

You may use a (non-programable) scientific calculator for the exam and you may use a  $3 \times 5$  note card. This exam has 20 questions worth 5 points each. Indicate your answers on the answer card.

1. Use the method of linear approximation to find the approximate value of  $\sqrt{3.01^2 + 4.02^2}$ .

a. 5.014

b. 5.016

c. 5.018

d. 5.020

e. 5.022

f. 5.024

g. 5.026

h. 5.028

i. 5.030

j. 5.032

$$f(x, y) = \sqrt{x^2 + y^2}$$

$$f(3.01, 4.02) \sim f(3, 4) + f_x(3, 4)(.01) + f_y(3, 4)(.02)$$

$$f_x = \frac{2x}{2\sqrt{x^2 + y^2}} \rightarrow \frac{3}{5}$$

$$f_y = \frac{2y}{2\sqrt{x^2 + y^2}} \rightarrow \frac{4}{5}$$

$$\begin{aligned} \text{Ans} &= 5 + \frac{3}{5}(.01) + \frac{4}{5}(.02) = 5 + .006 + .016 \\ &= 5.022 \end{aligned}$$

2. Find the linearization of the function

$$f(x, y) = \frac{1}{1 - x + 2y}$$

about  $(0, 0)$ .

a.  $1 + x + 2y$ b.  $1 - 2x - y$ c.  $x + 2y$ d.  $2x - 2y$ e.  $2 - x - y$ f.  $2 + 2x + y$ g.  $2 + x$ h.  $y$ i.  $1 + x - 2y$ j.  $1 + 2x - y$ 

$$f_x = \frac{-1}{(1 - x + 2y)^2} (-1) \rightarrow +1$$

$$f_y = \frac{-1}{(1 - x + 2y)^2} (2) \rightarrow -2$$

$$\text{lin} = f(0, 0) + f_x(0, 0)x + f_y(0, 0)y$$

$$= 1 + x - 2y$$

3. Find the maximum and minimum value of

$$f(x,y) = 10x^3e^x + 6y + 4$$

a. No maximum, no minimum

b. No maximum, minimum 0

c. Maximum 0, no minimum

d. Maximum 4, no minimum

e. No maximum, minimum 4

f. Maximum 4, minimum 0

g. Maximum 16, minimum 4

h. Maximum 20, minimum 16

i. Maximum 20, minimum 6

j. Maximum 20, minimum 4

$$f_x = 10(3x^2)e^x + 10x^3e^x$$

$$f_y = 6$$

$f_y$  never 0, no critical pts

no boundary points

hence no max, no min

4. Suppose the function  $f(x,y)$  is homogenous of degree 2 and that  $f(1,2) = 3$ . What is  $f(2,4)$ ?

a. Cannot be determined.

b. 0

c. 2

d. 4

e. 6

f. 8

g. 10

h. 12

i. 14

j. 16

$$f(\lambda x, \lambda y) = \lambda^2 f(x, y)$$

$$x=1, y=2, \lambda=2, f(1,2)=3$$

$$f(2,4) = 2^2 \cdot 3$$

5. Find the equation of the tangent plane to the surface

$$z = 2 + 3x + 4xy^2 + 4y.$$

at the point  $(0, 0, 2)$ .

$$f(x, y)$$

a.  $z = 2 - x + y$

b.  $z = 2 + x + y$

c.  $z = 2 + x - 3y$

d.  $z = 2 + x$

e.  $z = 2 - y$

f.  $z = 2 + 3x + 4y$

g.  $z = 2 + 4x + 3y$

h.  $z = 2 - x$

i.  $z = 2 + y$

j.  $z = 2 + 2y$

$$z = f(0, 0) + f'_x(0, 0)x + f'_y(0, 0)y$$

$$f'_x = 3 + 4y^2 \longrightarrow 3$$

$$f'_y = 8xy + 4 \longrightarrow 4$$

$$z = 2 + 3x + 4y$$

6. Find  $df$ , the differential of the function

$$f(x, y) = (2x + 3y)^3$$

a.  $3(2x + 3y)^2 dx + 3(2x + 3y)^2 dy$

b.  $3(2x + 3y)^2 dx + 6(2x + 3y)^2 dy$

c.  $6(2x + 3y)^2 dx + 9(2x + 3y)^2 dy$

d.  $6(2x + 3y) dx + 9(2x + 3y) dy$

e.  $6(2x + 3y)^3 dx + 9(2x + 3y)^3 dy$

f.  $x(2x + 3y)^2 + y(2x + 3y)^2 dy$

g.  $6x(2x + 3y)^2 dx + 3y(2x + 3y)^2 dy$

h.  $(2x + 3y)^2 dx - 3(2x + 3y)^2 dy$

i.  $(2x + 3y)^3 dx + (2x + 3y)^3 dy$

j.  $(2x - 3y)^2 dx + (2x - 3y)^2 dy$

$$df = f'_x dx + f'_y dy$$

$$= 3(2x + 3y)^2 (2) dx$$

$$+ 3(2x + 3y)^2 (3) dy$$