

**MITES 2010 ADVANCED CALCULUS
FORMULA SHEET FOR THE MIDTERM**

WEDNESDAY, JULY 7TH

$$\begin{aligned} \sin 2x &= 2 \sin x \cos x & \cos^2 x &= \frac{1}{2}(1 + \cos 2x) & \sin^2 x + \cos^2 x &= 1 \\ \cos 2x &= \cos^2 x - \sin^2 x & \sin^2 x &= \frac{1}{2}(1 - \cos 2x) & \tan^2 x &= \sec^2 x - 1 \end{aligned}$$

arc length for a curve $y = f(x)$:

$$\int_a^b \sqrt{1 + f'(x)^2} dx$$

arc length for a parametric curve $c(t) = (x(t), y(t))$:

$$\int_a^b \sqrt{x'(t)^2 + y'(t)^2} dt$$

arc length for a polar curve $r = f(\theta)$:

$$\int_\alpha^\beta \sqrt{f(\theta)^2 + f'(\theta)^2} d\theta$$

area for a polar curve $r = f(\theta)$:

$$\int_\alpha^\beta \frac{1}{2} f(\theta)^2 d\theta$$

dot product:

$$\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3 = \|\mathbf{a}\| \|\mathbf{b}\| \cos \theta$$

cross product:

$$\mathbf{a} \times \mathbf{b} = (a_2 b_3 - a_3 b_2, a_3 b_1 - a_1 b_3, a_1 b_2 - a_2 b_1)$$

$$\|\mathbf{a} \times \mathbf{b}\| = \|\mathbf{a}\| \|\mathbf{b}\| \sin \theta$$

equation of a plane:

$$(\mathbf{x} - \mathbf{x}_0) \cdot \mathbf{n} = 0$$

discriminant:

$$D = \frac{\partial^2 f}{\partial^2 x} \frac{\partial^2 f}{\partial^2 y} - \left(\frac{\partial^2 f}{\partial x \partial y} \right)^2$$

second derivative test:

- if $D > 0$ and $\frac{\partial^2 f}{\partial^2 x} > 0$, then local minimum
 - if $D > 0$ and $\frac{\partial^2 f}{\partial^2 x} < 0$, then local maximum
 - if $D < 0$, then saddle point
 - if $D = 0$, then the test is inconclusive
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