1. a) $\frac{d}{dx}\ \frac{\ln x}{x^2} = \frac{1 - 2x\ln x}{x^4}$

$\frac{d}{dx}\ \frac{u}{v} = \frac{u'v - uv'}{v^2}$

b) $\frac{d}{du}\sqrt{3\sin^2 u + 2}$

$\frac{1}{2\sqrt{3\sin^2 u + 2}} \cdot -6\sin u \cos u$

$= -\frac{3\sin u \cos u}{\sqrt{3\sin^2 u + 2}}$

c) $\frac{d^n}{dx^n} e^{kx}\Big|_{x=0}$ k costant

$= k^n e^{kx} = k^n$

4. $f(x) = \begin{cases} x^2 + x + a, & x \le 0 \\ bx + 2 & x > 0 \end{cases}$, a & b are constant.

$bx + 2 = x^2 + x + a$
@ $x = 0$

$2 = a$
$a = 2$

$bx + 2 = x^2 + x + 2$

$bx = x^2 + x$
$b = x + 1$

where

$2x + 1 = b$
$b = 1$

$\boxed{\begin{matrix} a = 2 \\ b = 1 \end{matrix}}$

7. $y = y(x)$

slope of normal line $\frac{\cancel{dy}}{dx} = \frac{y-1}{x}$

$y' = \frac{y-1}{x}$

but this is $\perp$ to it, so $y' = \frac{x}{1-y}$

b) $\dfrac{dy}{dx} = \dfrac{1-x}{y}$

$y\,dy = (1-x)\,dx$

$\int y\,dy = \int (1-x)\,dx$

$\frac{1}{2}y^2 + C_y = x - \frac{1}{2}x^2 + C_x$

$x^2 + y^2 + 2x + C = 0$

$(x+1)^2 + y^2 = 1$

c) Circle w/ origin at $(-1,0)$ and radius 1.

10. $F(x) = \int_0^x e^{-t^2}\,dt$

a) $F'(1) = \frac{d}{dx} \int_0^1 e^{-t^2}\,dt = \frac{d}{dx}\left[\int_0^1 \frac{1}{e^{t^2}}\,dt\right]$

$= \int_0^1 -2te^{-t^2}\,dt$

$= -\frac{2}{e}$

$F''(1) =$

13. $\displaystyle\int_0^1 \frac{dx}{(x^2+1)^2}$

$x = \tan u$

$dx = \sec^2 u\,du$

$\displaystyle\int_0^{\pi/4} \frac{\sec^2 u\,du}{\sec^4 u}$

$\displaystyle\int_0^{\pi/4} \cos^2 u\,du$

$\dfrac{1+\cos 2x}{2}\Big|_0^{\pi/4} = \frac{1}{2} + 1 = \boxed{\frac{3}{2}}$

16. $\int_1^\infty \frac{dx}{x^{3/2}}$

$= \lim_{b \to \infty} -\frac{2}{\sqrt{b}} + 2 = \boxed{2}$

19. $\frac{d}{dx}\tan^{-1} x = \frac{1}{1+x^2}$

$\frac{1}{1+x^2} = 1 - x^2 + x^4 - x^6 + x^8 - \ldots$

$\int \frac{1}{1+x^2} = x - \frac{1}{3}x^3 + \frac{1}{5}x^5 - \frac{1}{7}x^7 + \frac{1}{9}x^9 - \ldots$