MATH 110 Problem Set 4.3

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The following problems based on Section 4.3 of the textbook will help you study. *You do not need to hand in solutions to these problems.*

1. (Based on 4.3.7–18) Use the Fundamental Theorem of Calculus I to find the derivatives of the following.

   (a) $g(x) = \int_1^x (2+t^4)^5 \, dt$ (b) $h(r) = \int_0^r \sqrt{x^2+4} \, dx$ (c) $G(x) = \int_x^1 \cos\sqrt{t} \, dt$

2. (Based on 4.3.19–36) Evaluate the following definite integrals using the Fundamental Theorem of Calculus II.

   (a) $\int_0^1 (3+x\sqrt{x}) \, dx$ (b) $\int_0^{\pi/4} \sec\theta \tan\theta \, d\theta$ (c) $\int_1^2 \frac{s^4+1}{s^2} \, ds$

3. (Based on 4.3.37–38) Find $\int_{-2}^2 f(x) \, dx$ where

   $$f(x) = \begin{cases} 2 & \text{if } -2 \le x \le 0 \\ 4-x^2 & \text{if } 0 < x \le 2 \end{cases}$$

4. (Based on 4.3.49–52) What is wrong with the following equations?

   (a) $\int_{-1}^2 \frac{4}{x^3} \, dx = -\frac{2}{x^2}\Big|_{-1}^2 = -3$ (b) $\int_0^\pi \sec^2 x \, dx = \tan x\Big|_0^\pi = 0$

5. (Based on 4.3.67–68) Evaluate the limit

   $$\lim_{n\to\infty} \frac{1}{n}\left(\sqrt{\frac{1}{n}} + \sqrt{\frac{2}{n}} + \sqrt{\frac{3}{n}} + \cdots + \sqrt{\frac{n}{n}}\right)$$

   by first recognizing the sum as a Riemann sum for a function defined on $[0,1]$ then using the Fundamental Theorem of Calculus to evaluate the corresponding definite integral.

You may find the following additional exercises from Section 4.3 helpful.

4.3 C-level: 1–12, 19–38, 47–48, 53–56;
B-level: 13–18, 49–52, 57–58;
A-level: 59–62, 65–78