

Calculus 3, Chapter 13 Study Guide

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The following is a *brief* list of topics covered in Chapter 13 of *Thomas' Calculus*. Test questions will be chosen directly from the text. This list is not meant to be comprehensive, but only gives a list of several important topics. I reserve the right to ask you definitions and theorems on the tests. If I do so, then I will choose from the **bold-faced** items below.

13.1 Curves in Space and Their Tangents. Parametrized curves in 3-D, position vector, **definition of limit of a vector function** $\lim_{t \rightarrow t_0} \mathbf{r}(t) = \mathbf{L}$, **definition of a continuous vector function**, **definition of derivative of a vector function**, smooth vector function, tangent line to a 3-D curve, velocity vector, direction of motion, speed, acceleration vector, differentiation rules for vector functions, **proof of Dot Product Rule**, **proof of Cross Product Rule**.

13.2 Integrals of Vector Functions; Projectile Motion. Antiderivative/indefinite integral/definite integral of a vector function (the similarities and differences of these three things), trajectories where the only force is the force of gravity, launch angle, maximum height, flight time, range.

13.3 Arc Length in Space. Length of a smooth curve, arc length parameter, unit tangent vector \mathbf{T} .

13.4 Curvature and Normal Vectors of a Curve. Curvature κ , computation of curvature in terms of t , principal unit normal vector \mathbf{N} , computation of \mathbf{N} in terms of t , circle of curvature/osculating circle, radius of curvature, center of curvature.

13.5 Tangential and Normal Components of Acceleration. Unit binormal vector \mathbf{B} , Frenet frame/TNB frame, tangential and normal scalar components of acceleration (a_T and a_N), torsion and formulae for torsion.

13.6 Velocity and Acceleration in Polar Coordinates. Vectors \mathbf{u}_r and \mathbf{u}_θ , velocity and acceleration in terms of \mathbf{u}_r and \mathbf{u}_θ , cylindrical coordinates, Newton's Law of Gravitation, Newton's Second Law of Motion, Kepler's First Law of

Planetary Motion, Kepler's Second Law of Planetary Motion, Kepler's Third Law of Planetary Motion, Conservation of Angular Momentum (page 764, number 10).