Ray optics

Question 14

Concept: Prism and angle symmetry (isosceles prism case)

- Given: $i = e$, so the prism is in **minimum deviation** condition.
- Uses the relation:

$$\mu = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

- Calculate refractive index μ when angle of incidence = emergence.

Question 15

Concept: Power of corrective lens (spectacles)

- Uses lens formula:

$$P = \frac{100}{v}$$

  where $v =$ distance to desired object (in cm), and the person's far point is 30 cm.

Question 16

Concept: Concave mirror image formation

- Object at 40 cm, focal length = 20 cm → object is beyond center of curvature.
- Use mirror formula:

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

- Image is **real, inverted, and smaller**.

Question 17

Concept: Apparent depth and refraction in liquids

- Based on **Snell's Law and geometry**: the liquid makes the lower end visible via refraction.
- Use trigonometry in right triangle formed by actual and apparent positions.

Question 18

Concept: Effective focal length of lens system with liquid

- Combination of two **plano-concave lenses** with liquid in between.
- Use **lens maker's formula** and **effective focal length of combination**:

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{d(n-1)}{n}$$

Question 19

Concept: Special prism geometry with symmetric triangle and ray path

- Triangle setup with $AQ = AR$ implies **equal path**, symmetry in deviation.
- Use prism geometry and trigonometry to find angle of deviation.

Question 20

Concept: Critical angle and refraction from slab immersed in liquid

- Uses **Snell's Law** and nested trigonometric limits for **maximum incidence angle** that ensures exit only through opposite face.
- Concept: ray totally internally reflects at one face and exits only through another.

Question 21

Concept: Optical path shift due to glass slab

- When slab of refractive index μ and thickness t is introduced:
  Apparent shift:

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

- This determines **how much the microscope must be adjusted**.
