HOMEWORK 1 **MATH 200** **NAME:**

DIRECTIONS:

- Attach this page to the front of your homework (don't forget your name!).
- Please read article "A Guide to Writing Mathematics" by Dr. K. P. Lee which can be found on the class website, homework page. Note, homeworks in this course may be handwritten unless otherwise states.
- Show all work, clearly and in order.
- When required, **do not forget the units**!
- Circle your final answers. **You will loose points if you do not circle your answers**.

Question	Points	Score
1	1	
2	2	
3	3	
4	2	
5	2	
Total	10	

Problem 1: (1 points) After reading "A Guide to Writing Mathematic" by Dr. K. P. Lee, list five items pertaining to writing math of which you were previously unaware.

Answers will vary.

Problem 2: (2 points) How should writing homework solutions differ from writing reports? How should they be similar? List 5 points each.

Answers will vary.

Problem 3: (3 points) Let $\mathbf{u} = 15\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$ and $\mathbf{v} = \pi\mathbf{i} + 3\mathbf{j} - \mathbf{k}$.

(a) (1 points) Find $||\mathbf{u}||$ and $||\mathbf{v}||$.

The norms $||\mathbf{u}|| = 7\sqrt{5}$ and $||\mathbf{v}|| = \sqrt{10 + \pi^2}$.

(b) (2 points) Find the orthogonal projection of $\mathbf{u}$ onto $\mathbf{v}$.

The orthogonal projection $\mathbf{p}$ is given by

$$\mathbf{p} = \frac{\mathbf{v} \cdot \mathbf{u}}{||\mathbf{v}||^2}\mathbf{v} = \frac{5(3\pi - 2)}{\pi^2 + 10}(\pi\mathbf{i} + 3\mathbf{j} - \mathbf{k}).$$

Problem 4: (2 points) Suppose a 2 kg object is sliding down a ramp having a 30 degree incline with the horizontal. Neglecting friction, gravity is the only force acting on the gravity. What is the component of the gravitational force in the direction of the of the motion of the object.

Suppose the vector $\mathbf{a}$ is in the direction of movement of the block (i.e. points along the ramp) and $\mathbf{F}$ is the gravitational force vector. Let $\mathbf{a} = a_1\mathbf{i} + a_2\mathbf{j}$. What we really want to know here is the size of the projection of $\mathbf{F}$ onto $\mathbf{a}$. From trigonometry,

$$a_1 = -||\mathbf{a}||cos(30) \text{ and } a_2 = -||\mathbf{a}||sin(30).$$

Since we are only interested in the direction of $\mathbf{a}$ let us assume $||\mathbf{a}|| = 1$, so

$$\mathbf{a} = -\frac{\sqrt{3}}{2}\mathbf{i} - \frac{1}{2}\mathbf{j}.$$

Since the gravitational constant is $g = 9.8\text{m/s}^2$, we have $\mathbf{F} = -2\text{kg} \cdot g\mathbf{j} = -19.6\text{kg}\mathbf{j}$. Hence $\text{proj}_{\mathbf{a}}\mathbf{F} = 9.8\text{N}\left(-\frac{\sqrt{3}}{2}\mathbf{i} - \frac{1}{2}\mathbf{j}\right)$. So the answer we are seeking is

$$||\text{proj}_{\mathbf{a}}\mathbf{F}|| = 9.8\text{N}.$$

Problem 5: (2 points) Show that the two planes given by $Ax+By+Cz+D_1 = 0$ and $Ax+By+Cz+D_2 = 0$ are parallel, and that the distance between them is

$$\frac{|D_1 - D_2|}{\sqrt{A^2 + B^2 + C^2}}.$$

Clearly the two planes are parallel since a normal for both planes is given by $\mathbf{n} = A\mathbf{i}+B\mathbf{j}+C\mathbf{k}$. The distance between two parallel planes is given by

$$D = ||\text{proj}_{\mathbf{n}}\bar{P_1P_2}||.$$

Let $\Pi_1 : \quad Ax + By + Cz + D_1 = 0$ and $\Pi_2 : \quad Ax + By + Cz + D_2 = 0$ and let P_1 and P_2 be on Π_1 and Π_2 respectively. Then points on Π_i are given by $\left(0, 0, -\frac{D_i}{C}\right)$ (if $C = 0$, then either A or B must be nonzero and use $\left(-\frac{D_i}{A}, 0, 0\right)$ or $\left(0, -\frac{D_i}{B}, 0, 0\right)$). Simple arithmetic yields

$$\frac{|D_1 - D_2|}{\sqrt{A^2 + B^2 + C^2}}.$$