1.

a) $\frac{d}{dx}\left(\cos\left(\sqrt{x^2+5x}\right)\right)$

$= -\frac{d}{dx}\left(\sqrt{x^2+5x}\right)\sin\left(\sqrt{x^2+5x}\right)$

$= -\frac{d}{dx}\left(\left(x^2+5x\right)^{1/2}\right)\sin\left(\sqrt{x^2+5x}\right)$

$= -\frac{1}{2}\left(2x+5\right)\left(x^2+5x\right)^{-1/2}\sin\left(\sqrt{x^2+5x}\right)$

$= -\frac{1}{2}\frac{(2x+5)}{\sqrt{x^2+5x}}\sin\left(\sqrt{x^2+5x}\right).$

b) $\frac{d}{dx}\left(e^{\sin x}\right) = \cos x \, e^{\sin x}.$

c) $\frac{d}{dx}\tan(x^2+2^x) = \left(2x + 2^x . \ln 2\right)\sec^2(x^2+2^x).$

d) $\frac{d}{dx}\left(x^5 \sec(e^x)\right) = 5x^4 \sec(e^x) +$
$x^5 e^x \tan(e^x)\sec(e^x).$

2.

a) $\frac{d}{dx}\left(e^x \arcsin(2x)\right) = e^x \arcsin(2x) + e^x \frac{2}{\sqrt{1-4x^2}}$.

b) $\frac{d}{dx}\left(\arctan(x^2)\right) = \frac{2x}{1+(x^2)^2} = \frac{2x}{1+x^4}$

3.

a) $\int (2x^5 + 6x^2 + 4)\,dx = \frac{2x^6}{6} + \frac{6x^3}{3} + 4x + C$

$= \frac{x^6}{3} + 2x^3 + 4x + C$

b) $\int \left(\frac{1}{x} + \frac{1}{1+x^2}\right) dx = \ln|x| + \arctan x + C$

c) $\int (\sin x + \tan x \sec x)\,dx = -\cos x + \sec x + C$.

4

a) $\int 5(5x+3)^{10}\,dx$

Substitution: $u = 5x+3 \Rightarrow du = 5\,dx$

So $\int 5(5x+3)^{10}\,dx = \int u^{10}\,du = \frac{u^{11}}{11} + C$

$= \frac{(5x+3)^{11}}{11} + C$

b) $\int \frac{x^3}{\sqrt{5x^4+15}}\,dx$ Substitution: $u = 5x^4+15$

$\Rightarrow du = 20x^3\,dx \Rightarrow x^3\,dx = \frac{1}{20}\,du$

So $\int \frac{x^3}{\sqrt{5x^4+15}}\,dx = \int \frac{\frac{1}{20}\,du}{\sqrt{u}} = \frac{1}{20}\int u^{-1/2}\,du$

$= \frac{1}{20}\,\frac{u^{-1/2+1}}{-1/2+1} + C = \frac{1}{20}\,\frac{u^{1/2}}{1/2} + C$

$= \frac{1}{10}\sqrt{5x^4+15} + C$

c) $\int \frac{1}{x(\ln x)^3}\,dx$

Substitution: $u = \ln x \Rightarrow du = \frac{1}{x}\,dx$

So $\int \frac{1}{x(\ln x)^3}\,dx = \int \frac{1}{u^3}\,du = \int u^{-3}\,du$

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

d) $\int \sec^2(5x+10)\,dx$

Substitution: $u = 5x+10 \Rightarrow du = 5\,dx \Rightarrow dx = \frac{1}{5}\,du$

So $\int \sec^2(5x+10)\,dx = \int \frac{1}{5}\sec^2(u)\,du$

$= \frac{1}{5}\tan(u) + C = \frac{1}{5}\tan(5x+10) + C$

e) $\int \sin x \cos^2 x\,dx$ substitution: $u = \cos x$

$\Rightarrow du = -\sin x\,dx \Rightarrow \sin x\,dx = -du$

So $\int \sin x \cos^2 x\,dx = -\int u^2\,du = -\frac{u^3}{3} + C$

$= -\frac{\cos^3 x}{3} + C$

f) $\int x^2 e^{-x^3} dx$ Substitution: $u = -x^3$

$\Rightarrow du = -3x^2 dx \Rightarrow x^2 dx = -\frac{1}{3} du$

$\int x^2 e^{-x^3} dx = \int -\frac{1}{3} e^u du = -\frac{1}{3} \int e^u du$

$= -\frac{1}{3} e^u + C = -\frac{1}{3} e^{-x^3} + C$

5.

a) $\int_2^5 (2x^2+5)\, dx = 2\frac{x^3}{3} + 5x \Big|_2^5$

$= \left(2 \cdot \frac{5^3}{3} + 5(5)\right) - \left(2 \cdot \frac{2^3}{3} + 5(2)\right)$

$= \left(\frac{250}{3} + 25\right) - \left(\frac{16}{3} + 10\right)$

b) $\int_0^{1/\sqrt{3}} \frac{dx}{1+x^2} = \arctan x \Big|_0^{1/\sqrt{3}} = \pi/6 - 0 = \pi/6$

c) $\int_0^{\pi/4} \sin x \, dx = -\cos x \Big|_0^{\pi/4} = -\frac{1}{\sqrt{2}} + 1$

d) $\int_{-1}^{0} x e^{-x^2} dx$

Substitution: $u = -x^2 \Rightarrow du = -2x\,dx$

$\Rightarrow x\,dx = -\frac{1}{2} du$

So $\int_{-1}^{0} x e^{-x^2} dx = \int_{-1}^{0} -\frac{1}{2} e^u du = -\frac{1}{2} \int_{-1}^{0} e^u du$

$= -\frac{1}{2} e^u \Big|_{-1}^{0} = -\frac{1}{2}(e^0 - e^{-1}) = -\frac{1}{2}(1 - e^{-1})$

$= \frac{1}{2}\left(\frac{1}{e} - 1\right).$