1. Find \( \lim_{x \to 0} \frac{e^x - 1}{e^{2x} - 1} \)

2. Find \( \lim_{x \to -\infty} \frac{\sqrt{2 + 3x^2}}{x + 4} \)

3. Find \( \lim_{h \to 0} \frac{(5 + h)^4 - 5^4}{h} \)

4. If \( g(x) = \sqrt{x} + \frac{1}{\sqrt{x}} \) find \( g''(4) \)

5. On what open interval(s) is \( f(x) = x^3 - x^2 - x + 1 \) decreasing?
6. Find the slope of the line tangent to \( x^3y + xy^3 = 2 \) at \((1,1)\)

7. If \( f(x) = x^{2/3} \), find a value of \( x \) on \([0,1]\) that satisfies the Mean Value Theorem

8. A particle’s position is given by \( s(t) = \frac{t}{t^2 + 1} \) (\( s \) in feet, \( t \) in seconds).
   Find the velocity of the particle at 2 seconds (include units)

9. Find all \( x \) values for which \( f(x) = (2x + 1)^2 (x - 3)^4 \) has a horizontal tangent

10. Air is being pumped into a spherical balloon in such a way that its volume is increasing at a constant rate of \( 200\pi \) cm\(^3\)/s. Find the rate of change of the radius when the radius is 5 cm. (include units)
11. On what open interval(s) is $f(x) = xe^x$ concave up?

12. If $y = \cos^2(\tan x)$ find $\frac{dy}{dx}$

13. Find the minimum function value for $f(x) = x - \sqrt{1 - x^2}$ on $[-1, 1]$ (answer exactly)

14. Find $\frac{d}{dx} \int_{e}^{x^2} \ln x \, dx$

15. The figure shows the graph of the derivative $f'$ of a function. For what value(s) of $x$ does $f'$ have a local extreme value?
16. Given the values in the table below, if $h(x) = f(g(x))$, find $h'(2)$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
<th>$f'(x)$</th>
<th>$g(x)$</th>
<th>$g'(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>-2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>28</td>
<td>11</td>
<td>26</td>
<td>10</td>
</tr>
</tbody>
</table>

17. Find $\int_{-3}^{1} f(x)dx$ for $f(x) = \begin{cases} \frac{-x-1}{-\sqrt{1-x^2}} & \text{if } -3 \leq x \leq 0 \\ \frac{-3 \leq x \leq 0}{0 < x \leq 1} \end{cases}$ (answer exactly)

18. Find $\int \tan x \ln(\cos x)dx$

19. Find the average value of $f(x) = \frac{1}{x}$ on $[1, 3]$ (answer exactly)

20. Find the area enclosed by $y = e^x$, $y = e^{3x}$ and $x = 1$ (answer exactly)
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1. \( \frac{1}{2} \)

2. \( -\sqrt{3} \)

3. 500

4. \( -\frac{3}{1024} \)

5. \( \left( -\frac{1}{3}, 1 \right) \)

6. -1

7. \( \frac{8}{27} \)

8. \( -\frac{3}{25} \text{ ft/sec (must have units)} \)

9. \( x = -\frac{1}{2}, \frac{2}{3}, 3 \)

10. 2 cm/s

11. \((-2, \infty)\)

12. \(-\sin(2 \tan x) \sec^2 x \) or \(-2 \sin x \cos x \sec^2 x \)

13. \(-\sqrt{2} \)

14. \(2x \ln(x^2) \) or \(4x \ln x \)

15. -2, 0, 4

16. 44

17. \( \frac{3}{2} - \frac{\pi}{4} \) or \( \frac{6 - \pi}{4} \)

18. \( -\frac{1}{2} (\ln(\cos x))^2 + C \)

19. \( \frac{1}{2} \ln 3 \) or \( \ln \sqrt{3} \)

20. \( \frac{1}{3} e^3 - e + \frac{2}{3} \)