Review Test
Waves Light & Modern
January 2009

Name_____

This year had 24 credits out of 85 possible or about 28 %

22 A dampened fingertip rubbed around the rim of a crystal stemware glass causes the glass to vibrate and produce a musical note. This effect is due to

(1) resonance
(2) refraction
(3) reflection
(4) rarefaction

23 Which type of wave requires a material medium through which to travel?

(1) radio wave
(2) microwave
(3) light wave
(4) mechanical wave

Note that question 24 has only three choices.

24 Compared to the speed of a sound wave in air, the speed of a radio wave in air is

(1) less
(2) greater
(3) the same

Note that question 25 has only three choices.

25 If the amplitude of a wave is increased, the frequency of the wave will

(1) decrease
(2) increase
(3) remain the same

26 Which unit is equivalent to meters per second?

(1) Hz•s
(2) Hz•m
(3) s/Hz
(4) m/Hz

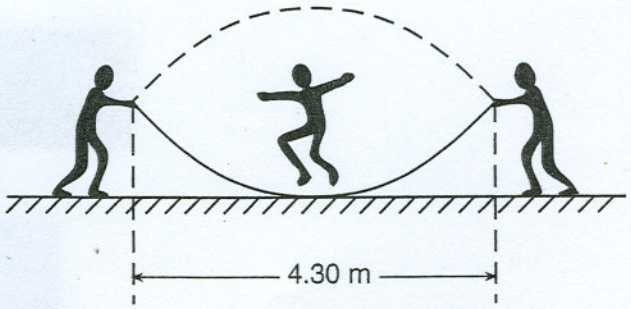
27 Which characteristic is the same for every color of light in a vacuum?

(1) energy
(2) frequency
(3) speed
(4) period

28 What is the speed of light ($f = 5.09 \times 10^{14}$ Hz) in flint glass?

(1) 1.81×10^8 m/s
(2) 1.97×10^8 m/s
(3) 3.00×10^8 m/s
(4) 4.98×10^8 m/s

29 While playing, two children create a standing wave in a rope, as shown in the diagram below. A third child participates by jumping the rope.



What is the wavelength of this standing wave?

(1) 2.15 m
(2) 4.30 m
(3) 6.45 m
(4) 8.60 m

30 A television remote control is used to direct pulses of electromagnetic radiation to a receiver on a television. This communication from the remote control to the television illustrates that electromagnetic radiation

(1) is a longitudinal wave
(2) possesses energy inversely proportional to its frequency
(3) diffracts and accelerates in air
(4) transfers energy without transferring mass

Note that question 31 has only three choices.

31 A wave of constant wavelength diffracts as it passes through an opening in a barrier. As the size of the opening is increased, the diffraction effects

(1) decrease
(2) increase
(3) remain the same

32 A car's horn produces a sound wave of constant frequency. As the car speeds up going away from a stationary spectator, the sound wave detected by the spectator

(1) decreases in amplitude and decreases in frequency
(2) decreases in amplitude and increases in frequency
(3) increases in amplitude and decreases in frequency
(4) increases in amplitude and increases in frequency

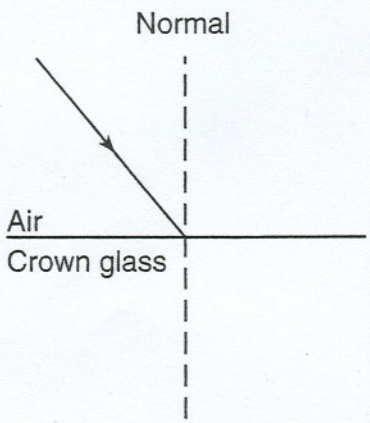
33 An electron in a mercury atom drops from energy level f to energy level c by emitting a photon having an energy of

(1) 8.20 eV
(2) 5.52 eV
(3) 2.84 eV
(4) 2.68 eV

35 Moving electrons are found to exhibit properties of

(1) particles, only
(2) waves, only
(3) both particles and waves
(4) neither particles nor waves

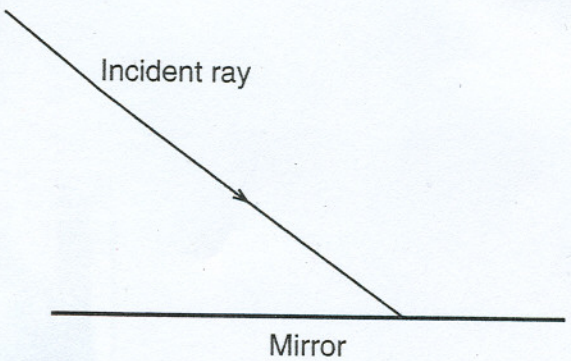
46 A ray of light ($f = 5.09 \times 10^{14}$ Hz) traveling in air is incident at an angle of 40.° on an air-crown glass interface as shown below.



What is the angle of refraction for this light ray?

(1) 25°
(2) 37°
(3) 40°
(4) 78°

54) The diagram below represents a ray of light incident on a plane mirror.



Using a protractor and straightedge, on the diagram *in your answer booklet*, construct the reflected ray for the incident ray shown. [1]

55) A periodic wave travels at speed v through medium A. The wave passes with all its energy into medium B. The speed of the wave through medium B is $\frac{v}{2}$. On the diagram *in your answer booklet*, draw the wave as it travels through medium B. [Show at least one full wave.] [1]

Base your answers to questions 64 through 66 on the information below.

A stationary research ship uses sonar to send a 1.18×10^3-hertz sound wave down through the ocean water. The reflected sound wave from the flat ocean bottom 324 meters below the ship is detected 0.425 second after it was sent from the ship.

64 Calculate the speed of the sound wave in the ocean water. [Show all work, including the equation and substitution with units.] [2]

65 Calculate the wavelength of the sound wave in the ocean water. [Show all work, including the equation and substitution with units.] [2]

66 Determine the period of the sound wave in the ocean water. [1]

Base your answers to questions 70 through 72 on the passage below.

For years, theoretical physicists have been refining a mathematical method called lattice quantum chromodynamics to enable them to predict the masses of particles consisting of various combinations of quarks and antiquarks. They recently used the theory to calculate the mass of the rare B_c particle, consisting of a charm quark and a bottom antiquark. The predicted mass of the B_c particle was about six times the mass of a proton.

Shortly after the prediction was made, physicists working at the Fermi National Accelerator Laboratory, Fermilab, were able to measure the mass of the B_c particle experimentally and found it to agree with the theoretical prediction to within a few tenths of a percent. In the experiment, the physicists sent beams of protons and antiprotons moving at 99.999% the speed of light in opposite directions around a ring 1.0 kilometer in radius. The protons and antiprotons were kept in their circular paths by powerful electromagnets. When the protons and antiprotons collided, their energy produced numerous new particles, including the elusive B_c.

These results indicate that lattice quantum chromodynamics is a powerful tool not only for confirming the masses of existing particles, but also for predicting the masses of particles that have yet to be discovered in the laboratory.

70 Identify the class of matter to which the B_c particle belongs. [1]

71 Determine both the sign and the magnitude of the charge of the B_c particle in elementary charges. [1]

72 Explain how it is possible for a colliding proton and antiproton to produce a particle with six times the mass of either. [1]

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Name _____

Part A

22 _____
23 _____
24 _____
25 _____
26 _____
27 _____
28 _____

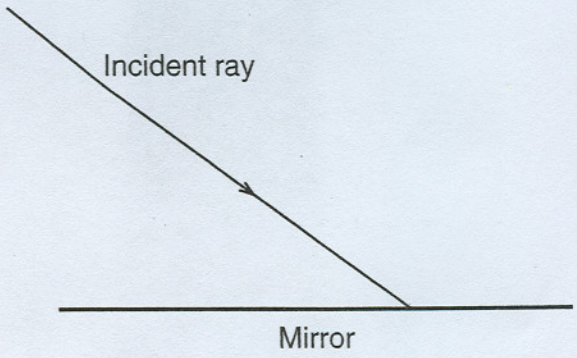
32 _____
33 _____
35 _____

29 _____
30 _____
31 _____

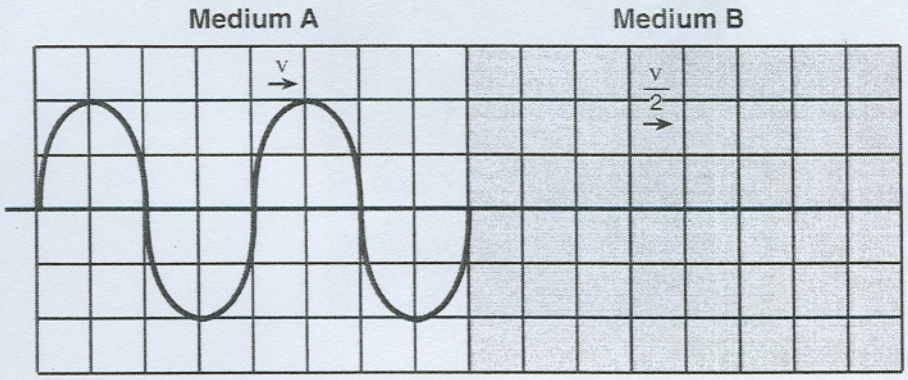
Part B

46 _____

54)



55



Part C

64

65

66 T= _____ seconds

70 _____

71 Charge = _____ C

72 -

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Name Answer Key

Part A

22 1
23 4
24 2
25 3
26 2
27 3
28 1

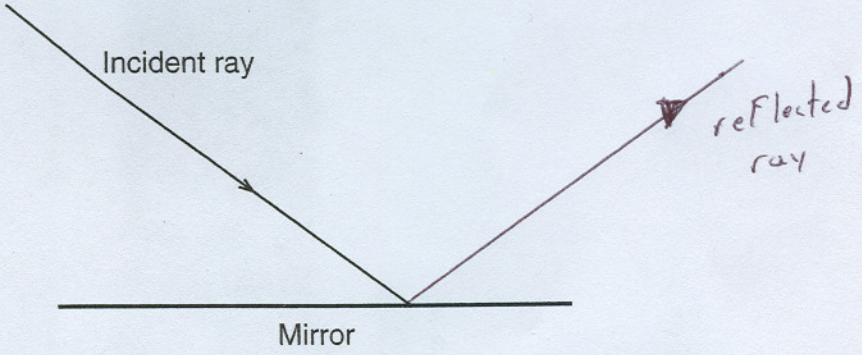
32 1
33 3
35 3

29 4
30 4
31 1

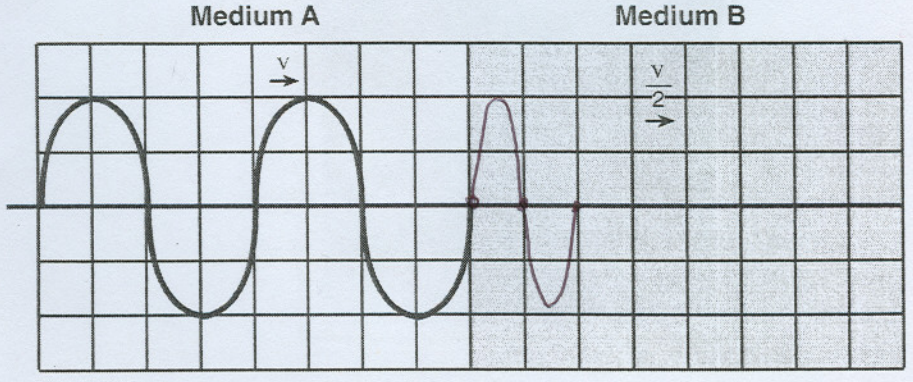
Part B

46 1

54)



55



Wavelength in B = $\frac{1}{2}$ wavelength in A

Part C

64 $V = \frac{d}{t} = \frac{2 \times (324\,m)}{0.425\,sec} = 1520\,m/s$

65 $V = f\lambda$

$1520\,m/s = (1.18 \times 10^3)\,Hz\,(\lambda)$

$\lambda = 1.29\,m$

66 $T = 8.47 \times 10^{-4}$ seconds

70 meson or haydron

71 Charge = +1 e

72 - Energy is converted to mass

Credits of 24

Credits of 85

Scaled regents score

	%		
24	100.0	85.0	100
23	95.8	81.5	99
22	91.7	77.9	94
21	87.5	74.4	91
20	83.3	70.8	88
19	79.2	67.3	85
18	75.0	63.8	82
17	70.8	60.2	79
16	66.7	56.7	76
15	62.5	53.1	72
14	58.3	49.6	69
13	54.2	46.0	65
12	50.0	42.5	62
11	45.8	39.0	58
10	41.7	35.4	53
9	37.5	31.9	50
8	33.3	28.3	45
7	29.2	24.8	41
6	25.0	21.3	35
5	20.8	17.7	31
4	16.7	14.2	25
3	12.5	10.6	20