Review 4 – waves and index of refraction

For questions 1-5: A wave has a speed of 20 m/s and a frequency of 5 Hz.

1. What is the wavelength of this wave?

2. What is the period of this wave?

3. How far will this wave travel in 50 seconds?

For questions 4-5: The wave above moves into a medium where its speed is 15 m/s.

4. What is the frequency of the wave in this medium?

5. What is the wavelength of the wave in this medium?

6. A source produces a sound wave with a speed of 340 m/s with a frequency of 200 Hz. The source is right of the observer. In which of the following situations will an observer hear a frequency lower than 200 Hz?

(a) The source is moving toward the stationary observer.

(b) The observer is moving away from the stationary source.

(c) The source is moving right and the observer is moving left at 50 m/s.

(d) The source is moving right and the observer is moving right at 340 m/s.

7. The stars in a galaxy emit light with a wavelength of 300 nm, but this light appears to have a wavelength of 400 nm to an astronomer on Earth. Which describes the motion of the galaxy relative to Earth?

A away from Earth B toward Earth C left of Earth D right of Earth

8. A physicist measures the speed of an electromagnetic wave as 1.3 x 108 m/s in a medium. What is the index of refraction of the medium?

9. An electromagnetic wave has a wavelength of 0.09 meters in space. What is the frequency of this wave?

10. A light wave has a wavelength of 400 nm in water (*n* = 1.33). What is the wavelength of this light wave in diamond (*n* = 2.4)?

11. A ray of light is incident on an air-glass (*n* = 1.5) boundary at an angle of 30o with the normal. What is the angle of refraction if the light moved

(a) from air into glass?

(b) from glass into air?

For questions 12-14 refer to an alcohol (*n* = 1.4) – plastic (*n* = 1.8) boundary.

12. In which material does the light have the higher speed?

13. In which material must a light ray be incident for the ray to experience total internal reflection?

14. What is the measure of the critical angle for this boundary?

15. Light first experiences total internal reflection at a liquid-air boundary at an incident angle of 45o. What is the index of refraction of the liquid?

medium P

medium Q

ΘP = 53o

ΘQ = 30o

incident ray

refracted ray

normal

normal

Questions 16-19 refer to the drawing

which shows the path of a light ray

as it moves from medium P into medium Q.

16. Which wave property does this illustrate?

17. In which medium does the wave have

the higher speed?

18. Which medium has the higher index

of refraction?

19. If the index of refraction of material P

is 1.2, what is the index of refraction

of material Q?

20. A light wave has a speed of 1.5 x 108 m/s

in a material with an index of refraction of 2.0.

This light wave moves into a new material which

has an index of refraction of 1.5. What is the speed

of the light wave in this new material?