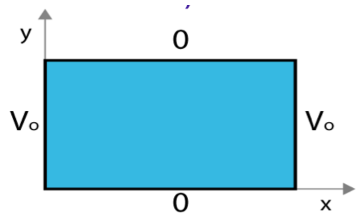
Given the two diff. eq's :

$$\frac{1}{X}\frac{d^2X}{dx^2} = C_1 \qquad \frac{1}{Y}\frac{d^2Y}{dy^2} = C_2$$

where $C_1 + C_2 = 0$. Given the boundary conditions in the figure, which coordinate should be assigned to the negative constant (and thus the sinusoidal solutions)?

A. x
B. y
C. $C_1 = C_2 = 0$ here
D. It doesn't matter.



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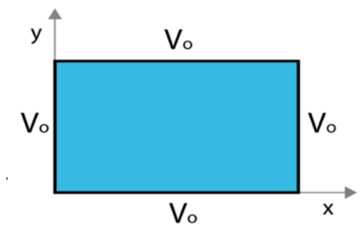


ANNOUNCEMENTS

- Exam 1 graded
  - Returned at the end of class today (Avg. 73; Median. 76)
- Sent out individual grade reports on Saturday
  - Please check that your grades make sense to you!
- Homework 5 is due on Friday
  - It's a bit longer...start early!

When does $\sin(ka)e^{-ky}$ vanish?

A. $k = 0$
B. $k = \pi/(2a)$
C. $k = \pi/a$
D. A and C
E. A, B, C

Suppose $V_1(r)$ and $V_2(r)$ are linearly independent functions which both solve Laplace's equation, $\nabla^2 V = 0$.

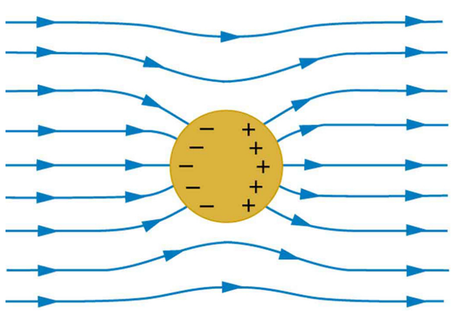
Does $aV_1(r) + bV_2(r)$ also solve it (with a and b constants)?

A. Yes. The Laplacian is a linear operator
B. No. The uniqueness theorem says this scenario is impossible, there are never two independent solutions!
C. It is a definite yes or no, but the reasons given above just aren't right!
D. It depends...

What is the value of $\int_0^{2\pi} \sin(2x)\sin(3x)\ dx$?

A. Zero
B. π
C. 2π
D. other
E. I need resources to do an integral like this!

SEPARATION OF VARIABLES (SPHERICAL)



Given $\nabla^2 V = 0$ in Cartesian coords, we separated $V(x, y, z) = X(x)Y(y)Z(z)$. Will this approach work in spherical coordinates, i.e. can we separate $V(r, \theta, \phi) = R(r)\Theta(\theta)\Phi(\phi)$?

A. Sure.
B. Not quite - the angular components cannot be isolated, e.g., $f(r, \theta, \phi) = R(r)Y(\theta, \phi)$
C. It won't work at all because the spherical form of Laplace's Equation has cross terms in it (see the front cover of Griffiths)

$$V(r,\theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+1}} \right) P_l(\cos\theta)$$

V everywhere on a spherical shell is a given constant, i.e. $V(R,\theta) = V_0$. There are no charges inside the sphere. Which terms do you expect to appear when finding V(inside)?

A. Many A_l terms (but no B_l's)
B. Many B_l terms (but no A_l's)
C. Just A_0
D. Just B_0
E. Something else!

Given $V_0(\theta) = \sum_l C_l P_l(\cos\theta)$, we want to get to the integral:

$$\int_{-1}^{+1} P_l(u)\ P_m(u)\ du = \frac{2}{2+1}\ (\text{for } l = m)$$

we can do this by multiplying both sides by:

A. $P_m(\cos\theta)$
B. $P_m(\sin\theta)$
C. $P_m(\cos\theta)\sin\theta$
D. $P_m(\sin\theta)\cos\theta$
E. $P_m(\sin\theta)\sin\theta$

$$V(r,\theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+1}} \right) P_l(\cos\theta)$$

Suppose V on a spherical shell is:

$$V(R,\theta) = V_0\left(1 + \cos^2\theta\right)$$

Which terms do you expect to appear when finding **V(inside)**?

A. Many A_l terms (but no B_l's)
B. Many B_l terms (but no A_l's)
C. Just A_0 and A_2
D. Just B_0 and B_2
E. Something else!

$$V(r,\theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+1}} \right) P_l(\cos\theta)$$

Suppose V on a spherical shell is:

$$V(R,\theta) = V_0\left(1 + \cos^2\theta\right)$$

Which terms do you expect to appear when finding **V(outside)**?

A. Many A_l terms (but no B_l's)
B. Many B_l terms (but no A_l's)
C. Just A_0 and A_2
D. Just B_0 and B_2
E. Something else!

How many boundary conditions (on the potential V) do you use to find V inside the spherical plastic shell?

A. 1
B. 2
C. 3
D. 4
E. It depends on $V_0(\theta)$