Homework 1 (Written Portion), PHYS 101 (Introductory Physics I)
Fall 2020
Due Thursday 27th August 2020 PRIOR TO beginning of class

Please read this introduction carefully. This portion of the homework assignment serves several purposes.

Firstly, it will allow you to practice the process of converting written homework solutions for this class to pdf documents for upload in Oaks. Given the circumstances for the semester, this procedure will be repeated for all homeworks, midterms, and your final exam – so it is worth taking a little time right away to make sure you have a system that works for you.

Secondly, since this is one of the very few homework assignments that is only going to be graded for completeness (not correctness), it gives you an opportunity to start the semester with a perfect grade on your first assignment.

Thirdly, it helps me calibrate the rest of the semester based on how much mathematics you know. Let me elaborate...

The background of students in this class is highly variable; a lot of our students taking this class have already had calculus, whereas some other people in this class haven't taken a math class in 4-5 years and the highest math class they've ever taken may have been trigonometry. Since mathematics is the language of physics, understanding what we're starting from helps me calibrate the course content.

I fully expect there are problems here that you are confused by and don't even understand what is being asked; that's ok!!! I just want to know what we're working with, so I'm going to ask some questions that go all the way up to differential equations in difficulty.

DO NOT USE EXTERNAL RESOURCES FOR THIS HOMEWORK. *YOU SHOULD NOT NEED A CALCULATOR OR MATHEMATICA TO DO ANY OF THESE PROBLEMS! AS SUCH, YOU ARE ON YOUR HONOR TO NOT USE THEM – OR OTHER AIDS – TO DO THIS WORK.* Also, though I normally encourage you to work with others on homework assignments, please do this one on your own.

Here is the recommended workflow for this assignment:

- First, complete the on-line quiz within Oaks that asks you for some basic information regarding your coursework background in Mathematics and Physics.
- Second, work out the answers to the following questions on paper at home. For any questions you don't know how to approach, just write something like "I never learned how to do this", "I used to know how to do this", or "I don't know what some of these symbols mean". This is ok!
- Third, find some method of taking your written work and converting this into a pdf for upload to Oaks. A number of different ways to do this are described on the "Content" part of our course Oaks page.

Here are the questions for the written portion of your first homework:

1. What is your name?
2. Solve for x: $6x + 7 = 55$
3. Solve for x: $6(x + 7) = 54$
4. What is the value of $\cos \pi$?
5. What is the value of $\sin(60°)$?
6. What is the value of $\tan\left(\frac{\pi}{3}\right)$?
7. Simplify $\sqrt{144a^2b^4c^7}$.
8. Evaluate $\sqrt[3]{-8}$
9. Evaluate $16^{-1/2}$
10. A right triangle has a hypotenuse of length 25, and one of the other sides has length 24. What is the length of the remaining side?
11. Solve for $x : 5x^2 + 6x = -1$.
12. Find x and y so that both of these equations are satisfied:

$$8x + 4y = 16$$
$$6x - 3y = 24$$

13. Evaluate: $\sqrt{-121}$
14. What is $\ln\left(e^{3\pi}\right)$
15. On some graph paper (or, if you don't have graph paper – on carefully constructed and measured axes), plot the equation $y = 3x + 5$.
16. On a different axes, plot the equation $y = |3x - 2| + 1$.
17. On a different axes, plot the equation $y = -3x^2 + 2$.
18. On a different axes, plot the equation $y = \frac{2x}{x^2 - x - 2}$.
19. What is the volume of a spherical ball with diameter 3 cm?
20. What is the surface area of a spherical ball with diameter 3 cm?
21. Find $\lim_{x \to 0}\left[\frac{\sin^2(3x)}{(2x)^2}\right]$
22. Calculate: $\frac{\mathrm{d}}{\mathrm{d}x}[3x^5]$
23. Integrate: $\int x^2 \mathrm{d}x$
24. Integrate: $\int_0^{\pi/2} (\cos x)\, \mathrm{d}x$

25. Calculate: $\frac{\partial}{\partial z}\left[\frac{4x^4}{y^3 z}\right]$

26. Put the following ten numbers in order from smallest (closest to $-\infty$) to largest (closest to ∞): the number of seconds in a year, the number of molecules in a mole, $|-3\times10^{-27}|$, π, 7×10^{-3}, -1, 0, 2×10^{17}, 5^3, $\frac{1}{100}$.

27. Integrate $\int_0^1 x\exp(-x^2)\mathrm{d}x$

28. A vector $\vec{r}$ has $|\vec{r}|=10$ and points 30° below the x-axis. What is the vector's y-component?

29. A vector is written $-3\hat{i}-3\hat{j}$. Write the vector in polar coordinates.

30. Vector $\vec{r}_1=3\hat{i}-2\hat{j}$. Vector $\vec{r}_2=-2\hat{j}$. What is $|\vec{r}_1+\vec{r}_2|$?

31. Evaluate the following: $\left(7\hat{i}+6\hat{k}\right)-\left(3\hat{i}+2\hat{j}+\hat{k}\right)$

32. Evaluate the following: $\left(7\hat{i}+6\hat{k}\right)\cdot\left(3\hat{i}+2\hat{j}+\hat{k}\right)$

33. Evaluate the following: $\left(7\hat{i}+6\hat{k}\right)\times\left(3\hat{i}+2\hat{j}+\hat{k}\right)$

34. Three blond-haired people and three red-haired people (a total of 6 people) are prepared to enter a room. Three of these people enter the room. What is the probability that there are 2 blond-haired people and 1 red-haired person in the room?

35. Two boxes contain colored balls. You are unable to look into the boxes, but you know that one box has a total of 11 balls – 7 red and 4 green. The other box has 12 balls – 3 red and 9 green. You reach into one of the boxes and pull out a red ball. What is the probability you pulled out of the first box?

36. Evaluate the following: $\vec{\nabla}[5x^2y-\sin(xz)+17]$

37. Evaluate the following: $\vec{\nabla}\cdot\left(4xz\hat{i}+3yz\hat{j}+4\hat{k}\right)$

38. Evaluate the following: $\vec{\nabla}\times\left(4xz\hat{i}+3yz\hat{j}+4\hat{k}\right)$

39. Find the eigenvalues and associated eigenvectors for the following matrix:

$$\begin{pmatrix} 2 & 3 & 0 \\ 3 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

40. Evaluate $\oint \vec{V}\cdot\mathrm{d}\vec{r}$ around the boundary of the square with vertices $(1,0),(0,1),(-1,0),(0,-1)$ if $\vec{V}=x^2\hat{i}+5x\hat{j}$.

41. Solve the following subject to the conditions $x(t=0)=0$ and $x(t=1)=3$:

$$\frac{\mathrm{d}^2x}{\mathrm{d}t^2}+5\frac{\mathrm{d}x}{\mathrm{d}t}+4x=0$$