Ray optics

Question 1

Concept: Relative motion in mirrors (convex mirror)

- Uses the **mirror formula and velocity magnification** for a convex mirror.
- Key idea: In convex mirrors, the image moves slower than the object, and its speed can be calculated using the **linear magnification** $m = \frac{v}{u}$ and differentiation to relate object and image velocities.

Question 2

Concept: Critical angle and total internal reflection in water

- Based on **Snell's law** and **critical angle** for light traveling from water to air.
- Concept of **circular horizon** or **Snell's window**: the cone of light visible to a submerged observer looking upward.
- Uses trigonometry:
  $\sin\theta_c = \frac{1}{n} \Rightarrow \theta_c = \sin^{-1}\left(\frac{1}{n}\right)$,
  and then $r = h\tan\theta_c$

Question 3

Concept: Combination of thin lenses and image formation

- Uses **lens formula**: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ for each lens in sequence.
- Applies **image formed by one lens becomes object for next**.
- Sequential ray tracing or calculation for 3 lenses.

Question 4

Concept: Minimum deviation in prisms

- Uses the relation:
  $\mu = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$
- Given $\mu = \cot\left(\frac{A}{2}\right)$, solve for **angle of minimum deviation** D_m.
- Involves trigonometric identity manipulations and properties of prism deviation.

Let me know if you want step-by-step solutions too.