Question 1. — Find $\dfrac{dy}{dx}$ if $y = e^x - x^e + \dfrac{e}{x} - \dfrac{x}{e} + \sqrt[e]{x} - e^e$.

Answer. — $\dfrac{dy}{dx} = e^x - ex^{e-1} - \dfrac{e}{x^2} + \dfrac{1}{e} + \dfrac{1}{e}x^{1/e-1}$

Question 2. — Find $\dfrac{du}{dv}$ if $u = (3v^2 - 2v\sqrt{v} + v - 3)\cos(v)$.

Answer. — $\dfrac{du}{dv} = (6v - 3\sqrt{v} + 1)\cos(v) - (3v^2 - 2v\sqrt{v} + v - 3)\sin(v)$

Question 3. — Find $\dfrac{dx}{dy}$ if $x = \dfrac{y\sqrt[3]{y^4} - \cos(y) + e^y}{\tan(y) - y^3 + 9}$.

Answer. — $\dfrac{dx}{dy} = \dfrac{\frac{7}{3}y\sqrt[3]{y} + \sin(y) + e^y}{\tan(y) - y^3 + 9} - \dfrac{y\sqrt[3]{y^4} - \cos(y) + e^y}{\Big(\tan(y) - y^3 + 9\Big)^2}\Big(\sec^2(y) - 3y^2\Big)$

Question 4. — Find $\dfrac{ds}{d\phi}$ if $s = \sin(\sqrt{\phi}) + \sqrt{\sin(\phi)}$.

Answer. — $\dfrac{ds}{d\phi} = \dfrac{\cos(\sqrt{\phi})}{2\sqrt{\phi}} + \dfrac{\cos(\phi)}{2\sqrt{\sin(\phi)}}$

Question 5. — Find $\dfrac{dr}{dt}$ if $r = \cos\Big(\sqrt{\tan(at^b)} - \sec\Big(\sqrt{2t^c - dt + 7}\Big)\Big)$, where a, b, c and d are real numbers (*i.e.*, constants).

Answer. — $\dfrac{dr}{dt} = \sin\left(\sqrt{\tan(at^b)} - \sec\Big(\sqrt{2t^c - dt + 7}\Big)\right)\left(\dfrac{abt^{b-1}\sec^2(at^b)}{2\sqrt{\tan(at^b)}} - \dfrac{(2ct^{c-1} - d)\sin\Big(\sqrt{2t^c - dt + 7}\Big)}{2\sqrt{2t^c - dt + 7}\cos^2\Big(\sqrt{2t^c - dt + 7}\Big)}\right)$

Question 6. — Find $\dfrac{dx}{d\vartheta}$ if $x = \cot\left(\dfrac{\sin(\log\vartheta) - e^{\cos(\vartheta)}}{5\csc(\vartheta) + \sqrt{1 + 4\vartheta^2}}\right)$.

Answer. — $\dfrac{dx}{d\vartheta} = \csc^2\left(\dfrac{\sin(\log\vartheta) - e^{\cos\vartheta}}{5\csc(\vartheta) + \sqrt{1 + 4\vartheta^2}}\right)\left(\dfrac{\cos(\log\vartheta)/\vartheta + e^{\cos(\vartheta)}\sin(\vartheta)}{5\csc(\vartheta) + \sqrt{1 + 4\vartheta^2}} - \dfrac{\sin(\log\vartheta) - e^{\cos(\vartheta)}}{\Big(5\csc(\vartheta) + \sqrt{1 + 4\vartheta^2}\Big)^2}\left(\dfrac{4\vartheta}{\sqrt{1 + 4\vartheta^2}} - \dfrac{5\cos(\vartheta)}{\sin^2(\vartheta)}\right)\right)$

Question 7. — **Use logarithmic differentiation** to find $\dfrac{dy}{dx}$, where $y = \dfrac{(3x^2 - 4)^{4/3}\sin^4(3x)\sqrt{x^2 + 4}}{e^{-x^3}(x^3 - x + 3)^{2/5}\sqrt[3]{x^2 - \tan^2(x^2)}}$.

Answer. — $\dfrac{dy}{dx} = \dfrac{(3x^2 - 4)^{4/3}\sin^4(3x)\sqrt{x^2 + 4}}{e^{-x^3}(x^3 - x + 3)^{2/5}\sqrt[3]{x^2 - \tan^2(x^2)}}\left(\dfrac{8x}{3x^2 - 4} + 12\cot(3x) + \dfrac{x}{x^2 + 4} + 3x^2 - \dfrac{2(3x^2 - 1)}{5(x^3 - x + 3)} - \dfrac{2x - 4x\sin(x^2)}{3\cos^3(x^2)\Big(x^2 - \tan^2(x^2)\Big)}\right)$

Question 8. — Find $\dfrac{dp}{dq}$ if $p = q^{\sec(q^2)}$.

Answer. — $\dfrac{dp}{dq} = q^{\sec(q^2)}\Big(2q\sec(q^2)\tan(q^2)\log(q) + \sec(q^2)/q\Big)$

Question 9. — Find $\dfrac{dy}{dx}$ if $y = \log\Big(\sin\Big(\log\Big(\cos\Big(\log\Big(\tan(\sqrt{x})\Big)\Big)\Big)\Big)\Big)$.

Answer. — $\dfrac{dy}{dx} = -\dfrac{\cot\Big(\log\Big(\cos\Big(\log\Big(\tan(\sqrt{x})\Big)\Big)\Big)\Big)\cdot\tan\Big(\log\Big(\tan(\sqrt{x})\Big)\Big)}{2\sqrt{x}\sin(\sqrt{x})\cos(\sqrt{x})}$

Question 10. — Find $\dfrac{dy}{dx}$ if $y = \exp\Big(\sec(x^x) + x^{\sec(x)}\Big)$.

Answer. — $\dfrac{dy}{dx} = \exp\Big(\sec(x^x) + x^{\sec(x)}\Big)\Big(x^x(1 + \log x)\sec(x^x)\tan(x^x) + x^{\sec(x)}\Big(\sec(x)\tan(x)\log(x) + \sec(x)/x\Big)\Big)$