1. Incident light in air impinges on a diamond. If the angle of the incident ray is 60° from the normal find the angles of the reflected and refracted rays. The speed of light in a diamond is $1.23932 \times 10^8 \text{ m/s}$. 

(15)

2. An illusionist causes a valuable piece of jewelry apparently to disappear by dropping it in a pool of water directly under the center of a circular platform floating on the surface. Find the minimum diameter of the platform that would prevent the jewel from being seen. Assume the water surface is calm, the index of refraction of water is 1.33, and the depth of the water is 2.00 m. 

(20)

3. A concave spherical mirror has a radius of 20 cm. A real object is placed on the optical axis 15 cm from the mirror.

a. Compute where the image is and describe it (real or virtual, upright or inverted, enlarged or diminished). 

(10)

b. Construct a ray tracing diagram. (try to draw it carefully to scale). 

(5)

4. A converging thin lens has a focal length of 20 cm. A real object is placed on the optical axis 15 cm from the lens.

a. Compute where the image is and describe it (real or virtual, upright or inverted, enlarged or diminished). 

(10)

b. Construct a ray tracing diagram. (try to draw it carefully to scale). 

(5)

5. A diverging thin lens has a focal length of 20 cm. A virtual object is placed on the optical axis 25 cm from the lens.

a. Compute where the image is and describe it (real or virtual, upright or inverted, enlarged or diminished). 

(10)

b. Construct a ray tracing diagram. (try to draw it carefully to scale). 

(5)

6. A thin film of oil covers the surface of a glass of water. White light is incident on the top surface. A red spot is observed when viewed normal to the surface. If the wavelength of the red light in air is 689 nm and the indices of refraction of the oil and water are 1.45 and 1.33, respectively, then what is the minimum thickness of the layer of oil? 

(15)

7. A diffraction grating has 15,000 lines per inch. What angle of deflection from the incident beam would you observe for light with a wavelength of 650 nm (a maximum) for:

a. first order 

(10)

b. second order 

(5)