

Vectors and Calculus Exam Review Concepts Checklist

Vectors

- How do you determine the angle between two vectors?
 - Tail to tail
 - When determining a resultant vector the angle used in the cos law calculation isn't necessarily the angle between the vectors
- The vectors \vec{i} , \vec{j} and \vec{k} are unit vectors along the x, y and z axes respectively
- In velocity questions, the resultant velocity is different than the component velocity vectors. (same holds true for forces)
- Equilibrium of forces
- Dot product using either component method or formula
 - Useful for finding the angle between two vectors in two dimensions or three dimensions

6. The scalar projection of \vec{a} on \vec{b} is $\frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$

7. The vector projection of \vec{a} on \vec{b} is $\left(\frac{\vec{a} \cdot \vec{b}}{\vec{b} \cdot \vec{b}} \right) \vec{b}$, $\vec{b} \neq \vec{0}$

8. If α , β , and γ are the angles that \vec{OP} makes with the positive x-axis, y-axis and z-axis, respectively, then

$$\cos \alpha = \frac{a}{\sqrt{a^2 + b^2 + c^2}}; \cos \beta = \frac{b}{\sqrt{a^2 + b^2 + c^2}}; \cos \gamma = \frac{c}{\sqrt{a^2 + b^2 + c^2}}$$

9. Cross product gives you a vector perpendicular to each of two other vectors in three dimensions
10. Work is measured as $W = \vec{f} \cdot \vec{s}$ where \vec{f} is the force acting on an object, measured in newtons (N); \vec{s} is the displacement of the object, measured in metres (m); and W is the work done, measured in joules (J).
11. The torque of the force \vec{f} about the point M is defined to be the vector $\vec{r} \times \vec{f}$.
12. The area of a parallelogram defined by the vectors \vec{a} and \vec{b} is given by $\text{Area} = |\vec{a} \times \vec{b}|$; the area of a triangle is half of that
13. Vector, Parametric, Symmetric equations of a line in 3 dimensions
 - Angle between them is angle between the direction vectors
 - 4 different ways that two lines can or not intersect
14. Vector, parametric and Cartesian equations of a plane
 - Angle between them is angle between the normal vectors; normal vector is the vector perpendicular to the surface of the plane
 - Normal vector gives the coefficients of the Cartesian equation of a plane
 - Three ways that two planes can or not intersect
 - Eight ways that three planes can or not intersect
15. Three ways that a line can or not intersect with a plane

18. How to find the points on each of two skew lines that determine the minimum distance between the two lines

20. Solving two equations with two variables or three equations with three variables using matrices.

21. Three ways that two planes may or may not intersect (two non-parallel planes will intersect along a line; know how to determine the equation of that line; you might use matrices for this)
22. Eight ways that three planes may or may not intersect

Calculus

1. Evaluating Limits graphically and algebraically
 - a) One sided limits
 - b) Limits as x approaches infinity
 - c) Numerous methods for evaluating limits of indeterminate form
2. Continuity at an x -value; function value exists, limit exists, they equal each other
3. Derivatives, evaluating from first principles
 - a) Power rule
 - b) Product rule
 - c) Quotient rule
 - d) Chain rule
 - e) Implicit differentiation
 - f) Trig differentiation
 - g) Exponential derivatives
 - h) Logarithmic differentiation
4. Displacement, velocity, acceleration
5. Optimization over an interval
 - a) Set derivative to zero, solve, plug into function
 - b) Plug in function end point values
6. Optimization word problems (using any of the many types of differentiation listed above)
7. Graphing
 - a) Intervals of increase and decrease
 - b) Maximum and minimum points
 - Occur at critical values of x , or critical points, points where the derivative is zero or undefined
 - c) Points of inflection and intervals of concavity
 - d) Horizontal and vertical asymptotes
 - e) Oblique asymptotes
 - f) Algorithm on page 207