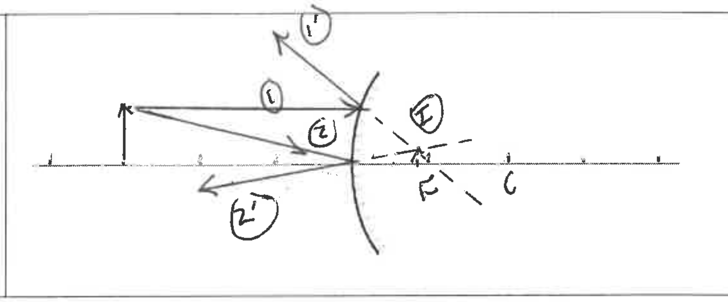
Physics 2100 (SP 2018), Exam3a, Name ____________ ID ____________ Score ________

P1. Convex spherical mirror (20%)

Given: R = 20 mm, h_0 = 8 mm, and p = 30 mm.

Find:

a) Focal length, f. Ans. -10 mm
b) q. Ans. -7.5 mm
c) h_i. Ans. 2 mm
d) Ray-diagram confirmation on ~~left~~ right
e) Is the image real or virtual? Ans. Virtual

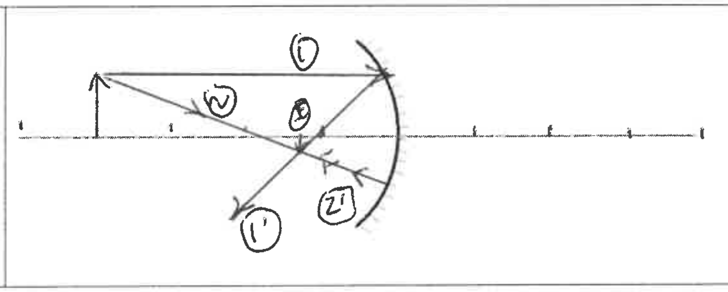


P2. Concave spherical mirror (20%)

Given: R = 20 mm, h_0 = 8 mm, and p = 40 mm.

Find:

a) Focal length, f. Ans. 10 mm
b) q. Ans. 13.3 mm
c) h_i. Ans. -2.7 mm
d) Ray-diagram confirmation on ~~left~~ right
e) Is the image real or virtual? Ans. Real

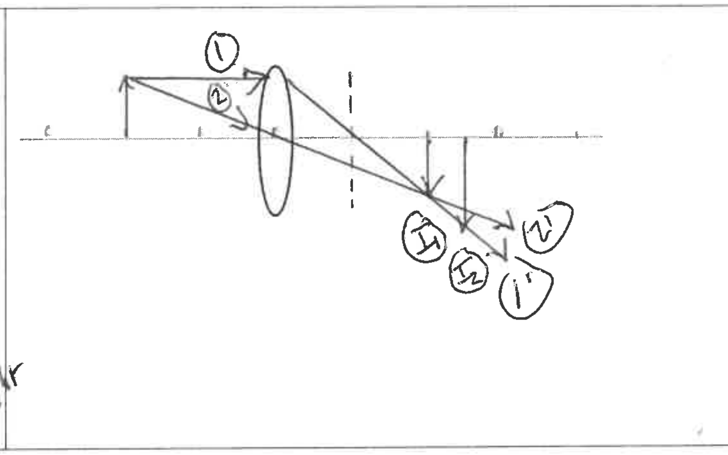


P3. Convergent/divergent thin-lens (30%)

Given: f1 = 10 mm, h_{01} = 8 mm, and p1 = 20 mm.

Find:

a) The image location, q1, Ans. 20 mm
b) The image height, h_{i1}, Ans. -8 mm
c) Ray-diagram confirmation for the 1st lens
d) Is the image real or virtual? Ans. Real
e) If the 2nd divergent lens (dashed) with f = - 30 mm is placed in the observer side, and separated with the 1st lens by 10 mm, find the final image location respect to the 2nd lens, (6%) Ans. 15 mm, and the final image height, h_{i2}, (2%) Ans. -12 mm (2%) **and indicate it on ~~left~~** right



P4. Wave diffraction/interference (30%)

A single-slit diffraction/interference pattern (Fig. 1) was taken using a 5mW (mW = 10^{-3} W) HeNe laser (λ = 632.8 nm, 1 nm = 10^{-9}m) under the condition: the distance between the slit and screen is 3 m.

a) (5 %) Assume circular laser beam cross-section with a diameter of 0.003 m, find the laser energy flux, Ans. 707 W/m²
b) (5 %) Find the electric field intensity at the slit, Ans. 516 V/m
c) (5 %) Indicate the dark locations of m = ±1, ±2, ±3 on the figure below:
d) (15%) Find the slit width in unit of μm (1 μm = 10^{-6} m), Ans. 121

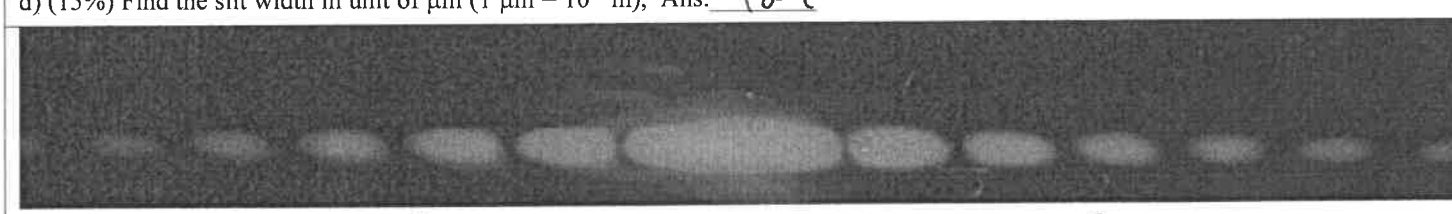


Fig. 1 -3 -2 -1 +1 +2 +3

Reference Equations:

Mirror (or thin-lens) equation: q = pf/(p – f), M = -q/p, hi = Mho, for mirror case, f = ± R/2

Diffraction/Interference: Two-slit **bright** condition: $d\sin(\theta_B) = m\lambda$, m = 0, ±1, ±2, ±3…Single-slit **dark** condition: $a\sin(\theta_D) = m\lambda$, m = ±1, ±2, ±3…Small-angle approximation: $\sin(\theta) \sim \tan(\theta) \sim y/L$. $S_{EM} = c\varepsilon_0 E^2$, c = 3E+8 m/s, ε_0 = 8.85E-12 F/m