Calculators are NOT permitted.
In problems 1–5, find the indicated general antiderivative. (5 points each)

1. \[ \int \left( 8.4e^{-1.3x} - \frac{7}{10} \right) \, dx = \frac{8.4}{-1.3} e^{-1.3x} - \frac{7}{10}x + C \]

2. \[ \int \left( \frac{6}{5x^3} + 5\sqrt{x} \right) \, dx = \int \frac{6}{5} x^{-3} + 5x^{\frac{1}{2}} \, dx = \frac{6}{5} \left( \frac{x^{-2}}{-2} \right) + \frac{5x^{\frac{3}{2}}}{\frac{3}{2}} + C \]

3. \[ \int \frac{d}{dx} (\ln(7x^3 + 4)) \, dx = \ln(7x^3 + 4) + C \]

4. \[ \int (12e^x - 42x^6) \, dx = 12e^x - \frac{42x^7}{7} + C \]

5. \[ \int \left( \frac{3.7}{x} - \frac{5x}{6} \right) \, dx = 3.7 \ln|x| - \frac{5x}{6\ln 5} + C \]

6. (4 points) Compute \[ \frac{d}{dx} \left( \int \frac{x^5 + 2xe^x}{\ln(x^3 + \sqrt{x})} \, dx \right) = \frac{x^5 + xe^x}{\ln(x^3 + \sqrt{x})} \]
7. (7 Points) Find $F$, the specific antiderivative of the function $f$, when $f(x) = 4x^3 - 6x^{-2}$, and $F(2) = 11$.

$$ F(x) = \int f(x) \, dx = x^4 + 6x^{-1} + C $$

$$ F(2) = 2^4 + \frac{6}{2} + C = 11 $$

$$ 19 + C = 11 $$

$$ C = -8 $$

8. (6 Points) The rate of change of books purchased by Snell Library can be modeled by the function:

$$ r(t) = 0.12t^2 - 1.6t + 2 $$

hundred books per year, $t$ years after 1980. Find a model for $B(t)$, the number of books purchased by Snell Library $t$ years after 1980. Use the fact that 900 books were purchased in 1980. Give units.

$$ B(t) = \int_{1980}^{t} r(t) \, dt = 0.12t^3 - \frac{1.6t^2}{2} + 2t + C = 0.4t^3 - 0.8t^2 + 2t + C $$

$$ B(0) = 9 $$

$$ C = 9 $$

$$ B(t) = 0.4t^3 - 0.8t^2 + 2t + 9 \text{ hundred books} $$

In the following questions, circle the correct answer. In each question there is only one correct answer and there is no partial credit.

9. (4 Points) The general antiderivative of $f(x) = 3.1^x + 3.9x^3 - e^{-x}$ is

(i) $\frac{3.1^x}{\ln 3.1} + 3.9x^4 + e^{-x} + C$

(ii) $3.1^x(\ln 3.1) + 0.975x^4 + e^{-x} + C$

(iii) $\frac{3.1^x}{\ln 3.1} + 0.975x^4 - e^{-x} + C$

(iv) $\frac{3.1^x}{\ln 3.1} + 0.975x^4 + e^{-x} + C$

(v) None of these

10. (4 Points) The general antiderivative of $f(x) = \frac{1}{x^2} + e^x - \sqrt[3]{x^2}$ is

(i) $x^{-1} + e^x - \frac{5}{3}x^{\frac{5}{3}} + C$

(ii) $-x^{-1} + e^x - \frac{5}{3}x^{\frac{5}{3}} + C$

(iii) $-x^{-1} + e^x - \frac{3}{5}x^{\frac{3}{5}} + C$

(iv) $-x^{-1} + \frac{e^x}{3} - \frac{3}{5}x^{\frac{3}{5}} + C$

(v) None of these
Calculators are NOT permitted.
In problems 1–5, find the indicated general antiderivative. (5 points each)

1. \[ \int \left( 8.6e^{-1.2x} - \frac{3}{10} \right) \, dx = \frac{8.6}{-1.2} e^{-1.2x} - \frac{3x}{10} + C \]

2. \[ \int \left( \frac{8}{5x^3} + 6\sqrt{x} \right) \, dx = \int \frac{8}{5} x^{-3} + 6x^{\frac{1}{2}} \, dx = \frac{8}{5} \left( \frac{x^{-2}}{-2} \right) + 6 \frac{x^{\frac{3}{2}}}{\frac{3}{2}} + C \]

3. \[ \int \frac{d}{dx} (\ln(5x^2 + 3)) \, dx = \ln(5x^2 + 3) + C \]

4. \[ \int (10e^x - 32x^7) \, dx = 10e^x - 32 \frac{x^8}{8} + C \]

5. \[ \int \left( \frac{3.5}{x} - \frac{7^x}{3} \right) \, dx = 3.5 \ln |x| - \frac{7^x}{3 \ln 7} + C \]

6. (4 points) Compute \[ \frac{d}{dx} \left( \int \frac{x^7 + xe^x}{\ln(x^4 + \sqrt{x})} \, dx \right) = \frac{x^7 + xe^x}{\ln(x^4 + \sqrt{x})} \]
7. (7 Points) Find $F$, the specific antiderivative of the function $f$, when $f(x) = 4x^3 - 6x^2$, and $F(2) = 10$.

$$F(x) = \int f(x) \, dx = x^4 + 6x^2 + C$$
$$F(2) = 2^4 - \frac{6}{2} + C = 10$$
$$19 + C = 10$$
$$C = -9$$
$$F(x) = x^4 + 6x^2 - 9$$

8. (6 points) The rate of change of books purchased by Snell Library can be modeled by the function:

$$r(t) = 0.12t^2 - 1.4t + 3$$

hundred books per year, $t$ years after 1990. Find a model for $B(t)$, the number of books purchased by Snell Library $t$ years after 1990. Use the fact that 800 books were purchased in 1990. Give units.

$$B(t) = \int r(t) \, dt = \frac{0.12}{3} t^3 - \frac{1.4t^2}{2} + 3t + C$$

$$B(0) = 8$$
$$B(t) = 0.4t^3 - 0.7t^2 + 3t + 8 \text{ hundred books}$$

In the following questions, circle the correct answer. In each question there is only one correct answer and there is no partial credit.

9. (4 points) The general antiderivative of $f(x) = \frac{1}{x^2} + e^3 - \sqrt[3]{x^2}$ is

(i) $x^{-1} + e^3x - \frac{5}{3}x^{\frac{2}{3}} + C$

(ii) $-x^{-1} + e^3x - \frac{5}{3}x^{\frac{2}{3}} + C$

(iii) $-x^{-1} + e^3x - \frac{3}{5}x^{\frac{2}{3}} + C$

(iv) $-x^{-1} + e^3x - \frac{3}{5}x^{\frac{2}{3}} + C$

(v) None of these

10. (4 points) The general antiderivative of $f(x) = 3.1x^3 + 3.9x^2 - e^{-x}$ is

(i) $\frac{3.1x^4}{\ln 3.1} + 3.9x^2 + e^{-x} + C$

(ii) $3.1x^3(\ln 3.1) + 0.975x^4 + e^{-x} + C$

(iii) $\frac{3.1x^4}{\ln 3.1} + 0.975x^4 - e^{-x} + C$

(iv) $\frac{3.1x^4}{\ln 3.1} + 0.975x^4 + e^{-x} + C$

(v) None of these
1. (6 points) Suppose that $F'(x) = f(x)$ for all $x$, and $F(3) = -7$, $F(7) = 12$, $f(3) = 5$ and $f(7) = 9$. Calculate $\int_{3}^{7} f(x) \, dx$.

\[
\int_{3}^{7} f(x) \, dx = F(x) \bigg|_{3}^{7} = F(7) - F(3) = 12 - (-7) = 19
\]

2. (a) (4 points) Sketch the region whose area is given by the definite integral: $\int_{2}^{6} 128 - 2x^2 \, dx$. Label the boundary curves, lines and corner points of the region. Then shade the region.

(b) (8 points) Estimate the area (in square units) of the region in part (a) using the 4 left rectangles approximation. Show all work including a sketch clearly shows the 4 left rectangles and give the exact answer.

\[
\Delta x = \frac{6 - 2}{4} = 1
\]

<table>
<thead>
<tr>
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<td>2</td>
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<td>5</td>
<td>78</td>
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\[
\text{Area} = (120 + 110 + 96 + 78) \times 1
\]

\[
= 404
\]
In problems 2 and 4, evaluate the given integral. (Do not use fnInt.) Give numerical answers to four decimal places. Show all work. Use your calculator only to perform basic arithmetic.

3. (8 points) \[ \int_{-2}^{0} (12x^2 + 4x + 1) \, dx \]

\[ = 4x^3 + 2x^2 + x \bigg|_{-2}^{0} = 26 \]

4. (8 points) \[ \int_{2}^{4} \left( \frac{3}{x} - 3e^{-x} \right) \, dx \]

\[ = 3 \left| \ln|x| + 3e^{-x} \right|_{2}^{4} = 1.7284 \]

5. (8 points) \[ \int_{1}^{4} \frac{d}{dx} (16x^{-4} + 4) \, dx \]

\[ = 16x^{-4} + 4 \bigg|_{1}^{4} = -15.9375 \]

6. (8 points) Let \( s(t) = 3.01(1.5)^t \) be the rate of change of the number of sports utility vehicles (SUVs) sold in the United States in millions of SUVs per year, \( t \) years after 1988.

Find the value of integral: \( \int_{5}^{8} s(t) \, dt \). **Show work, with units.** Round your answer to 3 decimal places.

\[ \int_{5}^{8} 3.01(1.5)^t \, dt = 3.01 \frac{(1.5)^t}{\ln 1.5} \bigg|_{5}^{8} = 133.885 \]

**millions of SUVs**
1. (6 points) Suppose that \( F'(x) = f(x) \) for all \( x \), and \( F(2) = -7, F(8) = 12, f(2) = 6 \) and \( f(8) = 8 \). Calculate \( \int_2^8 f(x) \, dx \).

\[
\int_2^8 f(x) \, dx = F(x) \bigg|_2^8 = F(8) - F(2) = 12 - (-7) = 19
\]

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\]  

millions of SUVs