

This fun fifty-minute test covers sections 3.1 through 3.9 of *Calculus: Early Transcendentals* (6ed) by James Stewart. Clearly indicate your answers. Unless otherwise indicated, all parts of problems are four points each.

1. Find the indicated limits. (3 points each)

a. $\lim_{x \rightarrow 0} \frac{1 - \cos(251x)}{13x}$

b. $\lim_{x \rightarrow 0} \frac{251x}{\sin 252x}$

2. Suppose a calculus teacher is thrown in the air and his height in feet is given by $s = 160t - 16t^2$ (t is the time in seconds). (3 points each)

a) At what time t is his velocity 0?

b) What is his velocity when he hits the ground?

c) What is the highest that he will go?

3. Find the derivative.

a) $x^{125} - 3x^{252} - 320$

b) $x \tan(2x)$

c) $V(r) = \frac{4}{3} \pi r^3$

d) $\frac{x-4}{x+4}$

e) $e^{\sin(x)}$

f) $\cos x \sec x$

g) $\sqrt[3]{t^4} - \sqrt{t^5}$

h) $\log_3(x^2+1)$

i) $\frac{\pi \cos(2)}{23}$

j) $\sin^{-1}(1+x)$

4. Use implicit differentiation to **find the equation of the tangent line** to $x^4 + y^4 = 17$ at the point (1,2). (8 points)

5. Suppose we are inflating “a balloon” that is always in the shape of a perfect cube. If the side of the cube is increasing 10cm/sec, find the rate at which the outside surface area is increasing when the side is 30cm. (10 points)

6. Use logarithmic differentiation to find the derivative of $x^{\sin x}$. (6 points)

7. Find y' and y'' for $y = \tan^{-1}x$

a) $y' =$

b) $y'' =$

8. The half-life of Calcium-251 is 45 minutes. Suppose we have a 100mg sample. How long until only 20mg is left?