1. $(x_0, y_0) = (1, f(1)) = (1, 1)$.

$m = f'(x_0)$; $f'(x) = 2x$; $f'(x_0) = 2(1) = \boxed{2 = m}$

$y = y_0 + m(x - x_0)$ $\boxed{\therefore y = 1 + 2(x-1)}$ or $y = 2x - 1$

2. (a) $f'(x) = 2x - 5$

(b) $f(x) = (x^3 - x)(x+1)^{-2}$, so

$f'(x) = (3x^2 - 1)(x+1)^{-2} + (x^3 - x)(-2)(x+1)^{-3}$,

or $f'(x) = \dfrac{(3x^2-1)(x+1) - 2x^3 + 2x}{(x+1)^3}$

$= \dfrac{3x^3 - x + 3x^2 - 1 - 2x^3 + 2x}{(x+1)^3}$

$= \dfrac{x^3 + 3x^2 + x - 1}{(x+1)^3}$

(c) $f'(x) = x\pi \cos \pi x + \sin \pi x$

(d) $f'(x) = 2xe^{-x} - x^2 e^{-x}$

(e) $f'(x) = \dfrac{1}{(x - x_0)^2 + 1}$

(f) $f'(x) = [x^{-1} \sin(x)]' = -x^{-2} \sin(x) + x^{-1} \cos(x)$

$= \dfrac{-\sin(x) + x\cos(x)}{x^2}$

(g) $f'(x) = \ln(x) + x\left(\frac{1}{x}\right) = \ln(x) + 1$

(h) $f'(x) = \dfrac{1}{\ln(10)} \cdot \dfrac{1}{(x^3 + x^2)} (3x^2 + 2x)$

$= \dfrac{1}{\ln(10)} \dfrac{x(3x+2)}{x(x^2+x)} = \dfrac{1}{\ln(10)} \dfrac{3x+2}{x^2+x}$.

3. $\ln(f) = \frac{1}{5}\ln(x^2+2x+1) - \frac{3}{4}\ln(x^3-x)$

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

$= \frac{2}{5(x+1)} - \frac{3(3x^2-1)}{4(x^3-x)}$,

so $f'(x) = \frac{(x^3-x)^{3/4}}{(x^2+2x+1)^{1/5}}\left[\frac{2}{5(x+1)} - \frac{3(3x^2-1)}{4(x^3-x)}\right]$

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4. (a) The units are barrels/year

(b) It would be negative, since the amount of recoverable petroleum generally decreases (barring technical advances)

(c) $P(11) \approx P(10) + \left.\frac{dP}{dt}\right|_{t=10}(11-10)$

$\approx 10{,}000 - 1000 = 9000$