

MATH 213 – 19 FEBRUARY 2008 – EXAM 1

Answer each of the following questions. Show all work, as partial credit may be given.

1. (5 pts. each) Let $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$, $\mathbf{b} = 3\mathbf{i} + 5\mathbf{j} - 4\mathbf{k}$, and $\mathbf{c} = \mathbf{i} + \mathbf{j} - 3\mathbf{k}$.
 - (a) Find the cosine of the angle between \mathbf{a} and \mathbf{b} .
 - (b) Write the vector \mathbf{a} as the product of its magnitude and its direction.
 - (c) $\mathbf{a} \times \mathbf{b}$
 - (d) $\text{proj}_{\mathbf{a}}(\mathbf{b})$
 - (e) Write the vector \mathbf{b} as the sum of a vector parallel to \mathbf{a} and a vector perpendicular to \mathbf{a} .
 - (f) Find the area of the parallelogram determined by the vectors \mathbf{a} and \mathbf{b} .
 - (g) Find the volume of the box determined by the vectors \mathbf{a} , \mathbf{b} and \mathbf{c} .
 - (h) Find parametric equations of the line parallel to \mathbf{a} and containing the point $(6, 5, -1)$.
 - (i) Find an equation for the plane perpendicular to \mathbf{a} and containing the point $(6, 5, -1)$.

2. (8 pts. each) A projectile is fired from ground level with an initial speed of 500 meters per second at an angle of elevation of 30 degrees.
 - (a) Find the maximum height of the projectile.
 - (b) When and how far away will the projectile strike the ground?

3. (8 pts. each) Consider the vector-valued function $\mathbf{r}(t) = t\mathbf{i} + (1/3)t^{3/2}\mathbf{j} + t\mathbf{k}$.
 - (a) Find $\mathbf{r}'(t)$, $\mathbf{r}''(t)$, $|\mathbf{r}'(t)|$, and $\mathbf{T}(t)$ (the unit tangent vector).
 - (b) Find the arclength of the above curve for $0 \leq t \leq 4$.

4. (8 pts. each) Let $A = (2, 4, 5)$, $B = (0, 0, 1)$ and $C = (3, -1, 2)$.
 - (a) Find an equation for the plane containing the points A , B , and C . Put your answer in the form $Ax + By + Cz = D$.
 - (b) Find parametric equations for the line that contains the points B and C .
 - (c) Find the distance from the point A to the line you found in part (b).