ind the derivative of each function.

a) $y = e^{\sqrt{x}}$ 1b) $y = x^3 e^x$ 1c) $g(t) = (e^{-t} + e^t)^3$ 1d) $y = \dfrac{e^x + 1}{e^x - 1}$

$\dfrac{dy}{dx} = \dfrac{e^{\sqrt{x}}}{2\sqrt{x}}$

$y' = x^3 e^x + e^x \cdot 3x^2$

or

$y' = x^2 e^x (x+3)$

$g'(t) = \boxed{3(e^{-t}+e^t)^2 \cdot (-e^{-t}+e^t)}$

$y' = \dfrac{(e^x-1)e^x - (e^x+1)\cdot e^x}{(e^x-1)^2}$

or

$y' = \dfrac{e^x(e^x - 1 - (e^x+1))}{(e^x-1)^2}$

$y' = \dfrac{e^x(-2)}{(e^x-1)^2} = \boxed{\dfrac{-2e^x}{(e^x-1)^2}}$

a) $y = 5^{-4x}$ 2b) $g(t) = t^2 2^t$ 2c) $h(\theta) = 2^{-\theta}\cos(\pi\theta)$

$y' = -4(\ln 5)5^{-4x}$

$= \dfrac{-4 \ln 5}{625^x}$

$g'(t) = t^2 \cdot 2^t \cdot \ln 2 + 2^t \cdot 2t$

$g'(t) = t \cdot 2^t (t\ln 2 + 2)$

$h'(\theta) = 2^{-\theta} \cdot (-\sin\pi\theta)\cdot\pi + \cos(\pi\theta)\cdot 2^{-\theta}\cdot(-1)\ln 2$

or

$h'(\theta) = 2^{-\theta}(-\pi\sin\pi\theta - \cos\pi\theta \cdot \ln 2)$

ind the equation of the tangent line at the given point of each function.

a) $f(x) = e^{1-x}$, $(1, 1)$

$f'(x) = -e^{1-x}$, $f'(1) = -1$

Tangent line: $y - 1 = -1(x - 1)$

$y = -x + 2$

3b) $y = x^2 e^x - 2xe^x + 2e^x$, $(1, e)$

$y' = x^2 e^x + 2x \cdot e^x - [2x e^x + e^x \cdot 2] + 2e^x$

$y'(1) = 1^2 e + 2(1)\cdot e - [2(1)e + 2e] + 2e$

$= 1e + 2e - 4e + 2e$

$= e$

so $\boxed{y - e = e(x-1) \text{ or } y = ex}$

se implicit differentiation to find $\dfrac{dy}{dx}$.

a) $xe^y - 10x + 3y = 0$

$xe^y \dfrac{dy}{dx} + e^y - 10 + 3\dfrac{dy}{dx} = 0$

$\dfrac{dy}{dx}(xe^y + 3) = 10 - e^y$

$\dfrac{dy}{dx} = \dfrac{10 - e^y}{xe^y + 3}$

4b) $e^{xy} + x^2 - y^2 = 10$

$e^{xy} \cdot [x\dfrac{dy}{dx} + y \cdot 1] + 2x - 2y\dfrac{dy}{dx} = 0$

$xe^{xy}\dfrac{dy}{dx} + ye^{xy} + 2x - 2y\dfrac{dy}{dx} = 0$

$xe^{xy}\dfrac{dy}{dx} - 2y\dfrac{dy}{dx} = -2x - ye^{xy}$

$\dfrac{dy}{dx}(xe^{xy} - 2y) = -2x - ye^{xy}$

$\boxed{\dfrac{dy}{dx} = \dfrac{-2x - ye^{xy}}{xe^{xy} - 2y}}$

5a) The value V of an item t years after it is purchased is $V = 15{,}000e^{-0.6286t}$, $0 \leq t \leq 10$.

Find the rate of change of V with respect to t when $t = 5$.

$$V' \; V'(t) = 15{,}000 \cdot e^{-.6286t} \cdot (-.6286)$$

$$V'(5) = 15{,}000 \cdot e^{-.6286(5)} \cdot (-.6286)$$

$$= \$-406.89 \text{ each year}$$

(slope)

5b) After t years, the value of a car purchased for \$20,000 is $V(t) = 20{,}000\left(\frac{3}{4}\right)^t$.
Find the rate of change of V with respect to t when $t = 4$. Label your answer and explain what it means in context to the problem.

$$V'(t) = 20{,}000\left(\tfrac{3}{4}\right)^t \cdot 1 \cdot \ln\left(\tfrac{3}{4}\right)$$

$$V'(4) = 20{,}000\left(\tfrac{3}{4}\right)^4 \cdot \ln\left(\tfrac{3}{4}\right)$$

$$= \$-1820.49 \text{ per year}$$

Change in car value per year after 4 years.

So... car dropping \$1820.49 per year in the 4th year

6) AP MULTIPLE CHOICE EXAMPLES

1) $\frac{d}{dx}(2^x) =$ $2^x \cdot \ln 2 \cdot 1$

(A) 2^{x-1} (B) $(2^{x-1})x$ (C) $(2^x)\ln 2$ (D) $(2^{x-1})\ln 2$ (E) $\frac{2x}{\ln 2}$

2) If $y = x^2e^x$, then $\frac{dy}{dx} =$ $x^2e^x + e^x \cdot 2x$

$xe^x(x+2)$

(A) $2xe^x$ (B) $x(x+2e^x)$ (C) $xe^x(x+2)$

(D) $2x+e^x$ (E) $2x+e$

3) If $y = 10^{(x^2-1)}$, then $\frac{dy}{dx} =$ $10^{x^2-1} \cdot 2x \cdot \ln 10$

(A) $(\ln 10)10^{(x^2-1)}$ (B) $(2x)10^{(x^2-1)}$ (C) $(x^2-1)10^{(x^2-2)}$

(D) $2x(\ln 10)10^{(x^2-1)}$ (E) $x^2(\ln 10)10^{(x^2-1)}$

4) If $y = e^{nx}$, then $\frac{d^n y}{dx^n} =$

(A) $n^n e^{nx}$ (B) $n!e^{nx}$ (C) ne^{nx} (D) $n^n e^x$ (E) $n!e^x$

$n=1$ $y = e^x$

$y' = 1e^x$

1^1

$n=2$ $y = e^{2x}$

$y' = e^{2x} \cdot 2$

$y'' = 2e^{2x} \cdot 2$

$= 4e^{2x}$

2^2

$n=3$ $y = e^{3x}$

$y' = e^{3x} \cdot 3$

$y'' = 3e^{3x} \cdot 3$

$y''' = 9e^{3x} \cdot 3$

$= 27e^{3x}$

3^3