The Hong Kong Polytechnic University

Department of Applied Mathematics

AMA1007 Calculus and Linear Algebra

Tutorial 8

Definite Integrals and Fundamental Theorem of Calculus

1. Find the values of the following definite integrals using the integration table, and the basic properties of integrals.

   (a) $\displaystyle\int_0^2 2\sin 3x\,dx$;

   (b) $\displaystyle\int_1^2 \left(x+\frac{1}{x}\right)dx$;

   (c) $\displaystyle\int_0^3 \frac{dx}{x^2+y^2}$ for $y\neq 0$;

   (d) $\displaystyle\int_0^1 (2x+3)^3\,dx$;

   (e) $\displaystyle\int_1^2 \frac{e^{2x}}{e^{2x}-1}\,dx$;

   (f) $\displaystyle\int_{-1}^2 |x|\,dx$.

2. Evaluate the following definite integrals.

   (a) $\displaystyle\int_0^1 x(x+1)^{95}\,dx$;   Check your answer with CoCalc Jupyter.

   (b) $\displaystyle\int_{\pi/6}^{\pi/2} \frac{\cos x}{\sin^3 x}\,dx$;

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

   (d) $\displaystyle\int_1^e \frac{\ln x}{x}\,dx$.

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3. Use the fundamental theorem of calculus, find

(a) $\dfrac{d}{dx}\displaystyle\int_0^x t\cos t^2 dt$;

(b) $\dfrac{d}{dx}\displaystyle\int_1^x (1+t)^{200} dt$;

(c) $\dfrac{d}{dx}\displaystyle\int_2^{x^3} e^t \sin t^2 dt$;

(d) $\dfrac{d}{dx}\displaystyle\int_{\cos x}^2 e^{t^2} dt$;

(e) $\dfrac{d}{dx}\displaystyle\int_{2x}^{3x} \dfrac{t^2-1}{t^2+1} dt$;

(f) $\dfrac{d}{dx}\displaystyle\int_{\cos x}^{x^5} \sqrt{t}\,\sin t\,dt$.

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