
Please show **all your work**. **No work - no credit**.

1. (35pt) Find the derivatives of the following functions.

(a) $f(x) = x^4 + 5^x$

(b) $f(x) = (x^2 + e^x) \cdot \ln x$

(c) $f(x) = \frac{x^2 + x}{\sqrt{x}}$

(d) $f(x) = \sqrt{x^3 + \frac{7}{x^2}}$

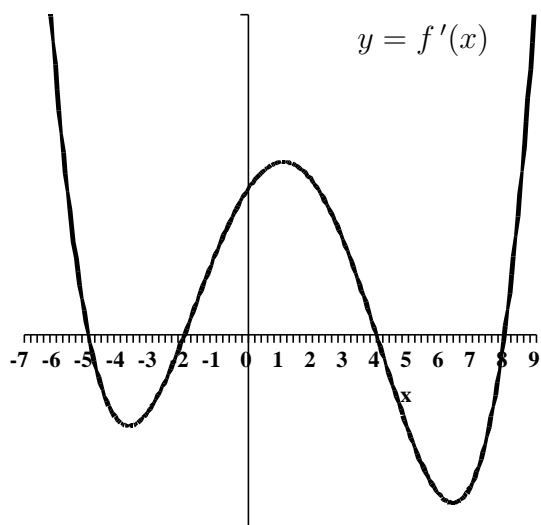
(e) $f(x) = e^{x^2+x}$

(f) $f(x) = \ln(x^4 + x^2 + 3)$

(g) Given $f(2) = 5$ and $f'(2) = -4$, find $h'(2)$, where $h(x) = \frac{x^3}{f(x)}$

2. (8pt) Find the tangent line approximation for $f(x) = \sqrt{x}$ near $x = 9$. Then use it to approximate $\sqrt{9.3}$.

3. (8pt) Below is the graph of the **derivative** of the function $f(x)$.



All the questions below are about the function f , **not** about its derivative f' whose graph is shown

- (a) List the critical points of f
- (b) State the intervals on which f is increasing
- (c) State the intervals on which f is decreasing
- (d) List all x at which f has a local **maximum**
- (e) List all x at which f has a local **minimum**
- (f) List all x at which f has an **inflection** point

4. (8pt) Find the global maximum and the global minimum of the function $f(x) = x^3 - 9x^2 + 15x + 5$ on the interval $[0, 2]$.

5. (4pt) Among the graphs shown below, find the graph of a function that satisfies all of the following conditions:

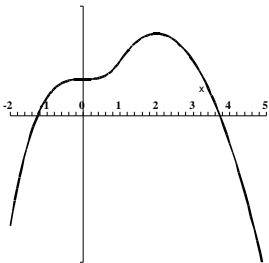
$y' > 0$ when $-2 < x < 0$ and $0 < x < 2$;

$y' < 0$ when $2 < x < 5$;

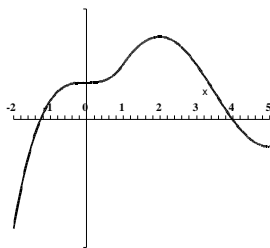
$y'' > 0$ when $0 < x < 1$;

$y'' < 0$ when $-2 < x < 0$ and $1 < x < 5$;

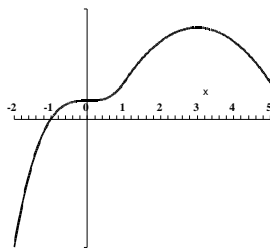
(a)



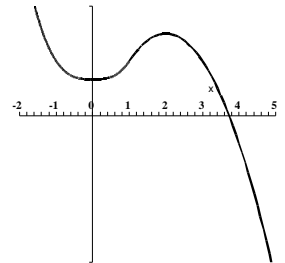
(b)



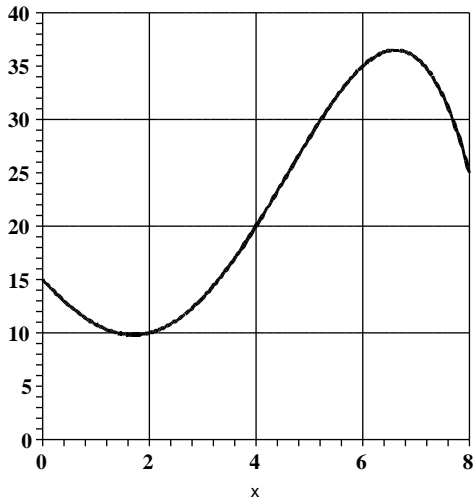
(c)



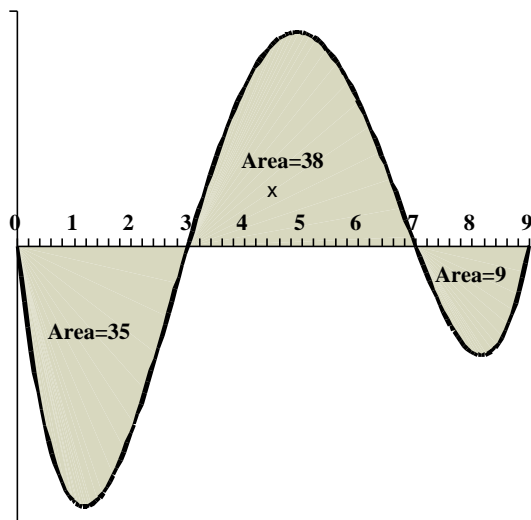
(d)



6. (10pt) Estimate the area under the graph of a function $f(x)$ below over the interval $0 \leq x \leq 8$ by taking the average of the left-hand and right-hand sums, L_n and R_n , with $n = 4$.



7. (8pt) Use the graph of a function $f(x)$ below to find the values of the following integrals



(a) $\int_0^3 f(x) dx$

(b) $\int_0^7 f(x) dx$

(c) $\int_0^9 f(x) dx$

(d) $\int_0^9 |f(x)| dx$

8. (7pt) Suppose $\int_0^6 f(x) dx = 3$ and $\int_0^6 g(x) dx = 7$

(a) Find $\int_0^6 [2f(x) - g(x)] dx$. Show your work.

(b) If $f(x)$ is **even**, find $\int_{-6}^6 f(x) dx$

(c) If $g(x)$ is **odd**, find $\int_{-6}^6 g(x) dx$

9. (6pt) Find the average value of the function $f(x) = \sqrt{x}$ on the interval $[0, 16]$.

10. (6pt) Give two antiderivatives of the function $f(x) = e^{-2x} + x$