#1.

$$f(x) = x^3 + 3x^2 - 9x + 5$$

$$f'(x) = 3x^2 + 6x - 9$$

$$= 3(x^2 + 2x - 3)$$

$$= 3(x-1)(x+3)$$

$f(x)$	$\cdots$	-3	$\cdots$	1	$\cdots$
$f'(x)$	$\nearrow$	0	$\searrow$	0	$\nearrow$

$\Rightarrow$ 극대값 : $f(-3) = 32$. ■

#2.

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

$$f'(x) = \frac{(2x+1)^3 - x \cdot 3(2x+1)^2 \cdot 2}{(2x+1)^6} = \frac{(2x+1)^2\{(2x+1) - 6x\}}{(2x+1)^6}$$

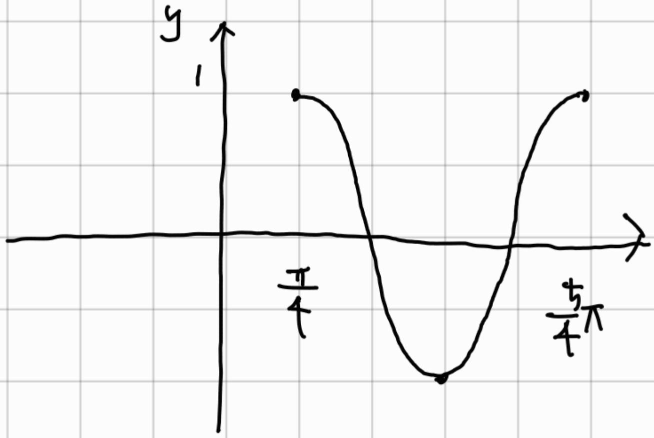
$$= \frac{(2x+1)^2(-4x+1)}{(2x+1)^6}$$

$$f'(x)\Big|_{x=1} = \frac{3^2 \times -3}{3^6} = -\frac{1}{27}$$ ■

#3.

$$f(x) = \cos\left(2x - \frac{\pi}{2}\right)$$

$$= \cos\left(2\left(x - \frac{\pi}{4}\right)\right)$$



#4.

$$f(x,y) = \frac{x}{y}$$

$$\frac{\partial f}{\partial y} = -\frac{x}{y^2}, \quad \frac{\partial f}{\partial x \partial y} = -\frac{1}{y^2}, \quad \left.\frac{\partial f}{\partial x \partial y}\right|_{(x,y)=(1,1)} = -1 \quad \blacksquare$$

#5.

$$\begin{matrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 1 & 1 & 0 \\ 3 & 0 & 0 \end{matrix} \qquad 0\mathbf{i} - 0\mathbf{j} + (-3)\mathbf{k} \quad \blacksquare$$

#6.

$$\int_0^{\pi} x\cos x\, dx = \left[x\sin x - \int \sin x\, dx \right]_0^{\pi}$$

$$= \left[x\sin x + \cos x \right]_0^{\pi}$$

$$= -1 - 1$$

$$= -2 \quad \blacksquare$$

#7.

$$\int_{-1}^{0} x\sqrt{x+1}\, dx$$

$$t = \sqrt{x+1}$$

$$\frac{dt}{dx} = \frac{1}{2\cdot\sqrt{x+1}} \rightarrow dx = 2\sqrt{x+1}\, dt = 2t\, dt$$

$$\int_0^1 (t^2-1)t\cdot 2t\, dt = \int_0^1 2t^4 - 2t^2\, dt$$

$$\left[\frac{2}{5}t^5 - \frac{2}{3}t^3 \right]_0^1 = -\frac{4}{15} \quad \blacksquare$$

#8.

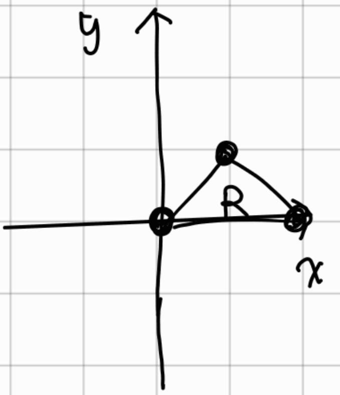
$$\int_1^\infty \frac{1}{\sqrt{x}}dx = \int_1^\infty x^{-\frac{1}{2}}dx = \left[2x^{\frac{1}{2}}\right]_1^\infty = \infty$$

#9.

$$A = \begin{pmatrix} 2 & 4 & 7 \\ 6 & 0 & 3 \\ 1 & 5 & 3 \end{pmatrix}$$

$$|A| = 6\cdot(12-35) + 3\cdot(10-4)$$
$$= 6\cdot(-23) + 3\cdot 6$$
$$= -138 + 18 = -120$$

#10.



$$\int_0^1 \int_0^x (2x+1)\,dy\,dx + \int_1^2 \int_0^{2-x} (2x+1)\,dy\,dx$$

$$= \int_0^1 x(2x+1)\,dx + \int_1^2 (2-x)(2x+1)\,dx$$

$$= \int_0^1 2x^2+x\,dx + \int_1^2 -2x^2+3x+2\,dx$$

$$= \left[\frac{2}{3}x^3+\frac{1}{2}x^2\right]_0^1 + \left[-\frac{2}{3}x^3+\frac{3}{2}x^2+2x\right]_1^2$$

$$= \frac{2}{3}+\frac{1}{2} - \frac{14}{3} + \frac{9}{2} + 2$$

$$= -4+5+2 = 3$$

#11.

$$\cos 2x = \cos^2 x - \sin^2 x$$
$$= 1 - 2\sin^2 x$$
$$\Rightarrow \sin^2 x = \frac{1-\cos 2x}{2}$$

$$\int_0^{\frac{\pi}{2}} \frac{1}{2} - \frac{\cos 2x}{2}\, dx$$
$$= \left[\frac{1}{2}x - \frac{\sin 2x}{4}\right]_0^{\frac{\pi}{2}}$$
$$= \frac{\pi}{4} \quad \blacksquare$$

#12.

$$f(x) = \sum_{n=0}^{\infty} \frac{f^{(n)}(c)}{n!}(x-c)^n$$

$$f(x) = \frac{f^{0}(0)}{0!}x^0 + \frac{f'(0)}{1!}x^1 + \frac{f''(0)}{2!}x^2 + \frac{f'''(0)}{3!}x^3 + \frac{f^{4}(0)}{4!}x^4$$
$$= \frac{1}{1+0}\cdot x + \frac{1}{2}\left(-\frac{1}{(1+0)^2}\right) + \frac{1}{6}\left(+2\cdot\frac{1}{(1+0)^3}\right) + \frac{1}{24}\left(-6\cdot\frac{1}{(1+0)^4}\right)$$

$$f(1) = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} = \frac{12-6+4-3}{12} = \frac{7}{12} \quad \blacksquare$$

#13.

$$\int_0^1 xe^{-x}dx = \left[x(-e^{-x}) + \int e^{-x}\,dx\right]_0^1$$
$$= \left[-xe^{-x} - e^{-x}\right]_0^1$$
$$= -e^{-1} - e^{-1} + 1 = 1 - \frac{2}{e} \quad \blacksquare$$

#14.

$$x^2-2xy+y^2-4=0$$

$$\frac{dy}{dx} = -\frac{f_x}{f_y} = -\frac{2x-2y}{-2x+2y}\Bigg|_{x=1} = -\frac{-2y+2}{2y-2} = +1$$ ▨

#15.

$$y=\log(x^3+2x+1)$$

$$= \frac{1}{\ln 10}\cdot \ln(x^3+2x+1)$$

$$y' = \frac{1}{\ln 10}\cdot\frac{3x^2+2}{(x^3+2x+1)}, \quad y'\Big|_{x=1} = \frac{1}{\ln 10}\cdot\frac{5}{4}$$ ▨

#16.

$x=r\cos\theta$

$y=r\sin\theta$

$dxdy = r\cdot dr\,d\theta$

$$\iint_R \sqrt{x^2+y^2}\,dA = \int_0^{\frac{\pi}{2}}\int_0^1 r\cdot r\,dr\,d\theta$$

$$= \int_0^{\frac{\pi}{2}}\int_0^1 r^2\,dr\,d\theta$$

$$= \int_0^{\frac{\pi}{2}}\frac{1}{3}\,d\theta = \frac{\pi}{6}$$ ▨

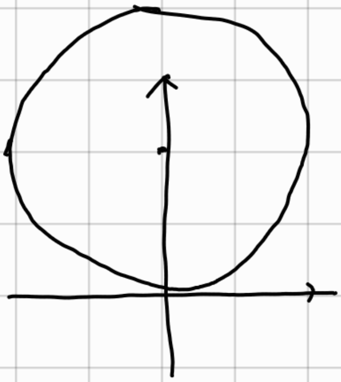
#17.

$r = 4\sin t$

$\Rightarrow r^2 = 4r\sin t$

$\Rightarrow x^2 + y^2 = 4y$

$\Rightarrow x^2 + (y-2)^2 = 4$



#18.

$$\int_1^4 \frac{1}{x^2 - x}\,dx = \int_2^4 \frac{1}{x(x-1)}\,dx = \int_2^4 \frac{1}{x-1} - \frac{1}{x}\,dx$$

$$= \Big[\ln(x-1) - \ln x\Big]_2^4 = \ln 3 - \ln 2 = \ln\frac{3}{2}$$

#19.

$z = x^2 - y^2$

$z_x = 2x$

$z_y = -2y$

$dz = (2x)dx - (2y)dy$

$dz\Big|_{x,y=4,5} = 8\,dx - 10\,dy$

$= 8 \cdot 0.3 - 10 \cdot -0.2$

$= 2.4 + 2 = 4.4$

#20.

$$\int_0^2 \int_0^{2-x} \int_0^{2-x-y} dz\, dy\, dx$$

$$= \int_0^2 \int_0^{2-x} (2-x-y)\, dy\, dx$$

$$= \int_0^2 4-2x-2x+x^2-\frac{1}{2}(2-x)^2\, dx$$

$$= \int_0^2 \frac{1}{2}x^2-2x+2\, dx = \left[\frac{1}{6}x^3-x^2+2x\right]_0^2$$

$$= \frac{8}{6}-4+4 = \frac{4}{3}$$