Name: _____

Please show all work and justify your statements. Label sketches, draw conclusions (using complete sentences and including units), and box your final answers as appropriate.

1. You are climbing a mountain by the steepest route with angle of ascent $20°$ when you come upon a branching trail $30°$ from yours. What is the angle of ascent of the other trail?

2. Find the second order Taylor approximation to $\cos(x + 2y)$ at the origin.

3. A child is sucking on a cylindrical popsicle with diameter $d$ and length $h$. When $d = 3$ cm and $h = 10$ cm, the diameter is shrinking at 0.2 cm/s and the length is shrinking at 0.1 cm/s. How fast is the popsicle disappearing? In other words, what is the rate of change of volume?

4. ACME produces roadrunner traps at two locations in quantities $q_1$ and $q_2$. The total cost of production is $2q_1^2 + q_1q_2 + q_2^2 + 500$. If ACME wants to produce 200 traps, how should the production be split between the two locations to minimize cost?

5. A solid is bounded by the coordinate planes and the plane $2x + 3y + z = 6$. If the density of the solid is $10 + x + y$, find its mass. You may omit the integration once you've set up the iterated integral.

| 1 | 2 | 3 | 4 | 5 | total (50) | % |
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Prelim. course grade: _____ %