Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 6: Integral Calculus)

February 23, 2025

Answer Key

Section A: Multiple Choice Solutions

1. Evaluating:
$$\int (3x^2 - 2x + 5)\,dx$$
$$= x^3 - x^2 + 5x + C$$
Answer: (a) $x^3 - x^2 + 5x + C$

2. Integral of e^x:
$$\int e^x\,dx = e^x + C$$
Answer: (a) $e^x + C$

3. Integral of $\frac{1}{x}$:
$$\int \frac{dx}{x} = \ln|x| + C$$
Answer: (c) $\ln|x| + C$

4. Definite integral:
$$\int_0^1 (x^3 + 2x)\,dx$$
$$\left[\frac{x^4}{4} + x^2\right]_0^1 = \left(\frac{1}{4} + 1\right) - 0 = \frac{5}{4}$$
Answer: (a) $\frac{5}{4}$

5. Applying Fundamental Theorem of Calculus:

$$f'(x) = x^2 + 3x$$

Answer: (a) $x^2 + 3x$

Section B: Problem-Solving Solutions

1. Evaluating:

$$\int (4x^3 - 2x + 1)\,dx$$
$$= x^4 - x^2 + x + C$$

2. Area under the curve:

$$\int_1^3 x^2\,dx$$
$$\left[\frac{x^3}{3}\right]_1^3 = \frac{27}{3} - \frac{1}{3} = \frac{26}{3}$$

3. Volume using disk method:

$$V = \pi \int_0^2 (x^2)^2\,dx$$
$$= \pi \int_0^2 x^4\,dx = \pi \left[\frac{x^5}{5}\right]_0^2$$
$$= \pi \left(\frac{32}{5} - 0\right) = \frac{32\pi}{5}$$

4. Solving differential equation:

$$y = \int (3x^2 - 2x)\,dx$$
$$y = x^3 - x^2 + C$$

Using $y(0) = 4$:

$$4 = 0 + 0 + C \Rightarrow C = 4$$
$$y = x^3 - x^2 + 4$$

5. Water added:

$$\int_0^4 3t^2\,dt$$
$$= 3\left[\frac{t^3}{3}\right]_0^4 = \left[t^3\right]_0^4 = 64 - 0 = 64$$

Total water: 64 liters.