Exam 1 Name:____________________

Math 202 F01 10/03/12

1. (15 pts.–5 pts. each) A plane is given by the equation $3x - 2y + 5z = 1$.

   (a) Give an equation for the parallel plane through the point $(3, 1, 2)$.

   (b) Give a parameterization of the line through the point $(3, 1, 2)$ that is orthogonal to the plane.

   (c) What is the angle between this plane and the xz-coordinate plane? (Your answer may involve an inverse trigonometric function.)

2. (14 pts.–7 pts. each) Due to gravity, an object that weighs 5 N slides down a straight frictionless ramp from the point $(0, 0, 10)$ m to the point $(0, 30, 0)$ m.

   (a) How much work was done by gravity? (Include appropriate units in your answer.)

(b) Give a vector describing a force along the ramp that would have prevented the object from moving.

3. (20 pts.–5 pts. each)Roughly sketch the following surfaces in 3-d, given by equations in various coordinate systems. Include the x-,y-, and z-axes in each sketch.

   (a) $\phi = \frac{3\pi}{4}$

   (b) $\theta = \frac{\pi}{2}$

   (c) $y^2 - z = 0$

   (d) $z = x^2 - y^2$

4. (14 pts.) An object moves through space with acceleration vector $\mathbf{a}(t) = \langle t, \pi \sin(\pi t), -2 \rangle \; m/sec^2$. At time $t = 0$, its velocity is $\mathbf{v}(0) = \langle 0, 0, 4 \rangle$.

   (a) (7 pts.) Find the object's velocity $\mathbf{v}(t)$, as a function of time.

   (b) (3 pts.) What is the object's speed at time $t = 1$?

   (c) (4 pts.) Give an integral for the total distance the object travels between time $t = 0$ and $t = 4$. (Do not evaluate the integral, but leave it in a form where only single-variable calculus is needed to understand it.)

5. (11 pts.) Find the distance between the point $(2, 3, 0)$ and the plane $x + y + z = 1$.

6. (12 pts.–6 pts. each) Consider the 3 vectors

$$\mathbf{a} = \langle 1, 1, 0\rangle,$$
$$\mathbf{b} = \langle 2, 1, 1\rangle,$$
$$\mathbf{c} = \langle 1, 0, 5\rangle.$$

(a) Compute $\mathbf{b} \times \mathbf{c}$, and state the geometric meaning of what you have computed.

(b) Compute $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$ and state the geometric meaning of what you have computed.

7. (14 pts.) Consider the parameterized path $\mathbf{r}(t) = \ln t\,\mathbf{i} + (t + 2)\,\mathbf{j}$.

(a) (6 pts.) Compute the unit tangent vector $\mathbf{T}(t)$.

(b) (6 pts.) Compute the unit normal vector $\mathbf{N}(t)$.

(c) (2 pts.) What does $\mathbf{N}(t)$ tell us about an object following the path?