PART A: MULTIPLE CHOICE (10 MARKS)

Choose the best response in each case and place your answer in the appropriate space on your answer sheet.

1. Maxwell's first law, known as Gauss's law:
   (a) relates a changing magnetic field and the induced emf.
   (b) relates magnetic field lines to the charges that create them.
   (c) relates electric field lines to the charges that create them.
   (d) predicts the existence of electromagnetic waves.

2. Electromagnetic waves propagate in a direction:
   (a) perpendicular to the oscillations of both the magnetic and electric fields.
   (b) parallel to the oscillation of the electric field.
   (c) parallel to the oscillation of the magnetic field.
   (d) independent of the oscillations of either the magnetic or electric field.

3. Although Maxwell correctly predicted the existence of electromagnetic waves and many of their properties, he never saw any experimental evidence of their evidence. Which scientist was able to provide this evidence?
   (a) Newton (b) Huygen
   (c) Hertz (d) Einstein

4. Which of the following phenomena leads to the interpretation that electromagnetic radiation is a transverse wave?
   (a) linear propagation
   (b) partial reflection, partial refraction
   (c) diffraction
   (d) polarization

5. Frequency modulated radio signals:
   (a) are used to send communications to deep-water submarines.
   (b) carry more data than amplitude modulated signals.
   (c) often interfere with other electrical back-ground signals.
   (d) require less frequency bandwidth than amplitude modulated signals.

6. Magnetic resonance imaging:
   (a) can produce three-dimensional images of a patient's internal organs.
   (b) requires magnetic fields 1 million times that of Earth's natural magnetic field.
   (c) require magnetic fields 100 times that of Earth's natural magnetic field.
   (d) requires regions of space in which a magnetic field is absent.

7. Which of the following statements about the electromagnetic spectrum is <u>false</u>?
   (a) Electromagnetic waves travel at 3.0×10^8 m/s in a vacuum.
   (b) Electromagnetic waves interact with matter in the same way the sound waves do.
   (c) The electromagnetic spectrum includes radio waves, light, and X rays.
   (d) Electromagnetic waves increase in energy as wavelength is reduced.

8. The three types of radiation placed in order of <u>increasing</u> frequency are:
   (a) radio waves, gamma rays, infrared radiation
   (b) infrared radiation, radio waves, gamma rays
   (c) gamma rays, infrared radiation, radio waves
   (d) radio waves, infrared radiation, gamma rays

9. The type of electromagnetic radiation that travels at the greatest speed is:
   (a) radio waves.
   (b) visible light.
   (c) gamma rays.
   (d) they all travel at the same speed.

10. The phenomenon in Earth's atmosphere that explains how long-distance radio communication was possible before the use of satellites is:
    (a) refraction.
    (b) reflection.
    (c) diffraction.
    (d) interference.

SPH4U-4 LIGHT: EM RADIATION & POLARIZATION QUIZ#2

PART A: MULTIPLE CHOICE (10 MARKS)

1	2	3	4	5	6	7	8	9	10

PART B: MATCH (5 MARKS)

1	2	3	4	5

Match the definition from the 1st column below to the best term in the 2nd column below and place the matching letter in the appropriate space above.

1. Number that characterizes a materials ability to become magnetized.
2. Light or an electromagnetic wave in which the vibrations of the electric field lie in one plane and are perpendicular to the direction of travel.
3. Series of four related equations that summarize the behaviour of electric and magnetic fields and their interactions.
4. Radio wave in which the information is carried by increasing and decreasing the frequency of the wave.
5. Materials that exhibit doubly refractive properties while under mechanical stress.

A) amplitude modulated radio
B) electric permittivity
C) electromagnetic spectrum
D) electromagnetic wave
E) frequency modulated radio
F) magnetic permeability
G) Maxwell's equations
H) photoelastic
I) plane polarized
J) triangulation

PART C: PROBLEMS (20 MARKS)

Answer the following questions on a separate sheet of paper. You may use the back of this sheet if you wish.

1. News media often conduct live interviews from locations halfway around the world. There is obviously a timelag between when a signal is sent and when it is received.

{4} (a) Calculate how long the time-lag should be for a signal sent from locations on Earth separated by 2.00×10^4 km.

{2} (b) Suggest reasons why the actual time-lag differs from the value in (a).

{5} 2. Airplanes have radar altimeters that bounce radio waves off the ground and measure the round-trip travel time. If the measured time is 75 μs, what is the airplane's altitude?

{3} 3. Determine the wavelength of an AM radio signal with a frequency of 6.40×10^6 Hz.

4. Microwave oven doors have metallic screens embedded in them. Light is able to pass through these screens, but the microwaves are not. Assume that the microwave radiation is in the order of 10^{10} Hz and the light in the order of 10^{14}.

{4} (a) Calculate the wavelengths of both the microwave radiation and visible radiation.

{2} (b) Suggest why a metallic screen is used in microwave oven doors.

PART D: MAKING CONNECTIONS (30 MARKS)

Answer the following questions on a separate sheet of paper.

{5} 1. What were Maxwell's 4 equations? Why were they so important?

{3} 2. Describe the process that allows an electromagnetic wave to exist as it radiates away from the source that created it.

{5} 3. Although Maxwell never saw the experimental evidence of his prediction, explain briefly who and what the experimental evidence was.

{6} 4. How do polarized lenses affect light? How do they exclusively absorb glare from the light that is reflected from a road surface or the hood of a car?

{3} 5. Light reflects off mirrors. Is the wavelength of light smaller or larger than the atoms that make up the mirror?

{2} 6. (a) Why are microwaves used for satellite communications rather than radio waves?

{3} (b) How do microwaves "cook" food?

{3} (c) Microwave ovens often have dead spots where food does not cook properly. Why might this occur?