St John Baptist De La Salle Catholic School, Addis Ababa

Homework 4
2nd Quarter

Aaron GK

December 29, 2022

Notes, and use of other aids is allowed. Read all directions carefully and write your answers in the space provided. To receive full credit, you must show all of your work. **Cheating or indications of cheating and similar answers will be punished accordingly**.

Information

- The homework is due on **Monday**, **December 19th**.
- You should Work on it **individually** and consult me if you have any questions. As I have reiterated multiple times, cheating will have a serious consequence.
- For purposes of neatness and simplicity of grading, you should do the homework on an **A-4 paper**.

Questions

1. Define electric field and factors affecting a field that emerges from a source charge.
2. Discuss the differences between a source charge and a test charge.
3. If there are two charges placed on the x-axis, a -2μC charge at x = 3nm and a +40μC charge at x = -2nm, compute the following:
   - Calculate the electrostatic force between the two charges.
   - If there is a charge of +1nC placed at the position $y = 1.0\text{a}^0$, find the net force and electric field at that point.
4. Discuss the superposition principle and its applications.
5. What is the electric field of the nucleus of a Hydrogen $^1_1$H atom 1m away from the nucleus. Compare this to the acceleration due to gravity by the nucleus.

Group Project

Information

- The group project is due is due on **Monday**, **January 9th**.
- You should work on the projects **in groups** and consult me if you have any questions. Every member should have meaningful contribution to the project.
- The assignment should be submitted via email(**aaron@stjohn.edu.et** or **aaron@sjbdcs.org**) as a PDF file. You can alternatively choose to submit a hard-copy paper submission.

Topics to work on

Black Holes: history, origin & scientific significance

Groups 1 & 7

Mathematical Proof of Kepler's Laws

Groups 2 & 8

General Theory of Relativity

Groups 3 & 9

Application of Electrostatics

Groups 4 & 10

History of Electromagnetism & Maxwell's Laws

Groups 5 & 6

If there's an 11th group, they can choose which topic they like the most out of the ones given above and join them.

Midterm Prep

> Notes, and use of other aids is **NOT** allowed. Read all directions carefully and **write your answers in the answer sheet**. To receive full credit, you must show all of your work.

Useful Constants

- $\mathbf{a}_g = 10m/s^2$ - acceleration due to gravity $\mathbf{G} = 6.672 \times 10^{-12} \frac{Nm^2}{kg^2}$ - gravitational constant

1. If the net torque in a system is 0, what can we say about the angular velocity, angular momentum, the torques on the system?
2. What are the physics concent behind each of Kepler's Laws of Planetary Motion(try to prove each one)?
3. The trajectory of planets & celestial bodies around the sun can only be a few shapes - what are they?
4. What are the factors affecting moment of inertia? How does the moment of inertia change if we change the factors?
5. How was the gravitational constant discovered?
6. Why do we have the door handles away from the hinges?
7. Prove Kepler's Third Law.(*For the sake of simplicity, assume the path of planets is circular).*
8. If a planet is orbitting the sun 10 AU away, find its period.
9. Convert the following quantities into their standard units:
    - 2 rev/min
    - 10 rev/s
    - 900^0
    - 100 revolution
    - 7 rev/min^2