- Print Name, ID number and Section on your blue book.
- BOOKS and CALCULATORS are NOT allowed.
  One page of notes (both sides) is allowed.
- **You must show your work to receive credit.**

1. (4 pts.) A street vendor sells a hot dogs and b soft drinks on a given day. He charges \$2 for a hot dog and \$1.50 for a soft drink, including taxes. If $\mathbf{A} = \langle a, b\rangle$ and $\mathbf{P} = \langle 200, 150\rangle$, what is the meaning of the dot product $\mathbf{A}\cdot\mathbf{P}$?

2. (6 pts.) Find the equation of the plane containing the three points (1,0,0), (0,2,0) and (1,0,1). Express your answer in the form $ax + by + cz = d$ for some constants a, b, c, d.

3. (6 pts.) Compute the angle between the two vectors $\langle 1, 2, 3\rangle$ and $\langle 3, -2, 1\rangle$. You may leave a trig function in your answer.

4. (6 pts.) The equation $x^3 - x^2y + y^3 = 5$ implicitly defines y as a function of x. Compute dy/dx at the point $x = 2$, $y = 1$. Your answer should be a number.

5. (12 pts.) Let $g(x, y, z) = \ln(x + 2y + z)$.
   (a) Find the domain of g. Give your answer in set notation; for example (but not the answer), $\{(x, y) \mid x^2 + y^2 < 1\}$.
   (b) Find $\nabla g(2, 1, -3)$.
   (c) Find $D_{\mathbf{u}}\, g(2, 1, -3)$ where the unit vector $\mathbf{u}$ points in the direction of the origin from the point $(2, 1, -3)$.

6. (6 pts.) Use the chain rule to find $\partial z/\partial s$ at $(s, t) = (1, 2)$, given that $z = x^2 + xy + y^2$, $x = s + t$ and $y = st$.

7. (6 pts.) Find the tangent plane to the surface $z = 4x^2 - y^2 + 2y$ at the point $(-1, 2, 4)$.

8. (10 pts.) Find the critical points of the function $f(x, y) = x^3y - 3xy + y^2 + 7$. You do NOT need to classify them as max/min/saddle. (There are five of them.)

9. (8 pts.) Find the *absolute* maximum and minimum values of $f(x, y) = 2x^4 + y^2$ subject to the constraint $x^2 + y^2 = 1$. Also find the points (x, y) at which these maximum and minimum values occur.

END OF EXAM