BE SURE to complete the green version first, entirely, before starting on this

Physics 3310: First Homework.

YOUR NAME (neatly!)_____

IMPORTANT, PLEASE READ THIS FIRST!!

I'd like you to do this homework twice.

You should already have done the Green (Pretest) version!!
THIS (white) version is a regular hw, due at the start of class Wed Jan 16

Use whatever resources you need, including Griffiths, your old 2210 text, talking to peers, office hours - whatever you need. In the end, though, what you turn in must be your own work, reflecting your own understanding

Note that in general, we grade homeworks for clarity of explanation as much as we do for mere "correctness" of final answer.

NOTE: No need to redo any questions you already did in the green version which you are confident about - just write down "*see green copy*" on any problems you want!
However, if you didn't explain your work there, you might want to do so here, since this version is graded.
There is one extra question at the end which didn't appear on the green version.

(If you run out of room, just attach some extra pages.)

Please do not "back fill" *anything* onto the other (green) version.

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Please *show your work* or explain your reasoning whenever possible.

1.) Given a triangle (NOT necessarily a "right triangle") with sides a, b, and c, and an angle (θ) opposite side c. Suppose I tell you a, b, and θ, and ask "what is c?"
-> do you know a formula? (what is it?)

2.) $\int \frac{4x}{\left(x^2+a^2\right)^{3/2}}\ dx$ (where a is a known constant. Note that it is an indefinite integral)

3.) $\frac{d}{dx}\int_1^x f(y)dy$ (where f(y) is some given, known (well behaved) function of y)

4.) $\frac{d}{dx}\ \int_0^1 (y+x)\ dy$

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Make a quick sketch, in the x-y plane, of the following vector functions.
Plot enough different vectors to get a feeling for what this field looks like in the x-y plane.

5.)(a) $y\,\hat{\mathbf{x}}$

(b) $r\,\hat{\mathbf{r}}$ (The symbol **r** here refers to the usual **r** in spherical coordinates)

(c) $\frac{x}{\sqrt{x^2+y^2}}\hat{\mathbf{x}}+\frac{y}{\sqrt{x^2+y^2}}\hat{\mathbf{y}}$

Also just for this one (part c) - can you explain in words what this plot is showing?

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6.) Given the scalar function T(x,y,z) (e.g. the temperature at any point in the room)
Which of the three operations (div, grad, or curl) can be sensibly operated on T?
For each which can:
a) give a formula for the result
b) explain in words how you would interpret the result.
c) is the result a vector or scalar?

7.) Given an arbitrary vector function **V**(x,y,z) (e.g. the velocity of a flowing liquid)
Which of the three operations (div, grad, or curl) can be sensibly operated on **V**?
For each which can:
a) give a formula for the result
b) explain in words how you would interpret the result.
c) is the result a vector or scalar?

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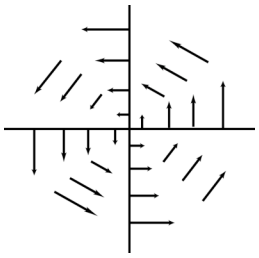
8.) For each of the four vector fields sketched below....

Which of them have nonzero *divergence* somewhere? _____
(If the divergence is nonzero *only* at isolated points, which point(s) would that be?)

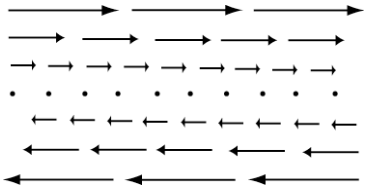
Which of the following fields have nonzero *curl* somewhere? _____
(If the curl is nonzero *only* at isolated points, which point(s) would that be?)

(A brief explanation of your answers below each figure would be welcome)

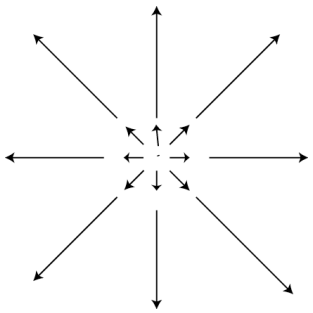
A.



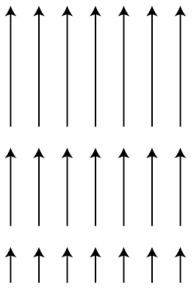
B



C.



D.



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9.) Given vectors **A** and **B**. ("Given" means you know the components, or alternatively, the length and angle of the vectors)

Define the dot product mathematically in two very different looking ways.
(Hint: one way should involve the components, the other, the length/angles)

Give a brief physical interpretation of what the dot product means or tells you (you can give a concrete example if you like)

10.) Define the vector cross product mathematically in two very different looking ways.
(Hint: one way should involve the components, the other, the length/angles)

Give a brief physical interpretation of what the cross product means or tells you (you can give a concrete example if you like)

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11.) Compute the gradient of the following two scalar fields?

a) $e^x \cos(y)$

b) $\cos(x^2 + y^2 + z^2)$

12.) Compute the divergence and curl of $\hat{\imath}(x^2 + yz) + \hat{\jmath}(y^2 + zx) + \hat{k}(z^2 + xy)$.

13.) (This is a new question - it was not on the green pretest) Evaluate the line integral $\int (y^2 dx - 2x^2 dy)$ along the parabola $y = x^2$ from the point (0,0) to the point (2,4).