$$\int \frac{(2x^3 - 3\sqrt{x})^2}{12x^7}\,dx$$

$$= \int \frac{4x^6 - 12x^{\frac{7}{2}} + 9x}{12x^7}\,dx$$

$$= \underbrace{\int \left(\frac{1}{3}x^{-1} - x^{-\frac{7}{2}} + \frac{3}{4}x^{-6}\right)dx}_{1}$$

$$= \frac{1}{3}\ln|x| - \left(-\frac{2}{5}\right)x^{-\frac{5}{2}} + \frac{3}{4}\left(-\frac{1}{5}\right)x^{-5} + C$$

$$= \underbrace{\frac{1}{3}\ln|x|}_{\frac{1}{2}} + \underbrace{\frac{2}{5}x^{-\frac{5}{2}}}_{\frac{1}{2}} - \underbrace{\frac{3}{20}x^{-5}}_{\frac{1}{2}} + \underbrace{C}_{\frac{1}{2}}$$

$$\int_{-1}^{1} \frac{\sin y}{1-\tan^2 y}\, dy$$

$1-\tan^2 y = 0$ WHEN $\tan y = \pm 1$

IE. 1 $\underbrace{y = \pm \frac{\pi}{4}}$

$\pm \frac{\pi}{4} \in [-1, 1]$

INTEGRAND IS $\underbrace{\text{DISCONTINUOUS}}$ $\frac{1}{2}$

$\underbrace{\text{SO FTC PART 2 DOESN'T APPLY}}$

$\frac{1}{2}$

$$\int_{-1}^{1} \frac{4t^3 - 16t}{t^4 - 16}\, dt$$

$$\frac{4(-t)^3 - 16(-t)}{(-t)^4 - 16} = \frac{-4t^3 + 16t}{t^4 - 16}$$

$$= -\frac{4t^3 - 16t}{t^4 - 16} \quad 1$$

INTEGRAND IS ODD $\frac{1}{2}$ + CONTINUOUS $\frac{1}{2}$

SO INTEGRAL IS 0

$\frac{1}{2}$

$$\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{6\cos 2\theta}{1+4\sin^2 2\theta}\, d\theta$$

(1) $u = 2\sin 2\theta$

$\theta = \frac{\pi}{2} \longrightarrow u = 0$

$\theta = \frac{\pi}{6} \longrightarrow u = \sqrt{3}$

$du = 4\cos 2\theta\, d\theta$

$\frac{3}{2} du = 6\cos 2\theta\, d\theta$

$(\frac{1}{2})$ (1)

$$\int_{\sqrt{3}}^{0} \frac{3}{2} \frac{1}{1+u^2}\, du$$

$(\frac{1}{2})$ $\frac{3}{2} \tan^{-1} u \Big|_{\sqrt{3}}^{0}$ (1)

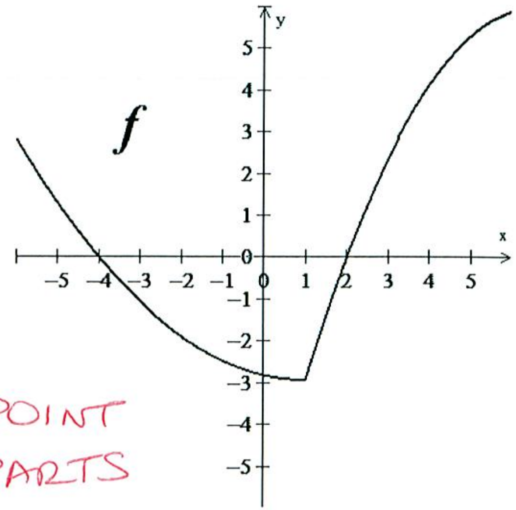
$= \frac{3}{2}(\tan^{-1} 0 - \tan^{-1}\sqrt{3})$

$= \frac{3}{2}(0 - \frac{\pi}{3})$

$= -\frac{\pi}{2}$ $(\frac{1}{2})$

Let $g(x) = \int_{-6}^{x} f(t)\,dt$, where f is the function whose graph is shown on the right. **SCORE: _____ / 7 PTS**

[a] Write "I UNDERSTAND THAT THE GRAPH SHOWS f, BUT THE QUESTIONS ASK ABOUT g".



[b] Find $g'(1)$. **Explain your answer very briefly.**

$g'(x) = f(x)$

$g'(1) = f(1) = -3$

ALL ITEMS 1 POINT EACH ON ALL PARTS

[c] Find all intervals over which g is increasing. **Explain your answer very briefly.**

$g'(x) = f(x) > 0$ ON $(-6, -4)$ AND $(2, 6)$

[d] Find all intervals over which g is concave down. **Explain your answer very briefly.**

$g'(x) = f(x)$ DECREASING ON $(-6, 1)$

If $q(x)=\int_{e^{3x}}^{5x}\cos t^2\,dt$, find $q'(x)$. **SCORE: _____ / 4 PTS**

$$q(x)=\int_{e^{3x}}^{0}\cos t^2\,dt+\int_0^{5x}\cos t^2\,dt$$

$$=-\int_0^{e^{3x}}\cos t^2\,dt+\int_0^{5x}\cos t^2\,dt$$

$$q'(x)=-\frac{d}{dx}\int_0^{e^{3x}}\cos t^2\,dt+\frac{d}{dx}\int_0^{5x}\cos t^2\,dt$$

$$=-\frac{d}{d(e^{3x})}\int_0^{e^{3x}}\cos t^2\,dt\cdot\frac{d(e^{3x})}{dx}+\frac{d}{d(5x)}\int_0^{5x}\cos t^2\,dt\cdot\frac{d(5x)}{dx}$$

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

$$= \underbrace{5}_{1}\,\underbrace{\cos 25x^2}_{\frac{1}{2}}\,\underbrace{-}_{1}\,\underbrace{3e^{3x}}_{1}\,\underbrace{\cos e^{6x}}_{\frac{1}{2}}$$

In complete sentences, using proper English and mathematical notation, state the Fundamental Theorem of Calculus (both parts) and the Net Change Theorem.

SCORE: _____ / 5 PTS

SEE LECTURE NOTES

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In manufacturing, marginal cost (measured in dollars per unit) is the cost per unit of producing additional units. **SCORE: _____ / 2 PTS**

At a toy manufacturing plant, if $M(x)$ is the marginal cost when x toys have been produced, what is the meaning of the equation

$$\int_{4000}^{6000} f(x)\,dx = 3000 \text{ ?}$$

NOTES: **Your answer must use all three numbers from the equation, along with correct units.**
Your answer should NOT use "x", "f(x)", "integral", "antiderivative", "rate of change" or "derivative".
Your answer should sound like normal spoken English.

IT COSTS $3000 TOTAL
TO INCREASE THE NUMBER OF TOYS PRODUCED
FROM 4000 TOYS TO 6000 TOYS

GRADED BY ME