

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

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

1 Antiderivatives

/ 3 pts

- Find the general antiderivative of $f(x) = 5x^4 - 3x^2 + x - 2$.
- Find the antiderivative F of $g(x) = 6x^2 + 4x$ satisfying $F(1) = 3$.

2 Riemann sums

/ 4 pts

Calculator allowed. Let $f(x) = x^2 + 2x$ on $[0, 2]$ and $n = 4$.

- Compute the right-endpoint sum.
- Compute the left-endpoint sum.
- Compute the exact integral and check that it lies between the two sums.

3 Properties

/ 3 pts

Suppose $\int_0^3 f = 4$, $\int_3^7 f = -1$ and $\int_0^7 g = 5$. Find:

- a. $\int_0^7 f$
- b. $\int_7^3 f$
- c. $\int_0^7 (2f - g)$

4 Fundamental Theorem

/ 4 pts

- a. Evaluate $\int_0^2 (6x^2 - 2x) dx$.
- b. If $F(x) = \int_0^x \sqrt{t^2 + 9} dt$, find $F'(4)$.
- c. If $G(x) = \int_0^{2x} (t^2 + 1) dt$, find $G'(x)$ and $G'(1)$.

5 Net change

/ 3 pts

A town's water use rate is $w(t) = 200 + 30t$ gallons per hour, where t is the number of hours after 6 a.m. and $0 \leq t \leq 4$.

- a. How many gallons are used between 6 a.m. and 10 a.m.?
- b. A reservoir holds 5,000 gallons at 6 a.m. and receives no water. How much remains at 10 a.m.?

6 Substitution

/ 3 pts

a. Find $\int 6x(x^2 - 4)^3 dx$.

b. Evaluate $\int_0^1 x^2 e^{x^3} dx$.



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