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

PHYSICAL SETTING
PHYSICS

Wednesday, June 13, 2012 — 1:15 to 4:15 p.m., only

Answer all questions in all parts of this examination according to the directions provided in the examination booklet.

A separate answer sheet for Part A and Part B–1 has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers to the Part A and Part B–1 multiple-choice questions on this separate answer sheet. Record your answers for the questions in Part B–2 and Part C in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All answers in your answer booklet 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 your separate answer sheet or in your answer booklet as directed.

When you have completed the examination, you must sign the statement printed on 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 *2006 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.

The use of any communications device is strictly prohibited when taking this examination. If you use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

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

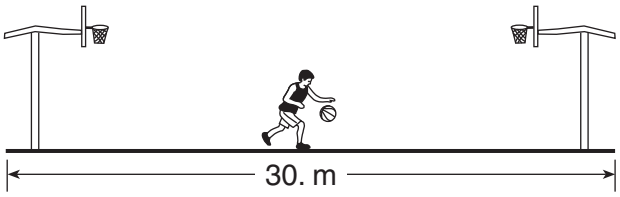
Part A

Answer all questions in this part.

Directions (1–35): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics.* Record your answers on your separate answer sheet.

Base your answers to questions 1 and 2 on the information below.

In a drill during basketball practice, a player runs the length of the 30.-meter court and back. The player does this three times in 60. seconds.



(Not drawn to scale)

1 The magnitude of the player's total displacement after running the drill is

(1) 0.0 m
(2) 30. m
(3) 60. m
(4) 180 m

2 The average speed of the player during the drill is

(1) 0.0 m/s
(2) 0.50 m/s
(3) 3.0 m/s
(4) 30. m/s

3 A baseball is thrown at an angle of 40.0° above the horizontal. The horizontal component of the baseball's initial velocity is 12.0 meters per second. What is the magnitude of the ball's initial velocity?

(1) 7.71 m/s
(2) 9.20 m/s
(3) 15.7 m/s
(4) 18.7 m/s

4 A particle could have a charge of

(1) 0.8×10^{-19} C
(2) 1.2×10^{-19} C
(3) 3.2×10^{-19} C
(4) 4.1×10^{-19} C

5 Which object has the greatest inertia?

(1) a 15-kg mass traveling at 5.0 m/s
(2) a 10.-kg mass traveling at 10. m/s
(3) a 10.-kg mass traveling at 5.0 m/s
(4) a 5.0-kg mass traveling at 15 m/s

6 A car, initially traveling east with a speed of 5.0 meters per second, is accelerated uniformly at 2.0 meters per second^2 east for 10. seconds along a straight line. During this 10.-second interval the car travels a total distance of

(1) 50. m
(2) 60. m
(3) 1.0×10^2 m
(4) 1.5×10^2 m

7 Which situation describes an object that has *no* unbalanced force acting on it?

(1) an apple in free fall
(2) a satellite orbiting Earth
(3) a hockey puck moving at constant velocity across ice
(4) a laboratory cart moving down a frictionless 30.° incline

8 A child riding a bicycle at 15 meters per second accelerates at –3.0 meters per second^2 for 4.0 seconds. What is the child's speed at the end of this 4.0-second interval?

(1) 12 m/s
(2) 27 m/s
(3) 3.0 m/s
(4) 7.0 m/s

9 An unbalanced force of 40. newtons keeps a 5.0-kilogram object traveling in a circle of radius 2.0 meters. What is the speed of the object?

(1) 8.0 m/s
(2) 2.0 m/s
(3) 16 m/s
(4) 4.0 m/s

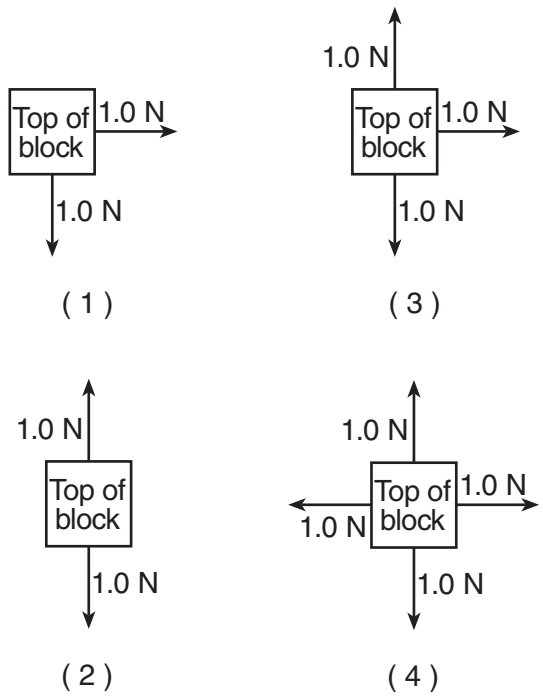
10 A 5.00-kilogram block slides along a horizontal, frictionless surface at 10.0 meters per second for 4.00 seconds. The magnitude of the block's momentum is

(1) 200. kg•m/s
(2) 50.0 kg•m/s
(3) 20.0 kg•m/s
(4) 12.5 kg•m/s

11 A 0.50-kilogram puck sliding on a horizontal shuffleboard court is slowed to rest by a frictional force of 1.2 newtons. What is the coefficient of kinetic friction between the puck and the surface of the shuffleboard court?

(1) 0.24
(2) 0.42
(3) 0.60
(4) 4.1

12 A number of 1.0-newton horizontal forces are exerted on a block on a frictionless, horizontal surface. Which top-view diagram shows the forces producing the greatest magnitude of acceleration of the block?



13 On a small planet, an astronaut uses a vertical force of 175 newtons to lift an 87.5-kilogram boulder at constant velocity to a height of 0.350 meter above the planet's surface. What is the magnitude of the gravitational field strength on the surface of the planet?

(1) 0.500 N/kg
(2) 2.00 N/kg
(3) 9.81 N/kg
(4) 61.3 N/kg

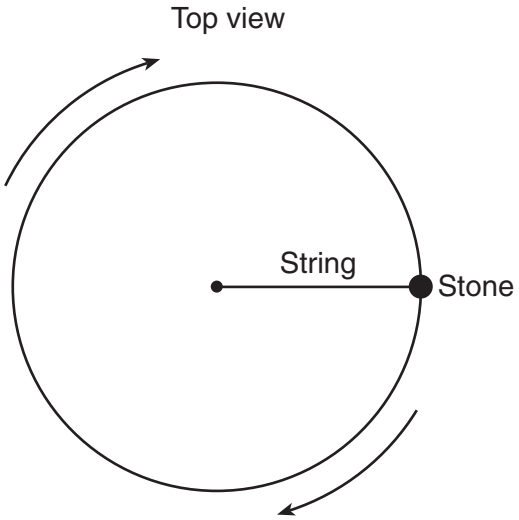
14 A car uses its brakes to stop on a level road. During this process, there must be a conversion of kinetic energy into

(1) light energy
(2) nuclear energy
(3) gravitational potential energy
(4) internal energy

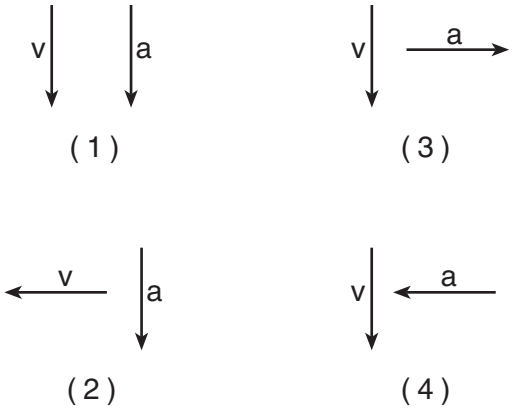
15 Which change decreases the resistance of a piece of copper wire?

(1) increasing the wire's length
(2) increasing the wire's resistivity
(3) decreasing the wire's temperature
(4) decreasing the wire's diameter

16 A stone on the end of a string is whirled clockwise at constant speed in a horizontal circle as shown in the diagram below.



Which pair of arrows best represents the directions of the stone's velocity, v, and acceleration, a, at the position shown?



17 How much work is done by the force lifting a 0.1-kilogram hamburger vertically upward at constant velocity 0.3 meter from a table?

(1) 0.03 J
(2) 0.1 J
(3) 0.3 J
(4) 0.4 J

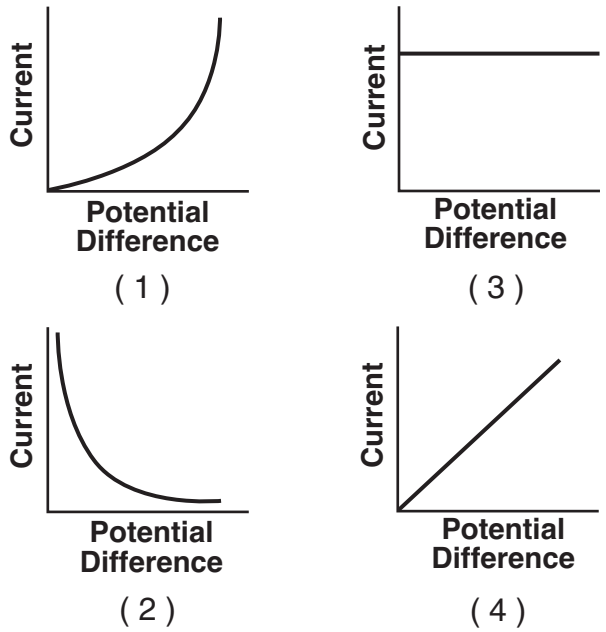
18 Two electrons are separated by a distance of 3.00×10^{-6} meter. What are the magnitude and direction of the electrostatic forces each exerts on the other?

(1) 2.56×10^{-17} N away from each other
(2) 2.56×10^{-17} N toward each other
(3) 7.67×10^{-23} N away from each other
(4) 7.67×10^{-23} N toward each other

19 Which object will have the greatest change in electrical energy?

(1) an electron moved through a potential difference of 2.0 V
(2) a metal sphere with a charge of 1.0×10^{-9} C moved through a potential difference of 2.0 V
(3) an electron moved through a potential difference of 4.0 V
(4) a metal sphere with a charge of 1.0×10^{-9} C moved through a potential difference of 4.0 V

20 The resistance of a circuit remains constant. Which graph best represents the relationship between the current in the circuit and the potential difference provided by the battery?



21 The wavelength of a wave doubles as it travels from medium *A* into medium *B*. Compared to the wave in medium *A*, the wave in medium *B* has

(1) half the speed
(2) twice the speed
(3) half the frequency
(4) twice the frequency

22 The watt•second is a unit of

(1) power
(2) energy
(3) potential difference
(4) electric field strength

23 Which quantity has both a magnitude and a direction?

(1) energy
(2) impulse
(3) power
(4) work

24 A tuning fork vibrates at a frequency of 512 hertz when struck with a rubber hammer. The sound produced by the tuning fork will travel through the air as a

(1) longitudinal wave with air molecules vibrating parallel to the direction of travel
(2) transverse wave with air molecules vibrating parallel to the direction of travel
(3) longitudinal wave with air molecules vibrating perpendicular to the direction of travel
(4) transverse wave with air molecules vibrating perpendicular to the direction of travel

25 A 3-ohm resistor and a 6-ohm resistor are connected in parallel across a 9-volt battery. Which statement best compares the potential difference across each resistor?

(1) The potential difference across the 6-ohm resistor is the same as the potential difference across the 3-ohm resistor.
(2) The potential difference across the 6-ohm resistor is twice as great as the potential difference across the 3-ohm resistor.
(3) The potential difference across the 6-ohm resistor is half as great as the potential difference across the 3-ohm resistor.
(4) The potential difference across the 6-ohm resistor is four times as great as the potential difference across the 3-ohm resistor.

26 A 3.6-volt battery is used to operate a cell phone for 5.0 minutes. If the cell phone dissipates 0.064 watt of power during its operation, the current that passes through the phone is

(1) 0.018 A
(2) 5.3 A
(3) 19 A
(4) 56 A

27 A monochromatic beam of light has a frequency of 7.69×10^{14} hertz. What is the energy of a photon of this light?

(1) 2.59×10^{-40} J
(2) 6.92×10^{-31} J
(3) 5.10×10^{-19} J
(4) 3.90×10^{-7} J

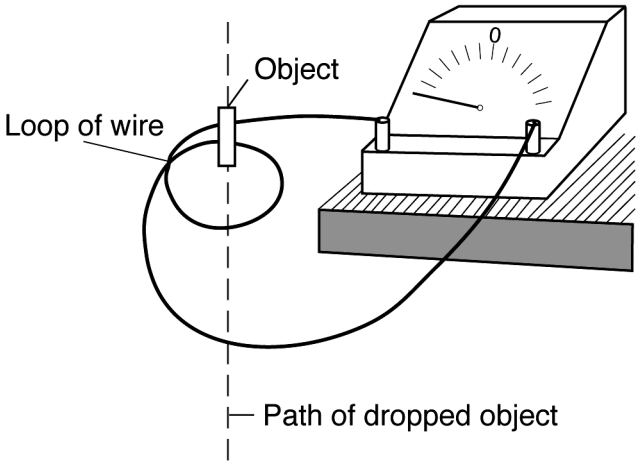
28 A 3.00×10^{-9}-coulomb test charge is placed near a negatively charged metal sphere. The sphere exerts an electrostatic force of magnitude 6.00×10^{-5} newton on the test charge. What is the magnitude and direction of the electric field strength at this location?

(1) 2.00×10^{4} N/C directed away from the sphere
(2) 2.00×10^{4} N/C directed toward the sphere
(3) 5.00×10^{-5} N/C directed away from the sphere
(4) 5.00×10^{-5} N/C directed toward the sphere

29 What is characteristic of both sound waves and electromagnetic waves?

(1) They require a medium.
(2) They transfer energy.
(3) They are mechanical waves.
(4) They are longitudinal waves.

30 A small object is dropped through a loop of wire connected to a sensitive ammeter on the edge of a table, as shown in the diagram below.



A reading on the ammeter is most likely produced when the object falling through the loop of wire is a

(1) flashlight battery
(2) bar magnet
(3) brass mass
(4) plastic ruler

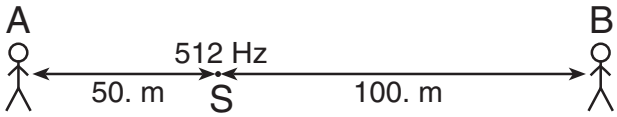
31 What is the wavelength of a 2.50-kilohertz sound wave traveling at 326 meters per second through air?

(1) 0.130 m
(2) 1.30 m
(3) 7.67 m
(4) 130. m

32 Ultrasound is a medical technique that transmits sound waves through soft tissue in the human body. Ultrasound waves can break kidney stones into tiny fragments, making it easier for them to be excreted without pain. The shattering of kidney stones with specific frequencies of sound waves is an application of which wave phenomenon?

(1) the Doppler effect
(2) reflection
(3) refraction
(4) resonance

33 In the diagram below, a stationary source located at point *S* produces sound having a constant frequency of 512 hertz. Observer *A*, 50. meters to the left of *S*, hears a frequency of 512 hertz. Observer *B*, 100. meters to the right of *S*, hears a frequency lower than 512 hertz.



Which statement best describes the motion of the observers?

(1) Observer *A* is moving toward point *S*, and observer *B* is stationary.
(2) Observer *A* is moving away from point *S*, and observer *B* is stationary.
(3) Observer *A* is stationary, and observer *B* is moving toward point *S*.
(4) Observer *A* is stationary, and observer *B* is moving away from point *S*.

34 While sitting in a boat, a fisherman observes that two complete waves pass by his position every 4 seconds. What is the period of these waves?

(1) 0.5 s
(2) 2 s
(3) 8 s
(4) 4 s

35 A wave passes through an opening in a barrier. The amount of diffraction experienced by the wave depends on the size of the opening and the wave's

(1) amplitude
(2) wavelength
(3) velocity
(4) phase

Part B–1

Answer all questions in this part.

Directions (36–50): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics.* Record your answers on your separate answer sheet.

36 The length of a football field is closest to

(1) 1000 cm
(2) 1000 dm
(3) 1000 km
(4) 1000 mm

37 A student on an amusement park ride moves in a circular path with a radius of 3.5 meters once every 8.9 seconds. The student moves at an average speed of

(1) 0.39 m/s
(2) 1.2 m/s
(3) 2.5 m/s
(4) 4.3 m/s

38 When a 1.0-kilogram cart moving with a speed of 0.50 meter per second on a horizontal surface collides with a second 1.0-kilogram cart initially at rest, the carts lock together. What is the speed of the combined carts after the collision? [Neglect friction.]

(1) 1.0 m/s
(2) 0.50 m/s
(3) 0.25 m/s
(4) 0 m/s

39 Two elevators, *A* and *B*, move at constant speed. Elevator *B* moves with twice the speed of elevator *A*. Elevator *B* weighs twice as much as elevator *A*. Compared to the power needed to lift elevator *A*, the power needed to lift elevator *B* is

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

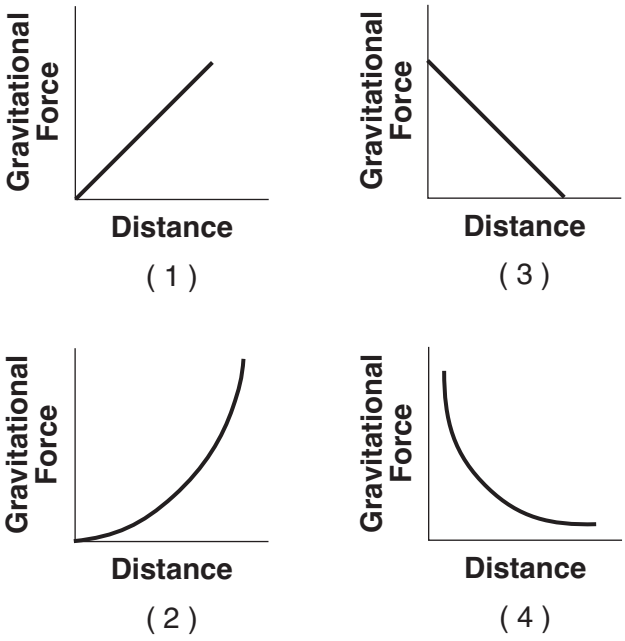
40 What is the maximum height to which a motor having a power rating of 20.4 watts can lift a 5.00-kilogram stone vertically in 10.0 seconds?

(1) 0.0416 m
(2) 0.408 m
(3) 4.16 m
(4) 40.8 m

41 What is the current in a wire if 3.4×10^{19} electrons pass by a point in this wire every 60. seconds?

(1) 1.8×10^{-18} A
(2) 3.1×10^{-11} A
(3) 9.1×10^{-2} A
(4) 11 A

42 Which graph represents the relationship between the magnitude of the gravitational force exerted by Earth on a spacecraft and the distance between the center of the spacecraft and center of Earth? [Assume constant mass for the spacecraft.]



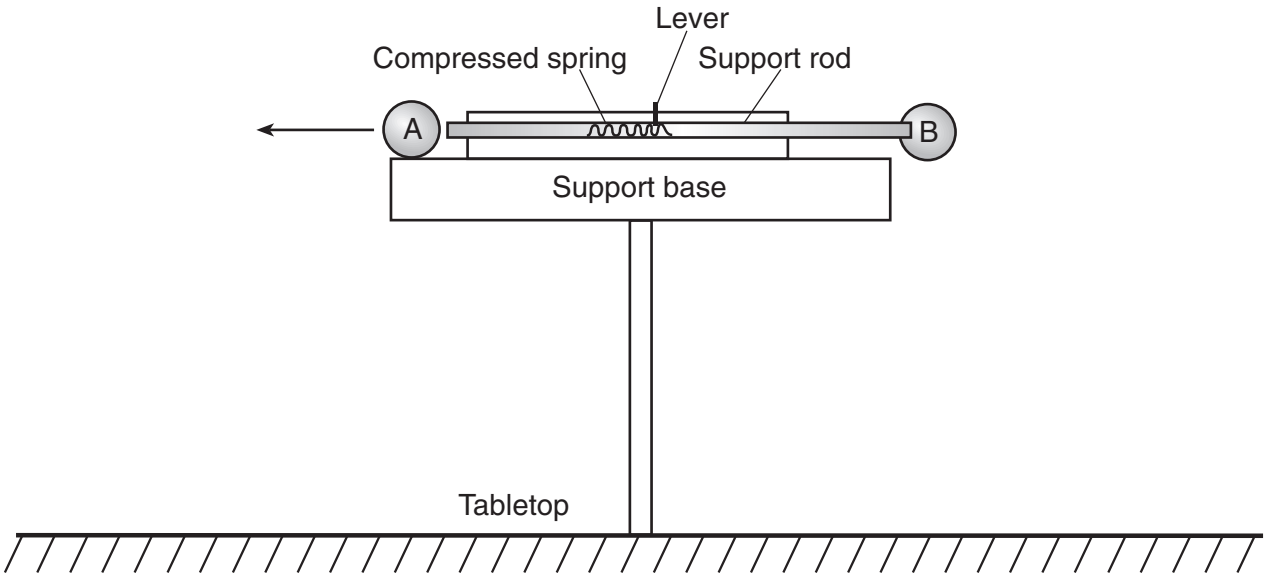
43 To increase the brightness of a desk lamp, a student replaces a 50-watt incandescent lightbulb with a 100-watt incandescent lightbulb. Compared to the 50-watt lightbulb, the 100-watt lightbulb has

(1) less resistance and draws more current
(2) less resistance and draws less current
(3) more resistance and draws more current
(4) more resistance and draws less current

44 Electrons in excited hydrogen atoms are in the $n = 3$ energy level. How many different photon frequencies could be emitted as the atoms return to the ground state?

(1) 1
(2) 2
(3) 3
(4) 4

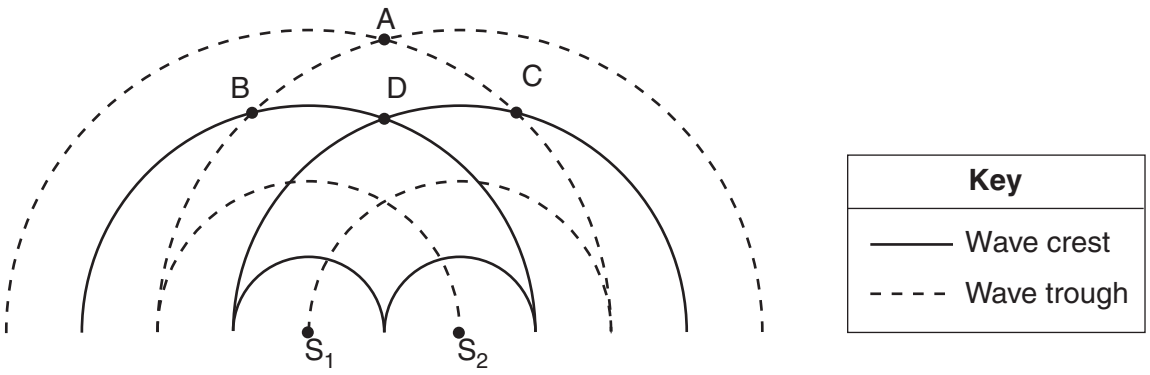
45 The diagram below represents a setup for demonstrating motion.



When the lever is released, the support rod withdraws from ball *B*, allowing it to fall. At the same instant, the rod contacts ball *A*, propelling it horizontally to the left. Which statement describes the motion that is observed after the lever is released and the balls fall? [Neglect friction.]

(1) Ball *A* travels at constant velocity.
(2) Ball *A* hits the tabletop at the same time as ball *B*.
(3) Ball *B* hits the tabletop before ball *A*.
(4) Ball *B* travels with an increasing acceleration.

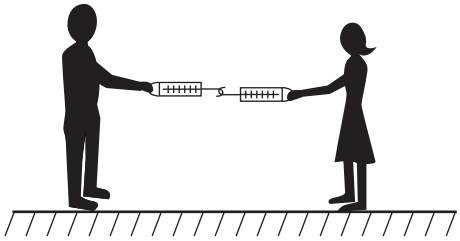
46 Two speakers, S_1 and S_2, operating in phase in the same medium produce the circular wave patterns shown in the diagram below.



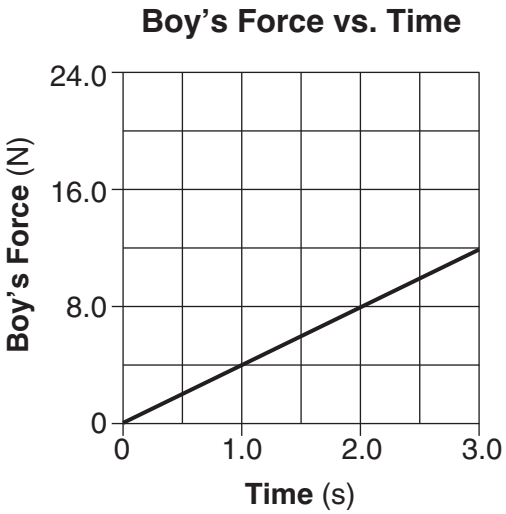
At which two points is constructive interference occurring?

(1) *A* and *B*
(2) *A* and *D*
(3) *B* and *C*
(4) *B* and *D*

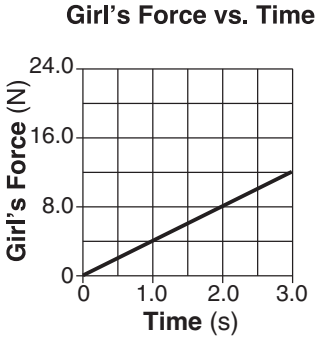
47 A 100.0-kilogram boy and a 50.0-kilogram girl, each holding a spring scale, pull against each other as shown in the diagram below.



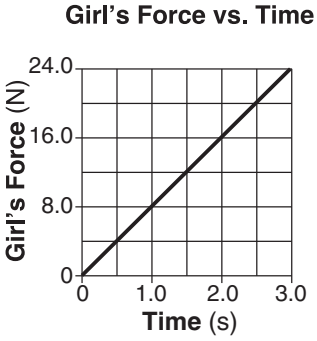
The graph below shows the relationship between the magnitude of the force that the boy applies on his spring scale and time.



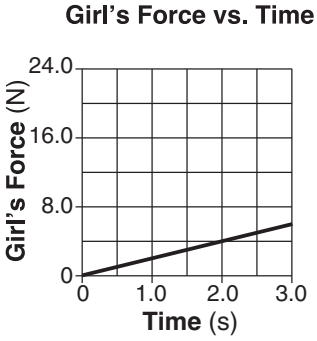
Which graph best represents the relationship between the magnitude of the force that the girl applies on her spring scale and time?



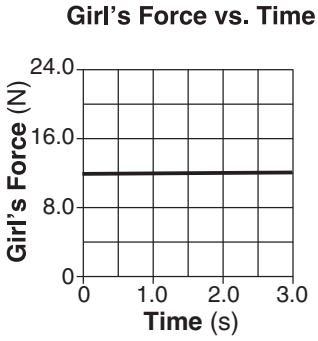
(1)



(2)

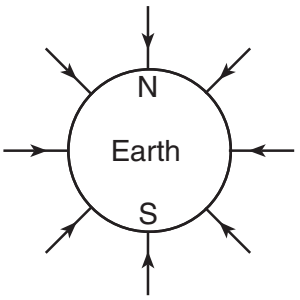


(3)

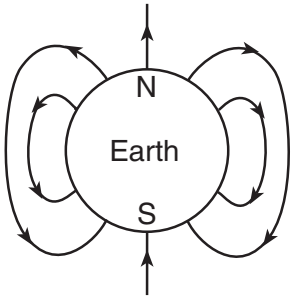


(4)

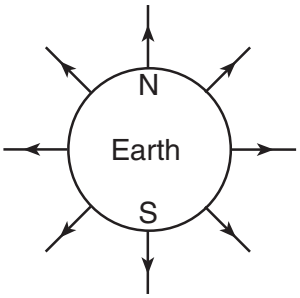
48 In which diagram do the field lines best represent the gravitational field around Earth?



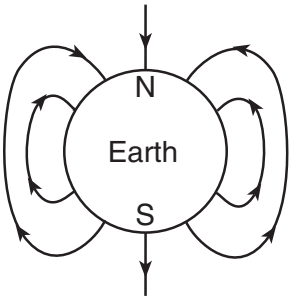
(1)



(3)

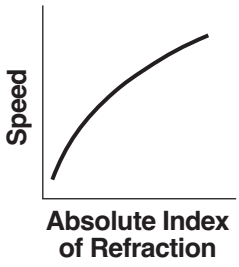


(2)



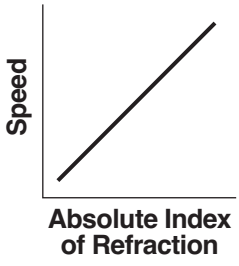
(4)

49 A ray of light ($f = 5.09 \times 10^{14}$ Hz) travels through various substances. Which graph best represents the relationship between the absolute index of refraction of these substances and the corresponding speed of light in these substances?

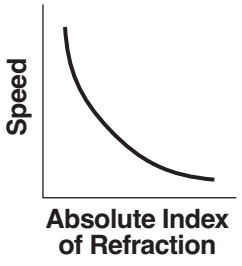


(1)

(3)

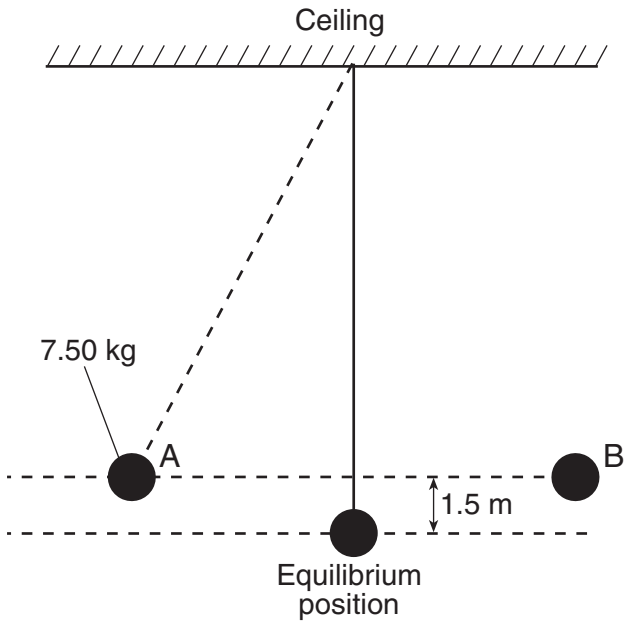


(2)



(4)

50 A pendulum is made from a 7.50-kilogram mass attached to a rope connected to the ceiling of a gymnasium. The mass is pushed to the side until it is at position *A*, 1.5 meters higher than its equilibrium position. After it is released from rest at position *A*, the pendulum moves freely back and forth between positions *A* and *B*, as shown in the diagram below.



What is the total amount of kinetic energy that the mass has as it swings freely through its equilibrium position? [Neglect friction.]

(1) 11 J
(2) 94 J
(3) 110 J
(4) 920 J

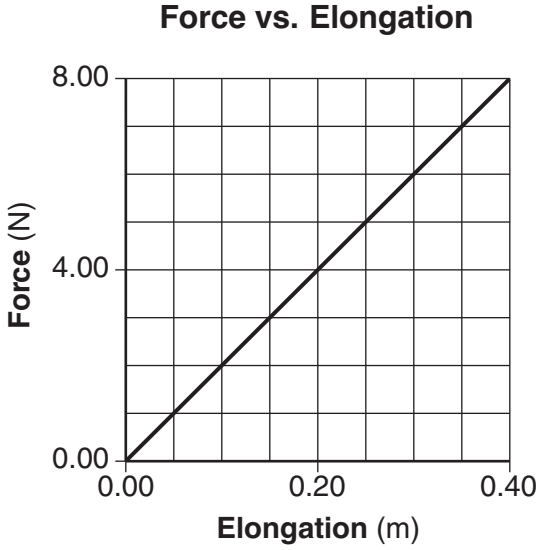
Part B–2

Answer all questions in this part.

Directions (51–65): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics.*

Base your answers to questions 51 through 53 on the information below.

A student produced various elongations of a spring by applying a series of forces to the spring. The graph below represents the relationship between the applied force and the elongation of the spring.



51 Determine the spring constant of the spring. [1]

52–53 Calculate the energy stored in the spring when the elongation is 0.30 meter. [Show all work, including the equation and substitution with units.] [2]

54–55 Calculate the time required for a 6000.-newton net force to stop a 1200.-kilogram car initially traveling at 10. meters per second. [Show all work, including the equation and substitution with units.] [2]

56–57 A toy rocket is launched twice into the air from level ground and returns to level ground. The rocket is first launched with initial speed v at an angle of 45° above the horizontal. It is launched the second time with the same initial speed, but with the launch angle increased to 60.° above the horizontal. Describe how *both* the total horizontal distance the rocket travels and the time in the air are affected by the increase in launch angle. [Neglect friction.] [2]

58–59 Calculate the magnitude of the average gravitational force between Earth and the Moon. [Show all work, including the equation and substitution with units.] [2]

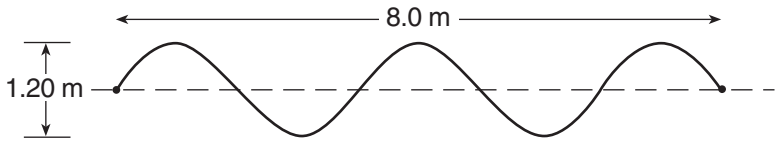
Base your answers to questions 60 through 63 on the information below.

A 15-ohm resistor and a 20.-ohm resistor are connected in parallel with a 9.0-volt battery. A single ammeter is connected to measure the total current of the circuit.

60–61 In the space *in your answer booklet*, draw a diagram of this circuit using symbols from the *Reference Tables for Physical Setting/Physics*. [Assume the availability of any number of wires of negligible resistance.] [2]

62–63 Calculate the equivalent resistance of the circuit. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 64 and 65 on the diagram below, which shows a wave in a rope.



64 Determine the wavelength of the wave. [1]

65 Determine the amplitude of the wave. [1]

Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics.*

Base your answers to questions 66 through 70 on the information below.

A runner accelerates uniformly from rest to a speed of 8.00 meters per second. The kinetic energy of the runner was determined at 2.00-meter-per-second intervals and recorded in the data table below.

Data Table

Speed (m/s)	**Kinetic Energy** (J)
0.00	0.00
2.00	140.
4.00	560.
6.00	1260
8.00	2240

Directions (66–67): Using the information in the data table, construct a graph on the grid *in your answer booklet* following the directions below.

66 Plot the data points for kinetic energy of the runner versus his speed. [1]

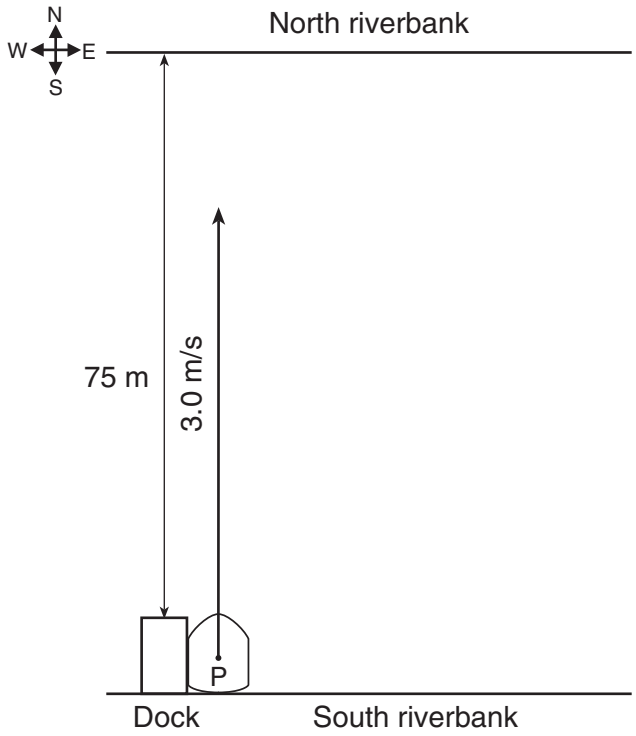
67 Draw the line or curve of best fit. [1]

68–69 Calculate the mass of the runner. [Show all work, including the equation and substitution with units.] [2]

70 A soccer player having less mass than the runner also accelerates uniformly from rest to a speed of 8.00 meters per second. Compare the kinetic energy of the less massive soccer player to the kinetic energy of the more massive runner when both are traveling at the same speed. [1]

Base your answers to questions 71 through 75 on the information below.

A river has a current flowing with a velocity of 2.0 meters per second due east. A boat is 75 meters from the north riverbank. It travels at 3.0 meters per second relative to the river and is headed due north. In the diagram below, the vector starting at point *P* represents the velocity of the boat relative to the river water.



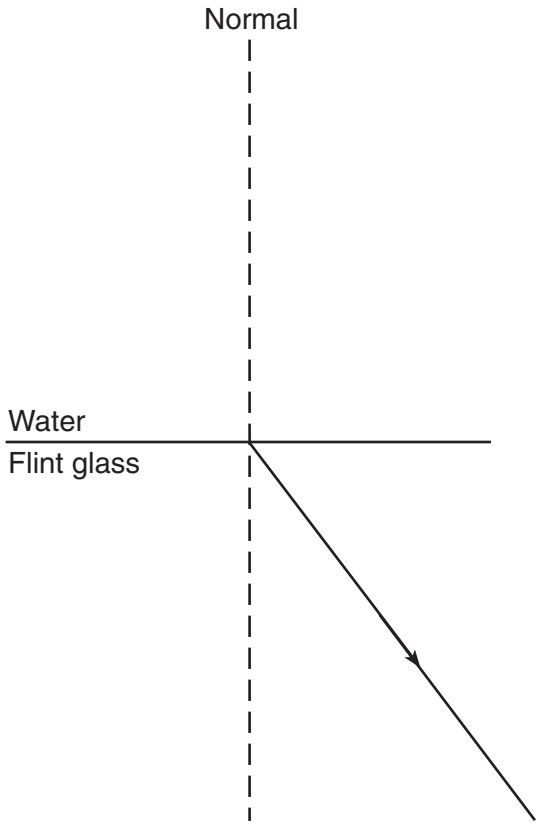
71–72 Calculate the time required for the boat to cross the river. [Show all work, including the equation and substitution with units.] [2]

73 On the diagram *in your answer booklet*, use a ruler and protractor to construct a vector representing the velocity of the river current. Begin the vector at point *P* and use a scale of 1.0 centimeter = 0.50 meter per second. [1]

74–75 Calculate *or* find graphically the magnitude of the resultant velocity of the boat. [Show all work, including the equation and substitution with units *or* construct the resultant velocity vector *in your answer booklet* for question 73, using a scale of 1.0 centimeter = 0.50 meter per second. The value of the magnitude must be written *in your answer booklet* in the space for questions 74–75.] [2]

Base your answers to questions 76 through 80 on the information below.

A light ray ($f = 5.09 \times 10^{14}$ Hz) is refracted as it travels from water into flint glass. The path of the light ray in the flint glass is shown in the diagram below.



76 Using a protractor, measure the angle of refraction of the light ray in the flint glass. [1]

77–78 Calculate the angle of incidence for the light ray in water. [Show all work, including the equation and substitution with units.] [2]

79 Using a protractor and straightedge, on the diagram *in your answer booklet*, draw the path of the incident light ray in the water. [1]

80 Identify *one* physical event, other than transmission or refraction, that occurs as the light interacts with the water-flint glass boundary. [1]

Base your answers to questions 81 through 85 on the information below.

Two experiments running simultaneously at the Fermi National Accelerator Laboratory in Batavia, Ill., have observed a new particle called the cascade baryon. It is one of the most massive examples yet of a baryon—a class of particles made of three quarks held together by the strong nuclear force—and the first to contain one quark from each of the three known families, or generations, of these elementary particles.

Protons and neutrons are made of up and down quarks, the two first-generation quarks. Strange and charm quarks constitute the second generation, while the top and bottom varieties make up the third. Physicists had long conjectured that a down quark could combine with a strange and a bottom quark to form the three-generation cascade baryon.

On June 13, the scientists running Dzero, one of two detectors at Fermilab's Tevatron accelerator, announced that they had detected characteristic showers of particles from the decay of cascade baryons. The baryons formed in proton-antiproton collisions and lived no more than a trillionth of a second. A week later, physicists at CDF, the Tevatron's other detector, reported their own sighting of the baryon...

Source: D.C., "Pas de deux for a three-scoop particle," *Science News*, Vol. 172, July 7, 2007

81 Which combination of *three* quarks will produce a neutron? [1]

82 What is the magnitude and sign of the charge, in elementary charges, of a cascade baryon? [1]

83 The Tevatron derives its name from teraelectronvolt, the maximum energy it can impart to a particle. Determine the energy, in joules, equivalent to 1.00 teraelectronvolt. [1]

84–85 Calculate the maximum total mass, in kilograms, of particles that could be created in the head-on collision of a proton and an antiproton, each having an energy of 1.60×10^{-7} joule. [Show all work, including the equation and substitution with units.] [2]

Printed on Recycled Paper

P.S./PHYSICS