General Physics IIA — PHYS120
Quest 4 (1 Hour)
Ch. 22 (Induction), Ch. 24 (EM Waves), Ch. 25 (Mirrors), Ch. 26 (Lenses)

Part I: Conceptual Multiple Choice (8 questions, 2 pts each)

Circle the best answer.

1. A loop of wire is placed in a magnetic field that is constant in time. Which statement is correct? (**2 pts**)

   (a) An emf is induced.

   (b) An emf is induced only if the loop moves.

   (c) No emf is induced.

   (d) A current is always induced.

2. According to Lenz's Law, the induced current in a loop acts to: (**2 pts**)

   (a) Increase the magnetic flux.

   (b) Decrease the magnetic field strength.

   (c) Oppose the change in magnetic flux.

   (d) Align with the external field.

3. Electromagnetic waves in vacuum all have the same: (**2 pts**)

   (a) Frequency

   (b) Wavelength

   (c) Speed

   (d) Energy

4. If light enters a medium with a higher index of refraction, its speed: (**2 pts**)

   (a) Increases

   (b) Decreases

   (c) Stays the same

   (d) Becomes zero

5. A concave mirror produces a virtual image when the object is: (**2 pts**)

   (a) Beyond the focal point.

   (b) At the focal point.

(c) Between the focal point and the mirror.

(d) At infinity.

6. A plane mirror always produces an image that is: (**2 pts**)

(a) Real and inverted.

(b) Virtual and upright.

(c) Real and upright.

(d) Virtual and inverted.

7. A diverging lens produces an image that is always: (**2 pts**)

(a) Real and inverted

(b) Virtual and upright

(c) Real and upright

(d) Inverted and virtual

8. Increasing the wavelength of an EM wave (in vacuum) will: (**2 pts**)

(a) Increase its frequency

(b) Decrease its frequency

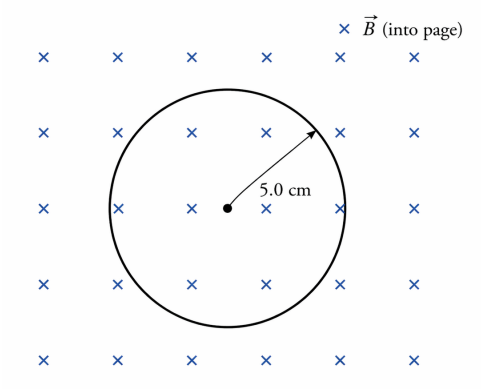
(c) Increase its speed

(d) Decrease its speed

Part II: Quantitative Problems (6 problems)

Show all work. Include units.

1. **Faraday's Law**
   A circular loop of radius 5.0 cm is placed in a magnetic field perpendicular to the loop, as shown in the figure below.



   The magnetic field increases uniformly from 0.10 T to 0.50 T in 0.20 s.
   (a) Calculate the induced emf.
   (b) State the direction of the induced current. (**10 pts**)

2. **Induced Current**
   A coil with resistance 4.0 Ω experiences an induced emf of 0.80 V.
   (a) What is the current in the coil?
   (b) If the resistance doubles, what happens to the current? (**8 pts**)

3. **Electromagnetic Waves**
   An electromagnetic wave has a frequency of 6.0×10^{14} Hz.
   (a) What is its wavelength in vacuum?
   (b) Identify the region of the electromagnetic spectrum. (**8 pts**)

4. **Concave Mirror**
   An object is placed 30 cm in front of a concave mirror with focal length 10 cm.
   (a) Find the image distance.
   (b) Determine if the image is real or virtual.
   (c) Find the magnification. (**10 pts**)

5. **Thin Lens**
   A converging lens has a focal length of 15 cm. An object is placed 40 cm from the lens.
   (a) Find the image distance.
   (b) Is the image real or virtual?
   (c) Is it upright or inverted? (**10 pts**)

6. **Index of Refraction**
   Light travels from air into water (index $n = 1.33$).
   (a) What is the speed of light in water?
   (b) If the frequency is constant, what happens to the wavelength? (**8 pts**)