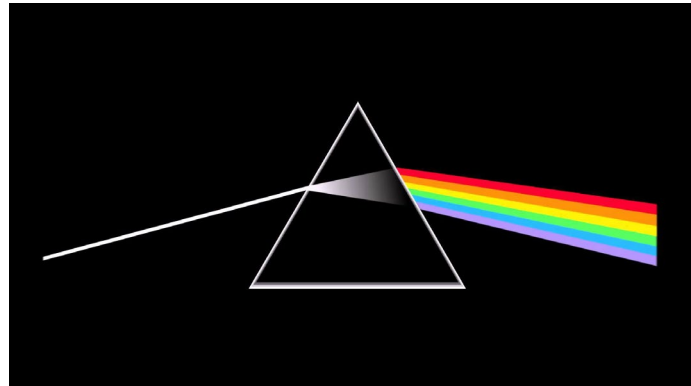1. Is this person below near-sighted or far-sighted? Justify your answer.

2. Pink Floyd's The Dark Side of the Moon Album cover depicts an equilateral prism dispersing incident white light into a spectrum. The yellow band in the emerging spectrum is fairly realistic in terms of its angle of refraction leaving the prism. Unfortunately, the other colors do not obey the laws of optics, but we won't hold that against the designer Storm Thorgerson and artist George Hardie. With respect to the first surface normal, the angle of incidence of the white light is $\theta_1 = 45.3°$. With respect to the second surface normal, the angle of refraction of the yellow light is $\theta_2' = -40.446°$. Using Snell's law and the fact that the internal angles satisfy $\theta_1' - \theta_2 = A$, where A is the apex angle of the prism, do the following:

   (a) Find the refractive index of the prism.

   (b) Find a suitable optical material that has this refractive index.

3. In Alfred Hitchcock's movie *Rear Window*, Jimmy Stewart witnesses a murder in a neighboring apartment. In the scene shown below, he is using a 35 mm film camera, and a lens with a focal length $f = 400mm$ and $F/\# = 5.6$. Based on this information, answer the following questions:

(a) Estimate the resolution limit of the camera.

(b) Estimate the horizontal and vertical full field of view?

(c) What is the entrance pupil diameter of the camera?

(d) What is the power of the lens?

(e) Let's assume the lens is a telephoto design consisting of two *thin* lenses separated by a distance $t = 100mm$. The paraxial raytrace of the marginal and chief rays is shown below. Where is the aperture stop located?

		Lens 1		Lens 2		Image
-phi		-0.005		0.005		
t			100		200	
y(marg)		35.71429		17.85714		0
u(marg)	0		-0.17857		-0.08929	
y(chief)		0		5.4125		21.65
u(chief)	0.054125		0.054125		0.081188	

(f) What is the distance from the front of the telephoto lens to the image plane?

(g) Where is the rear principal plane located relative to the first lens?

(h) What is the Lagrange Invariant of the system?

4. An optical element consists of a spherical front surface with radii of curvature $R1 = 42\ mm$ and a flat back surface. The back surface is located at the rear focal point of the first surface. The index of refraction of the element is 1.50.

(a) What is the thickness of the optical element?

(b) Using the real raytracing equations developed in class, calculate where a ray with origin $\vec{r}_o = (0, 12.5, -10)$ and direction $\vec{r}_d = (0, 0, 1)$ intersects the back surface. For convenience, put the origin at the vertex of the first surface.

(c) The incident ray is parallel to the optical axis, but doesn't intersect the optical axis at the back surface. Why?