Student #: _____ Student Name: _____

Grade 12 Physics Class 12: Diffraction and Interference

_____ 1. An ocean wave diffracts as it travels through an opening in a barrier in a harbour. Which of the following variables can be altered to change the amount of diffraction the wave experiences?

I. distance between the source of the waves and the barrier
II. amplitude
III. frequency
IV. wavelength
V. slit width

(a) I and II
(b) II, III, and IV
(c) I, III, and IV
(d) III, IV, and V
(e) I and IV

_____ 2. As a student is performing a double slit experiment to determine the wavelength of a light source, she realizes that the nodal lines are too close together to be accurately measured. To increase the distance between the nodal lines, she could:

(a) decrease the slit separation
(b) decrease the distance between the slits and the screen
(c) move the light source closer to the slits
(d) both (a) and (b)
(e) (a), (b), and (c)

_____ 3. An observer can hear sound from around a corner but cannot see light from around the same corner. Which of the following helps to explain this phenomenon?

(a) Sound is a longitudinal wave, and light is an electromagnetic wave.
(b) Sound is a mechanical wave, and light is a transverse wave.
(c) Light travels at a speed much faster than that of sound.
(d) Light has a much shorter wavelength than sound.

_____ 4. The brightest and clearest diffraction patterns are seen when light is shone through:

(a) a single slit
(b) a double slit
(c) a diffraction grating
(d) a polarizing filter
(e) a thin soap film

_____ 5. The greater the number of lines on a diffraction grating of a given size,

(a) the greater the range of wavelengths that can be diffracted
(b) the smaller the range of wavelengths that can be diffracted
(c) the greater the distance between the bright fringes produced
(d) the smaller the distance between the bright fringes produced
(e) the less clear the diffraction pattern will be

6. A prism bends blue light more than red. Is the same true of a diffraction grating? Explain.

7. Upon observing an interference pattern produced onto a screen, how could you identify whether a single slit or double slit produced the pattern?

8. Blue light ($\lambda = 475\,\text{nm}$) is sent through a single slit with a width of $2.1\,\mu\text{m}$. What is the maximum possible number of bright fringes produced on the screen?

9. Determine the distance that the *third* bright fringe would lie from the central bisector in a single slit diffraction pattern generated with $542\,\text{nm}$ light incident on a $1.2 \times 10^{-4}\,\text{m}$ slit falling onto a screen $68\,\text{cm}$ away.

10. Predict whether violet light ($\lambda = 404\,\text{nm}$) or red light ($\lambda = 702\,\text{nm}$) will have a wider central maximum in a single-slit diffraction pattern. Calculate the difference if the light is incident on a $6.9 \times 10^{-5}\,\text{m}$ wide slit falling onto a screen $85\,\text{cm}$ away.

11. A double slit apparatus is held $1.2\,\text{m}$ from a screen.
    (a) When red light ($\lambda = 600\,\text{nm}$) is sent through the double slit, the interference pattern on the screen shows a distance of $12.5\,\text{cm}$ between the first and tenth dark fringes. What is the separation of the slits?
    (b) What will be the difference in path length for the waves travelling from each slit to the tenth nodal line?

12. The signal from a $103.9\,\text{MHz}$ FM radio station reflects off a building $400\,\text{m}$ away, effectively creating two sources of the same signal. You are driving at $60\,\text{km/h}$ along a road parallel to a line between the station's antenna and the building, and locate at a perpendicular distance of $6.5\,\text{km}$ from them. How often does the signal appear to fade when you are driving long the road? The speed of radio waves is $3.00 \times 10^{8}\,\text{m/s}$.

13. A beam of parallel rays from a $29\,\text{MHz}$ radio transmission passes between two electrically conducting (therefore opaque to radio waves) buildings $45\,\text{m}$ apart. What is the angular width (i.e. what is the angle θ of the first minima) of the beam when it emerges from between the buildings?