MA 213 — Calculus III Fall 2017
Exam 1 September 20, 2017

Name: ____________________

Section: ____________________

Last 4 digits of student ID #: ________

- No books or notes may be used.
- Turn off all your electronic devices and do not wear ear-plugs during the exam.
- You may use a calculator, but not one which has symbolic manipulation capabilities or a QWERTY keyboard.
- Additional blank sheets for scratch work are available upon request.
- All questions are free response questions. Show all your work on the page of the problem. Clearly indicate your answer and the reasoning used to arrive at that answer. Unsupported answers may not receive credit.

Exam Scores

Do not write in the table below

Question	Score	Total
1		9
2		8
3		8
4		9
5		8
6		10
7		9
8		9
9		10
10		10
11		10
Total		100

Free Response. Show your work!

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1. (9 points) Find the center and radius of the sphere

$$2x^2 + 2y^2 + 2z^2 = 8x - 24z + 1.$$

2. (8 points) Find a unit vector parallel to $\mathbf{a} = \langle 8, -1, 4 \rangle$ and having negative first coordinate.

3. (8 points) Find a vector that is orthogonal to both $\mathbf{i} + \mathbf{j}$ and $\mathbf{i} + \mathbf{k}$.

Free Response. Show your work!

4. (9 points) Find the volume of the parallelepiped with adjacent edges PQ, PR, and PS, where

$$P = (-2, 1, 0), \quad Q = (2, 3, 2), \quad R = (5, 4, -1), \quad S = (3, 6, 1).$$

5. (8 points) Find an equation of the plane through the point $(1, -1, -1)$ and parallel to the plane

$$5x - y - z = 6.$$

Free Response. Show your work!

6. (10 points) Find an equation of the plane with x-intercept a, y-intercept b, and z-intercept c.

7. (9 points) Reduce the surface

$$9x^2 + 4z^2 = y^2 + 36$$

to one of the standard forms and classify it according to the provided table.

Free Response. Show your work!

8. (9 points) Find a vector function that represents the curve of intersection of the hyperboloid $z = x^2 - y^2$ and the cylinder $x^2 + y^2 = 1$.

9. (10 points) Find parametric equations for the tangent line to the curve

$$x = t\cos t, \quad y = t, \quad z = t\sin t$$

at the point $(-\pi, \pi, 0)$.

Free Response. Show your work!

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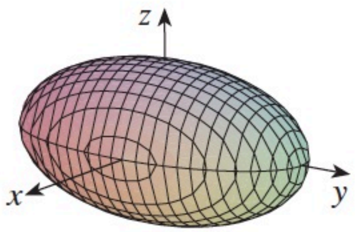
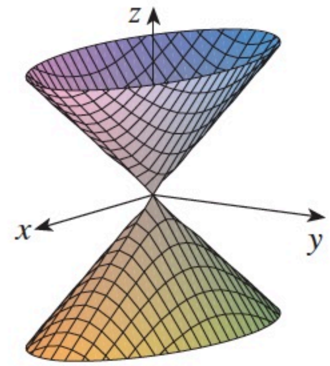
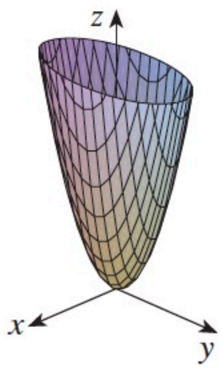
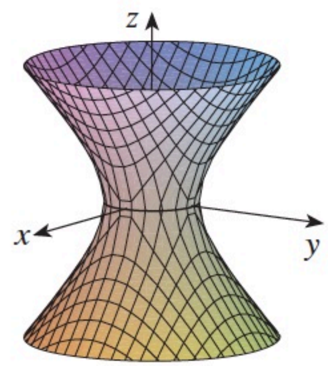
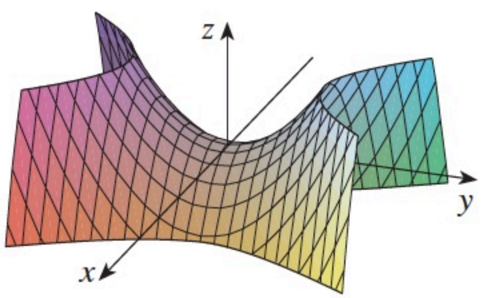
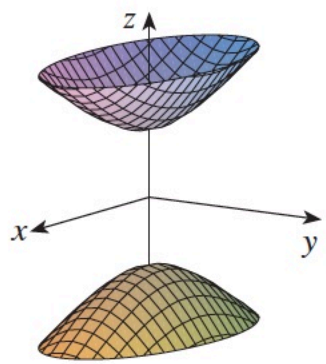
10. (10 points) Compute the curvature $\kappa(t)$ of the plane curve

$$y = 2x - x^2.$$

11. (10 points) A ball is thrown from the ground at an angle of 45° to the ground. If the ball lands 90 m away, what was the initial speed of the ball? [You may need to use the value $g = 9.8$ m/sec^2 for the acceleration due to gravity. The answer should be in m/sec.]

Surface	Equation	Surface	Equation
Ellipsoid 	$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ All traces are ellipses. If $a = b = c$, the ellipsoid is a sphere.	Cone 	$\frac{z^2}{c^2} = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ Horizontal traces are ellipses. Vertical traces in the planes $x = k$ and $y = k$ are hyperbolas if $k \neq 0$ but are pairs of lines if $k = 0$.
Elliptic Paraboloid 	$\frac{z}{c} = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ Horizontal traces are ellipses. Vertical traces are parabolas. The variable raised to the first power indicates the axis of the paraboloid.	Hyperboloid of One Sheet 	$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$ Horizontal traces are ellipses. Vertical traces are hyperbolas. The axis of symmetry corresponds to the variable whose coefficient is negative.
Hyperbolic Paraboloid 	$\frac{z}{c} = \frac{x^2}{a^2} - \frac{y^2}{b^2}$ Horizontal traces are hyperbolas. Vertical traces are parabolas. The case where $c < 0$ is illustrated.	Hyperboloid of Two Sheets 	$-\frac{x^2}{a^2} - \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ Horizontal traces in $z = k$ are ellipses if $k > c$ or $k < -c$. Vertical traces are hyperbolas. The two minus signs indicate two sheets.

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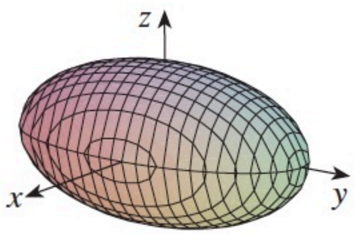
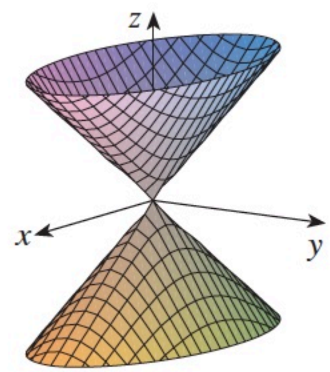
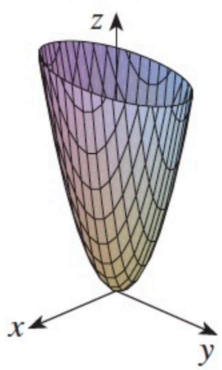
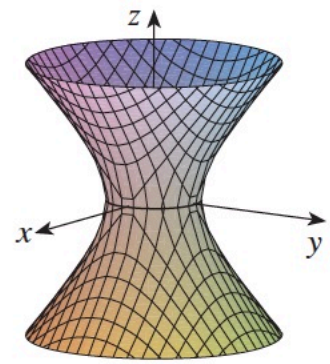
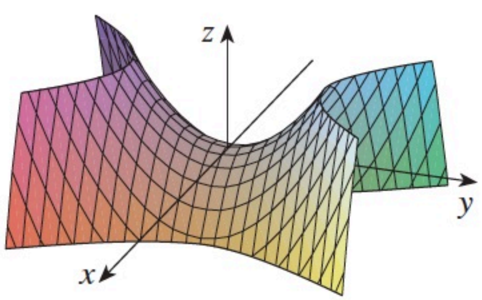
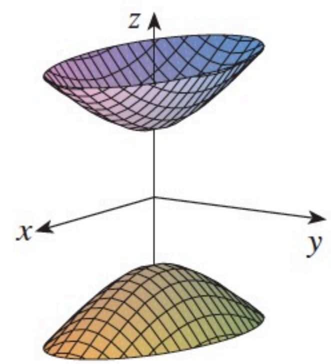
Ellipsoid 	$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ All traces are ellipses. If $a = b = c$, the ellipsoid is a sphere.	Cone 	$\frac{z^2}{c^2} = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ Horizontal traces are ellipses. Vertical traces in the planes $x = k$ and $y = k$ are hyperbolas if $k \neq 0$ but are pairs of lines if $k = 0$.
Elliptic Paraboloid 	$\frac{z}{c} = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ Horizontal traces are ellipses. Vertical traces are parabolas. The variable raised to the first power indicates the axis of the paraboloid.	Hyperboloid of One Sheet 	$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$ Horizontal traces are ellipses. Vertical traces are hyperbolas. The axis of symmetry corresponds to the variable whose coefficient is negative.
Hyperbolic Paraboloid 	$\frac{z}{c} = \frac{x^2}{a^2} - \frac{y^2}{b^2}$ Horizontal traces are hyperbolas. Vertical traces are parabolas. The case where $c < 0$ is illustrated.	Hyperboloid of Two Sheets 	$-\frac{x^2}{a^2} - \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ Horizontal traces in $z = k$ are ellipses if $k > c$ or $k < -c$. Vertical traces are hyperbolas. The two minus signs indicate two sheets.