i.

In which way does blue light change as it travels from diamond into crown glass?

- (1) Its frequency decreases.
- (2) Its frequency increases.
- (3) Its speed decreases.
- (4) Its speed increases.
- 2. The diagram below represents straight wave fronts passing from deep water into shallow

Shallow water

2

1

water, with a change in speed and direction. Which phenomenon is illustrated in the diagram?

(1) reflection	(3) diffraction
(2) refraction	(4) interference

3. The speed of light ( $f= 5.09 \ge 10^{14} \text{ Hz}$ ) in a transparent material is 0.75 times its speed in air. The absolute index of refraction of the material is approximately

(1)0.75	(3)2.3	
(2)1.3	(4)4.0	3_

- 4. What is the speed of a ray of light  $(f= 5.09 \times 10^{14} \text{ hertz})$  traveling through a block of sodium chloride?
  - (1) 1.54 x 10<sup>s</sup> m/s
  - (2) 1.95 x 10<sup>s</sup> m/s
  - (3)  $3.00 \times 10^8 \text{ m/s}$
  - (4)  $4.62 \times 10^8 \text{m/s}$

5. The diagram below shows a ray of light passing from medium X into air.



What is the absolute index of refraction of medium X?

(3)1.73 (4) 0.577

(1)0.500(2) 2.00

6. Aray of light ( $f= 5.09 \ge 10^{14}$  Hz) traveling in air is incident at an angle of 40.° on an air-crown glass interface as shown below.



What is the angle of refraction for this light ray?

(1)25°	(3)40°
(2)37°	(4)78°
6	

Base your answers to questions la and b on the information and accompanying diagram. A monochromatic beam of yellow light, *AB*, is incident upon a Lucite block in air at an angle of  $33^{\circ}$ .

a) Calculate the anglejjf refraction for incident beam *AB*. [Show all work, including the equation and substitution with units.]

*b)* Using a straightedge, a protractor, and your answer from question 7a, draw an arrow to

represent the path of the refracted beam.

Base your answers to questions 8a and b on the information and accompanying diagram. A ray of light passes from air into a block of transparent material Jf as shown in the accompanying diagram.

8. *a)* Measure the angles of incidence and refraction to the nearest degree for this light ray at the air into material *X* boundary and write your answers in the space below.

angle of incidence\_\_\_\_\_

angle of refraction

*b)* Calculate the absolute index of refraction of material *X*. [Show all work, including the equation and substitution with units.]

0



## Normal

Base your answers to questions 9a and b on the



accompany diagram, which shows a light ray ( $f= 5.09 \times 10^{14}$  Hz) in air, incident on a boundary with fused quartz. At the boundary, part of the light is refracted and part of the light is reflected.

- 9. *a)* Using a protractor, measure the angle of incidence of the light ray at the air-fused quartz boundary.
  - *b)* Calculate the angle of refraction of the incident light ray. [Show all work, including the equation and substitution with units.]

Base your answers to questions 10a and *b* on the accompanying diagram which shows a ray of monochromatic light ( $= 5.09 \times 10^{14}$  hertz) passing through a flint glass prism.

10. *a*) Calculate the angle of refraction (in degrees) of the light ray as it enters the air from the flint glass prism. [Show all calculations, including



*b)* Using a protractor and a straightedge, construct the refracted light ray in the air on the diagram above.

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sm oot h, cal m pon d as repr ese nte d in the dia gra m bel ow.



11. A by the laser light?

Normal

11

- (1) the bird and the fish
- (2) the bird and the seaweed
- (3) the crab and the seaweed
- (4) the crab and the fish

Wh ich org anis ms cou ld be illu min

## 1

4

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p r d u c

- t of the absolute index of refraction of water and the speed of light in water?
  - (1) wavelength of light in a vacuum
  - (2) frequency of light in water
  - (3) sine of the angle of incidence
- (4) speed of light in a vacuum
- 14
- 15. What is the speed of light (/"= 5.09 x 10<sup>14</sup> Hz) in flint glass?
  - (1) 1.81 x 10<sup>8</sup>m/s
  - (2) 1.97 x 10<sup>8</sup>m/s
  - (3) 3.00 x 10<sup>8</sup>m/s
  - (4)  $4.98 \ge 10^8 \text{m/s}$
- 15

- 12. What happens to the frequency and the speed of an electromagnetic wave as it passes from air into glass?
  - (1) The frequency decreases and the speed increases.
  - (2) The frequency increases and the speed decreases.
  - (3) The frequency remains the same and the speed increases.
  - (4) The frequency remains the same and the speed decreases. 12
- 13. The speed of light in a material is 2.50 x 10<sup>8</sup> meters per second. What is the absolute index of refraction of the material?

(1)1.20	(3)7.50	
(2)2.50	(4)0.833	13

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16. The diagram below represents a light ray traveling from air to Lucite to medium *Y* 



and back into air. Light travels slowest in

- (1) air, only
- (2) Lucite, only
- (3) medium *Y*, only
- (4) air, Lucite, and medium Y

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Waves

## Normal



Base your answers to questions 17a and b on the information and accompanying diagram.

A ray of light of frequency  $5.09 \times 10^{M}$  hertz is incident on a water-air interface as shown in the accompanying diagram.

17. *a*) Calculate the angle of refraction of the light ray in air.[Show all work, including the equation and substitution with units.]

/;) Calculate the speed of the light while in the water. [Show all work, including the equation and substitution with units.]

- 18. A straight glass rod appears to bend when placed in a beaker of water, as shown in the accompanying diagram. Give an explanation for this phenomenon?
- 19. A beam of monochromatic light has a wavelength of  $5.89 \times 10^{-7}$  meter in air. Calculate the wavelength of this light in zircon. [Show all work, including the equation and substitution with units.]

