EVALUATING INTEGRALS

NAME: ________________

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The Fundamental Theorem of Calculus, Part I. If f is continuous on $[a, b]$, then for every x in $[a, b]$,

$$\frac{d}{dx}\int_a^x f(t)\,dt = f(x)$$

(1) For the following problems, use the Fundamental Theorem of Calculus Part I to find $F'(x)$.

(a) $F(x) = \displaystyle\int_1^x \sqrt[4]{t}\,dt$

(b) $F(x) = \displaystyle\int_x^0 \sec^3 t\,dt$

(c) $F(x) = \displaystyle\int_2^{x^2} \frac{1}{t^3}\,dt$. (Don't forget the chain rule!)

The Fundamental Theorem of Calculus, Part II. If $F(x)$ is an antiderivative for $f(x)$, then

$$\int_a^b f(x)\,dx = F(b) - F(a).$$

(2) Use the Fundamental Theorem of Calculus Part II to evaluate the following integrals.

(a) $\displaystyle\int_0^3 x^3\,dx$

(b) $\displaystyle\int_\pi^{3\pi/2} \cos(x)\,dx$

(c) $\displaystyle\int_e^{e^2} \frac{1}{x}\,dx$

This material is based upon original Active Calculus materials produced by the University of Nebraska at Omaha.

The Substitution Method. To evaluate $\int f(g(x))g'(x)\,dx$:

(1) Substitute $u = g(x)$ and $du = g'(x)\,dx$ to get $\int f(u)\,du$.

(2) Integrate with respect to u.

(3) Replace u by $g(x)$.

(3) Use the substitution method to evaluate the following integrals:

(a) $\displaystyle\int_0^1 \frac{x}{(x^2+1)^3}\,dx$

(b) $\displaystyle\int_{10}^{17} (x-9)^{-2/3}\,dx$

(c) $\displaystyle\int_1^8 \sqrt{t+8}\,dt$

(d) $\displaystyle\int_1^5 \frac{e^x}{3+e^x}\,dx$

(e) $\displaystyle\int_0^{\pi/2} \sec^2(\cos\theta)\sin\theta\,d\theta$

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