Some useful formulas *provided without explanation.*
You are expected to know when and how to use them.

De Moivre's formula: $(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin n\theta$.
The Cauchy–Riemann equations: $\dfrac{\partial u}{\partial x} = \dfrac{\partial v}{\partial y}, \quad \dfrac{\partial u}{\partial y} = -\dfrac{\partial v}{\partial x}$.
Some complex functions:

$$e^z = \exp z = e^x(\cos y + i\sin y)$$
$$\ln z = \log z = \ln|z| + i\arg z, \quad \operatorname{Ln} z = \operatorname{Log} z = \ln|z| + i\operatorname{Arg} z$$
$$\cos z = \frac{e^{iz} + e^{-iz}}{2}, \quad \sin z = \frac{e^{iz} - e^{-iz}}{2i}$$

Cauchy's generalized formula:

$$f^{(n)}(z) = \frac{n!}{2\pi i}\int_C \frac{f(\zeta)}{(\zeta - z)^{n+1}}\,d\zeta$$

Some power series:

$$\frac{1}{1-z} = \sum_{n=0}^{\infty} z^n = 1 + z + z^2 + z^3 + \cdots$$
$$e^z = \sum_{n=0}^{\infty} \frac{z^n}{n!} = 1 + z + \frac{z^2}{2!} + \frac{z^3}{3!} + \cdots$$
$$\cos z = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k)!} z^{2k} = 1 - \frac{z^2}{2!}z + \frac{z^4}{4!} - \frac{z^6}{6!} + \cdots$$
$$\sin z = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1)!} z^{2k+1} = z - \frac{z^3}{3!}z + \frac{z^5}{5!} - \frac{z^7}{7!} + \cdots$$

Some trigonometric identities:

$$\sin(u \pm v) = \sin u\cos v \pm \cos u\sin v \qquad \cos(u \pm v) = \cos u\cos v \mp \sin u\sin v$$
$$\sin 2u = 2\sin u\cos u \qquad \cos 2u = \cos^2 u - \sin^2 u = 2\cos^2 u - 1 = 1 - 2\sin^2 u$$
$$2\sin u\cos v = \sin(u - v) + \sin(u + v) \qquad 2\cos u\cos v = \cos(u - v) + \cos(u + v)$$
$$2\sin u\sin v = \cos(u - v) - \cos(u + v)$$

Fourier series for a periodic function with period $2L$:

$$f(x) = \sum_{n=-\infty}^{\infty} c_n e^{in\pi x/L} = a_0 + \sum_{n=1}^{\infty}\left(a_n \cos\frac{n\pi x}{L} + b_n \sin\frac{n\pi x}{L}\right)$$

$$c_n = \frac{1}{2L}\int_{-L}^{L} f(x) e^{-in\pi x/L}\,dx,$$

$$a_0 = \frac{1}{2L}\int_{-L}^{L} f(x)\,dx, \quad a_n = \frac{1}{L}\int_{-L}^{L} f(x)\cos\frac{n\pi x}{L}\,dx,$$

$$b_n = \frac{1}{L}\int_{-L}^{L} f(x)\sin\frac{n\pi x}{L}\,dx.$$

Cosine and sine series for a function defined on $[0, L]$:

$$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \cos\frac{n\pi x}{L}, \qquad a_0 = \frac{1}{L}\int_0^L f(x)\,dx,$$

$$a_n = \frac{2}{L}\int_0^L f(x)\cos\frac{n\pi x}{L}\,dx,$$

$$f(x) = \sum_{n=1}^{\infty} b_n \sin\frac{n\pi x}{L}, \qquad b_n = \frac{2}{L}\int_{-L}^{L} f(x)\sin\frac{n\pi x}{L}\,dx.$$

Some integrals:

$$\int x^n e^x\,dx = x^n e^x - n\int x^{n-1} e^x\,dx$$

$$\int x^n \ln x\,dx = \frac{x^{n+1}}{n+1}\ln x - \frac{x^{n+1}}{(n+1)^2} + C$$

$$\int x^n (\ln x)^m\,dx = \frac{x^{n+1}}{n+1}(\ln x)^m - \frac{m}{n+1}\int x^n (\ln x)^{m-1}\,dx$$

$$\int e^{ax}\cos bx\,dx = \frac{e^{ax}}{a^2+b^2}(a\cos bx + b\sin bx) + C$$

$$\int e^{ax}\sin bx\,dx = \frac{e^{ax}}{a^2+b^2}(a\sin bx - b\cos bx) + C$$

$$\int x^m \cos bx\,dx = \frac{x^m \sin bx}{b} - \frac{m}{b}\int x^{m-1}\sin bx\,dx$$

$$\int x^m \sin bx\,dx = -\frac{x^m \cos bx}{b} + \frac{m}{b}\int x^{m-1}\cos bx\,dx$$