Name:

- Start by printing your name in the above box.
- Try to answer each question on the same page as the question is asked. If needed, use the back or the next empty page for work. If you need additional paper, write your name on it.
- Do not detach pages from this exam packet or unstaple the packet.
- Please write neatly. Answers which are illegible for the grader can not be given credit.
- No notes, books, calculators, computers, or other electronic aids can be allowed.
- You have 90 minutes time to complete your work.

1		20
2		10
3		10
4		10
5		10
6		10
7		10
8		10
9		10
Total:		100

Problem 1) (20 points)

Circle for each of the 20 questions the correct letter. No justifications are needed.

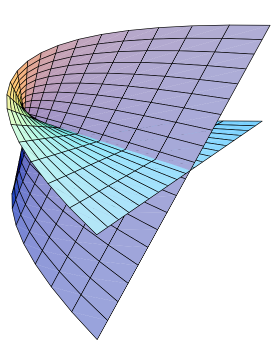
T	F	The length of the sum of two vectors is the sum of the length of the vectors.
T	F	For any three vectors, $\vec{v} \cdot (\vec{w} + \vec{u}) = \vec{w} \cdot \vec{v} + \vec{u} \cdot \vec{v}$.
T	F	The set of points which satisfy $x^2 + 2x + y^2 - z^2 = 0$ is a cone.
T	F	If P, Q, R are 3 different points in space that don't lie in a line, then $\vec{PQ} \times \vec{RQ}$ is a vector orthogonal to the plane containing P, Q, R.
T	F	The line $\vec{r}(t) = (1 + 2t, 1 + 3t, 1 + 4t)$ hits the plane $2x + 3y + 4z = 9$ at a right angle.
T	F	A surface which is given as $r = \sin(z)$ in cylindrical coordinates stays the same when we rotate it around the y axis.
T	F	For any two vectors, $\vec{v} \times \vec{w} = \vec{w} \times \vec{v}$.
T	F	If $\|\vec{v} \times \vec{w}\| = 0$ for all vectors $\vec{w}$, then $\vec{v} = \vec{0}$.
T	F	If $\vec{u}$ and $\vec{v}$ are orthogonal vectors, then $(\vec{u} \times \vec{v}) \times \vec{u}$ is parallel to $\vec{v}$.
T	F	Every vector contained in the line $\vec{r}(t) = (1 + 2t, 1 + 3t, 1 + 4t)$ is parallel to the vector $(1, 1, 1)$.
T	F	If in spherical coordinates a point is given by $(\rho, \theta, \phi) = (2, \pi/2, \pi/2)$, then its rectangular coordinates are $(x, y, z) = (0, 2, 0)$.
T	F	The set of points which satisfy $x^2 - 2y^2 - 3z^2 = 0$ form an ellipsoid.
T	F	If $\vec{v} \times \vec{w} = (0, 0, 0)$, then $\vec{v} = \vec{w}$.
T	F	The set of points in $\mathbf{R}^3$ which have distance 1 from a line form a cylinder.
T	F	If in rectangular coordinates, a point is given by $(1, 0, 1)$, then its spherical coordinates are $(\rho, \theta, \phi) = (\sqrt{2}, \pi/2, -\pi/2)$.
T	F	In spherical coordinates the equation $\cos(\theta) = \sin(\theta)$ defines the plane $x - y = 0$.
T	F	For any three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$, we always have $(\vec{a} \times \vec{b}) \cdot \vec{c} = -(\vec{a} \times \vec{c}) \cdot \vec{b}$.
T	F	The set of points in the xy-plane which satisfy $x^2 - y^2 = -1$ is a hyperbola.
T	F	If $\|\vec{v} \times \vec{w}\| = 0$ then $\vec{v} = 0$ or $\vec{w} = 0$.
T	F	Two nonzero vectors are parallel if and only if their cross product is $\vec{0}$.

Space for work

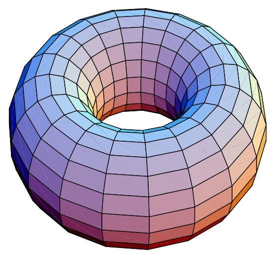
Problem 2) (10 points)

Match the surfaces with their parameterization $\vec{r}(u,v)$ or equation $g(x,y,z) = 0$. Note that one of the surfaces is not represented by a formula. No justifications are needed.

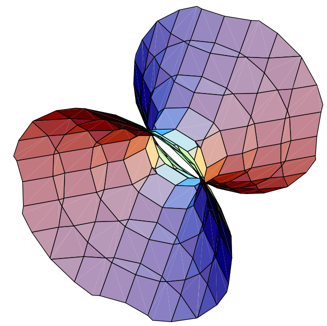
I



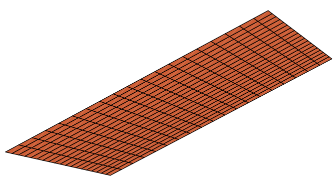
II



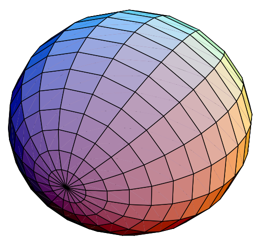
III



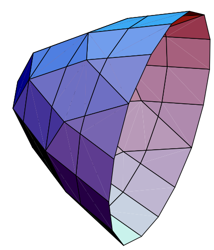
IV



V



VI

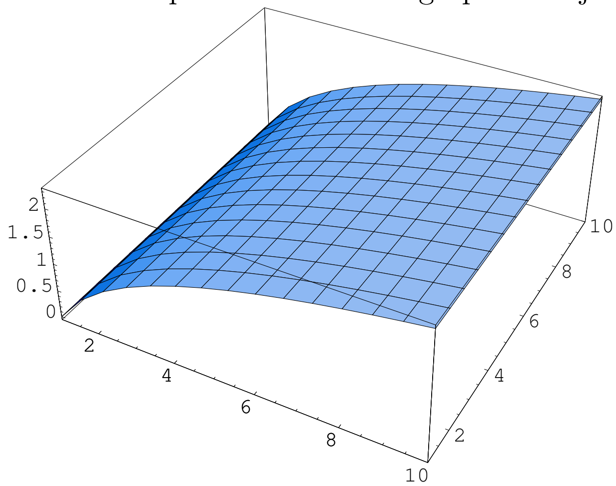


Enter I,II,III,IV,V,VI here	Equation or Parameterization
	$\vec{r}(u,v) = ((1+\sin(u))\cos(v), (1+\sin(u))\sin(v), \cos(u))$
	$\vec{r}(u,v) = (v, v-u, u+v)$
	$\vec{r}(u,v) = (u^2, vu, v)$
	$x^2 - y^2 + z^2 - 1 = 0$
	$\vec{r}(u,v) = (\cos(u)\sin(v), \cos(v), \sin(u)\sin(v))$

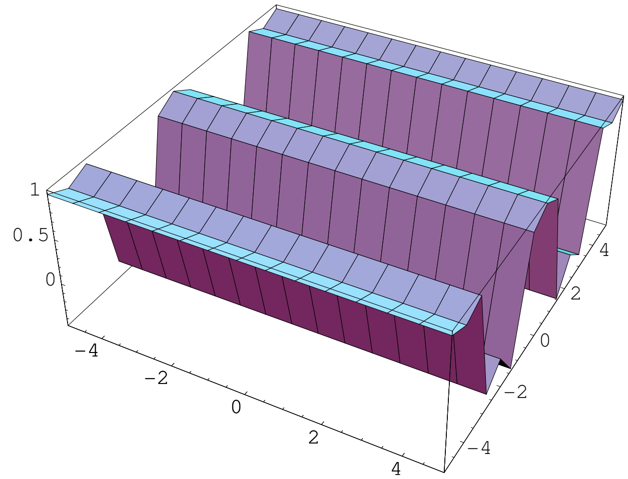
Space for work

Problem 3) (10 points)

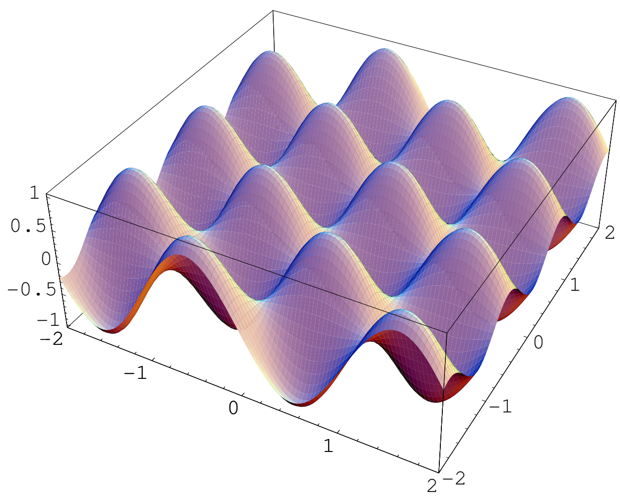
Match the equation with their graphs and justify briefly your choice.



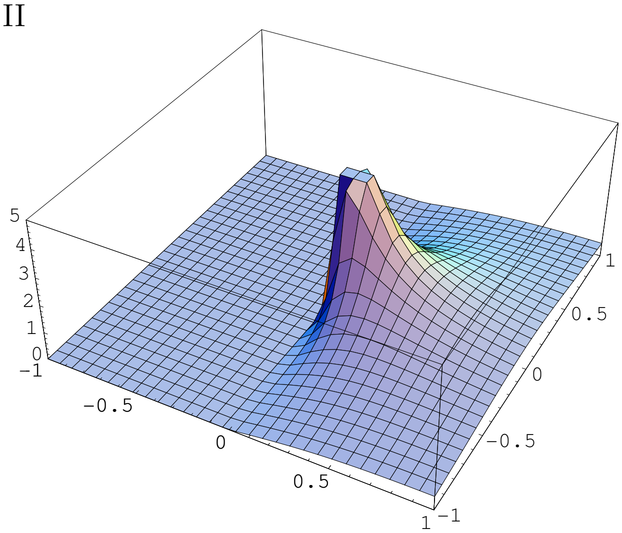
I



II



III



IV

Enter I,II,III,IV here	Equation	Short Justification
	$z = \sin(3x)\cos(5y)$	
	$z = \cos(y^2)$	
	$z = \log(x)$	
	$z = x/(x^2 + y^2)$	

Space for work

Problem 4) Distances (10 points)

Let L be the line

$$x = 1 + 2t, y = -3t, z = t$$

and let S be the plane $x + y + z = 2$.

a) Verify that L and S have no intersections.
b) Compute the distance between the line L and plane S.
Hint. Just take any point P on the line and compute the distance from the line to the plane.

Space for work

Problem 5) (10 points)

Let $\vec{a}$ and $\vec{b}$ be two vectors in $\mathbf{R}^3$. Assume that the length of $\vec{a} \times \vec{b}$ is equal to 10. What is the length of $(\vec{a}+\vec{b}) \times (\vec{a}-\vec{b})$?

Space for work

Problem 6) (10 points)

Find the distance between the two lines

$$\vec{r}_1(t) = (t, 2t, -t)$$

and

$$\vec{r}_2(t) = (1 + t, t, t) .$$

Space for work

Problem 7) (10 points)

Given the vectors $v = (1, 1, 0)$ and $w = (0, 0, 1)$ and the point $P = (2, 4, -2)$. Let Σ be the plane which goes through the origin and contains the vectors v and w.

a) Determine the distance from P to the origin.

b) Determine the distance from P to the plane Σ.

Space for work

Problem 8) (10 points)

a) (6 points) Find a parameterization of the line of intersection of the planes $3x - 2y + z = 7$ and $x + 2y + 3z = -3$.

b) (4 points) Find the symmetric equations

$$\frac{x - x_0}{a} = \frac{y - y_0}{b} = \frac{z - z_0}{c}$$

representing that line.

Space for work

Problem 9) (10 points)

Let S be the surface given in cylindrical coordinates as $r = 2 + \sin(z)$.

(10 points) Find a parameterization

$$\vec{r}(u,v) = (x(u,v), y(u,v), z(u,v))$$

of the surface and sketch the surface.

Space for work