Physics 3034 – Spring 2026
Due January 30.

Homework 01 – Rev C

SPN 1–01 Optics vocabulary
The following terms are discussed in Pedrotti Chapter 2. They can be defined in words but the definitions are clearer if you use a sketch AND a brief (one or two sentences) description. Do not be shy about your sketching ability. The same sketch can be used for multiple related terms at your option.

a. Wavefront

b. Isotropic radiation

c. Paraxial rays

d. Critical Angle

e. Object Plane

f. Image Plane

g. Conjugate points

h. Principal of Reversability

SPN 1–02

a. Define Fermat's principle (sketch optional)

b. Define optical path length (sketch optional)

c. How are these two concepts related?

SPN 1–03 Fermat and Snell's law
Copy figure 2-6 from Pedrotti and show the steps that lead from Fermat's theorem to snell's law.

SPN 1–04 Physics Phun with Protractors – Understanding the fish illusion (Requires understanding Pedrotti section 2-5)

[a] Sketch a fish in water Make at least a 3" x 3" sketch of a fish under water. (the sketch is 3", not the fish – the fish is a point, use it's eyeball!). Draw three rays leaving the fish's eyeball and emerging from the water. Use a protractor to do Snell's law properly ($n_{water} = 1.33$). Show that the three rays converge (approximately) to a point and that a fish in water looks closer to the surface than it actually is.
[b] Measure how much closer your fish appears in water and compare that result with equation 2.4. Why don't they agree exactly? (Is it because you are a terrible artist? Some other reason?)

SPN 1–05 Physics Phun with Protractors – Ray Tracing a lens
A page was attached at the end of this assignment to make the drawing easier. The page has a large sketch of a lens 3 parallel rays are drawn entering the lens, and the center of the radius of curvature is indicated as point P. Assume the lens is made of glass (so n=1.5).

[a] Use your protractor to measure θ_1 for each ray. Use Snell's law to calculate θ_2. Tabulate θ_1 and θ_2 for the three rays. (Note that your table will have six entries because each ray has a set of entrance and exit angles from the glass.)
[b] Now that you have calculated the angles, draw the path of the rays entering and leaving the glass. (Note that you probably have to draw the ray moving through the glass before you can even measure the exit angle).
[c] Based on your sketch, determine the focal length of the lens.
[d] Based on the lensmaker's equation, determine the focal length of the lens. Do they agree? (If not, why not?)

SPN 1–06

[a] A meniscus lens made of glass (convex on front size, concave on back) has radii of curvature with magnitudes of 20 cm and 60 cm respectively. Calculate the focal length (get the signs right!)

[b] Repeat part 'a' but with a bi-convex lens (same magnitude of radii.

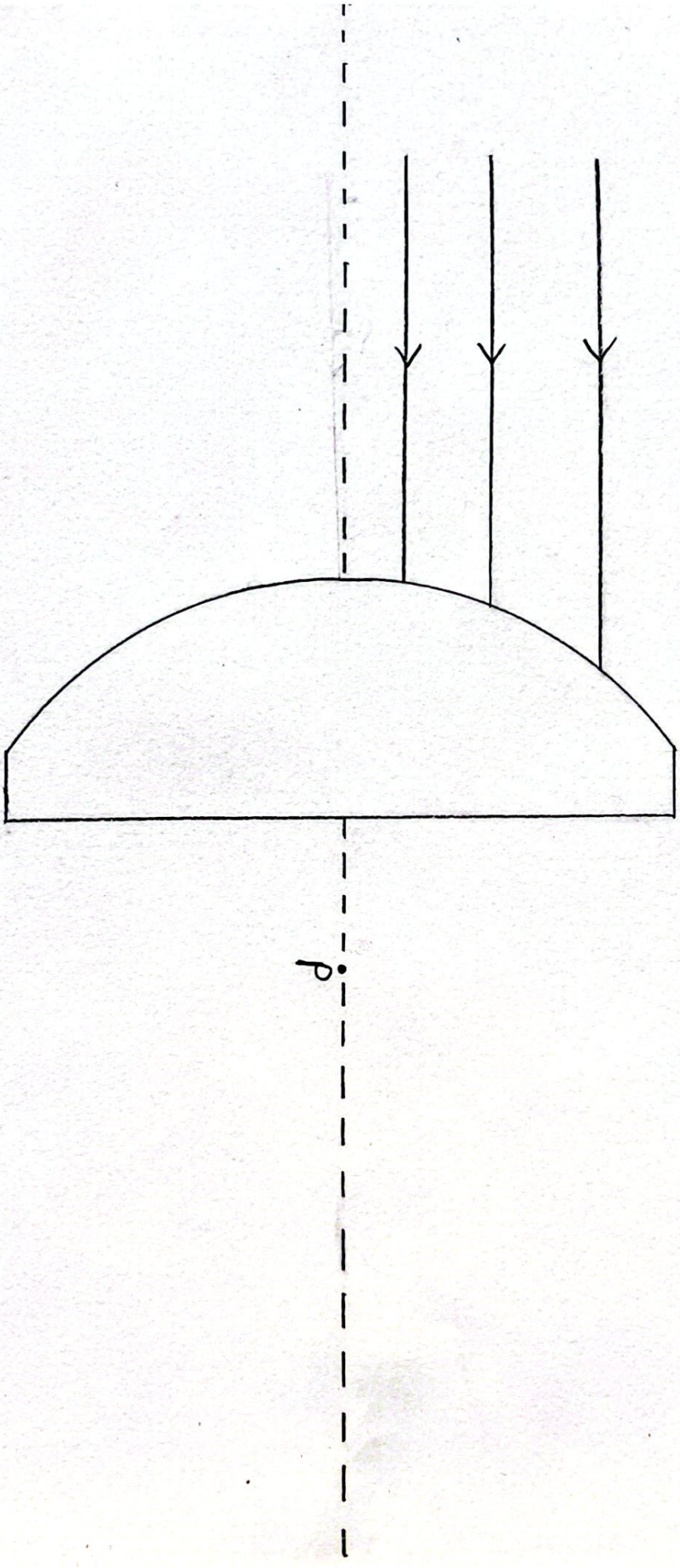
[c] For lens of part 'a' an object is placed 150 cm from the lens. Where is the image and what is the magnification?

[d] Sketch the case of part 'c' with the three principal rays. Draw it to scale (it should confirm your answer to part c.

[e] For the part 'a' lens, let the object be placed 30 cm from the lens. Where is the image and what is the magnification?

[f] Sketch the case of part 'e' with the three principal rays. Draw it to scale.

SPN 1–07 Pedrotti 2-19 (Requires understanding section 2-9)


P