Math 20550 - Calculus III - Summer 2014
June 20, 2014
Exam 1

Name: _____

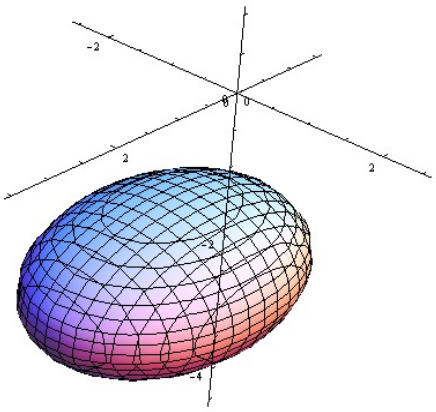
There is no need to use calculators on this exam. This exam consists of 6 problems on 7 pages. You have 50 minutes to work on the exam. There are a total of 65 available points and a perfect score on the exam is 60 points. There will be a lecture after the exam. All electronic devices should be turned off and put away. The only things you are allowed to have are: a writing utensil(s) (pencil preferred), an eraser, and an exam. No notes, books, or any other kind of aid are allowed. All answers should be given as exact, closed form numbers as opposed to decimal approximations (i.e., $\pi$ as opposed to 3.14159265358979...). You must show all of your work to receive credit. Please box your final answers. Cheating is strictly forbidden. Good luck!

**Honor Pledge:** As a member of the Notre Dame community, I will not participate in, nor tolorate academic dishonesty. My signature here binds me to the Notre Dame Honor Code:

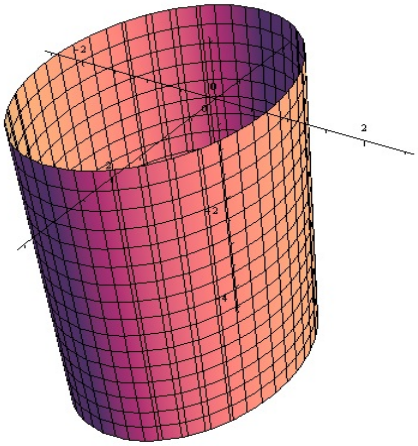
Signature:_____

| Problem | Score |
|---|---|
| 1 | /10 |
| 2 | /15 |
| 3 | /10 |
| 4 | /10 |
| 5 | /10 |
| 6 | /10 |
| Score | /60 |

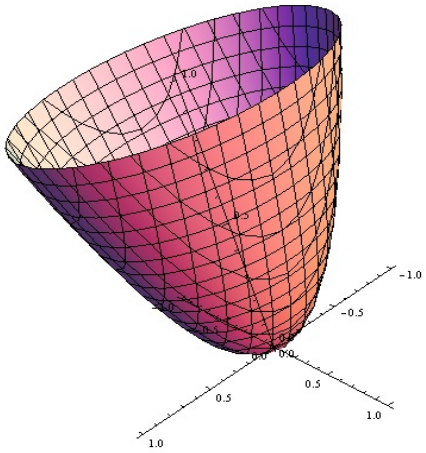
**Problem 1** (10 points - 2.5 points each)**.** *Match the equation to the surface*



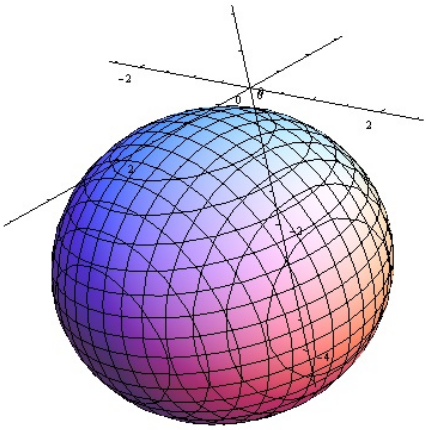
*I.*



*II.*



*III.*



*IV.*

*Write I, II, III, or IV next to the appropriate equation:*

(a) _____ $x^2 + 2y^2 - z = 0$

(b) _____ $(x-1)^2 + y^2 + (z+2)^2 = 4$

(c) _____ $(x-1)^2 + 2y^2 + 4(z+2)^2 = 4$

(d) _____ $(x-1)^2 + 2y^2 = 4$

**Problem 2** (15 points - 5 points each)**.** *Consider the two points* $P = (2, 0, 1)$ *and* $Q = (0, 1, 1)$*.*

(a) *Find an equation for the plane which contains* $Q$ *and is perpendicular to* $\overrightarrow{QP}$*.*

(b) *Find the distance from this plane to the origin.*

(c) *Give an equation for a plane which passes through* $Q$ *and is perpendicular to the plane you found in part* (a)*. (There are several correct answers. You only need to give one example.)*

**Problem 3** (10 points - 5 points each)**.**

(a) *A sphere with center* $(2, 1, 3)$ *contains a point* $(6, 1, 3)$*. Find an equation of the sphere.*

(b) *What is the intersection of this sphere with the* $yz$*-plane?*

**Problem 4** (10 points - 5 points each)**.**

(a) *Find the area of the triangle with vertices* $(0,0,0)$*,* $(1,2,3)$*, and* $(-1,1,-4)$*.*

(b) *Find the volume of the parallelepiped spanned by the vectors*

$$\mathbf{u} = \langle 3,3,2\rangle, \mathbf{v} = \langle 2,0,1\rangle, \text{ and } \mathbf{w} = \langle 0,-3,0\rangle.$$

**Problem 5** (10 points)**.** *Benjamin's Audi broke down and he needs it towed 3km down the street to the mechanic's shop. The tow truck picks up the useless Audi and the tow truck's chain makes an angle of* $60^\circ$ *with the ground. The truck tows the car using a force of 1600N. How much work does the tow truck do in moving the useless Audi down the street?*

**Problem 6** (10 points)**.** *Determine if the lines*

$$L_1 \quad : \quad x = 4t + 2, \quad y = 3, \qquad z = -t + 1$$

$$L_2 \quad : \quad x = 2s + 2, \quad y = 2s + 3, \quad z = s + 1$$

*intersect. If they do, find the point of intersection and the cosine of the angle of their intersection.*