

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 p.m., only

The answer sheet for Part A and Part B–1 is the last page of this examination booklet. Turn to the last page and fold it along the perforations. Then, slowly and carefully, tear off the answer sheet and fill in the heading.

The answer booklet for Part B–2 and Part C is stapled in the center of this examination booklet. Open the examination booklet, carefully remove the answer booklet, and close the examination booklet. Then fill in the heading of your answer booklet.

You are to answer *all* questions in all parts of this examination according to the directions provided in the examination booklet. Record your answers to the Part A and Part B–1 multiple-choice questions on your separate answer sheet. Write your answers to the Part B–2 and Part C questions in your answer booklet. All work should be written in pen, except for graphs and drawings, which should be done in pencil. You may use scrap paper to work out the answers to the questions, but be sure to record all your answers on the answer sheet and in the answer booklet.

When you have completed the examination, you must sign the statement printed at the end of your separate answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet and answer booklet cannot be accepted if you fail to sign this declaration.

Notice . . .

A scientific or graphing calculator, a centimeter ruler, a protractor, and a copy of the *2002 Edition Reference Tables for Physical Setting/Physics*, which you may need to answer some questions in this examination, must be available for your use while taking this examination.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

Answer all questions in this part.

Directions (1–35): For each statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

1 A ball dropped from rest falls freely until it hits the ground with a speed of 20 meters per second. The time during which the ball is in free fall is approximately

- (1) 1 s (3) 0.5 s
(2) 2 s (4) 10 s

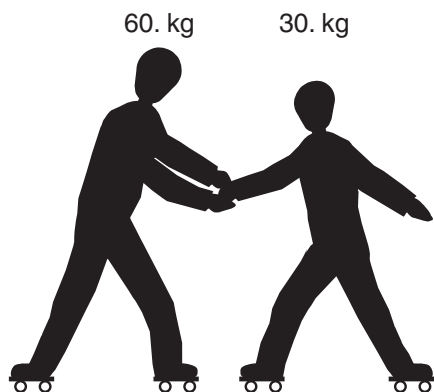
2 In a 4.0-kilometer race, a runner completes the first kilometer in 5.9 minutes, the second kilometer in 6.2 minutes, the third kilometer in 6.3 minutes, and the final kilometer in 6.0 minutes. The average speed of the runner for the race is approximately

- (1) 0.16 km/min (3) 12 km/min
(2) 0.33 km/min (4) 24 km/min

3 A golf ball is hit with an initial velocity of 15 meters per second at an angle of 35 degrees above the horizontal. What is the vertical component of the golf ball's initial velocity?

- (1) 8.6 m/s (3) 12 m/s
(2) 9.8 m/s (4) 15 m/s

4 In the diagram below, a 60.-kilogram rollerskater exerts a 10.-newton force on a 30.-kilogram rollerskater for 0.20 second.

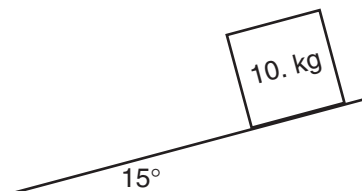


What is the magnitude of the impulse applied to the 30.-kilogram rollerskater?

- (1) 50. N•s (3) 6.0 N•s
(2) 2.0 N•s (4) 12 N•s

Note that question 5 has only three choices.

5 In the diagram below, a 10.-kilogram block is at rest on a plane inclined at 15° to the horizontal.



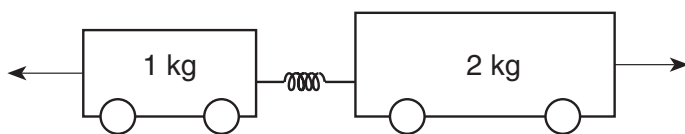
As the angle of the incline is increased to $30.^\circ$, the mass of the block will

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

6 If the direction of a moving car changes and its speed remains constant, which quantity must remain the same?

- (1) velocity (3) displacement
(2) momentum (4) kinetic energy

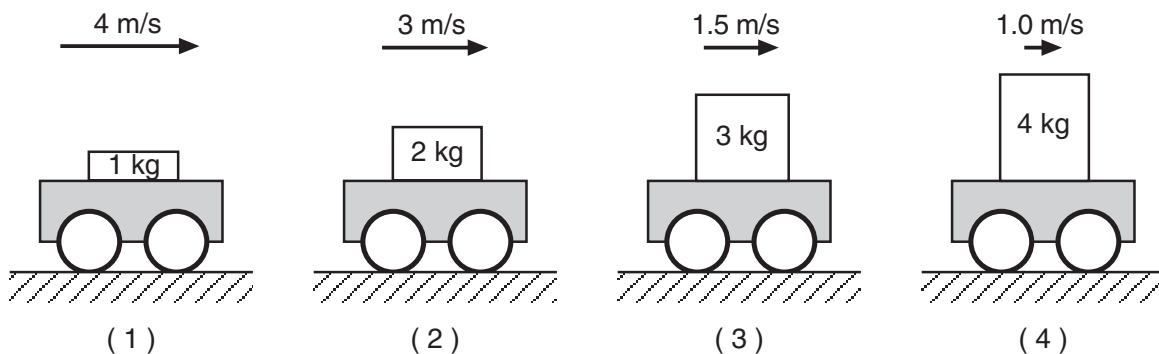
7 Two carts are pushed apart by an expanding spring, as shown in the diagram below.



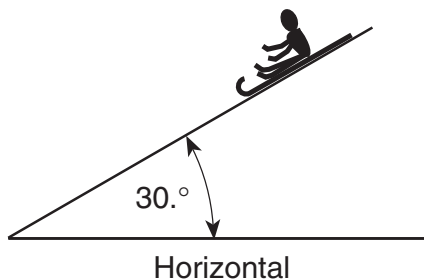
If the average force on the 1-kilogram cart is 1 newton, what is the average force on the 2-kilogram cart?

- (1) 1 N (3) 0.5 N
(2) 0.0 N (4) 4 N

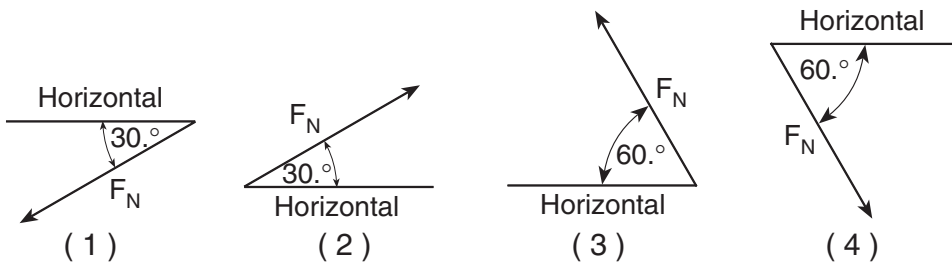
8 A lab cart is loaded with different masses and moved at various velocities. Which diagram shows the cart-mass system with the greatest inertia?



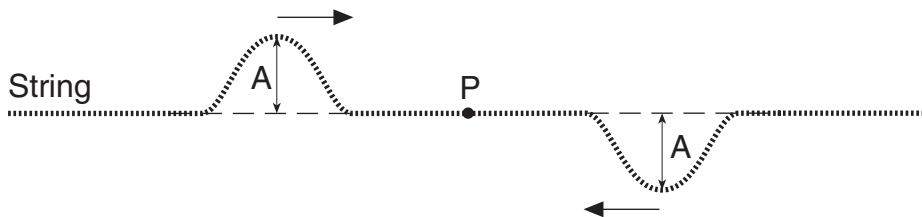
9 The diagram below shows a sled and rider sliding down a snow-covered hill that makes an angle of 30° with the horizontal.



Which vector best represents the direction of the normal force, F_N , exerted by the hill on the sled?



10 The diagram below shows two pulses of equal amplitude, A , approaching point P along a uniform string.



When the two pulses meet at P , the vertical displacement of the string at P will be

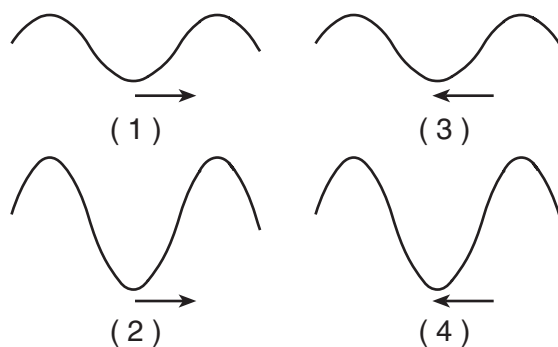
- (1) A (3) 0
 (2) $2A$ (4) $\frac{A}{2}$

- 11 The energy of a water wave is most closely related to its
- (1) frequency (3) period
 (2) wavelength (4) amplitude
- 12 Which form(s) of energy can be transmitted through a vacuum?
- (1) light, only
 (2) sound, only
 (3) both light and sound
 (4) neither light nor sound
- 13 A tuning fork vibrating in air produces sound waves. These waves are best classified as
- (1) transverse, because the air molecules are vibrating parallel to the direction of wave motion
 (2) transverse, because the air molecules are vibrating perpendicular to the direction of wave motion
 (3) longitudinal, because the air molecules are vibrating parallel to the direction of wave motion
 (4) longitudinal, because the air molecules are vibrating perpendicular to the direction of wave motion
- 14 A student in a band notices that a drum vibrates when another instrument emits a certain frequency note. This phenomenon illustrates
- (1) reflection (3) refraction
 (2) resonance (4) diffraction
- 15 Which quantity is equivalent to the product 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
- 16 Radio waves and gamma rays traveling in space have the same
- (1) frequency (3) period
 (2) wavelength (4) speed

- 17 The spreading of a wave into the region behind an obstruction is called
- (1) diffraction (3) reflection
 (2) absorption (4) refraction
- 18 The diagram below represents a wave moving toward the right side of this page.



Which wave shown below could produce a standing wave with the original wave?



- 19 A train sounds a whistle of constant frequency as it leaves the train station. Compared to the sound emitted by the whistle, the sound that the passengers standing on the platform hear has a frequency that is
- (1) lower, because the sound-wave fronts reach the platform at a frequency lower than the frequency at which they are produced
 (2) lower, because the sound waves travel more slowly in the still air above the platform than in the rushing air near the train
 (3) higher, because the sound-wave fronts reach the platform at a frequency higher than the frequency at which they are produced
 (4) higher, because the sound waves travel faster in the still air above the platform than in the rushing air near the train

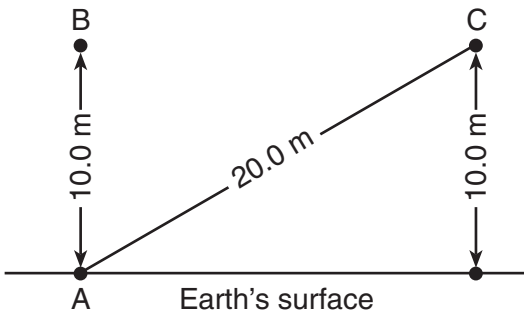
20 What is the gravitational potential energy with respect to the surface of the water of a 75.0-kilogram diver located 3.00 meters above the water?

- (1) 2.17×10^4 J (3) 2.25×10^2 J
 (2) 2.21×10^3 J (4) 2.29×10^1 J

21 A 60.0-kilogram runner has 1920 joules of kinetic energy. At what speed is she running?

- (1) 5.66 m/s (3) 32.0 m/s
 (2) 8.00 m/s (4) 64.0 m/s

22 The diagram below shows points A, B, and C at or near Earth's surface. As a mass is moved from A to B, 100. joules of work are done against gravity.



What is the amount of work done against gravity as an identical mass is moved from A to C?

- (1) 100. J (3) 200. J
 (2) 173 J (4) 273 J

23 When a force moves an object over a rough, horizontal surface at a constant velocity, the work done against friction produces an increase in the object's

- (1) weight (3) potential energy
 (2) momentum (4) internal energy

24 A motor used 120. watts of power to raise a 15-newton object in 5.0 seconds. Through what vertical distance was the object raised?

- (1) 1.6 m (3) 40. m
 (2) 8.0 m (4) 360 m

25 In an electric field, 0.90 joule of work is required to bring 0.45 coulomb of charge from point A to point B. What is the electric potential difference between points A and B?

- (1) 5.0 V (3) 0.50 V
 (2) 2.0 V (4) 0.41 V

26 In a flashlight, a battery provides a total of 3.0 volts to a bulb. If the flashlight bulb has an operating resistance of 5.0 ohms, the current through the bulb is

- (1) 0.30 A (3) 1.5 A
 (2) 0.60 A (4) 1.7 A

Note that question 27 has only three choices.

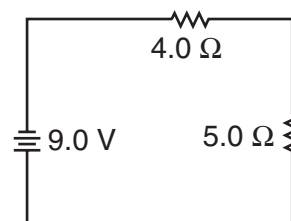
27 A complete circuit is left on for several minutes, causing the connecting copper wire to become hot. As the temperature of the wire increases, the electrical resistance of the wire

- (1) decreases
 (2) increases
 (3) remains the same

28 A 1.5-volt, AAA cell supplies 750 milliamperes of current through a flashlight bulb for 5.0 minutes, while a 1.5-volt, C cell supplies 750 milliamperes of current through the same flashlight bulb for 20. minutes. Compared to the total charge transferred by the AAA cell through the bulb, the total charge transferred by the C cell through the bulb is

- (1) half as great (3) the same
 (2) twice as great (4) four times as great

29 A 9.0-volt battery is connected to a 4.0-ohm resistor and a 5.0-ohm resistor as shown in the diagram below.



What is the current in the 5.0-ohm resistor?

- (1) 1.0 A (3) 2.3 A
 (2) 1.8 A (4) 4.0 A

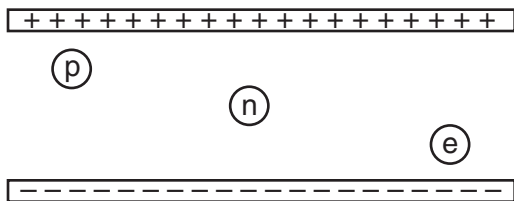
30 A 100.-ohm resistor and an unknown resistor are connected in series to a 10.0-volt battery. If the potential drop across the 100.-ohm resistor is 4.00 volts, the resistance of the unknown resistor is

- (1) 50.0 Ω
- (2) 100. Ω
- (3) 150. Ω
- (4) 200. Ω

31 If the potential difference applied to a fixed resistance is doubled, the power dissipated by that resistance

- (1) remains the same
- (2) doubles
- (3) halves
- (4) quadruples

32 In the diagram below, proton p , neutron n , and electron e are located as shown between two oppositely charged plates.



The magnitude of acceleration will be greatest for the

- (1) neutron, because it has the greatest mass
- (2) neutron, because it is neutral
- (3) electron, because it has the smallest mass
- (4) proton, because it is farthest from the negative plate

33 Two protons are located one meter apart. Compared to the gravitational force of attraction between the two protons, the electrostatic force between the protons is

- (1) stronger and repulsive
- (2) weaker and repulsive
- (3) stronger and attractive
- (4) weaker and attractive

34 A meson may *not* have a charge of

- (1) $+1e$
- (2) $+2e$
- (3) $0e$
- (4) $-1e$

35 A balloon is rubbed against a student's hair and then touched to a wall. The balloon "sticks" to the wall due to

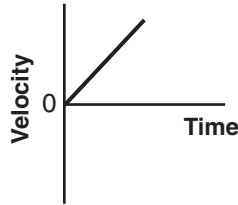
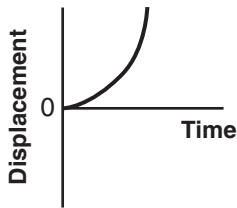
- (1) electrostatic forces between the particles of the balloon
- (2) magnetic forces between the particles of the wall
- (3) electrostatic forces between the particles of the balloon and the particles of the wall
- (4) magnetic forces between the particles of the balloon and the particles of the wall

Part B-1

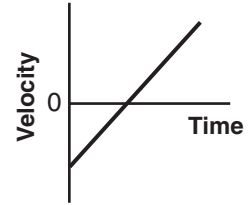
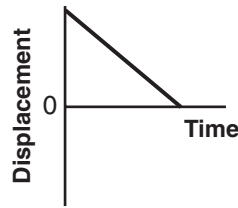
Answer all questions in this part.

Directions (36–48): For each statement or question, write on the separate answer sheet the number of the word or expression that, of those given, best completes the statement or answers the question.

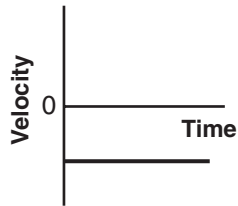
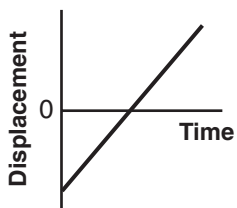
36 Which pair of graphs represents the same motion of an object?



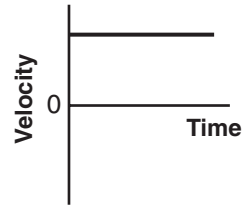
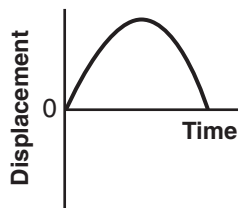
(1)



(3)

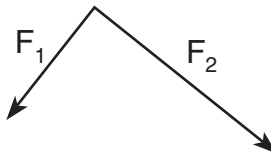


(2)

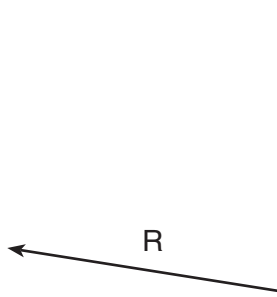


(4)

37 The vector diagram below represents two forces, F_1 and F_2 , simultaneously acting on an object.



Which vector best represents the resultant of the two forces?



(1)



(2)



(3)



(4)

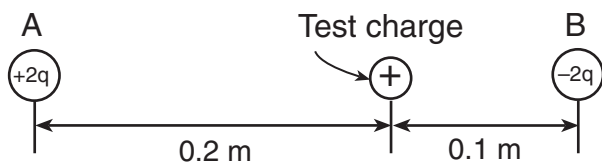
38 An egg is dropped from a third-story window. The distance the egg falls from the window to the ground is closest to

- (1) 10^0 m (3) 10^2 m
 (2) 10^1 m (4) 10^3 m

39 Which unit is equivalent to a newton per kilogram?

- (1) $\frac{\text{m}}{\text{s}^2}$ (3) $\text{J}\cdot\text{s}$
 (2) $\frac{\text{W}}{\text{m}}$ (4) $\frac{\text{kg}\cdot\text{m}}{\text{s}}$

40 In the diagram below, a positive test charge is located between two charged spheres, *A* and *B*. Sphere *A* has a charge of $+2q$ and is located 0.2 meter from the test charge. Sphere *B* has a charge of $-2q$ and is located 0.1 meter from the test charge.



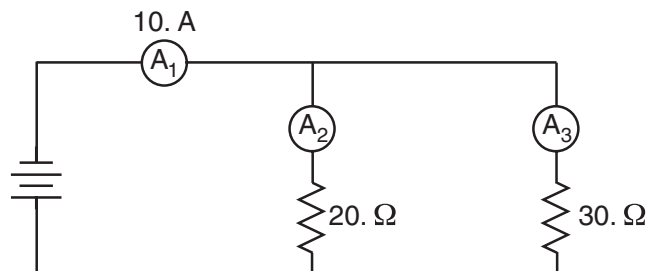
If the magnitude of the force on the test charge due to sphere *A* is F , what is the magnitude of the force on the test charge due to sphere *B*?

- (1) $\frac{F}{4}$ (3) $\frac{F}{2}$
 (2) $2F$ (4) $4F$

41 Electrons oscillating with a frequency of 2.0×10^{10} hertz produce electromagnetic waves. These waves would be classified as

- (1) infrared (3) microwave
 (2) visible (4) x ray

42 In the circuit diagram shown below, ammeter A_1 reads 10. amperes.



What is the reading of ammeter A_2 ?

- (1) 6.0 A (3) 20. A
 (2) 10. A (4) 4.0 A

43 According to the Standard Model, a proton is constructed of two up quarks and one down quark (uud) and a neutron is constructed of one up quark and two down quarks (udd). During beta decay, a neutron decays into a proton, an electron, and an electron antineutrino. During this process there is a conversion of a

- (1) u quark to a d quark
 (2) d quark to a meson
 (3) baryon to another baryon
 (4) lepton to another lepton

44 The bright-line emission spectrum of an element can best be explained by

- (1) electrons transitioning between discrete energy levels in the atoms of that element
 (2) protons acting as both particles and waves
 (3) electrons being located in the nucleus
 (4) protons being dispersed uniformly throughout the atoms of that element

45 How much energy is required to move an electron in a mercury atom from the ground state to energy level h ?

- (1) 1.57 eV (3) 10.38 eV
 (2) 8.81 eV (4) 11.95 eV

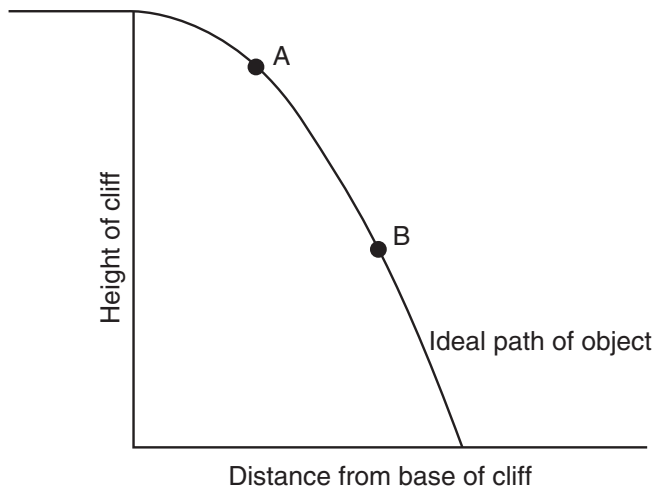
Part B–2

Answer all questions in this part.

Directions (49–61): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 49 through 51 on the information and diagram below.

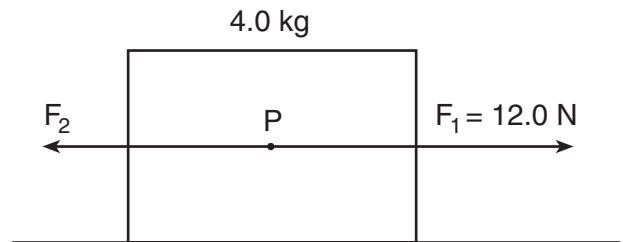
An object was projected horizontally from a tall cliff. The diagram below represents the path of the object, neglecting friction.



- 49 How does the magnitude of the horizontal component of the object's velocity at point A compare with the magnitude of the horizontal component of the object's velocity at point B? [1]
- 50 How does the magnitude of the vertical component of the object's velocity at point A compare with the magnitude of the vertical component of the object's velocity at point B? [1]
- 51 On the diagram *in your answer booklet*, sketch a likely path of the horizontally projected object, assuming that it was subject to air resistance. [1]
-

Base your answers to questions 52 through 54 on the information and diagram below.

In the scaled diagram, two forces, F_1 and F_2 , act on a 4.0-kilogram block at point P. Force F_1 has a magnitude of 12.0 newtons, and is directed toward the right.

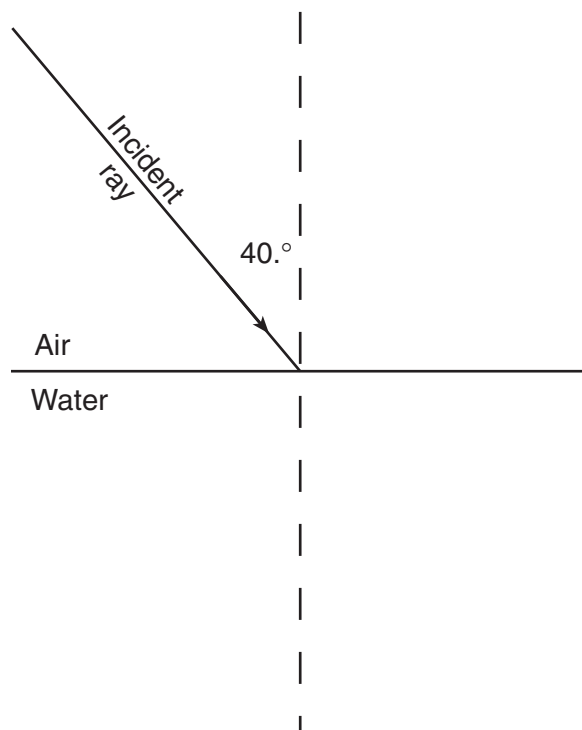


(Drawn to scale)

- 52 Using a ruler and the scaled diagram, determine the magnitude of F_2 in newtons. [1]
- 53 Determine the magnitude of the net force acting on the block. [1]
- 54 Calculate the magnitude of the acceleration of the block. [Show all work, including the equation and substitution with units.] [2]
-
- 55 The coefficient of kinetic friction between a 780.-newton crate and a level warehouse floor is 0.200. Calculate the magnitude of the horizontal force required to move the crate across the floor at constant speed. [Show all work, including the equation and substitution with units.] [2]
-
- 56 A photon has a wavelength of 9.00×10^{-10} meter. Calculate the energy of this photon in joules. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 57 through 59 on the information and diagram below.

A light ray with a frequency of 5.09×10^{14} hertz traveling in air is incident at an angle of 40° on an air-water interface as shown. At the interface, part of the ray is refracted as it enters the water and part of the ray is reflected from the interface.

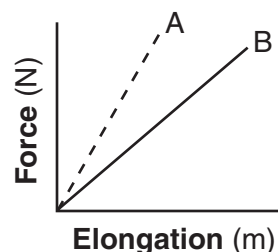


- 57 Calculate the angle of refraction of the light ray as it enters the water. [Show all work, including the equation and substitution with units.] [2]
- 58 On the diagram *in your answer booklet*, using a protractor and straightedge, draw the refracted ray. Label this ray "Refracted ray." [1]
- 59 On the diagram *in your answer booklet*, using a protractor and straightedge, draw the reflected ray. Label this ray "Reflected ray." [1]

Base your answers to questions 60 and 61 on the information and graph below.

The graph represents the relationship between the force applied to each of two springs, A and B, and their elongations.

Force vs. Elongation



- 60 What physical quantity is represented by the slope of each line? [1]
- 61 A 1.0-kilogram mass is suspended from each spring. If each mass is at rest, how does the potential energy stored in spring A compare to the potential energy stored in spring B? [1]

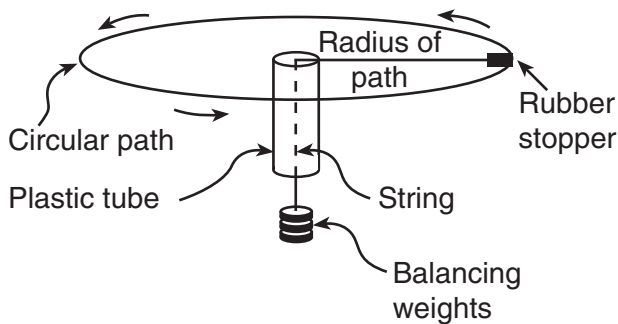
Part C

Answer all questions in this part.

Directions (62–74): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 62 through 65 on the information and diagram below.

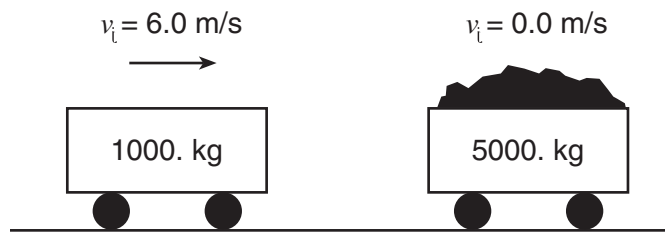
In an experiment, a rubber stopper is attached to one end of a string that is passed through a plastic tube before weights are attached to the other end. The stopper is whirled in a horizontal circular path at constant speed.



- 62 On the diagram of the top view *in your answer booklet*, draw the path of the rubber stopper if the string breaks at the position shown. [1]
- 63 Describe what would happen to the radius of the circle if the student whirls the stopper at a greater speed without changing the balancing weights. [1]
- 64 List *three* measurements that must be taken to show that the magnitude of the centripetal force is equal to the balancing weights. [Neglect friction.] [3]
- 65 The rubber stopper is now whirled in a vertical circle at the same speed. On the diagram *in your answer booklet*, draw and label vectors to indicate the direction of the weight (F_g) and the direction of the centripetal force (F_c) at the position shown. [2]
-

Base your answers to questions 66 through 68 on the information and diagram below.

A 1000.-kilogram empty cart moving with a speed of 6.0 meters per second is about to collide with a stationary loaded cart having a total mass of 5000. kilograms, as shown. After the collision, the carts lock and move together. [Assume friction is negligible.]



- 66 Calculate the speed of the combined carts after the collision. [Show all work, including the equation and substitution with units.] [2]
- 67 Calculate the kinetic energy of the combined carts after the collision. [Show all work, including the equation and substitution with units.] [2]
- 68 How does the kinetic energy of the combined carts after the collision compare to the kinetic energy of the carts before the collision? [1]
-

Base your answers to questions 69 through 72 on the information and data table below.

An experiment was performed using various lengths of a conductor of uniform cross-sectional area. The resistance of each length was measured and the data recorded in the table below.

Length (meters)	Resistance (ohms)
5.1	1.6
11.0	3.8
16.0	4.6
18.0	5.9
23.0	7.5

Directions (69–71): Using the information in the data table, construct a graph on the grid provided in *your answer booklet*, following the directions below.

- 69 Mark an appropriate scale on the axis labeled “Length (m).” [1]
- 70 Plot the data points for resistance versus length. [1]
- 71 Draw the best-fit line. [1]
- 72 Calculate the slope of the best-fit line. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 73 and 74 on the information below.

A transverse wave with an amplitude of 0.20 meter and wavelength of 3.0 meters travels toward the right in a medium with a speed of 4.0 meters per second.

- 73 On the diagram in *your answer booklet*, place an **X** at each of *two* points that are in phase with each other. [1]
- 74 Calculate the period of the wave. [Show all work, including the equation and substitution with units.] [2]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 p.m., only

ANSWER SHEET

Student Sex: Male Female Grade

Teacher School

Record your answers to Part A and Part B-1 on this answer sheet.

Part A

- 1 13 25
- 2 14 26
- 3 15 27
- 4 16 28
- 5 17 29
- 6 18 30
- 7 19 31
- 8 20 32
- 9 21 33
- 10 22 34
- 11 23 35
- 12 24

Part A Score

Part B-1

- 36 43
- 37 44
- 38 45
- 39 46
- 40 47
- 41 48
- 42 Part B-1 Score

Write your answers to Part B-2 and Part C in your answer booklet.

The declaration below should be signed when you have completed the examination.

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

Signature

Tear Here

Tear Here

Tear Here

**PHYSICAL SETTING
 PHYSICS**

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 p.m., only

ANSWER BOOKLET

Student Sex: Male
 Female
 Teacher.....
 School..... Grade

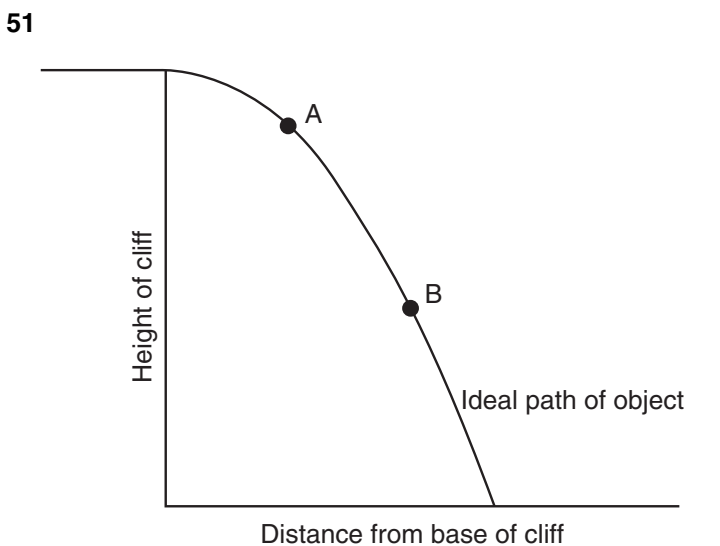
Answer all questions in Part B-2 and Part C. Record your answers in this booklet.

Part	Maximum Score	Student's Score
A	35	
B-1	13	
B-2	17	
C	20	
Total Written Test Score (Maximum Raw Score: 85)		<input type="text"/>
Final Score (From Conversion Chart)		<input type="text"/>
Raters' Initials:		
Rater 1		Rater 2

Part B-2

49 _____

 50 _____



52 _____ N
 53 _____ N

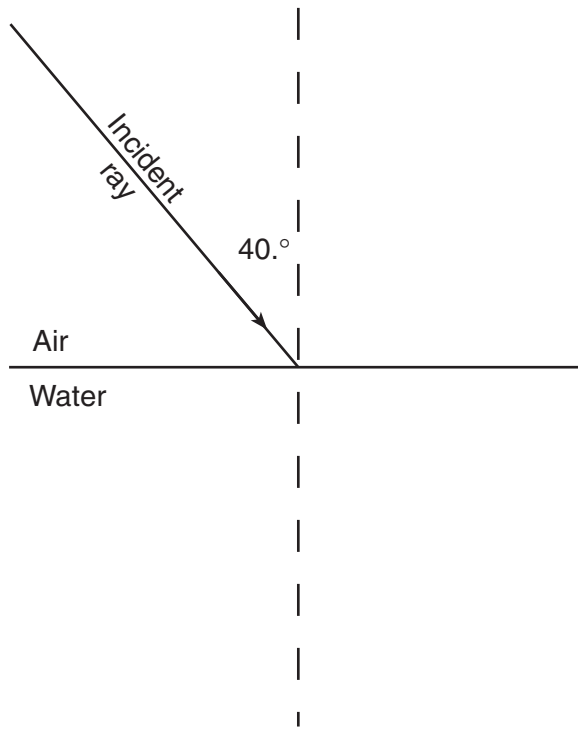
54

55

56

57

58–59

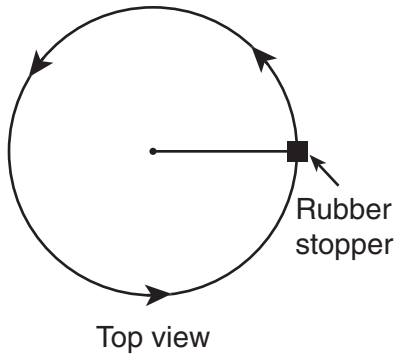


60

61

Part C

62

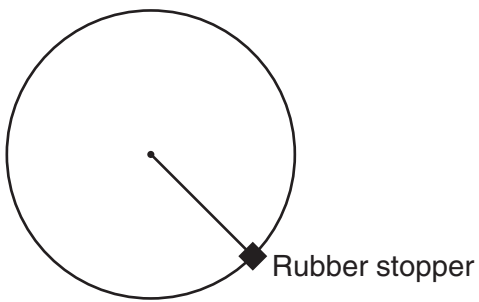


63

64

65

Vertical Circle (side view)



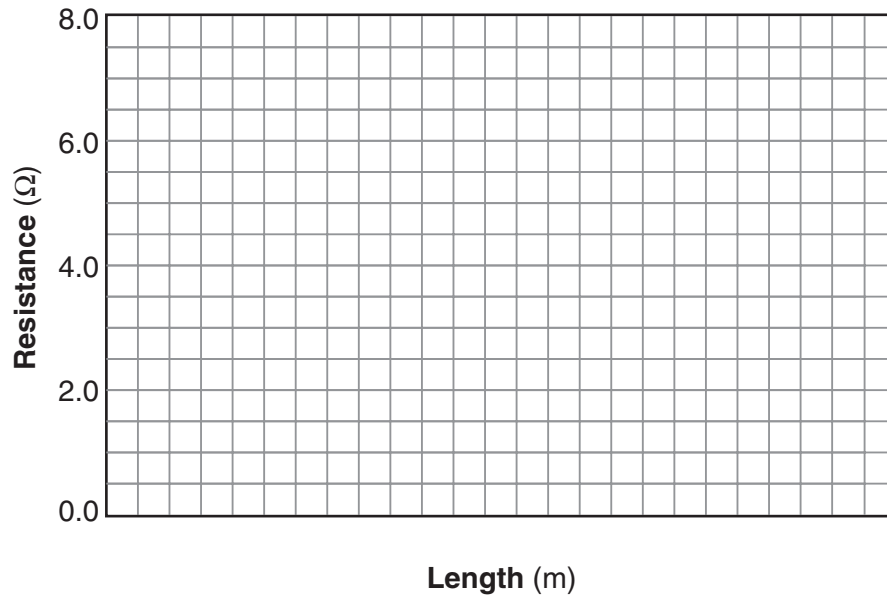
66

67

68

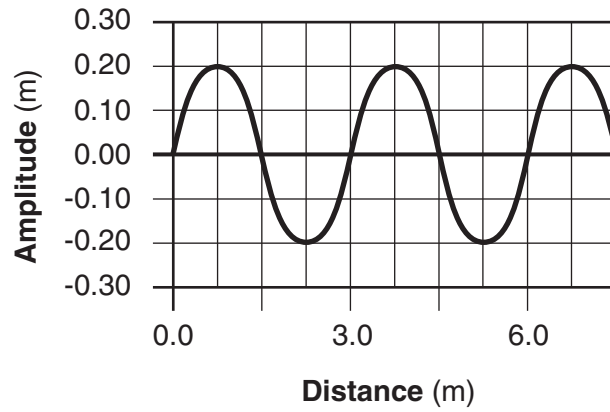
69-71

Resistance vs. Length



72

73



74