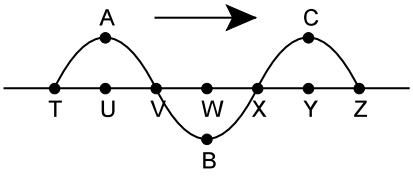
PART A: MULTIPLE CHOICE (10 MARKS)

Choose the best response in each case and place your answer in the appropriate space on your answer sheet.

The following wave disturbance is travelling from left to right through a medium.



1. In the diagram above what is the direction of the instantaneous velocity of a particle of the medium located at point V?
   (a) → (b) ← (c) ↑ (d) ↓

2. In the diagram above , in which direction do the particles of the medium vibrate?
   (a) ⇆ (b) ↓↑

3. A metre stick is immersed half way in a tank of water. The apparent bending of the metre stick at the boundary between air and water is caused by:
   (a) diffraction. (b) interference.
   (c) reflection. (d) refraction.

4. A node is a point where there is always:
   (a) a double crest.
   (b) a double trough.
   (c) destructive interference.
   (d) constructive interference.

5. The fact that we cannot see an interference pattern from the filaments of two small light bulbs which are close together is due to the:
   (a) random phase difference between the light waves from the two sources.
   (b) air molecules diffracting the light waves coming from the two sources.
   (c) very short wavelengths of the light waves.
   (d) very high velocity of light waves.

6. Waves provide a means of transferring:
   (a) liquids. (b) energy.
   (c) particles. (d) matter.

7. Which of the statements below regarding Young's experiment is <u>not</u> true?
   (a) The separation of the modal lines is dependent on the wavelength of the light.
   (b) The interference pattern from this experiment has a nodal line down the centre of the pattern.
   (c) Light waves leaving the two slits have a fixed phase.
   (d) Diffraction of light occurs at both slits.

8. Digital videodiscs (DVDs) use:
   (a) thin-film principles.
   (b) interference effects.
   (c) shorter laser light than compact disc players.
   (d) all of the above.

9. Colours are often observed when gasoline is poured onto water. This effect is primarily produced by:
   (a) interference. (b) absorption.
   (c) diffraction. (d) diffuse reflection.

10. Two objects are just able to be resolved when:
    (a) the distance from the objects to your eyes is sufficiently reduced.
    (b) the angle separating them is greater than the wavelength of light.
    (c) the central maxima of the objects do not overlap.
    (d) the central maximum of one falls on the first minimum of the other.

PART B: MATCH (5 MARKS)

Match the definition from the 1st column to the best term in the 2nd column and place the matching letter in the appropriate space on your answer sheet.

1. A stationary point in a medium produced by destructive interference of two waves travelling in opposite directions.
2. The bending of waves around a barrier.
3. The ability of a telescope or microscope to distinguish objects that are close together.
4. Situation in which a combined or resultant wave has a smaller amplitude than at least one of its component waves.
5. Light that is in phase (the maxima and minima occur at the same time and place).

A) central maxima
B) coherent
C) constructive interference
D) destructive interference
E) diffraction
F) dispersion
G) line spectrum
H) monochromatic
I) nodal point
J) resolving power

SPH4U-4 LIGHT: DIFFRACTION & INTERFERENCE QUIZ#1

PART A: MULTIPLE CHOICE (10 MARKS)

1	2	3	4	5	6	7	8	9	10

PART B: MATCH (5 MARKS)

1	2	3	4	5

PART C: PROBLEMS (35 MARKS)

Answer the following questions on a separate sheet of paper. You may use the back of this sheet if you wish.

1. An interference pattern is set up by two point sources of the same frequency, which are in phase. A point on the second nodal line is 25 cm from one source and 34 cm from the other source. The speed of the waves is 9.5 cm/s.

{2} (a) Include a sketch of the situation.
{4} (b) Calculate the wavelength.
{3} (c) Calculate the frequency of the sources.

2. Two sources 6.0 cm apart, operating in phase, produce water waves. A student selects a point on the second nodal line and measures from it 38 cm to a point midway between the sources and 21 cm (on the perpendicular) to the right bisector.

{2} (a) Include a sketch of the situation.
{4} (b) What is the wavelength of the waves?
{4} (c) What would be the value of the angle θ for a point on the first nodal line?

3. In an interference experiment, red light (600 nm) passes through a double slit. On a screen 1.5 m away, the distance between the 1^{st} and 11^{th} dark bands is 13.2 cm.

{3} (a) What is the spacing between adjacent dark bands?
{4} (b) What is the separation of the slits?
{3} (c) What would the spacing be, between adjacent nodal lines, if blue light (450 nm) were used?

4. When 640 nm light passes through a single slit, the central maximum produced on a screen 2.0 m away is 8.0 cm wide.

{2} (a) What is the separation of adjacent minima (excluding the pair on either side of the central maximum)?
{4} (b) What is the width of the slit?

PART D: MAKING CONNECTIONS (20 MARKS)

Answer the following questions on a separate sheet of paper.

{5} 1. Explain with the use of a diagram how a ripple tank, or a glass-bottomed tank on legs, is able to create dark and bright areas on a screen located beneath when illuminated from above.

{4} 2. By the 17^{th} century, the apparently contradictory views of the nature of light placed scientists in two camps. What were the names of the two theories of light? Who was the principle advocate of each?

{4} 3. Which property of light posed the greatest difficulty for physicists attempting to observe the diffraction of light?

{2} 4. Why did the success of Young's experiment convince physicists of the time that light was some type of wave?

{5} 5. Many butterflies have coloured wings due to pigmentation. In some, however, such as the Morpho butterfly, the colours do not result from pigmentation and, when the wing is viewed from different angles, the colours change. Explain how these colours are produced.