General instructions: give exact answers to all problems unless otherwise noted. Simplify all answers completely.

Math& 163 Big List of Homework, part one.

A. See the syllabus for this homework.

B. 12.1. Recommended textbook problems: 1, 3, 4, 5, 7, 10, 12, 14, 15, 17, 21, 23, 29, 33, 34, 35. (40 is a good challenge problem for people with too much time on their hands.) Turn in:

1. Describe in words the set of points in space satisfying $x^2 + y^2 + z^2 = 1$, $z \leq 0$.
2. Do the points P(2, 4, 2), Q(3, 7, -2), and R(1, 1, 3) lie on a straight line? If not, find a z-coordinate for point R such that they do lie all on a straight line. (Hint: think about the projections onto the xy-, xz-, and yz- planes.)
3. Find the equation of the sphere with center (1, -4, 3) and radius 5. Find the equation of the intersection of this sphere with the xz-plane.
4. Describe in words, and find an equation for, the set of points in space that are equidistant from the origin and from the point (0,2,0).
5. Find an equation for the set of points in space that are both a distance of two units from the point (0,0,1) *and* a distance of two units from the point (0, 0, -1).

C. 12.2. Recommended textbook problems: 3, 4, 9, 11, 13, 15, 17, 19, 21 (exact values for the components, please), 23 (exact values, please), 24 (exact values), 25 (exact values), 35, 36. Turn in:

1. Give an example of three nonzero vectors **u**, **v**, and **w** such that their sum is equal to **0**. (give your answers in component form. Your vectors may exist in whatever number of dimensions you like.)
2. Find a unit vector that has the same direction as $2\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$.
3. If **w** lies in the second quadrant and makes an angle of $\frac{5\pi}{6}$ with the positive x-axis, and $|\mathbf{w}| = 10$, express **w** in component form.
4. Find the magnitude and direction of $\mathbf{v} = \dfrac{12}{7}\mathbf{i} - \dfrac{4}{7}\mathbf{j} + \dfrac{6}{7}\mathbf{k}$.
5. Recall that, as described in class, a vector **v** can be expressed as the product of its length, $|\mathbf{v}|$, and its direction, $\dfrac{\mathbf{v}}{|\mathbf{v}|}$. Express the vector $\dfrac{\mathbf{i}}{\sqrt{6}} - \dfrac{\mathbf{j}}{\sqrt{6}} - \dfrac{\mathbf{k}}{\sqrt{6}}$ in this way.

D. 12.3. Recommended textbook problems: 1, 3, 5, 6, 8, 9, 14, 15, 19, 22, 23, 26, 27, 28, 31, 34, 37, 39, 40, 43. Turn in:

1. Suppose vectors **a** and **b** are orthogonal. What is the scalar component of the projection of **a** onto **b**? (You don't need to show any work for this.)
2. A gun with muzzle velocity of 1200 ft/sec is fired at an angle of eight degrees above the horizontal. Find the horizontal and vertical components of the velocity.
3. If $\mathbf{v} = \langle 3, 0, -5 \rangle$, fnid a vector **w** such that $\text{comp}_{\mathbf{v}}\mathbf{w} = 2$.
4. Find the angle between the vectors $\mathbf{u} = 2\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ and $\mathbf{v} = 3\mathbf{i} + 4\mathbf{k}$ to the nearest hundredth of a radian.
5. Find the vector projection of $\mathbf{v} = 8\mathbf{i} + 4\mathbf{j} - 12\mathbf{k}$ onto $\mathbf{w} = \mathbf{i} + 2\mathbf{j} - \mathbf{k}$.

E. 12.4. Recommended textbook problems: 2, 5, 13, 14, 19, 20, 27, 32, 43 (remember this result from problem 43, it can be VERY useful). Turn in:

1. Do problem 43 from section 12.4 in your textbook. This result is VERY useful.

2. For each of the following, which are *always true* and which are *not* always true? Give reasons.

   (a) $|\mathbf{u}| = \sqrt{\mathbf{u} \cdot \mathbf{u}}$

   (b) $\mathbf{u} \times \mathbf{0} = \mathbf{0} \times \mathbf{u} = \mathbf{0}$

   (c) $\mathbf{u} \times -\mathbf{u} = \mathbf{0}$

   (d) $\mathbf{u} \times \mathbf{v} = \mathbf{v} \times \mathbf{u}$

   (e) $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{v} = 0$

   (f) $\mathbf{u} \cdot \mathbf{v} = \mathbf{v} \cdot \mathbf{u}$

   (g) $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{u} = \mathbf{v} \cdot (\mathbf{u} \times \mathbf{v})$

F. 12.5. Recommended textbook problems: 2, 4, 5, 7, 9, 12, 19, 21, 22, 23, 27, 31, 32, 35, 44, 56, 62, 66, 67
Turn in:

1. Find an equation for the plane through (1, -1, 3) parallel to the plane $3x + y + z = 7$.

2. Find a parametric equation for the line through (2, 4, 5) perpendicular to the plane $3x + 7y - 5z = 21$.

3. Use the formula from problem 43 in section 12.4 to determine the distance from the point (0,1,3) to the line given by the parametric equations $x = 2t$, $y = 6 - 2t$, $z = 3 + t$.