# St John Baptist De La Salle Catholic School, Addis Ababa Homework 1 4th Quarter

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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 primarily on Friday, May 19th. You can submit it on Monday, May 22nd, but the Advanced Problems won't count.
- You should Work on it **in groups** and consult me if you have any questions. As I have reiterated multiple times, cheating between groups 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. If we are using a microwave microscope, what is the finest detail that we are able to see using the microscope?
- 2. When light is used to view an object, the detail it can show is limited according its wavelength. The smaller the wavelength, the more detail we can get from the object. What is the smallest detail visible by a light whose frequency is yellow light( $\lambda = 580nm$ )?
- 3. Some radar systems detect the size and shape of objects such as aircraft and geological terrain. Approximately what is the smallest observable detail utilizing 500-MHz radar? Would we be able to observe a small bird with a wingspan of 0.4m?
- 4. Radar is used to determine distances to various objects by measuring the round-trip time for an echo from the object.
  - (a) How far away is the planet Venus if the echo time is 989 s?
  - (b) What is the echo time for a car 75.0 m from a Highway Police radar unit?
  - (c) How accurately (in nanoseconds) must you be able to measure the echo time to an airplane 12.0 km away to determine its distance within 10.0 m?

## **Advanced Problems**

- 5. Show that the Electric and Magnetic fields of all electromagnetic waves are related in such a way that  $\mathbf{E} = c\mathbf{B}$ .
- 6. Assume the helium-neon lasers commonly used in student physics laboratories have power outputs of  $0.250~\mathrm{mW}.$

- (a) If such a laser beam is projected onto a circular spot  $0.500\mu$ m in radius, what is its intensity?
- (b) Find the peak magnetic field strength.
- (c) Find the peak electric field strength.