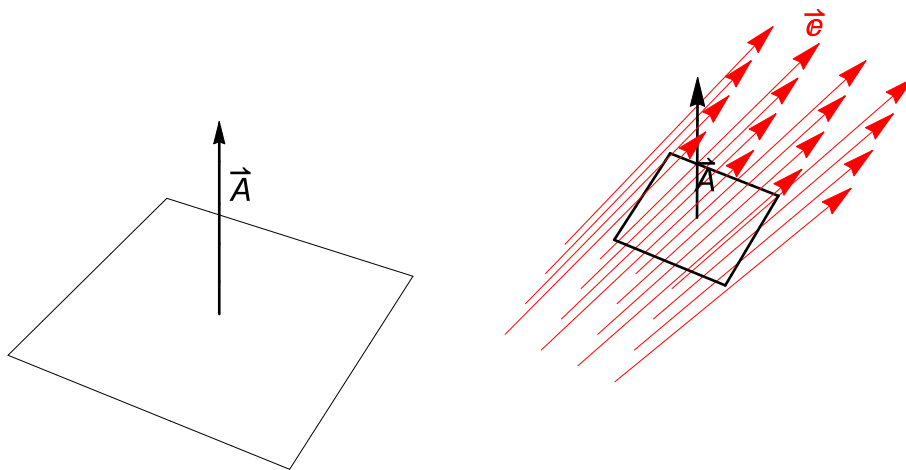


Gauss

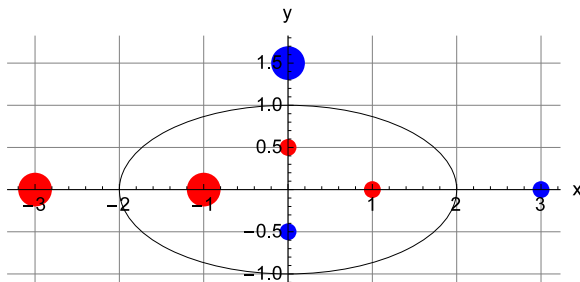
In all pictures below $q = \pm 1 \mu C$ (small red/blue circles) or $q = \pm 2 \mu C$ (large red/blue). Distances in pictures are given in mm .

$$\Phi = q_{enc}/\epsilon_0$$

1. A square has a side of 1 cm . The field $E = 10^5 \text{ N/C}$ makes an angle 30° with the normal. Find $\Delta\Phi$.



2. Find Φ through an elliptically shaped surface



3. A metal sphere with $R = 2 \text{ m}$ has a charge $Q = 0.5 \text{ nC}$.
 - a) find E for $r = 0.25 \text{ m}$ away from the center
 - b) same for $r = 3 \text{ m}$

4. A metal spherical shell with $R_1 = 1\text{ m}$ and $R = 2\text{ m}$ has a charge $Q = 0.5\text{ nC}$
- (a) find Q_{in} and Q_{out}
 - (b) find E for $r = 0.25\text{ m}$
 - (c) find E for $r = 1.5\text{ m}$
 - (d) find E for $r = 3\text{ m}$
 - (e) sketch the charge distribution and the field
5. An additional positive charge $q = 1\text{ nC}$ is placed at the center of the cavity
- (a) find Q_{in} and Q_{out}
 - (b) find E for $r = 0.25\text{ m}$
 - (c) find E for $r = 1.5\text{ m}$
 - (d) find E for $r = 3\text{ m}$
 - (e) sketch the charge distribution and the field
6. the shell in problem 4 (with an empty cavity and the same extra charge Q) is deformed so that both the cavity and the outer surface take the shape of an ellipsoid
- (a) find Q_{in} and Q_{out} and sketch
 - (b) find E for $r = 2.5\text{ mm}$ away from the center of the cavity
 - (c) find E (approximately) for $r = 25\text{ m}$ away from the center of the cavity
7. A large non-conducting sheet is uniformly charged with $\sigma = 1.8\text{ nC/m}^2$.
- (a) find E at 1 mm away from the center of the sheet
 - (b) find the force which acts on a charge $Q = -0.5\text{ nC}$ placed 8 mm away from the sheet
 - (c) sketch the field and the force