NAME: (print!) ____

Section: ____ **E-Mail address:** ____________________

MATH 251 (22,23,24) [Fall 2020], Dr. Z. , Makeup for Exam 1, Sunday, Oct. 25, 2020, 9:00-11:00am

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WRITE YOUR FINAL ANSWERS BELOW

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1.

2.

3.

4.

5.

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7.

8.

9.

10.

Types: Number, Function of *variable*(s), 2D vector of numbers, 3D vector of numbers, 2D vector of functions, 3D vector of functions, equation of a plane, parametric equation of a line, equation of a line, equation of a surface, equation of a line, DNE (does not exist).

Sign the following declaration:

I Hereby declare that all the work was done by myself. I was allowed to use Maple, calculators, the book, and all the material in the web-page of this class but **not** other resources on the internet.

I only spent (at most) 90 minutes on doing the exam. The last 30 minutes were spent in checking and double-checking the answers.

I also understand that I may be subject to a random short chat to verify that I actually did it all by myself.

Signed:

1. (10 pts.) Find a parametric representation, in terms of the parameter, t, of the line of intersection of the planes $y = 0$ and $z = 0$. What is the usual name for that line?

The **type** of the answers is:

ans.

2. (10 points) Use any method to find $\frac{\partial^2 h}{\partial r^2}$ at $(q, r) = (1, 1)$ where $h(u, v) = u^5\, v^6$, $u = q^2\, r$, $v = q\, r^2$

The **type** of the answer is:

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ans.

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3. (10 points) Find the point on the line $y = x + 6$ (in the xy-plane) where the rate of change of the function $f(x, y) = x^2 + y^2$ in the direction $< 1, 1 >$ is zero.

The **type** of the answer is:

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ans.

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4. (10 points) Find an equation of the tangent plane to the following surface at the given point

$$z = x^2 + y^3 \quad , \quad (1, 2, 9) \quad .$$

The **type** of the answer is:

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ans.

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5. (10 points) Compute $f_{xyy}(1,1)$ (aka $\frac{\partial^3 f}{\partial x \partial^2 y}(1,1)$), if $f(x,y) = \ln(x^2 + y)$.

The **type** of the answer is:

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ans.

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6. (10 points) Use Linearization to approximate $\sqrt{(3.001)^2 + (3.999)^2}$. Part of the challenge is to find the appropriate function $f(x, y)$ and the appropriate 'nice' point (x_0, y_0).

The **type** of the answer is:

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ans.

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7. (10 points) Decide whether the following limit exists. If it does find it. If it does not **Explain** why not?

$$\lim_{(x,y,z)\to(1,1,1)} \frac{x+2y+3z-6}{3x+2y+z-6}$$

Hint: To prove that a limit **exists** at a designated point you first try to plug it in. If there are no issues you are done, and the value is the limit. Failing this, you try to use **algebra** to simplify and then plug it in, if possible. Failing this you try to prove that it does **not** exist. One way of doing it is to pick any two **different** lines through the point in question and show that if you approach the designated point via these lines you get **different** limits (in the sense of single-variable calculus).

8. (10 points) Find the minimum **location(s)** (i.e the **point(s)** where the function is the smallest) of the function

$$f(x, y, z) = x + 2y - z$$

in the **closed pyramid** whose vertices are

$$(1, 1, 0) \quad , \quad (-1, 1, 0), \quad (1, -1, 0), \quad (-1, -1, 0), \quad (0, 0, 1)$$

The **type** of the answer(s) is:

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ans.

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9. (10 points) A certain particle of mass 2 kilograms has position function, expressed in meters, where t is time, expressed in seconds,

$$\mathbf{r}(t) = \langle\, e^t, 2\cos t, 2\cos t\,\rangle \quad ,$$

(i) Find the **magnitude** of the force acting on it at time $t = 0$. **Explain!**

(ii) Find the **unit direction** of that force.

Reminder from physics: $F = ma$, i.e. the force equals the mass times the acceleration.

The **types** of the answers are (i) (ii)

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ans. (i) magnitude : Newtons ; (ii) unit direction:

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10. (10 points) A certain function $f(x, y, z)$ depends on three variables called x, y and z. At a certain time the rate of change of this function with respect to time happens to be 140. It is also known, that at that same time

• The rate of change of $f(x, y, z)$ with respect to x is 1

• The rate of change of $f(x, y, z)$ with respect to y is 2

• The rate of change of $f(x, y, z)$ with respect to z is 3

• The rate of change of y with respect to time is **two times** The rate of change of x with respect to time.

• The rate of change of z with respect to time is **three times** The rate of change of x with respect to time.

What is the rate of change of x with respect to time at that time?

The **type** of the answer is:

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ans.
