Student #: _____ Student Name: _____

Grade 12 Physics Class 11: Wave and Optics

_____ 1. Of the following properties of a wave, the one that is *independent* of the others is its:

(a) amplitude
(b) speed
(c) wavelength
(d) frequency

_____ 2. Light travelling in one material enters another material in which it travels faster. The light wave will:

(a) increase in frequency
(b) increase in wavelength
(c) decrease in frequency
(d) decrease in wavelength
(e) travel through the new material inverted

_____ 3. Two point sources are vibrating in phase producing two-dimensional water wave interference. The first anti-nodal line on either side of the central one will occur at locations where the path difference of the arriving waves is:

(a) $\lambda/4$
(b) $\lambda/2$
(c) $3\lambda/4$
(d) λ
(e) 2λ

4. Two waves travel towards each other, as shown in the figure. Sketch at least three unique interference patterns that will be seen as the waves pass each other.

5. A beam of monochromatic red light with a wavelength of $650\,\text{nm}$ in air travels in water.
   (a) What is the wavelength in water?
   (b) Does a swimmer underwater observe the same or different colour for this light? Explain.

6. Explain Huygens' principle and point source model, and use the model to sketch how a plane wave and a circular wave front propagate forward.

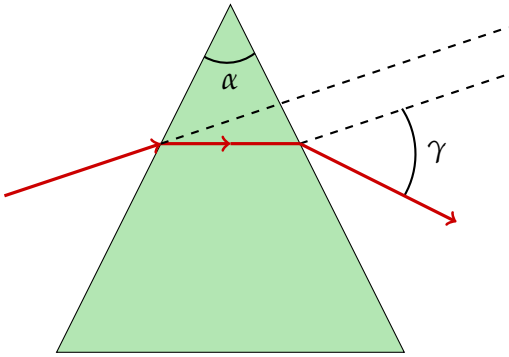
7. A silver coin sits on the bottom of a swimming pool that is $4.0\,\mathrm{m}$ deep. A beam of light reflected from the coin emerges from the pool making a 20° with respect to the water's surface and enters the eye of the observer. Draw a ray from the coin to the eye of the observer. Extend this ray, which goes from the water-air vertical line drawn through the coin, straight back until it intersects with the vertical line drawn through the coin. What is the apparent depth of the swimming pool to this observer?

8. Light passes symmetrically through a prism having an apex angle of α as shown in the figure.

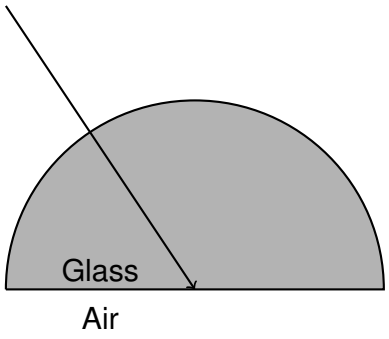
   (a) Show that the angle of deviation δ is related to the apex angle α by:

$$\sin\frac{\alpha+\gamma}{2} = n\sin\frac{\alpha}{2}$$

   (b) If the index of refraction for red light is 1.48 and for violet is 1.52, what is the angle of separation of visible light for a prism with an apex angle of 60°?



9. A student is given a semicircular glass prism and a laser. The student directs the laser perpendicular to the curved surface, as shown in the figure below.



(a) Sketch the paths of the ray exiting the prism.
(b) Explain the paths of the light exiting the prism, making reference to the speed of light in the glass and air.
(c) The index of refraction of the glass can be found by graphing a straight line. Indicate what quantities should be graphed to produce a straight line graph and how the graph could be used to determine the index of refraction of the glass.

10. A laser is directed at a rectangular block of glass, as shown in the figure below. When the laser is directed along path A, the light exits both the top and left side of the glass block. When directed along path B, the light only exits the left side of the glass block.

(a) Explain why the light behaves differently depending on the path.
(b) Using a solid line, sketch the light along path A. Be sure to show enough detail so it is apparent how the light exits both the top and the left side of the block.
(c) Using a dashed line, sketch the light along path B. Be sure to show enough detail so it is apparent how the light exits the left side of the block.
(d) Which path will produce the brightest beam exiting the left side of the block? Justify your reasoning.

11. A ray of light falls on a rectangular glass block ($n = 1.50$) that is almost completely submerged in water ($n = 1.33$) as shown below.
    (a) Find the angle θ for which total internal reflection just occurs at point P.
    (b) Would the total internal reflection at point P occur for the value of θ in part (a) if the water were removed?