First & Last Name: _____ Student ID: _____

**Math 2310 Multivariable Calculus III Quiz 3 version a** 

**Instructions:** No notes or calculators are allowed. Please box your final answer.

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**1.** (6 pts) Find an equation of the plane tangent to the surface $2e^{xy} - z = 0$ at the point $(9, 0, 2)$. (Show all work on this paper.)

**Solution:** (Taken from MML Sec 15.6 Problem 5. For more practice, do Problems 1, 3, 4, 6, 7.)

Let $F(x, y, z) = 2e^{xy} - z$, and compute the partial derivatives at the point $P_0 = (9, 0, 2)$:

$$\begin{aligned} F_x &= 2ye^{xy} & F_x(P_0) &= 0 \\ F_y &= 2xe^{xy} & F_y(P_0) &= 2(9)e^0 = 2(9) \\ F_z &= -1 & F_z(P_0) &= -1 \end{aligned}$$

An equation of the plane tangent to the surface $F(x, y, z) = 0$ at $P_0(a, b, c)$ is

$$F_x(P_0)(x - a) + F_y(P_0)(y - b) + F_z(P_0)(z - c) = 0,$$

so an answer is

$$0(x - 9) + 2(9)(y - 0) - 1(z - 2) = 0 \text{ or } \boxed{2(9)y - z + 2 = 0} \text{ or } \boxed{z = 2(9)y + 2}$$

**2.** (1 pt) If $f_x(4,5) = 0$ and $f_y(4,5) = 0$, does it follow that $f$ has a local maximum or local minimum at $(4,5)$? Explain.

◯ No. It follows that $(4,5)$ is a critical point of $f$, and $(4,5)$ is a candidate for a local maximum or local minimum.

◯ Yes. The tangent plane to $f$ at $(4,5)$ is horizontal. This indicates the presence of a local maximum or a local minimum at $(4,5)$.

◯ No. One (or both) of $f_x$ and $f_y$ must also not exist at $(4,5)$ to be sure that $f$ has a local maximum or local minimum at $(4,5)$.

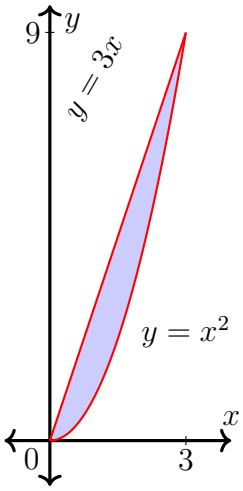
◯ Yes. The point $(4,5)$ is a critical point and must be a local maximum or local minimum.

(Fill in the circle next to the correct answer. There is only one correct answer.)

**Solution:** (From MML Section 15.7 Problem 1)
First choice:
No. It follows that $(4,5)$ is a critical point of $f$, and $(4,5)$ is a candidate for a local maximum or local minimum.

**3.** (3 pts) Reverse the order of integration in

$$\int_0^9 \int_{y/3}^{\sqrt{y}} f(x,y)\, dx\, dy$$




**Solution:**

$$\int_0^3 \int_{x^2}^{3x} f(x,y)\, dy\, dx$$

(Taken from MML 16.2 Problem 11. For similar problems, see also Problems 1, 6, 8, 12, 13.)