1 Find Area/Volume from the Vector Differential

Start with $d\vec{r}$ in rectangular, cylindrical, and spherical coordinates. Use these expressions to write the scalar area elements dA (for different coordinate equals constant surfaces) and the volume element $d\tau$. It might help you to think of the following surfaces: The various sides of a rectangular box, a finite cylinder with a top and a bottom, a half cylinder, and a hemisphere with both a curved and a flat side, and a cone.

(a) Rectangular:

$$dA = \tag{1}$$
$$d\tau = \tag{2}$$

(b) Cylindrical:

$$dA = \tag{3}$$
$$d\tau = \tag{4}$$

(c) Spherical:

$$dA = \tag{5}$$
$$d\tau = \tag{6}$$