1. Find $\lim\limits_{x \to 0} \left(\dfrac{e^x - 1}{e^{2x} - 1} \right)$

2. Find $\lim\limits_{x \to -\infty} \left(\dfrac{\sqrt{2 + 3x^2}}{x + 4} \right)$

3. Find $\lim\limits_{h \to 0} \dfrac{(5 + h)^4 - 5^4}{h}$

4. If $g(x) = \sqrt{x} + \dfrac{1}{\sqrt{x}}$ 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 $s(t) = \dfrac{t}{t^2 + 1}$ (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 200π cm^3/s. Find the rate of change of the radius when the radius is 5
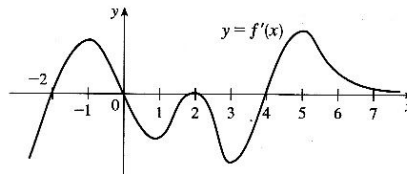   cm. (include units)

11. On what open interval(s) is $f(x) = xe^x$ concave up?

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

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

14. Find $\dfrac{d}{dx} \displaystyle\int_e^{x^2} \ln x \, dx$

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 $h'(2)$

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
2	3	−2	5	4
5	28	11	26	10

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

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

19. Find the average value of $f(x)=\dfrac{1}{x}$ 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. $\dfrac{1}{2}$

2. $-\sqrt{3}$

3. 500

4. $-\dfrac{3}{1024}$

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

6. -1

7. $\dfrac{8}{27}$

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

9. $x = -\dfrac{1}{2}, \dfrac{2}{3}, 3$

10. 2 cm/s

11. $(-2, \infty)$

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

13. $-\sqrt{2}$

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

15. $-2, 0, 4$

16. 44

17. $\dfrac{3}{2} - \dfrac{\pi}{4}$ or $\dfrac{6-\pi}{4}$

18. $-\dfrac{1}{2}\left(\ln(\cos x)\right)^2 + C$

19. $\dfrac{1}{2}\ln 3$ or $\ln\sqrt{3}$

20. $\dfrac{1}{3}e^3 - e + \dfrac{2}{3}$