King Fahd University of Petroleum and Minerals
Department of Mathematics
MATH 201
Second Major Exam
Term 261
3 November 2026
Net Time Allowed: 90 Minutes

MASTER VERSION

1. An equation of the plane passing through the points $(3, -1, 2)$, $(2, 1, 5)$, and $(1, -2, -2)$ is

   (a) $x + 2y - z = -1$ _____(correct)
   (b) $x + 2y - z = 1$
   (c) $x - 2y - z = 3$
   (d) $x + 2y + z = 3$
   (e) $2x + y - z = 3$

2. Which of the following equations does **NOT** represent a real quadric surface?

   (a) $15x^2 + 4y^2 + 15z^2 = -4$ _____(correct)
   (b) $15x^2 - 4y^2 + 15z^2 = -4$
   (c) $4x^2 + 9y^2 + 16z^2 = 36$
   (d) $4x^2 + 9y^2 - 16z^2 = 0$
   (e) $z = 4x^2 - 9y^2$

3. Consider the function

$$f(x,y) = \frac{8}{1+2x^2+y^2}.$$

The level curve corresponding to $c = 2$ is

(a) an ellipse. (correct)
(b) a circle.
(c) a parabola.
(d) a straight line.
(e) a hyperbola.

4. Consider the function

$$f(x,y) = \begin{cases} \dfrac{x^2+2xy^2+y^2}{x^2+y^2}, & (x,y) \neq (0,0), \\ L, & (x,y) = (0,0). \end{cases}$$

The value of L that makes f continuous at $(0,0)$ is

(a) 1 (correct)
(b) 0
(c) 2
(d) -1
(e) No such value exists.

5. Let

$$f(x,y) = \left(x^3 + y^3\right)^{1/3}.$$

Then $f_x(0,0) + f_y(0,0) =$

(a) 2 _____ (correct)
(b) 0
(c) 1
(d) $\frac{2}{3}$
(e) Does not exist.

6. Consider the function

$$f(x,y) = \begin{cases} \dfrac{3x^2y}{x^4+y^2}, & (x,y) \neq (0,0), \\ 0, & (x,y) = (0,0). \end{cases}$$

Which of the following statements is **FALSE**?

(a) f is differentiable at $(0,0)$. _____ (correct)
(b) $f_x(0,0)$ exists.
(c) $f_y(0,0)$ exists.
(d) $f_{xx}(0,0) = 0$.
(e) $f_y(1,0) = 3$.

7. The radius and height of a right circular cylinder are measured to be 3 cm and 10 cm, respectively. If the maximum error in each measurement is 0.10 cm, then the approximate maximum propagated error in the calculated volume is

   (a) 6.90π cm^3 (correct)

   (b) 6π cm^3

   (c) 0.90π cm^3

   (d) 2.10π cm^3

   (e) 13.80π cm^3

8. Let $w = f(x, y)$, where f is differentiable, $x = u - v$, and $y = v - u$. Then

   $$\frac{\partial w}{\partial u} + \frac{\partial w}{\partial v} =$$

   (a) 0 (correct)

   (b) 2

   (c) -1

   (d) -2

   (e) Cannot be determined without knowing f.

9. Suppose that w is defined by

$$w = \sqrt{x-y} - \sqrt{y-z}, \qquad x > y > z.$$

Then

$$\frac{\partial w}{\partial x} + \frac{\partial w}{\partial y} =$$

(a) $-\dfrac{\partial w}{\partial z}$ (correct)

(b) $\dfrac{1}{2}\dfrac{\partial w}{\partial z}$

(c) $2\dfrac{\partial w}{\partial z}$

(d) 0

(e) None of the above.

10. Consider the function

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

Which of the following statements is **TRUE**?

(a) The maximum rate of change of f is constant wherever f is differentiable. (correct)

(b) The maximum rate of change of f increases as the distance from the origin increases.

(c) The gradient of f is the same at all points on any sphere centered at the origin.

(d) The maximum rate of change of f is zero on the unit sphere.

(e) The gradient of f at every point other than the origin points toward the origin.

11. In the three-dimensional coordinate system, which of the following is/are **FALSE**?

I) Two distinct planes in space are either parallel or intersect in a line.

II) If two lines are each parallel to the same plane, then the two lines are parallel to each other.

III) If two planes are each perpendicular to a third plane, then the two planes are parallel to each other.

(a) II and III only (correct)

(b) I only

(c) II only

(d) III only

(e) I, II, and III

12. Let

$$f(x, y, z) = e^{-x} \sin(yz).$$

Then

$$f_{xy}(0, 0, 1) + f_{yx}\left(0, \frac{\pi}{2}, 2\right) =$$

(a) 1 (correct)

(b) -1

(c) 3

(d) -3

(e) 0

13. Consider the function

$$f(x, y) = x^2y + y^2 - 4y + 3.$$

At how many distinct points (x, y) are both first partial derivatives of f equal to zero?

(a) 3 _____(correct)

(b) 2

(c) Infinitely many.

(d) 4

(e) 0

14. Let $f(x, y)$ be differentiable at $(0, 0)$, and suppose its maximum directional derivative at $(0, 0)$ is 3. If

$$g(u, v) = f(2u - v, u + 2v),$$

then the maximum directional derivative of g at $(0, 0)$ is

(a) $3\sqrt{5}$ _____(correct)

(b) 3

(c) 6

(d) 15

(e) $\dfrac{3}{\sqrt{5}}$

15. The surface consisting of all points equidistant from the point $(0, 0, 3)$ and the plane $z = -1$ is

(a) an elliptic paraboloid. _____(correct)

(b) an ellipsoid.

(c) an elliptic cone.

(d) a hyperboloid of one sheet.

(e) a hyperboloid of two sheets.