## 326 Appendix B Useful Formulas

Sphere: vol $=4 \pi r^{3} / 3$, surface area $=4 \pi r^{2}$.
Cylinder: vol $=\pi r^{2} h$, lateral area $=2 \pi r h$, total surface area $=2 \pi r h+2 \pi r^{2}$.
Cone: $\mathrm{vol}=\pi r^{2} h / 3$, lateral area $=\pi r \sqrt{r^{2}+h^{2}}$, total surface area $=\pi r \sqrt{r^{2}+h^{2}}+$ $\pi r^{2}$.

## Analytic geometry

Point-slope formula for straight line through the point $\left(x_{0}, y_{0}\right)$ with slope $m: y=$ $y_{0}+m\left(x-x_{0}\right)$.
Circle with radius $r$ centered at $(h, k):(x-h)^{2}+(y-k)^{2}=r^{2}$.
Ellipse with axes on the $x$-axis and $y$-axis: $\frac{x^{2}}{a^{2}}+\frac{y^{2}}{b^{2}}=1$.

## Trigonometry

$\sin (\theta)=$ opposite/hypotenuse
$\cos (\theta)=$ adjacent/hypotenuse
$\tan (\theta)=$ opposite/adjacent
$\sec (\theta)=1 / \cos (\theta)$
$\csc (\theta)=1 / \sin (\theta)$
$\cot (\theta)=1 / \tan (\theta)$
$\tan (\theta)=\sin (\theta) / \cos (\theta)$
$\cot (\theta)=\cos (\theta) / \sin (\theta)$
$\cos ^{2}(\theta)+\sin ^{2}(\theta)=1$
$\tan ^{2}(\theta)+1=\sec ^{2}(\theta)$
$\sec ^{2}(\theta)-1=\tan ^{2}(\theta)$
$\sin (\theta)=\cos \left(\frac{\pi}{2}-\theta\right)$
$\cos (\theta)=\sin \left(\frac{\pi}{2}-\theta\right)$
$\sin (\theta+\pi)=-\sin (\theta)$
$\cos (\theta+\pi)=-\cos (\theta)$
Law of cosines: $a^{2}=b^{2}+c^{2}-2 b c \cos A$
Law of sines: $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$
Sine of sum of angles: $\sin (x+y)=\sin x \cos y+\cos x \sin y$

Sine of double angle: $\sin (2 x)=2 \sin x \cos x$
Sine of difference of angles: $\sin (x-y)=\sin x \cos y-\cos x \sin y$
Cosine of sum of angles: $\cos (x+y)=\cos x \cos y-\sin x \sin y$
Cosine of double angle: $\cos (2 x)=\cos ^{2} x-\sin ^{2} x=2 \cos ^{2} x-1=1-2 \sin ^{2} x$
Cosine of difference of angles: $\cos (x-y)=\cos x \cos y+\sin x \sin y$
Tangent of sum of angles: $\tan (x+y)=\frac{\tan x+\tan y}{1-\tan x \tan y}$
$\sin ^{2}(\theta)$ and $\cos ^{2}(\theta)$ formulas:

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

