Ray optics

Question 22

Concept: Mirror in water and apparent distance

- **Refraction through water** affects the apparent position of the object seen by the mirror.
- Uses **mirror formula** and apparent depth formula:

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

Adjusted for refractive index $\mu = 1.33$.

Question 23

Concept: Compound microscope – final image at infinity

- Use of **lens combination**:
  - Objective forms a real image at the focal point of eyepiece.
  - Image distance = objective image to eyepiece = focal length of eyepiece.
- Uses lens formula and ray tracing.

Question 24

Concept: Apparent shift due to glass block

- Based on **optical path and apparent depth**:

$$\Delta = d\left(1 - \frac{1}{\mu}\right)$$

or related shift equations depending on setup.

Question 25

Concept: Image through plano-concave lens on paper

- The lens acts as a **diverging lens**, so image appears **closer to the lens**.
- Basic image formation using thin lens approximation.

Question 26

Concept: Dispersion without deviation using prism combination

- Condition:

$$\mu_1 A_1 = \mu_2 A_2$$

where A is angle of prism. Used to cancel deviation while allowing dispersion.

Question 27

Concept: Telescope angular magnification

- Angular magnification:

$$M = \frac{f_o}{f_e}$$

- Subtended angle at eye = $M \times \theta_{\text{object}}$

Question 28

Concept: Lens in a denser medium (liquid)

- Focal length changes with medium:

$$f_{\text{medium}} = f_{\text{air}} \cdot \frac{(n_{\text{glass}} - 1)}{(n_{\text{glass}} - n_{\text{medium}})}$$

- Sign change depends on net power.

Question 29

Concept: Formation of multiple images with mirrors

- Uses formula:

$$n = \frac{360°}{\theta} - 1$$

To get 3 images, solve for θ.

Question 30

Concept: Lens power in a different medium

- Power in medium:

$$P = \left(\frac{\mu_{\text{lens}}}{\mu_{\text{medium}}} - 1 \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

- Use given power and focal length to compute refractive index of liquid.