(1) removable, $x = 2\pi$

(2) $\frac{dy}{dx} = 3\frac{d}{dx}(e^{2x}) + 5\frac{d}{dx}(x^{-4}) - \frac{d}{dx}(x^{3/5})$

$= 3\cdot e^{2x}\cdot 2 + 5\cdot(-4)x^{-5} - \frac{3}{5}x^{\frac{3}{5}-\frac{5}{5}}$

$= 6e^{2x} - 20x^{-5} - \frac{3}{5}x^{-2/5}$

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(3) $\ln y = \ln\left[(1+4x)^5(3+x-x^2)^8\right]$

$\frac{d}{dx}(\ln(y)) = \frac{d}{dx}\left[5\ln(1+4x) + 8\ln(3+x-x^2)\right]$

$\frac{y'}{y} = 5\cdot\frac{1}{1+4x}\cdot(4) + 8\frac{1}{3+x-x^2}\cdot(1-2x)$

$\frac{dy}{dx} = y\left(\frac{20}{1+4x} + \frac{8(1-2x)}{3+x-x^2}\right)$

$= (1+4x)^5(3+x-x^2)^8\left[\frac{20}{1+4x} + \frac{8(1-2x)}{3+x-x^2}\right]$

$= 4(1+4x)^4(3+x-x^2)^7\left[5(3+x-x^2) + 2(1-2x)(1+4x)\right]$

$= 4(1+4x)^4(3+x-x^2)^7\left[15+5x-5x^2+2[1+2x-8x^2]\right]$

$= 4(1+4x)^4(3+x-x^2)^7\left[15+5x-5x^2+2+4x-16x^2\right]$

$= 4(1+4x)^4(3+x-x^2)^7(-21x^2+9x+17)$

$= -4(1+4x)^4(3+x-x^2)^7(21x^2-9x-17)$

(3) $$\frac{dy}{dx} = \left[\frac{d}{dx}(1+4x)^5\right]\cdot(3+x-x^2)^8 + (1+4x)^5\,\frac{d}{dx}\left(3+x-x^2\right)^8$$

$$= \left[5(1+4x)^4\cdot\frac{d}{dx}(1+4x)\right](3+x-x^2)^8 + (1+4x)^5\cdot 8\left(3+x-x^2\right)^7\cdot\frac{d}{dx}(3+x-x^2)$$

$$= 5(1+4x)^4\cdot 4\left(3+x-x^2\right)^8 + 8(1+4x)^5(3+x-x^2)^7(1-2x)$$

$$= 4(1+4x)^4(3+x-x^2)^7\left[5(3+x-x^2)+2(1+4x)(1-2x)\right]$$

$$= -4(1+4x)^4(3+x-x^2)^7(21x^2-9x-17)$$

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(4) $$\frac{dy}{dx} = \frac{d}{dx}(\cos(\tan x)) = -\sin(\tan x)\cdot\frac{d}{dx}(\tan x)$$

$$= -\sin(\tan x)\sec^2(x)$$

---

(5) $$\frac{dy}{dx} = \frac{(2x-1)^{1/2}\cdot 3 - (3x-2)\cdot\frac{d}{dx}(2x-1)^{1/2}}{2x-1}$$

$$= \frac{3(2x-1)^{1/2} - (3x-2)\frac{1}{2}(2x-1)^{-1/2}\cdot\frac{d}{dx}(2x-1)}{2x-1}$$

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

$$= \frac{(2x-1)^{-1/2}\left[3(2x-1)-(3x-2)\right]}{2x-1} = \frac{6x-3-3x+2}{(2x-1)^{3/2}} = \frac{3x-1}{(2x-1)^{3/2}}$$

(6) $\frac{dy}{dx} = \frac{d}{dx}\left(10^{1-x^2}\right) = 10^{1-x^2} \cdot \ln 10 \cdot \frac{d}{dx}(1-x^2)$

$= -2x(\ln 10) \cdot 10^{1-x^2}$

---

(7) $\frac{dy}{dx} = -\sin\left(\frac{1-e^{2x}}{1+e^{2x}}\right) \cdot \frac{d}{dx}\left(\frac{1-e^{2x}}{1+e^{2x}}\right)$

$= -\sin\left(\frac{1-e^{2x}}{1+e^{2x}}\right) \cdot \left[\frac{(1+e^{2x})(-2e^{2x}) - (1-e^{2x})(2e^{2x})}{(1+e^{2x})^2}\right]$

$= 2e^{2x}\sin\left(\frac{1-e^{2x}}{1+e^{2x}}\right)\left[\frac{1+e^{2x}+1-e^{2x}}{(1+e^{2x})^2}\right]$

$= \frac{4e^{2x}\sin\left(\frac{1-e^{2x}}{1+e^{2x}}\right)}{(1+e^{2x})^2}$

---

(8) $\frac{dy}{dx} = \frac{1}{\csc(5x)} \cdot \frac{d}{dx}(\csc(5x)) = \frac{1}{\csc(5x)} \cdot -\csc(5x)\cot(5x) \cdot \frac{d}{dx}(5x)$

$= -5\cot(5x)$

---

(9) $\frac{d}{dx}\left(x^2\cos(y)\right) + \frac{d}{dx}(\sin(2y)) = \frac{d}{dx}(xy)$

$\left[2x\cos y + x^2(-\sin y)\,y'\right] + 2\cos(2y) - y' = y + xy'$

$-xy' + x^2\sin(y)\,y' - y'2\cos(2y) = y - 2x\cos y$

$y' \cdot (-1) \cdot (x + x^2\sin y + 2\cos 2y) = y - 2x\cos y$

$\boxed{y' = \frac{2x\cos y - y}{x + x^2\sin y + 2\cos(2y)}}$

(10) $$\frac{dy}{dx} = \frac{d}{dx}\left[2\ln x + 3x \ln e\right]$$

$$= 2 \cdot \frac{d}{dx}(\ln x) + \frac{d}{dx}(3x) = \frac{2}{x} + 3$$

---

(11) $$y = \left(\tan^{-1}(x^2)\right)^{1/2}$$

$$\frac{dy}{dx} = \frac{1}{2}\left(\tan^{-1}(x^2)\right)^{-1/2} \cdot \frac{d}{dx}\left(\tan^{-1}(x^2)\right)$$

$$= \frac{1}{2}\left(\tan^{-1}(x^2)\right)^{-1/2} \cdot \frac{1}{1+(x^2)^2} \cdot \frac{d}{dx}(x^2)$$

$$= \frac{1}{2}\left(\tan^{-1}(x^2)\right)^{-1/2} \cdot \frac{1}{1+x^4} \cdot 2x$$

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

---

(12) $$\frac{dy}{dx} = \frac{d}{dx}\left(3\ln(2x+1) - 4\ln(3x-1)\right)$$

$$= 3 \cdot \frac{1}{2x+1} \cdot 2 - 4 \cdot \frac{1}{3x-1} \cdot 3$$

$$= 6\left(\frac{1}{2x+1} - \frac{2}{3x-1}\right)$$

$$= 6\left(\frac{3x-1-2(2x+1)}{(2x+1)(3x-1)}\right) = \frac{6(3x-1-4x-2)}{(2x+1)(3x-1)} = \frac{6(-x-3)}{(2x+1)(3x-1)} = \boxed{\frac{-6(x+3)}{(2x+1)(3x-1)}}$$

(13) $\ln y = \ln e^{x^2} + \ln x^{1/2} + 10 \ln (x^2+1)$

$$\frac{y'}{y} = \frac{d}{dx}(x^2) + \frac{1}{2}\frac{d}{dx}(\ln x) + 10\frac{d}{dx}\ln(x^2+1)$$

$$\frac{dy}{dx} = y\left(2x + \frac{1}{2x} + 10 \cdot \frac{1}{x^2+1} \cdot 2x\right)$$

$$= e^{x^2}\sqrt{x}\,(x^2+1)^{10}\left(2x + \frac{1}{2x} + \frac{20x}{x^2+1}\right)$$

(14) $\ln y = \cos(x) \ln(\ln x)$

$$\frac{y'}{y} = \frac{d}{dx}\left(\cos(x) \ln(\ln x)\right)$$

$$\frac{1}{y}\frac{dy}{dx} = -\sin(x)\ln(\ln x) + \cos x \frac{1}{\ln x} \cdot \frac{1}{x}$$

$$\frac{dy}{dx} = (\ln x)^{\cos(x)}\left(\frac{\cos x}{x \ln x} - \sin(x)\ln(\ln x)\right)$$

(15) $f'(x) = 2ax + b$

$$\left.\begin{array}{l} [f'(-1) = 6] \Rightarrow [-2a+b = 6] \\ [f'(5) = -2] \Rightarrow [10a+b = -2] \\ [f(1) = 4] \Rightarrow [4 = a+b+c] \end{array}\right\} \Rightarrow \left\{\begin{array}{l} a+b+c = 4 \\ -2a+b = 6 \\ 10a+b = -2 \end{array}\right\}$$

$$\Leftrightarrow \left\{ \begin{bmatrix} 1 & 1 & 1 \\ -2 & 1 & 0 \\ 10 & 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 4 \\ 6 \\ -2 \end{bmatrix} \right\} \Leftrightarrow \left[(a,b,c) = \left(\tfrac{-2}{3}, \tfrac{4}{3}, 0\right) \right]$$

$$\Rightarrow \left[f(x) = -\frac{2}{3}x^2 + \frac{14}{3}x \right]$$

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(16) $$\frac{dK}{dt} = \frac{1}{2} m \frac{d}{dt} v^2$$

$$= \frac{1}{2} m \, 2v \frac{dv}{dt}$$

$$\frac{dK}{dt} = mv \frac{dv}{dt}$$