

1. $\int (3x^2 - 2x + 3) dx =$

- (A) $x^3 - x^2 + C$ (B) $3x^3 - x^2 + 3x + C$ (C) $x^3 - x^2 + 3x + C$
 (D) $\frac{1}{2}(3x^2 - 2x + 3)^2 + C$ (E) none of these

20. $\int \frac{x^3 - x - 1}{x^2} dx =$

(A) $\frac{\frac{1}{4}x^4 - \frac{1}{2}x^2 - x}{\frac{1}{3}x^3} + C$

(B) $1 + \frac{1}{x^2} + \frac{2}{x^3} + C$

(C) $\frac{x^2}{2} - \ln|x| - \frac{1}{x} + C$

(D) $\frac{x^2}{2} - \ln|x| + \frac{1}{x} + C$

(E) $\frac{x^2}{2} - \ln|x| + \frac{2}{x^3} + C$

3. Let $f(x)$ be defined as below. Evaluate $\int_0^6 f(x) dx$.

$$f(x) = \begin{cases} x & 0 < x \leq 2 \\ 1 & 2 < x \leq 4 \\ \frac{1}{2}x & 4 < x \leq 6 \end{cases}$$

A) 5

B) 6

C) 7

D) 8

E) 9

77. The equation of the curve whose slope at point (x, y) is $x^2 - 2$ and which contains the point $(1, -3)$ is

(A) $y = \frac{1}{3}x^3 - 2x$ (B) $y = 2x - 1$ (C) $y = \frac{1}{3}x^3 - \frac{10}{3}$

(D) $y = \frac{1}{3}x^3 - 2x - \frac{4}{3}$ (E) $3y = x^3 - 10$

8. Which of the following statements are true?

- I. If the graph of a function is always concave up, then the left-hand Riemann sums with the same subdivisions over the same interval are always less than the right-hand Riemann sum.
- II. If the function f is continuous on the interval $[a, b]$ and $\int_a^b f(x) dx = 0$, then f must have at least one zero between a and b .
- III. If $f'(x) > 0$ for all x in an interval, then the function f is concave up in that interval.

A) I only

B) II only

C) III only

D) II and III only

E) None are true.

1101 (1999AB, Calculator). The rate at which water flows out of a pipe, in gallons per hour, is given by a differentiable function R of time t . The table below shows the rate as measured every 3 hours for a 24-hour period.

t (hours)	0	3	6	9	12	15	18	21	24
$R(t)$ (gal/hr)	9.6	10.4	10.8	11.2	11.4	11.3	10.7	10.2	9.6

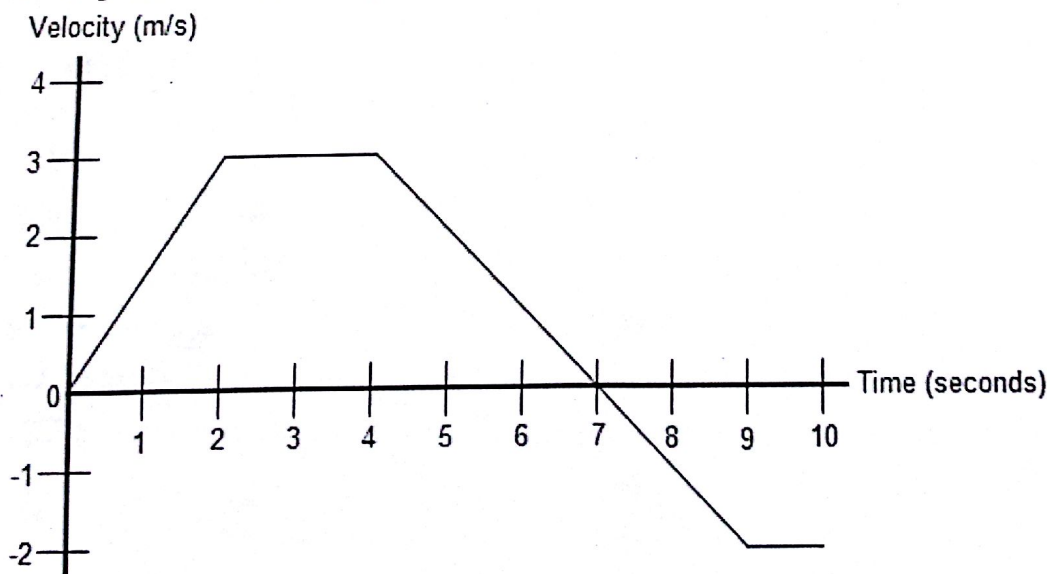
- a) Use a midpoint Riemann sum with 4 subdivisions of equal length to approximate the value of $\int_0^{24} R(t) dt$. Using correct units, explain the meaning of your answer in terms of water flow.
- b) Is there some time t , $0 < t < 24$, such that $R'(t) = 0$? Justify your answer.

922. Oil is leaking out of a tanker damaged at sea. The damage to the tanker is worsening as evidenced by the increased leakage each hour, recorded in the following table.

Time (hours)	0	1	2	3	4	5	6	7	8
Leakage (gal./hour)	50	70	97	136	190	265	369	516	720

- a) Give an upper and lower estimate of the total quantity of oil that has escaped after 5 hours.

An object's velocity during a 10 second time interval is shown by the graph below:



- a.) Determine the object's total distance traveled and displacement.
- b.) At $t = 0$, the object's position is $x = 2$ m. Find the object's position at $t = 2$, $t = 4$.

1. $\int (3x^2 - 2x + 3) dx =$

- (A) $x^3 - x^2 + C$ (B) $3x^2 - x^2 + 3x + C$ (C) $x^3 - x^2 + 3x + C$
 (D) $\frac{1}{2}(3x^2 - 2x + 3)^2 + C$ (E) none of these

~~$\frac{3x^3}{3} - \frac{2x^2}{2} + 3x + C$~~

20. $\int \frac{x^3 - x - 1}{x^2} dx =$

- (A) $\frac{\frac{1}{4}x^4 - \frac{1}{2}x^2 - x}{\frac{1}{3}x^3} + C$
 (B) $1 + \frac{1}{x^2} + \frac{2}{x^3} + C$
 (C) $\frac{x^2}{2} - \ln|x| - \frac{1}{x} + C$
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3. Let $f(x)$ be defined as below. Evaluate $\int_0^6 f(x) dx$.

$\frac{x^2}{2} \Big|_0^2 = 2 - 0 = 2$

$f(x) = \begin{cases} x & 0 < x \leq 2 \\ 1 & 2 < x \leq 4 \\ \frac{1}{2}x & 4 < x \leq 6 \end{cases}$

- (A) 5
 (B) 6
 (C) 7
 (D) 8
 (E) 9

$x - \frac{1}{x} - x^{-2}$

$\frac{1}{4}x^2 \Big|_4^6 = 9 - 4 = 5$

$\frac{x^2}{2} - \ln|x| - \frac{x^{-1}}{-1}$

$\frac{x^2}{2} - \ln|x| + \frac{1}{x} + C$

77. The equation of the curve whose slope at point (x, y) is $x^2 - 2$ and which contains the point $(1, -3)$ is

- (A) $y = \frac{1}{3}x^3 - 2x$ (B) $y = 2x - 1$ (C) $y = \frac{1}{3}x^3 - \frac{10}{3}$
 (D) $y = \frac{1}{3}x^3 - 2x - \frac{4}{3}$ (E) $3y = x^3 - 10$

$\int (x^2 - 2) dx$

$\frac{x^3}{3} - 2x + C$

$-3 = \frac{1}{3} - 2(1) + C$

$-3 = \frac{1}{3} - 2 + C$

$-3 = -\frac{5}{3} + C$

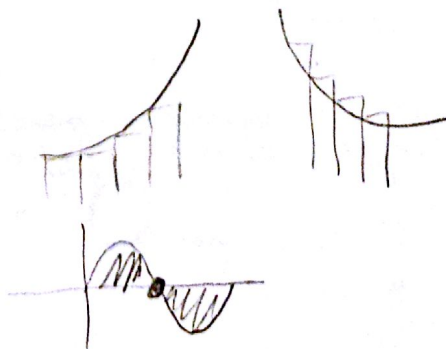
$-\frac{9}{3} = -\frac{5}{3} + C$

$C = -\frac{4}{3}$

8. Which of the following statements are true?

- I. If the graph of a function is always concave up, then the left-hand Riemann sums with the same subdivisions over the same interval are always less than the right-hand Riemann sum.
 II. If the function f is continuous on the interval $[a, b]$ and $\int_a^b f(x) dx = 0$, then f must have at least one zero between a and b .
 III. If $f'(x) > 0$ for all x in an interval, then the function f is concave up in that interval.

- (A) I only
 (B) I only
 (C) III only
 (D) II and III only
 (E) None are true.



$3 \left(\frac{x^3}{3} - 2x + \frac{-4}{3} \right)$
 $x^3 - 6x - 4$

B

F

F

1101 (1999AB, Calculator). The rate at which water flows out of a pipe, in gallons per hour, is given by a differentiable function R of time t . The table below shows the rate as measured every 3 hours for a 24-hour period.

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$R(t)$ (gal/hr)	9.6	10.4	10.8	11.2	11.4	11.3	10.7	10.2	9.6

(2) a) Use a midpoint Riemann sum with 4 subdivisions of equal length to approximate the value of $\int_0^{24} R(t) dt$. Using correct units, explain the meaning of your answer in terms of water flow.

(2) b) Is there some time t , $0 < t < 24$, such that $R'(t) = 0$? Justify your answer.

a) $6(10.4) + 6(11.2) + 6(11.3) + 6(10.2) = 258.6$ gal
 Between 0 and 24 hrs, ^{about} 258.6 gal flow out

b) yes, $R(0) = R(24)$, RT guarantees there is a t , $0 < t < 24$ such that $R'(t) = 0$

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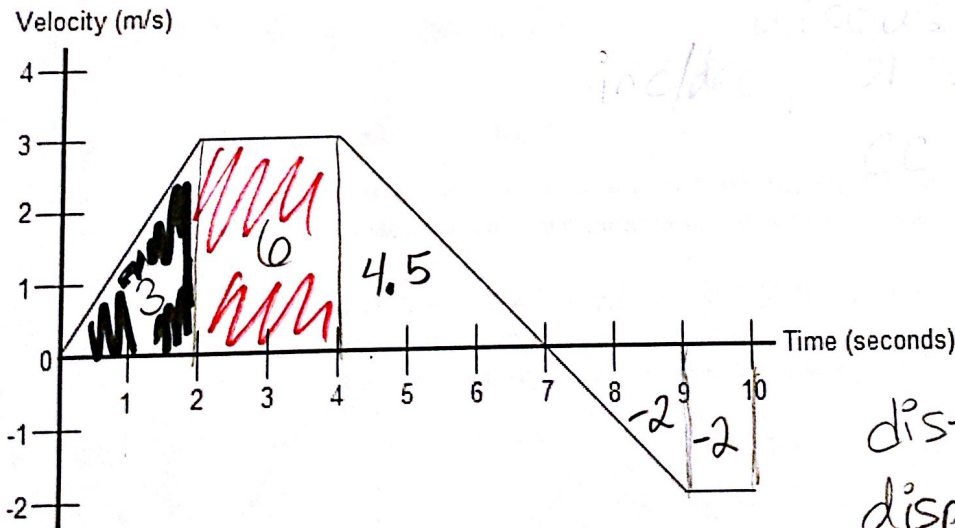
a) Give an upper and lower estimate of the total quantity of oil that has escaped after 5 hours.

~~X~~ Give an upper and lower estimate of the total quantity of oil that has escaped after 8 hours.

(2) LRAM: $1(50 + 70 + 97 + 136 + 190) = 543$ gal (lower)

RRAM: $1(70 + 97 + 136 + 190 + 265) = 758$ gal (upper)

An object's velocity during a 10 second time interval is shown by the graph below:



a.) Determine the object's total distance traveled and displacement.

b.) At $t = 0$, the object's position is $x = 2$ m. Find the object's position at $t = 2$, $t = 4$.

$t = 2: 2 + 3 = 5$ m (↑)

$t = 4: 2 + 9 = 11$ m (↑)

dist = 17.5 m (↑)

displace = 9.5 m (↑)