

This test consists of 4 pages, none of which is intentionally left blank. Take a few seconds right now to be sure you have all the pages. The point value of each question is to the left of the question number. Show all your work in the space provided. If you run out of room for an answer, continue working on the back of the page. Your answers must be justified by your work.

1. Find and simplify the derivative of each of the following functions:

(5) (a)  $f(x) = e^{x^2+1}$

(5) (b)  $f(x) = \tan(\ln(x))$

(5) (c)  $g(x) = \cosh(x)e^x$

(5) (d)  $h(x) = \frac{x+1}{\sqrt{x^2+3}}$

Question 1 continued

(5) (e)  $g(x) = (\sin(x))^x$

(10) 2. If  $\sinh(x) = \frac{5}{12}$  what are the values of the other hyperbolic trig functions.

(10) 3. Find the equation of the line tangent to the graph of  $f(x) = x^2 + 5x - 6$  which is parallel to the line  $3x - 5y = 15$

4. The following parts refer to the function  $f(x) = \sqrt[3]{x}$ .

(5) (a) What is the equation of the line tangent to graph of  $f$  at the point  $(27, 3)$ ?

(5) (b) Use a linear approximation to  $f$  to approximate  $\sqrt[3]{26}$

(10) 5. Use logarithmic differentiation to find  $y'$  if  $y = (x + 2)(x - 3)^2(x^2 + 2)^4$

(10) 6. Find the points on the graph of  $f(x) = x^3 + 3x^2 - 9x - 3$  where the tangent is horizontal.

7. When finding the formula for the derivative of  $\sin(x)$ , we had to derive and use the fact that  $\lim_{x \rightarrow 0} \frac{\sin(x)}{x} = 1$ . You may find this fact useful in evaluating the following limits. (Calculator answers are not acceptable.)

(7) (a)  $\lim_{x \rightarrow 0} \frac{\sin 2x}{\sin(x)}$

(8) (b)  $\lim_{x \rightarrow 0} \frac{1 - \cos(3x)}{x^2}$

(10) 8. A spherical snowball is melting at a rate of 2 cubic centimeters per second. How fast is the radius changing at the instant the radius is 6cm? (The volume of a sphere of radius  $r$  is  $v = \frac{4}{3}\pi r^3$ )