

## Exam 1 Preparation

The following formulæ will be provided on your exam:

$$\mathbf{a} \cdot \mathbf{b} = a_1b_1 + a_2b_2 + a_3b_3 \quad \mathbf{a} \times \mathbf{b} = \langle a_2b_3 - a_3b_2, a_3b_1 - a_1b_3, a_1b_2 - a_2b_1 \rangle$$
$$|\mathbf{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2}.$$

Everything else must be committed to memory.

Looking over your homework assignments, I have seen questions of the following types; You should be prepared to answer at least all these questions:

1. What's the difference between a scalar and a vector?
2. Which operations yield scalars, and which vectors?
3. Given  $\mathbf{v}$  find  $|\mathbf{v}|$ .
4. Given  $\mathbf{v}$  find a unit length vector in the same direction as  $\mathbf{v}$ .
5. Given  $\mathbf{a}$ ,  $\mathbf{b}$  find  $\mathbf{a} \cdot \mathbf{b}$ .
6. Given  $\mathbf{a}$ ,  $\mathbf{b}$  find  $\mathbf{a} \times \mathbf{b}$ .
7. Given  $\mathbf{a}$ ,  $\mathbf{b}$  find  $|\mathbf{a} \times \mathbf{b}|$ .
8. Given  $\mathbf{a}$ ,  $\mathbf{b}$  find the angle subtended by the two vectors.
9. Given  $\mathbf{a}$ ,  $\mathbf{b}$  find the projection of  $\mathbf{a}$  onto  $\mathbf{b}$ .
10. Given  $\mathbf{a}$ ,  $\mathbf{b}$  find a unit vector orthogonal to  $\mathbf{a}$  and  $\mathbf{b}$ .
11. Given point  $P$ , and  $\mathbf{v}$ , find a parametrization of the line through  $P$  and parallel to  $\mathbf{v}$ .
12. Given the parametrization of two lines, determine if they are parallel.
13. Given point  $P$ , and  $\mathbf{n}$ , find the equation of the plane containing  $P$  and normal to  $\mathbf{n}$ .
14. Given points  $P, Q, R$ , find the equation of the plane containing all three points.
15. Given points  $P, Q, R$ , find the area of the triangle  $\Delta PQR$ .
16. Given point  $P$ , and the equation of a line, find the distance from the  $P$  to the line.
17. Given point  $P$ , and the equation of a line, find the point on the line closest to  $P$ .
18. Given point  $P$ , and the equation of a plane, find the distance from the  $P$  to the plane.
19. Given point  $P$ , and the equation of a plane, find the point on the plane closest to  $P$ .
20. Given parametrizations of two lines, find the angle subtended by the lines.
21. Given equations of two planes, find the angle subtended by the planes.
22. Given vector valued function,  $\mathbf{R}(t)$ , find  $\lim_{t \rightarrow a} \mathbf{R}(t)$ .
23. What defines a continuous vector valued function?
24. Given vector valued function,  $\mathbf{R}(t)$ , find  $\mathbf{R}'(t)$ .
25. What are the product rules for the vector derivative? *e.g.*, what is  $\frac{d}{dt} [\mathbf{R}(t) \times \mathbf{Q}(t)]$ ?
26. Given vector valued function,  $\mathbf{R}(t)$ , find the unit tangent vector,  $\mathbf{T}(t)$ .
27. Given vector valued function,  $\mathbf{R}(t)$ , find  $\int_a^b \mathbf{R}(t) dt$ .
28. Given two curves, parametrized by  $\mathbf{R}(t)$ ,  $\mathbf{Q}(t)$ , determine if the curves intersect. If so, find the point of intersection.
29. What characterizes a smooth curve?
30. Find the arc length of a curve parametrized by  $\mathbf{R}(t)$  for  $a \leq t \leq b$ .