

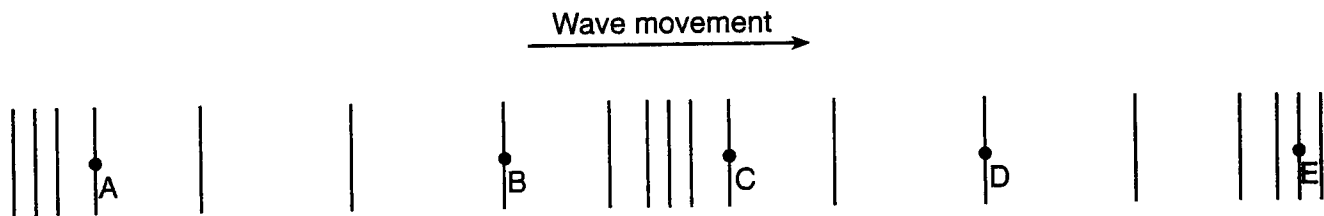
# Review Test - Waves Light and Modern June 2010

This test had 24 credits of 85 for this section of the course (about 28 %). Answer all questions and grade yourself on last page.

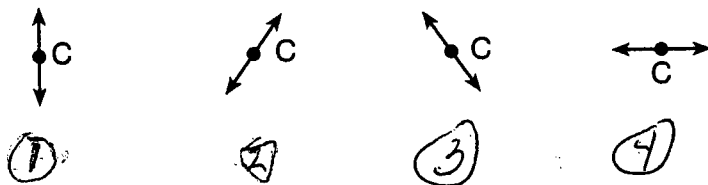
## Part A Questions

Base your answers to questions 24 through 26 on the information and diagram below.

A longitudinal wave moves to the right through a uniform medium, as shown below. Points A, B, C, D, and E represent the positions of particles of the medium.



24 Which diagram best represents the motion of the particle at position C as the wave moves to the right?



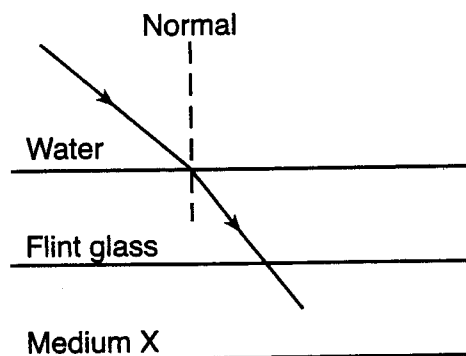
25 The wavelength of this wave is equal to the distance between points

- 1 A and B                       3 B and C  
 2 A and C                       4 B and E

26 The energy of this wave is related to its

- 1 amplitude                       3 speed  
 2 period                           4 wavelength

27 A ray of monochromatic yellow light ( $f = 5.09 \times 10^{14}$  Hz) passes from water through flint glass and into medium X, as shown below.



The absolute index of refraction of medium X is

- 1 less than 1.33                       3 greater than 1.52 and less than 1.66  
 2 greater than 1.33 and less than 1.52                       4 equal to 1.66

28 A light ray traveling in air enters a second medium and its speed slows to  $1.71 \times 10^8$  meters per second. What is the absolute index of refraction of the second medium?

- 1 1.00                       3 1.75  
 2 0.570                       4 1.94

29 Playing a certain musical note on a trumpet causes the spring on the bottom of a nearby snare drum to vibrate. This phenomenon is an example of

- 1 resonance                       3 reflection  
 2 refraction                       4 diffraction

30 In a vacuum, all electromagnetic waves have the same

- 1 speed                       3 frequency  
 2 phase                       4 wavelength

31 A particle that is composed of two up quarks and one down quark is a

- 1 meson                       3 proton  
 2 neutron                       4 positron

32 A helium atom consists of two protons, two electrons, and two neutrons. In the helium atom, the strong force is a fundamental interaction between the

- 1 electrons, only  
 2 electrons and protons  
 3 neutrons and electrons  
 4 neutrons and protons

33 What total mass must be converted into energy to produce a gamma photon with an energy of  $1.03 \times 10^{-13}$  joule?

- 1  $1.14 \times 10^{-30}$                        3  $3.09 \times 10^{-5}$   
 2  $3.43 \times 10^{-22}$                        4  $8.75 \times 10^{29}$

34 Compared to the mass and charge of a proton, an antiproton has

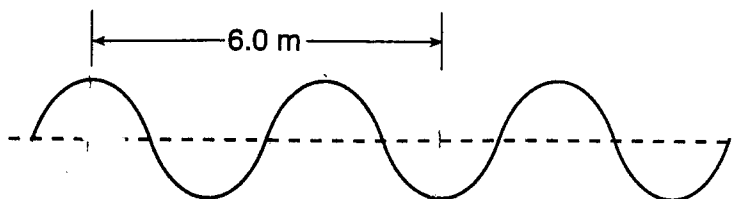
- 1 the same mass and the same charge  
 2 greater mass and the same charge  
 3 the same mass and the opposite charge  
 4 greater mass and the opposite charge

**Note that question 35 has only three choices.**

35 As viewed from Earth, the light from a star has lower frequencies than the light emitted by the star because the star is

- 1 moving toward Earth  
 2 moving away from Earth  
 3 stationary

48 The diagram below represents a periodic wave traveling through a uniform medium.

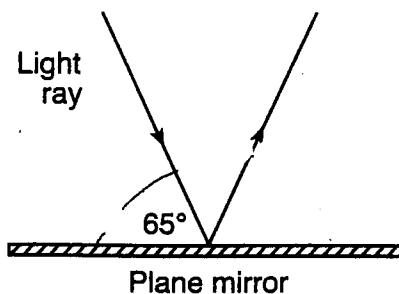


If the frequency of the wave is 2.0 hertz, the speed of the wave is

- Ⓐ 6.0 m/s
- Ⓑ 2.0 m/s

- Ⓒ 8.0 m/s
- Ⓓ 4.0 m/s

49 The diagram below represents a light ray reflecting from a plane mirror.

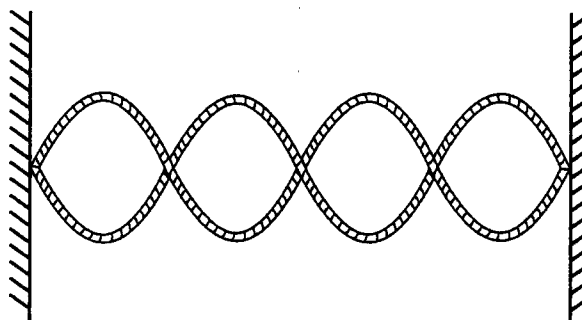


The angle of reflection for the light ray is

- Ⓐ 25°
- Ⓑ 35°

- Ⓒ 50°
- Ⓓ 65°

50 The diagram below shows a standing wave in a string clamped at each end.



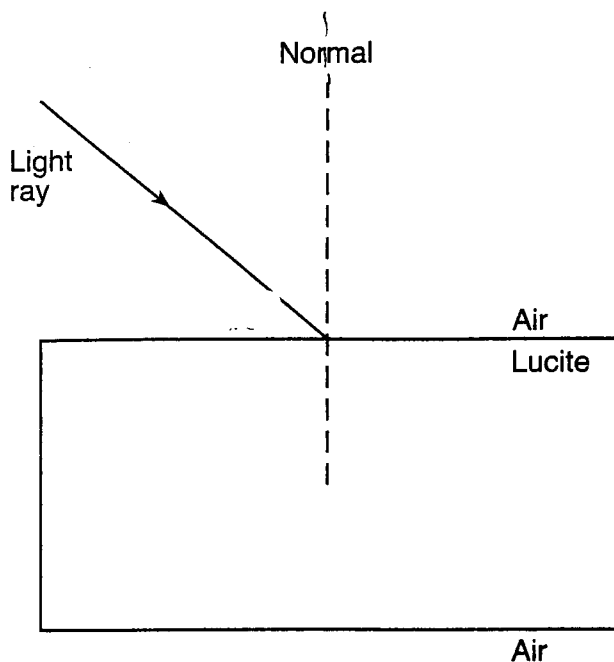
What is the total number of nodes and antinodes in the standing wave?

- Ⓐ 3 nodes and 2 antinodes
- Ⓑ 2 nodes and 3 antinodes

- Ⓒ 5 nodes and 4 antinodes
- Ⓓ 4 nodes and 5 antinodes

Base your answers to questions 69 through 71 on the information and diagram below.

A monochromatic light ray ( $f = 5.09 \times 10^{14}$  Hz) traveling in air is incident on the surface of a rectangular block of Lucite.



69 Measure the angle of incidence for the light ray to the *nearest degree*. [1]

70 Calculate the angle of refraction of the light ray when it enters the Lucite block. [Show all work, including the equation and substitution with units.] [2]

71 What is the angle of refraction of the light ray as it emerges from the Lucite block back into air? [1]

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Base your answers to questions 72 through 75 on the information below.

As a mercury atom absorbs a photon of energy, an electron in the atom changes from energy level  $d$  to energy level  $e$ .

72 Determine the energy of the absorbed photon in electronvolts. [1]

73 Express the energy of the absorbed photon in joules. [1]

74 Calculate the frequency of the absorbed photon. [Show all work, including the equation and substitution with units.] [2]

75 Based on your calculated value of the frequency of the absorbed photon, determine its classification in the electromagnetic spectrum. [1]

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**Part A**

- 24 \_\_\_\_\_
- 25 \_\_\_\_\_
- 26 \_\_\_\_\_
- 27 \_\_\_\_\_
  
- 28 \_\_\_\_\_
- 29 \_\_\_\_\_
- 30 \_\_\_\_\_
- 31 \_\_\_\_\_
- 32 \_\_\_\_\_
  
- 33 \_\_\_\_\_
- 34 \_\_\_\_\_
- 35 \_\_\_\_\_

**Part B**

- 48 \_\_\_\_\_
- 49 \_\_\_\_\_
- 50 \_\_\_\_\_

**Part C**

69 -  $\theta_{incidence} =$  \_\_\_\_\_

71

72  $\theta =$  \_\_\_\_\_

72 \_\_\_\_\_ eV

73 \_\_\_\_\_ joules

74

75

# Answer Sheet

Name                      Score            Key           

## Part A

- 24 4
- 25 2
- 26 1
- 27 4
  
- 28 3
- 29 1
- 30 1
- 31 3
- 32 4
  
- 33 1
- 34 3
- 35 2

| Credits of 24 | %     | Credit of 85 | Regents Score |
|---------------|-------|--------------|---------------|
| 24            | 100.0 | 85.0         | 100           |
| 23            | 95.8  | 81.5         | 96            |
| 22            | 91.7  | 77.9         | 93            |
| 21            | 87.5  | 74.4         | 90            |
| 20            | 83.3  | 70.8         | 87            |
| 19            | 79.2  | 67.3         | 83            |
| 18            | 75.0  | 63.8         | 81            |
| 17            | 70.8  | 60.2         | 77            |
| 16            | 66.7  | 56.7         | 74            |
| 15            | 62.5  | 53.1         | 71            |
| 14            | 58.3  | 49.6         | 68            |
| 13            | 54.2  | 46.0         | 64            |
| 12            | 50.0  | 42.5         | 61            |
| 11            | 45.8  | 39.0         | 57            |
| 10            | 41.7  | 35.4         | 52            |
| 9             | 37.5  | 31.9         | 49            |
| 8             | 33.3  | 28.3         | 44            |
| 7             | 29.2  | 24.8         | 40            |
| 6             | 25.0  | 21.3         | 35            |
| 5             | 20.8  | 17.7         | 31            |
| 4             | 16.7  | 14.2         | 25            |
| 3             | 12.5  | 10.6         | 20            |

## Part B

- 48 3
- 49 1
- 50 3

## Part C

69 -  $\theta_{\text{incidence}} = \underline{50^\circ}$

71  $n_1 \sin \theta_1 = n_2 \sin \theta_2$   
 $1 \sin 50^\circ = 1.5 \sin \theta_2$   
 $\theta_2 = 31^\circ$

72  $\theta = \underline{50^\circ}$

72 -  $\underline{1.24 \text{ eV}}$

73  $1.98 \times 10^{-19} \text{ J}$

74 -  $E = hf$   
 $1.98 \times 10^{-19} \text{ J} = 6.63 \times 10^{-34} \text{ s} (F)$   
 $F = 2.99 \times 10^{14} \text{ Hz}$

75 - infrared