The Interference of Light Assignment 1 NAME_____

1.

a) Describe what is meant by two wave sources being in phase or out of phase.

/1

b) Explain why light from an incandescent source is neither coherent nor monochromatic.

/2

c) Describe constructive and destructive interference in terms of the principle of superposition.

/1

d) Describe diffraction of light by a narrow slit, where the width of the slit is about the same size as the wavelength.

/2

2. Explain why a single slit is used before a double slit for two-slit interference when the light source used is not coherent.

/2

3. Draw an intensity distribution of the pattern caused by a two-slit interference apparatus for monochromatic light and explain why it looks the way it does.

/2

4.

a) Derive $d \sin \theta = m\lambda$ for two-slit interference, where d is the distance between the slits and θ is the angular position of the mth maximum.

/3

b) Calculate the wavelength of light required for two slit interference to produce first order maxima at 5.0° if the slits are 1.1×10^{-6} m apart.

/2

c) If the pattern illuminates a screen 5 m away, determine the distance between the maxima.

/2

5.

a) Describe the interference pattern produced by monochromatic light through a diffraction grating, and explain the large regions of negligible intensity between the maxima.

/2

b) The Antisaurus Defence System uses a $\lambda = 5.1 \times 10^{-7}$ m laser and diffraction grating to deter oncoming formations of pterosaurs*. For the system to work, the second order maxima should be at about 20°.

Show that there are 3400 lines per centimetre in the system's grating.

/3

TOTAL /22

*Pterosaurs are careful creatures, you see, so if a hazard like a laser is shining in their direction they tend to give up formation and go to the beach instead.

The Interference of Light Assignment 2 NAME_____

1. Derive $d \sin \theta = m\lambda$ for the intensity maxima in the pattern produced by a transmission diffraction grating, where d is the distance between the slits in the grating and θ is the angular position of the mth maximum (m specifies the order of the maximum).

/3

2.

a) Sketch a graph of the intensity distribution of the maxima produced by a grating, for monochromatic light.

/2

b) The Antisaurus Defence System uses a $\lambda = 5.1 \times 10^{-7}$ m laser and transmission diffraction grating with 4300 lines per centimetre. Calculate the maximum possible number of pterosaurs that could be deterred at the same time.

/3

3. Describe how a grating can be used to measure the wavelength of light from a monochromatic source.

/2

4.

a) Describe and explain the pattern produced by shining white light through a diffraction grating.

/3

b) Identify the properties of a grating which make it useful in spectroscopy.

/2

5.

a) Explain the speckle effect in terms of interference.

/2

b) Explain how the interference of light can be used to read the information stored on an optical disc.

/3

c) Explain how a diffraction grating is used in the three-beam method to keep the laser on the correct track of a compact disc.

/2

TOTAL /22