♢♡ Differential Surface Area ♡♢

Let $\vec{r}(u, v)$ define a surface, then the differential surface area is

$$||\vec{r}_u \times \vec{r}_v|| \, du \, dv$$

For a sphere of radius a: $u = \phi, v = \theta$
The differential surface area is

$$a^2 \sin\phi \, d\phi \, d\theta$$

For a graph $z = f(x, y)$: $u = x, v = y$
The differential surface area is

$$\sqrt{1 + f_x^2 + f_y^2} \, dx \, dy$$
