BIRZEIT UNIVERSITY
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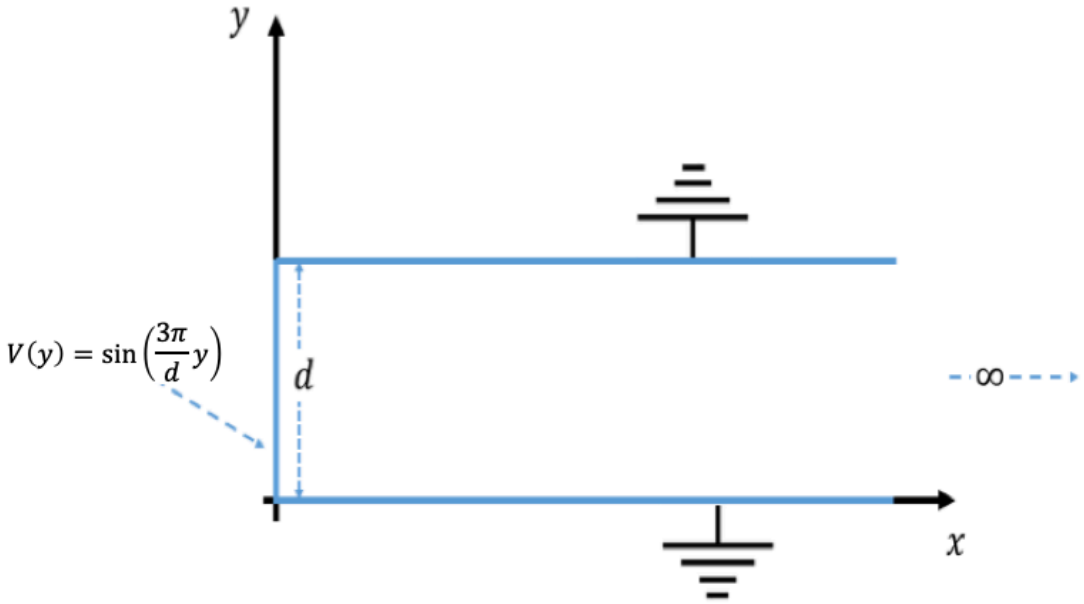
Phys331/Midterm Exam
Spring 2020/2021

1) (10%) If Ω is a sphere of radius R that is centered around the origin. Use appropriate functions and theorems you learned to evaluate

$$\int_{\Omega} \left(\frac{\vec{r}}{r^3}\right)\vec{\nabla}\left(\frac{r^4 - R^4}{r^5 + 7r^3 + 2}\right) d\tau$$

2) An infinitely long 2-D slot has a width d. The walls are conductors that held at fixed potentials as shown in the figure.



a. (20%) Determine the electric potential inside the slot.

b. (5%) If a positive charge q is placed at the coordinates $(d, \frac{d}{2}, 0)$, find the force $(\vec{F})$ on q.

3) If the linear charge density of a circular ring of radius R that is placed in the xy −plane and centered around the origin is given by

$$\lambda(\phi) = \lambda_0 \cos^3 \phi$$

a. (3%) Write the linear charge density as a volume charge density in cylindrical coordinates.

b. (3) Calculate the total charge (Q) on the ring.

c. (9%) Calculate the electric dipole moment ($\vec{p}$) of the ring.

4) (10%) If $\vec{c}$ is a constant vector, find the charge density that give rise to the electric field $\vec{E} = (\vec{c} \cdot \vec{r})\vec{c}$.

5) A conducting spherical shell of radius R and zero thickness is held at a potential $V(\theta) = V_0 \sin^4(\theta)$.

a. (20%) Determine the potential produced by the sphere everywhere.

b. (10%) Determine the electric field produced by the sphere everywhere.

c. (10%) Determine the surface charge density on the sphere.