1. If $f(x) = \int_3^x t^4 \, dt$ then $f'(x) = \ldots$ $f'(3) = \ldots$

2. If $f(x) = \int_x^{20} t^2 \, dt$ then $f'(x) = \ldots$

3. If $f(x) = \int_x^6 t^8 \, dt$ then $f'(x) = \ldots$

4. If $f(x) = \int_x^{x^3} t^4 \, dt$ then $f'(x) = \ldots$

5. If $f(x) = \int_x^x t^2 \, dt$ then $f'(x) = \ldots$ $f'(-1) = \ldots$

6. If $f(x) = \int_x^{x^2} t^2 \, dt$ then $f'(x) = \ldots$

7. If $f(x) = \int_0^x (t^3 + 7t^2 + 1) \, dt$ then $f''(x) = \ldots$

8. Given $f(x) = \int_0^x \frac{t^2 - 4}{1 + \cos^2(t)} \, dt$ At what value of $x$ does the local max of $f(x)$ occur? $x = \ldots$

9. Given $f(t) = \int_0^t \frac{x^2 + 10x + 21}{1 + \cos^2(x)} \, dx$ At what value of $t$ does the local max of $f(t)$ occur? $t = \ldots$

10. (1 pt) NOTE: It will be easier to see the function $f(x)$ if you use the display mode "typeset". Keep in mind, though, that loading the problem into your computer using this display mode will take longer.

   Let $f(x) = \begin{cases} 
   0 & \text{if } x < -5 \\
   2 & \text{if } -5 \leq x < 1 \\
   -3 & \text{if } 1 \leq x < 5 \\
   0 & \text{if } x \geq 5 
   \end{cases}$

and

$$g(x) = \int_5^x f(t) \, dt$$

Determine the value of each of the following:

(a) $g(-8) = \ldots$
(b) $g(-4) = \ldots$
(c) $g(2) = \ldots$
(d) $g(6) = \ldots$
(e) The absolute maximum of $g(x)$ occurs when $x = \ldots$ and is the value $\ldots$

It may be helpful to make a graph of $f(x)$ when answering these questions.

11. (1 pt) Use part I of the Fundamental Theorem of Calculus to find the derivative of

$$f(x) = \int_4^x \left( \frac{1}{4}t^2 - 1 \right)^{12} \, dt$$

$f'(x) = \ldots$ [NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary *, (, ), etc.]

12. (1 pt) Use part I of the Fundamental Theorem of Calculus to find the derivative of

$$f(x) = \int_{-1}^x \sqrt{t^3 + 1} \, dt$$

$f'(x) = \ldots$ [NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary (, ), etc.]

13. (1 pt) Use part I of the Fundamental Theorem of Calculus to find the derivative of

$$f(x) = \int_5^x \frac{1}{1 + t^3} \, dt$$

$f'(x) = \ldots$

14. (1 pt) Use part I of the Fundamental Theorem of Calculus to find the derivative of

$$F(x) = \int_3^x \sin(t^2) \, dt$$

$F'(x) = \ldots$ [NOTE: Enter a function as your answer.]

15. (1 pt) Use part I of the Fundamental Theorem of Calculus to find the derivative of

$$h(x) = \int_{-4}^{\sin(x)} \left( \cos(t^2) + t \right) \, dt$$

$h'(x) = \ldots$ [NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary *, (, ), etc.]
16. Use part I of the Fundamental Theorem of Calculus to find the derivative of
\[ h(x) = \int_{-5}^{\sin(x)} (\cos(t^3) + t) \, dt \]
\[ h'(x) = \quad \text{[NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary *, (, ), etc.]} \]

17. Find the derivative of
\[ g(x) = \int_{5x}^{8x} \frac{u + 4}{u - 1} \, du \]
\[ g'(x) = \quad \text{[NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary *, (, ), etc.]} \]

18. Use part I of the Fundamental Theorem of Calculus to find the derivative of
\[ g(x) = \int_{2x}^{5x} \frac{u + 4}{u - 5} \, du \]
\[ g'(x) = \quad \text{[NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary *, (, ), etc.]} \]

19. Find the derivative of the following function
\[ F(x) = \int_{x^3}^{5} (2t - 1)^3 \, dt \]
\[ F'(x) = \quad \text{using the Fundamental Theorem of Calculus.} \]

20. Find the derivative of the following function
\[ F(x) = \int_{\sqrt{7}}^{1} \frac{s^2}{4 + 3s^4} \, ds \]
\[ F'(x) = \quad \text{using the appropriate form of the Fundamental Theorem of Calculus.} \]

21. Find a function \( f \) and a number \( a \) such that
\[ 2 + \int_{a}^{x} f(t) \, dt = 5x^{-3} \]
\[ f(x) = \quad a = \quad \text{[NOTE: Enter a function as your answer. Make sure that your syntax is correct, i.e. remember to put all the necessary *, (, ), etc.]} \]

22. Evaluate the definite integral
\[ \int_{2}^{5} \left( \frac{d}{dt} \sqrt{5 + 2t^3} \right) \, dt \]
\[ \quad \text{using the Fundamental Theorem of Calculus.} \]
\[ \quad \text{You will need accuracy to at least 4 decimal places for your numerical answer to be accepted. You can also leave your answer as an algebraic expression involving square roots.} \]
\[ \quad \int_{2}^{5} \left( \frac{d}{dt} \sqrt{5 + 2t^3} \right) \, dt = \quad \]

23. Evaluate the following definite integrals using the Fundamental Theorem of Calculus.
\[ \int_{-14}^{3} |49 - s^2| \, ds = \quad \int_{0}^{49\pi^2} \frac{\sin(\sqrt{x})}{\sqrt{x}} \, dx = \quad \int_{7}^{14} \frac{t - 7}{t^2 - 14t + 50} \, dt = \quad \]

24. Compute the following limit. Use INF to denote \( \infty \) and MINF to denote \(-\infty\).
\[ \lim_{x \to 0} \int_{x}^{2} \sqrt{64 - 5t^2} \, dt = \quad \]