; $B = \int_{\pi/6}^{\pi/2} \cot x dx = \ln |\sin x| \Big|_{\pi/6}^{\pi/2} = 0 - \ln \frac{1}{2} = \ln 2$
 $\ln 2 - \frac{1}{2} \ln 2 = \frac{1}{2} \ln 2$ or $\ln \sqrt{2}$
- $y = \sin(xy) + \tan(2x)$; $y' = (xy' + y) \cos(xy) + 2 \sec^2(2x)$. At the point $\left(\frac{\pi}{2}, 1\right)$, $y' = 2 \sec^2 \pi = 2$.
 $f(t) = \ln(t^2 + 2)$ and $f'(t) = \frac{2t}{t^2 + 2}$ and so $f'(4) = \frac{4}{9}$
- $\frac{dy}{dx} = \frac{4t^3 - 6t^2}{2t} = 2t^2 - 3t$. $\frac{d^2y}{dx^2} = \frac{4t-3}{2t}$. The graph intersects the x -axis when $t = 2$ and so $\frac{d^2y}{dx^2} = \frac{5}{4}$
- $16x^2 + 9y^2 = 144 \Rightarrow y = \pm \sqrt{16 - \frac{16}{9}x^2}$ and $s = 2\sqrt{16 - \frac{16}{9}x^2}$ and so $A = \frac{s^2 \sqrt{3}}{4}$ and
 $V = 2 \int_0^3 \sqrt{3} \left(16 - \frac{16}{9}x^2\right) dx = 2\sqrt{3} \left(16x - \frac{16}{27}x^3\right) \Big|_0^3 = 2\sqrt{3}(48 - 16) = 64\sqrt{3}$
- $y = \frac{1}{x^2}$; $\frac{dy}{dx} = \frac{-2}{x^3}$ at the point (1,1) gives $m = -2$. Equation of L is $y - 1 = \frac{1}{2}(x - 1)$ or $y = \frac{1}{2}x + \frac{1}{2}$.
Area of triangle is $\frac{1}{2} \cdot 1 \cdot \frac{1}{2} = \frac{1}{4}$
- When $t = 0, V = 800\pi$. $\frac{dV}{dt} = k\sqrt{V} \Rightarrow \int V^{-1/2} dV = k \int dt \Rightarrow 2\sqrt{V} = kt + C$ and so $C = 40\sqrt{2\pi}$.
Also, since $\frac{dV}{dt} = k\sqrt{V}$, then $-20\pi = k\sqrt{800\pi} \Rightarrow k = \frac{-\sqrt{\pi}}{\sqrt{2}}$. So now $2\sqrt{V} = \frac{-\sqrt{\pi}}{\sqrt{2}}t + 40\sqrt{2\pi}$ and
let $V = 0$ and solve for t . $\frac{\sqrt{\pi}}{\sqrt{2}}t = 40\sqrt{2\pi} \Rightarrow t = 40\sqrt{2\pi} \cdot \frac{\sqrt{2}}{\sqrt{\pi}} = 80$

$$11. A = \lim_{x \rightarrow 0} \frac{3 \sin x}{e^x} = \frac{3 \cdot 0}{1} = 0. \quad B = \lim_{x \rightarrow 0} \left(\frac{1}{x} - \frac{1}{xe^{2x}} \right) = \lim_{x \rightarrow 0} \left(\frac{e^{2x} - 1}{xe^{2x}} \right) = \lim_{x \rightarrow 0} \left(\frac{2e^{2x}}{2xe^{2x} + e^{2x}} \right) = \frac{2}{1} = 2.$$

$$C = \lim_{x \rightarrow 0^+} x^2 \ln x = \lim_{x \rightarrow 0^+} \frac{\ln x}{x^{-2}} = \lim_{x \rightarrow 0^+} \frac{1/x}{-2x^{-3}} = \lim_{x \rightarrow 0^+} \frac{1}{-2x^{-2}} = \lim_{x \rightarrow 0^+} \frac{-1}{2} x^2 = 0. \quad A + B + C = 0 + 2 + 0 = 2.$$

$$12. \text{Revolving } R \text{ about the } x\text{-axis: } V = \pi \int_0^1 (x^2 - x^6) dx = \pi \left(\frac{1}{3} - \frac{1}{7} \right) = \frac{4\pi}{21}.$$

$$\text{Revolving } R \text{ about the } y\text{-axis: } V = 2\pi \int_0^1 x(x - x^3) dx = 2\pi \int_0^1 (x^2 - x^4) dx = 2\pi \left(\frac{1}{3} - \frac{1}{5} \right) = \frac{4\pi}{15}.$$

$$\frac{4\pi}{15} - \frac{4\pi}{21} = \frac{28\pi - 21\pi}{105} = \frac{8\pi}{105}$$