17. (a) It should be emphasized that the result, given in terms of $\sin(2\pi f t)$, could as easily be given in terms of $\cos(2\pi f t)$ or even $\cos(2\pi f t + \phi)$ where ϕ is a phase constant as discussed in Chapter 16. The angular position θ of the rotating coil is measured from some reference line (or plane), and which line one chooses will affect whether the magnetic flux should be written as $BA\cos\theta$, $BA\sin\theta$ or $BA\cos(\theta+\phi)$. Here our choice is such that $\Phi_B = BA\cos\theta$. Since the coil is rotating steadily, θ increases linearly with time. Thus, $\theta = \omega t$ (equivalent to $\theta = 2\pi f t$) if θ is understood to be in radians (and ω would be the angular velocity). Since the area of the rectangular coil is $A = ab$, Faraday's law leads to

$$\mathcal{E} = -N\frac{d(BA\cos\theta)}{dt} = -NBA\frac{d\cos(2\pi f t)}{dt} = NBab2\pi f \sin(2\pi f t)$$

which is the desired result, shown in the problem statement. The second way this is written ($\mathcal{E}_0 \sin(2\pi f t)$) is meant to emphasize that the voltage output is sinusoidal (in its time dependence) and has an amplitude of $\mathcal{E}_0 = 2\pi f NabB$.

(b) We solve $\mathcal{E}_0 = 150\,\mathrm{V} = 2\pi f NabB$ when $f = 60.0$ rev/s and $B = 0.500$ T. The three unknowns are N, a, and b which occur in a product; thus, we obtain $Nab = 0.796$ m^2. This means, for instance, that if we wanted the coil to have a square shape and consist of 50 turns, then the side length of the square would be $a = b = 0.126$ m.