

General Physics IIA — PHYS120

Practice Quest 4 (1 Hour)

Ch. 22 (Induction), Ch. 24 (EM Waves), Ch. 25 (Mirrors), Ch. 26 (Lenses)

Part I: Conceptual Multiple Choice (8 questions)

Circle the best answer.

1. An emf is induced in a loop of wire when: (2 pts)
 - (a) The magnetic field is constant.
 - (b) The magnetic flux through the loop changes.
 - (c) The loop is stationary.
 - (d) The loop has zero resistance.
2. A conducting loop moves into a region of magnetic field. The induced current direction is determined by: (2 pts)
 - (a) Ohm's law
 - (b) Coulomb's law
 - (c) Lenz's law
 - (d) Snell's law
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 convex 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
6. A concave mirror produces a real image when the object is: (2 pts)
- (a) Inside the focal point
 - (b) At the focal point
 - (c) Beyond the focal point
 - (d) At any distance
7. A converging lens produces a real image when the object is: (2 pts)
- (a) Inside the focal length.
 - (b) At the focal length.
 - (c) Beyond the focal length.
 - (d) At any distance.
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. Induced EMF

A circular loop of radius 4.0 cm is placed in a perpendicular magnetic field that decreases from 0.60 T to 0.20 T in 0.10 s.

- (a) Calculate the magnitude of the induced emf.
- (b) State the direction of the induced current (qualitative). (10 pts)

2. Ohm's Law with Induction

A coil has a resistance of $2.0\ \Omega$ and an induced emf of 1.2 V.

- (a) Find the current in the coil.
- (b) What happens to the current if the resistance is tripled? (8 pts)

3. Electromagnetic Waves

A radio wave has a wavelength of 3.0 m.

- (a) What is its frequency?
- (b) Identify the region of the electromagnetic spectrum. (8 pts)

4. **Convex Mirror**

An object is placed 20 cm in front of a convex mirror with focal length -15 cm.

- (a) Find the image distance.
- (b) Is the image real or virtual?
- (c) Find the magnification.

(10 pts)

5. **Thin Lens**

A diverging lens has a focal length of -12 cm. An object is placed 30 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 a medium where its speed is 2.0×10^8 m/s.

- (a) Calculate the index of refraction of the medium.
- (b) What happens to the wavelength in the medium?

(8 pts)

Useful Equations:

$$\mathcal{E} = \frac{\Delta\Phi_B}{\Delta t}, \quad \Phi_B = BA$$

$$c = \lambda f, \quad n = \frac{c}{v}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}, \quad m = -\frac{d_i}{d_o}$$