

Integrals and the Fundamental Theorem: math test solutions, College – download the PDF

Test solutions with the detailed point scale. Add up your points and spot what to review.

Suggested time: 45 minutes. Out of 20 points. Calculator allowed only when the problem says so.

1 Antiderivatives

/ 3 pts

a. $F(x) = x^5 - x^3 + \frac{x^2}{2} - 2x + C$. (1.5 pt)

b. $F(x) = 2x^3 + 2x^2 + C$; $F(1) = 4 + C = 3$ gives $C = -1$, so
 $F(x) = 2x^3 + 2x^2 - 1$. (1.5 pt)

2 Riemann sums

/ 4 pts

$$\Delta x = 0.5.$$

- a. Right endpoints 0.5, 1, 1.5, 2 give heights 1.25, 3, 5.25, 8: sum 17.5, so $R_4 = 8.75$. (1.5 pt)
- b. Left endpoints 0, 0.5, 1, 1.5 give heights 0, 1.25, 3, 5.25: sum 9.5, so $L_4 = 4.75$. (1.5 pt)
- c. $\left[\frac{x^3}{3} + x^2 \right]_0^2 = \frac{8}{3} + 4 = \frac{20}{3} \approx 6.67$, and $4.75 < 6.67 < 8.75$. (1 pt)

3 Properties

/ 3 pts

- a. $4 + (-1) = 3$. (1 pt)
- b. $-\int_3^7 f = 1$. (1 pt)
- c. $2(3) - 5 = 1$. (1 pt)

4 Fundamental Theorem

/ 4 pts

- a. $[2x^3 - x^2]_0^2 = (16 - 4) - 0 = 12$. (1.5 pt)
- b. $F'(x) = \sqrt{x^2 + 9}$, so $F'(4) = \sqrt{25} = 5$. (1 pt)
- c. Chain rule: $G'(x) = ((2x)^2 + 1) \cdot 2 = 8x^2 + 2$, so $G'(1) = 10$. (1.5 pt)

5 Net change

/ 3 pts

- a. $\int_0^4 (200 + 30t) dt = [200t + 15t^2]_0^4 = 800 + 240 = 1,040$ gallons. (2 pts)
- b. $5,000 - 1,040 = 3,960$ gallons. (1 pt)

6 Substitution

/ 3 pts

a. Let $u = x^2 - 4$, $du = 2x dx$: $3 \int u^3 du = \frac{3u^4}{4} + C = \frac{3}{4}(x^2 - 4)^4 + C$. (1.5 pt)

b. Let $u = x^3$, $x^2 dx = \frac{1}{3} du$, limits 0 to 1: $\frac{1}{3}[e^u]_0^1 = \frac{e-1}{3} \approx 0.573$. (1.5 pt)



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