Derivatives

$\frac{d}{dx}e^x = e^x$
$\frac{d}{dx}\sin(x) = \cos(x)$
$\frac{d}{dx}\cos(x) = -\sin(x)$
$\frac{d}{dx}\tan(x) = \sec^2(x)$
$\frac{d}{dx}\cot(x) = -\csc^2(x)$
$\frac{d}{dx}\sec(x) = \sec(x)\tan(x)$
$\frac{d}{dx}\csc(x) = -\csc(x)\cot(x)$
$\frac{d}{dx}\sin^{-1} = \frac{1}{\sqrt{1-x^2}}, x \in [-1,1]$
$\frac{d}{dx}\cos^{-1} = \frac{-1}{\sqrt{1-x^2}}, x \in [-1,1]$
$\frac{d}{dx}\tan^{-1} = \frac{1}{1+x^2}, \frac{-\pi}{2} \leq x \leq \frac{\pi}{2}$
$\frac{d}{dx}\sec^{-1} = \frac{1}{|x|\sqrt{x^2-1}}, |x| > 1$
$\frac{d}{dx}\sinh(x) = \cosh(x)$
$\frac{d}{dx}\cosh(x) = \sinh(x)$
$\frac{d}{dx}\tanh(x) = sech^2(x)$
$\frac{d}{dx}\coth(x) = -csch^2(x)$
$\frac{d}{dx}sech(x) = -sech(x)\tanh(x)$
$\frac{d}{dx}csch(x) = -csch(x)\coth(x)$
$\frac{d}{dx}\sinh^{-1} = \frac{1}{\sqrt{x^2+1}}$
$\frac{d}{dx}\cosh^{-1} = \frac{-1}{\sqrt{x^2-1}}, x > 1$
$\frac{d}{dx}\tanh^{-1} = \frac{1}{1-x^2}\ -1 < x < 1$
$\frac{d}{dx}sech^{-1} = \frac{1}{x\sqrt{1-x^2}}, 0 < x < 1$
$\frac{d}{dx}\ln(x) = \frac{1}{x}$
$\frac{d}{dx}b^x = b^x \ln x$

Integrals

$\int \sin(x)dx = -\cos(x)$
$\int \cos(x)dx = \sin(x)$
$\int \tan(x)dx = -\ln|\cos(x)|$
$\int \sec x \tan x dx = \sec x$
$\int \sec x dx = \ln|\sec x + \tan x|$
$\int \sec^2(x)dx = \tan(x) + C$
$\int \sec^3(x)dx = \frac{1}{2}(\sec x \tan x + \ln|\sec x \tan x|)$
$\int \csc^2(x)dx = -\cot(x)$
$\int \csc(x)\cot(x)dx = -\csc(x)$
$\int \csc(x)dx = \ln|\csc(x) - \cot(x)|$
$\int \cot(x)dx = \ln|\sin(x)|$
$\int \frac{1}{x}dx = \ln|x|$
$\int e^x dx = e^x$
$\int a^x dx = \frac{1}{\ln a}a^x$
$\int e^{ax}dx = \frac{1}{a}e^{ax}$
$\int \frac{1}{\sqrt{a^2-x^2}}dx = \sin^{-1}(\frac{x}{a})$
$\int \frac{1}{a^2+x^2}dx = \frac{1}{a}\tan^{-1}(\frac{x}{a})$
$\int \frac{1}{x^2-a^2}dx = \frac{1}{2a}\ln|\frac{x-a}{x+a}|$
$\int \frac{1}{\sqrt{x^2 \pm a^2}}dx = \ln|x + \sqrt{x^2 \pm a^2}|$
$\int \frac{1}{x\sqrt{x^2-1}}dx = \sec^{-1}(x)$
$\int \sinh(x)dx = \cosh(x)$
$\int \cosh(x)dx = \sinh(x)$
$\int \tanh(x)dx = \ln|\cosh(x)|$
$\int \tanh(x)sech(x)dx = -sech(x)$
$\int \text{sech}^2(x)dx = \tanh(x)$
$\int \text{csch}(x)\coth(x)dx = -\text{csch}(x)$
$\int \ln(x)dx = (x\ln(x)) - x$
$\int_{-r}^{r}\sqrt{r^2-x^2}\ dx = \frac{\pi r^2}{2}$
$\int \frac{1}{\sqrt{x}}dx = 2\sqrt{x}$

Integrals of inverse trig functions are solved using integration by parts.

Weierstrass

$t = \tan\frac{x}{2} \quad \cos x = \frac{1-t^2}{1+t^2}$
$\sin x = \frac{2t}{1+t^2} \quad dx = \frac{2}{1+t^2}dt$

$\int \sin^m x \cos^n x$
m is odd factor sines, then sub $u = \cos x$ If n is odd factor cosines, then sub $u = \sin x$.

If both even, use $\frac{1-\cos(2x)}{2}, \frac{1+\cos(2x)}{2}$. If both odd, factor one with less power.

$\int \tan^m x \sec^n x$

n even save one $\sec^2 x$ and sub $u = \tan x$.

m odd save one $\sec x \tan x$ and sub $u = \sec x$

$\int \sqrt{a^2-x^2}dx \implies x = a\sin\theta$
$\int \sqrt{a^2+x^2}dx \implies x = a\tan\theta$
$\int \sqrt{x^2-a^2}dx \implies x = a\sec\theta$
$\int_1^\infty \frac{1}{x^p}$, $p > 1$: converge, $p \leq 1$: diverges
e.o=o e.e=e o.o=e e+e=e o+o=o

Integration by Parts
$\int udv = uv - \int vdu$

Functions/ Identities

$\sin(\cos^{-1}(x)) = \sqrt{1-x^2}$
$\cos(\sin^{-1}(x)) = \sqrt{1-x^2}$
$\sec(\tan^{-1}(x)) = \sqrt{1+x^2}$
$\tan(\sec^{-1}(x))$
$= (\sqrt{x^2-1}$ if $x \geq 1)$
$= (-\sqrt{x^2-1}\ if\ x \leq -1)$
$\sin^2(x) + \cos^2(x) = 1$
$1 + \tan^2(x) = \sec^2(x)$
$1 + \cot^2(x) = \csc^2(x)$
$\sin(x \pm y) = \sin(x)\cos(y) \pm \cos(x)\sin(y)$
$\cos(x \pm y) = \cos(x)\cos(y) \pm \sin(x)\sin(y)$
$\tan(x \pm y) = \frac{\tan(x) \pm \tan(y)}{1 \mp \tan(x)\tan(y)}$
$\sin(2x) = 2\sin(x)\cos(x)$
$\cos(2x) = \cos^2(x) - \sin^2(x)$
$1 + \tan^2(x) = \sec^2(x)$
$1 + \cot^2(x) = \csc^2(x)$
$\sin^2(x) = \frac{1-\cos(2x)}{2}$
$\cos^2(x) = \frac{1+\cos(2x)}{2}$
$\tan^2(x) = \frac{1-\cos(2x)}{1+\cos(2x)}$
$\sin(-x) = -\sin(x)$
$\cos(-x) = \cos(x)$
$\tan(-x) = -\tan(x)$
$\sin A \cos B = \frac{1}{2}(\sin(A-B) + \sin(A+B))$
$\sin A \sin B = \frac{1}{2}(\cos(A-B) - \cos(A+B))$
$\cos A \cos B = \frac{1}{2}(\cos(A-B) + \cos(A+B))$

$\sinh(x) = \frac{e^x - e^{-x}}{2}$
$\cosh(x) = \frac{e^x + e^{-x}}{2}$
$\cosh^2 x - \sinh^2 x = 1$
$1 - \tanh^2(x) = \text{sech}^2(x)$
$\sinh^{-1}(x) = \ln x + \sqrt{x^2+1}$
$\sinh^{-1}(x) = \ln x + \sqrt{x^2-1},\ x \geq -1$
$\tanh^{-1}(x) = \frac{1}{2}\ln x + \frac{1+x}{1-x},\ 1 < x < -1$
$\text{sech}^{-1}(x) = \ln[\frac{1+\sqrt{1-x^2}}{x}],\ 0 < x \leq -1$
$\cosh^2(x) - \sinh^2(x) = 1$
$\sinh(A+B) = \sinh A \cosh B + \cosh A \sinh B$
$\cosh(A+B) = \cosh A \cosh B + \sinh A \sinh B$

3D

given two points:
(x_1, y_1, z_1) and (x_2, y_2, z_2),
Distance between them:
$\sqrt{(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2}$
Midpoint:
$(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}, \frac{z_1+z_2}{2})$
Sphere with center (h,k,l) and radius r:
$(x-h)^2 + (y-k)^2 + (z-l)^2 = r^2$

Vectors

Vector: $\vec{u}$
Unit Vector: $\hat{u}$
Magnitude: $||\vec{u}|| = \sqrt{u_1^2 + u_2^2 + u_3^2}$
Unit Vector: $\hat{u} = \frac{\vec{u}}{||\vec{u}||}$

Dot Product
$\vec{u} \cdot \vec{v}$
Produces a Scalar
(Geometrically, the dot product is a vector projection)
$\vec{u} =< u_1, u_2, u_3 >$
$\vec{v} =< v_1, v_2, v_3 >$
$\vec{u} \cdot \vec{v} = \vec{0}$ means the two vectors are Perpendicular θ is the angle between them.
$\vec{u} \cdot \vec{v} = ||\vec{u}||\ ||\vec{v}||\cos(\theta)$
$\vec{u} \cdot \vec{v} = u_1v_1 + u_2v_2 + u_3v_3$
NOTE:
$\hat{u} \cdot \hat{v} = \cos(\theta)$
$||\vec{u}||^2 = \vec{u} \cdot \vec{u}$
$\vec{u} \cdot \vec{v} = 0$ when $\perp$
Angle Between $\vec{u}$ and $\vec{v}$:
$\theta = \cos^{-1}(\frac{\vec{u} \cdot \vec{v}}{||\vec{u}||\ ||\vec{v}||})$
Projection of $\vec{u}$ onto $\vec{v}$:
$pr_{\vec{v}}\vec{u} = (\frac{\vec{u} \cdot \vec{v}}{||\vec{v}||^2})\vec{v}$

Cross Product
$\vec{u} \times \vec{v}$
Produces a Vector
(Geometrically, the cross product is the area of a paralellogram with sides $||\vec{u}||$ and $||\vec{v}||$)
$\vec{u} =< u_1, u_2, u_3 >$
$\vec{v} =< v_1, v_2, v_3 >$

$$\vec{u} \times \vec{v} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix}$$

$\vec{u} \times \vec{v} = \vec{0}$ means the vectors are parallel
$\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a}.\vec{c})\vec{b} - (\vec{a}.\vec{b})\vec{c}$

Volume of Parallelpiped

$$(\vec{v} \times \vec{u}).\vec{w}$$

However, in the case the question gave you three vectors directly

$$Volume = det\left(\begin{bmatrix} v_1 & v_2 & v_3 \\ u_1 & u_2 & u_3 \\ w_1 & w_2 & w_3 \end{bmatrix}\right)$$

Lines and Planes

Equation of a Plane
(x_0, y_0, z_0) is a point on the plane and
$< A, B, C >$ is a normal vector
$A(x-x_0) + B(y-y_0) + C(z-z_0) = 0$
$< A, B, C > \cdot < x-x_0, y-y_0, z-z_0 >= 0$
$Ax + By + Cz = D$ where
$D = Ax_0 + By_0 + Cz_0$

Equation of a line
A line requires a Direction Vector
$\vec{u} =< u_1, u_2, u_3 >$ and a point (x_1, y_1, z_1)

Parametric equation:
$x = u_1t + x_1 \quad y = u_2t + y_1 \quad z = u_3t + z_1$
Symmetric equations:
$t = \frac{x-x_1}{u_1} = \frac{y-y_1}{u_2} = \frac{z-z_1}{u_3})$

Distance from a Point to a Plane
The distance from a point (x_0, y_0, z_0) to a plane Ax+By+Cz=D can be expressed by the formula:
$d = \frac{|Ax_0 + By_0 + Cz_0 - D|}{\sqrt{A^2+B^2+C^2}}$

A line intersects a plane Just put the equations of x, y, z in the equation of the plane given, and solve for t. Then you'll have the points.

Distance between two skew lines through $P_1P_2,\ P_3P_4$

$$D = \frac{Vol_{parallelepiped}}{Area_{base}} = \frac{|(P_1\vec{P}_2 \times P_3\vec{P}_4).P_1\vec{P}_3|}{|P_1\vec{P}_2 \times P_3\vec{P}_4|}$$

Or go for the intuitive approach of forcing perpendicularity.

If two vectors are parallel $|\vec{v_1} \times \vec{v_2}| = 0$

Distance between a point and a line $\vec{v}$
$D = \frac{|P\vec{v}_0 \times \ \vec{v}|}{|\vec{v}|}$

Other Information

$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$
Law of Cosines:
$a^2 = b^2 + c^2 - 2bc(\cos(\theta))$
Quadratic Formula:
$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$, when $ax^2 + bx + c = 0$

Logarithmic

$\log(xy) = \log(x) + \log(y)$
$\log(\frac{x}{y}) = \log(x) - \log(y)$ $\log(\sqrt[y]{x}) = \frac{\log(x)}{y}$
$\log_b(1) = 0$ $\log_a(x) = \frac{1}{\log_x(a)}$