Find the point-slope form of the equation of the **normal** line to the curve $y = \dfrac{x^2}{f(x)}$ at the point where $x = -3$ **SCORE: ____ / 5 PTS**

if $f(-3) = -2$ and $f'(-3) = 5$.

$\dfrac{dy}{dx} = \dfrac{2xf(x) - x^2 f'(x)}{[f(x)]^2}$ (2)

$x = -3 \rightarrow y = \dfrac{(-3)^2}{f(-3)} = -\dfrac{9}{2}$

$\left.\dfrac{dy}{dx}\right|_{x=-3} = \dfrac{2(-3)f(-3) - (-3)^2 f'(-3)}{[f(-3)]^2} = \dfrac{12 - 45}{4} = -\dfrac{33}{4}$ (1)

(1)

(½) $y + \dfrac{9}{2} = \dfrac{4}{33}(x + 3)$ (½)

Prove the derivative of $\csc x$ using the quotient rule. **Show all steps.** **SCORE: ____ / 3 PTS**

$\dfrac{d}{dx}\dfrac{1}{\sin x} = \dfrac{0(\sin x) - 1(\cos x)}{\sin^2 x}$ (½) (½) (½)

$= -\dfrac{\cos x}{\sin x} \cdot \dfrac{1}{\sin x}$ (1)

$= -\cot x \csc x$ (½)

Prove the derivative of $\tan x$ using the definition of the derivative function. **Show all steps.** **SCORE: ____ / 5 PTS**

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The position of an object at time t is given by $s(t) = e^t \sin t$.

SCORE: ____ / 4 PTS

Find the **acceleration** of the object at time $t = \frac{\pi}{2}$.

$s'(t) = e^t \sin t + e^t \cos t$ (1)

$s''(t) = (e^t \sin t + e^t \cos t) + (e^t \cos t - e^t \sin t)$ (2)

$= 2e^t \cos t$ (½)

$s''\left(\frac{\pi}{2}\right) = 2e^{\frac{\pi}{2}}(0) = 0$ (½)

Find the following derivatives. Simplify all answers appropriately.

SCORE: ____ / 13 PTS

[a] $\frac{d^3}{dx^3}\frac{9x^2 - 18x}{\sqrt[3]{x}}$

$= \frac{d^3}{dx^3}(9x^{\frac{5}{3}} - 18x^{\frac{2}{3}})$ (½)

$= \frac{d^2}{dx^2}(15x^{\frac{2}{3}} - 12x^{-\frac{1}{3}})$ (1)

$= \frac{d}{dx}(10x^{-\frac{1}{3}} + 4x^{-\frac{4}{3}})$ (1)

$= -\frac{10}{3}x^{-\frac{4}{3}} - \frac{16}{3}x^{-\frac{7}{3}}$ (1)

[b] $\frac{d}{db}\frac{1-5b^3}{4b-b^2}$ (1) (Your final answer must be a single fraction) (1)

$= \frac{-15b^2(4b-b^2) - (1-5b^3)(4-2b)}{(4b-b^2)^2}$

$= \frac{-60b^3 + 15b^4 - 4 + 2b + 20b^3 - 10b^4}{(4b-b^2)^2}$

$= \frac{5b^4 - 40b^3 + 2b - 4}{(4b-b^2)^2}$ (1) (1)

[c] $\frac{d}{dx}(3t^x + \frac{1}{e^t} - 5x^e)$

$= 3t^x \ln t - 5ex^{e-1}$

(1) (1)

MINUS (1) POINT
IF YOU HAD ANY OTHER
TERMS IN THIS DERIVATIVE
eg. $-e^{-t}$

[d] $\frac{d}{dx}(\cot x \cos x - \sec x)$ (1) (1)

$= -\csc^2 x \cos x - \cot x \sin x - \sec x \tan x$ (1)

$= -\csc x \cot x - \cos x$ (½) $- \sec x \tan x$