

Name: _____ / 25

There are 25 points possible on this quiz. No aids (book, calculator, etc.) are permitted. **Show all work for full credit.**

1. **[10 points]** (Related Rate Problem) A spherical snowball is melting so that its volume is decreasing at a constant rate of $4\pi \text{ cm}^3/\text{min}$. Use this information to answer the following questions.

a. How fast is the **radius** of the snowball decreasing when the radius is 8 cm ? Include units in your answer. (Use the fact that the volume of a sphere is given by $V = \frac{4}{3}\pi r^3$.)

b. How fast is the **surface area** of the snowball decreasing when the radius is 8 cm ? Include units in your answer. (Use your answer in part (a) and that the surface area of a sphere is given by $S = 4\pi r^2$.)

2. [7 points] (Linear Approximation and Differentials) Let $f(x) = x^3 - \ln(x)$.

a. Find the linear approximation $L(x) = f(a) + f'(a)(x - a)$ to $y = f(x)$ at $a = 1$.

b. Use your linear approximation to estimate $f\left(\frac{3}{2}\right)$.

3. [8 points] Let $h(x) = 4x^3 - 3x^4 + 6$.

a. Find all critical points for $h(x)$.

b. Determine the absolute maximum and absolute minimum of $h(x)$ on the interval $[-1, 2]$ or state that none exist. You must show your work to receive full credit. See the answer-blank below.

maximum value of $h(x)$: _____

minimum value of $h(x)$: _____