

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

PHYSICAL SETTING
PHYSICS

Wednesday, June 25, 2008 — 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 answers to the questions in Part B–2 and Part C are to be written in your separate answer booklet. Be sure to fill in the heading on the front 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 *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.

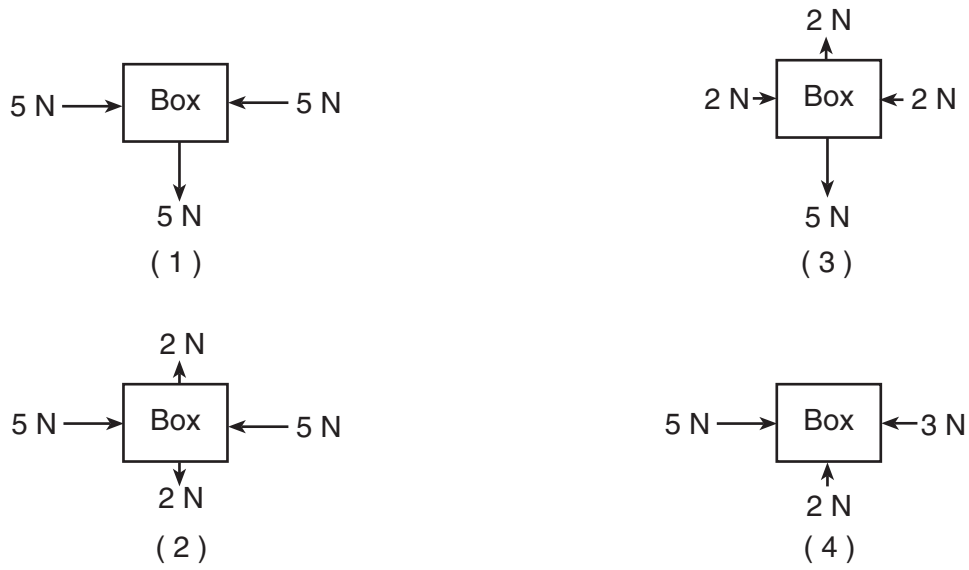
Part A

Answer all questions in this part.

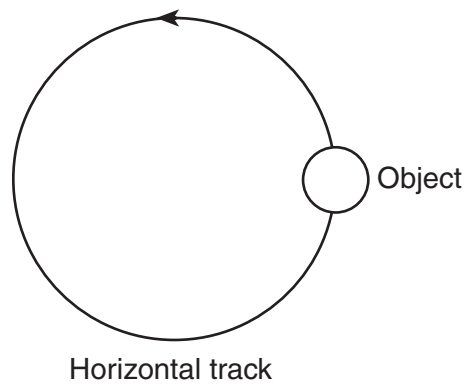
Directions (1–35): For *each* statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

- 1 The speedometer in a car does *not* measure the car's velocity because velocity is a
- (1) vector quantity and has a direction associated with it
 - (2) vector quantity and does not have a direction associated with it
 - (3) scalar quantity and has a direction associated with it
 - (4) scalar quantity and does not have a direction associated with it
- 2 A projectile launched at an angle of 45° above the horizontal travels through the air. Compared to the projectile's theoretical path with no air friction, the actual trajectory of the projectile with air friction is
- (1) lower and shorter
 - (2) lower and longer
 - (3) higher and shorter
 - (4) higher and longer
- 3 Cart *A* has a mass of 2 kilograms and a speed of 3 meters per second. Cart *B* has a mass of 3 kilograms and a speed of 2 meters per second. Compared to the inertia and magnitude of momentum of cart *A*, cart *B* has
- (1) the same inertia and a smaller magnitude of momentum
 - (2) the same inertia and the same magnitude of momentum
 - (3) greater inertia and a smaller magnitude of momentum
 - (4) greater inertia and the same magnitude of momentum
- 4 Approximately how much time does it take light to travel from the Sun to Earth?
- (1) 2.00×10^{-3} s
 - (2) 1.28×10^0 s
 - (3) 5.00×10^2 s
 - (4) 4.50×10^{19} s
- 5 A rock falls from rest a vertical distance of 0.72 meter to the surface of a planet in 0.63 second. The magnitude of the acceleration due to gravity on the planet is
- (1) 1.1 m/s^2
 - (2) 2.3 m/s^2
 - (3) 3.6 m/s^2
 - (4) 9.8 m/s^2
- 6 Two stones, *A* and *B*, are thrown horizontally from the top of a cliff. Stone *A* has an initial speed of 15 meters per second and stone *B* has an initial speed of 30. meters per second. Compared to the time it takes stone *A* to reach the ground, the time it takes stone *B* to reach the ground is
- (1) the same
 - (2) twice as great
 - (3) half as great
 - (4) four times as great
- 7 The speed of an object undergoing constant acceleration increases from 8.0 meters per second to 16.0 meters per second in 10. seconds. How far does the object travel during the 10. seconds?
- (1) 3.6×10^2 m
 - (2) 1.6×10^2 m
 - (3) 1.2×10^2 m
 - (4) 8.0×10^1 m
- 8 A 1200-kilogram space vehicle travels at 4.8 meters per second along the level surface of Mars. If the magnitude of the gravitational field strength on the surface of Mars is 3.7 newtons per kilogram, the magnitude of the normal force acting on the vehicle is
- (1) 320 N
 - (2) 930 N
 - (3) 4400 N
 - (4) 5800 N

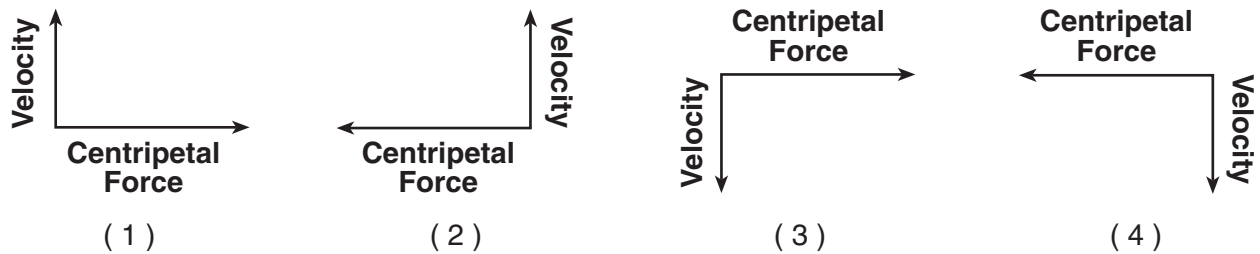
9 Which diagram represents a box in equilibrium?



10 The diagram below shows an object moving counterclockwise around a horizontal, circular track.



Which diagram represents the direction of both the object's velocity and the centripetal force acting on the object when it is in the position shown?



11 An airplane flies with a velocity of 750. kilometers per hour, 30.0° south of east. What is the magnitude of the eastward component of the plane's velocity?

- (1) 866 km/h (3) 433 km/h
 (2) 650. km/h (4) 375 km/h

12 An 80-kilogram skier slides on waxed skis along a horizontal surface of snow at constant velocity while pushing with his poles. What is the horizontal component of the force pushing him forward?

- (1) 0.05 N (3) 40 N
 (2) 0.4 N (4) 4 N

13 A 1750-kilogram car travels at a constant speed of 15.0 meters per second around a horizontal, circular track with a radius of 45.0 meters. The magnitude of the centripetal force acting on the car is

- (1) 5.00 N (3) 8750 N
 (2) 583 N (4) 3.94×10^5 N

14 A 0.45-kilogram football traveling at a speed of 22 meters per second is caught by an 84-kilogram stationary receiver. If the football comes to rest in the receiver's arms, the magnitude of the impulse imparted to the receiver by the ball is

- (1) 1800 N•s (3) 4.4 N•s
 (2) 9.9 N•s (4) 3.8 N•s

Note that question 15 has only three choices.

15 A carpenter hits a nail with a hammer. Compared to the magnitude of the force the hammer exerts on the nail, the magnitude of the force the nail exerts on the hammer during contact is

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

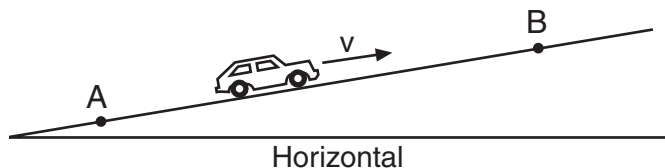
16 As a meteor moves from a distance of 16 Earth radii to a distance of 2 Earth radii from the center of Earth, the magnitude of the gravitational force between the meteor and Earth becomes

- (1) $\frac{1}{8}$ as great (3) 64 times as great
 (2) 8 times as great (4) 4 times as great

17 A 60.-kilogram student climbs a ladder a vertical distance of 4.0 meters in 8.0 seconds. Approximately how much total work is done against gravity by the student during the climb?

- (1) 2.4×10^3 J (3) 2.4×10^2 J
 (2) 2.9×10^2 J (4) 3.0×10^1 J

18 A car travels at constant speed v up a hill from point A to point B, as shown in the diagram below.



As the car travels from A to B, its gravitational potential energy

- (1) increases and its kinetic energy decreases
 (2) increases and its kinetic energy remains the same
 (3) remains the same and its kinetic energy decreases
 (4) remains the same and its kinetic energy remains the same

19 What is the maximum amount of work that a 6000.-watt motor can do in 10. seconds?

- (1) 6.0×10^1 J (3) 6.0×10^3 J
 (2) 6.0×10^2 J (4) 6.0×10^4 J

20 Three resistors, 4 ohms, 6 ohms, and 8 ohms, are connected in parallel in an electric circuit. The equivalent resistance of the circuit is

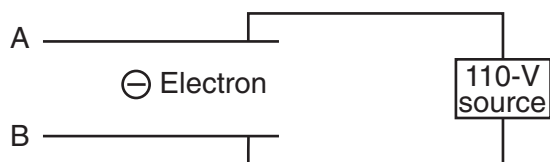
- (1) less than 4 Ω
 (2) between 4 Ω and 8 Ω
 (3) between 10. Ω and 18 Ω
 (4) 18 Ω

Note that question 21 has only three choices.

21 An electric circuit contains a variable resistor connected to a source of constant voltage. As the resistance of the variable resistor is increased, the power dissipated in the circuit

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

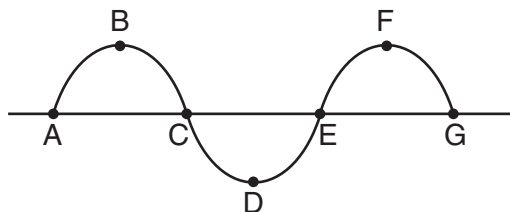
- 22 An electron is located in the electric field between two parallel metal plates as shown in the diagram below.



If the electron is attracted to plate A, then plate A is charged

- (1) positively, and the electric field is directed from plate A toward plate B
 - (2) positively, and the electric field is directed from plate B toward plate A
 - (3) negatively, and the electric field is directed from plate A toward plate B
 - (4) negatively, and the electric field is directed from plate B toward plate A
- 23 A potential difference of 10.0 volts exists between two points, A and B, within an electric field. What is the magnitude of charge that requires 2.0×10^{-2} joule of work to move it from A to B?
- (1) 5.0×10^2 C
 - (2) 2.0×10^{-1} C
 - (3) 5.0×10^{-2} C
 - (4) 2.0×10^{-3} C
- 24 A circuit consists of a resistor and a battery. Increasing the voltage of the battery while keeping the temperature of the circuit constant would result in an increase in
- (1) current, only
 - (2) resistance, only
 - (3) both current and resistance
 - (4) neither current nor resistance
- 25 The time required for a wave to complete one full cycle is called the wave's
- (1) frequency
 - (2) period
 - (3) velocity
 - (4) wavelength
- 26 An electromagnetic AM-band radio wave could have a wavelength of
- (1) 0.005 m
 - (2) 5 m
 - (3) 500 m
 - (4) 5 000 000 m

- 27 The diagram below represents a transverse wave.



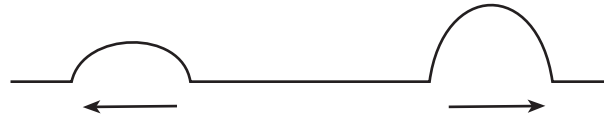
The wavelength of the wave is equal to the distance between points

- (1) A and G
 - (2) B and F
 - (3) C and E
 - (4) D and F
- 28 When a light wave enters a new medium and is refracted, there must be a change in the light wave's
- (1) color
 - (2) frequency
 - (3) period
 - (4) speed
- 29 The speed of light in a piece of plastic is 2.00×10^8 meters per second. What is the absolute index of refraction of this plastic?
- (1) 1.00
 - (2) 0.670
 - (3) 1.33
 - (4) 1.50
- 30 Wave X travels eastward with frequency f and amplitude A . Wave Y, traveling in the same medium, interacts with wave X and produces a standing wave. Which statement about wave Y is correct?
- (1) Wave Y must have a frequency of f , an amplitude of A , and be traveling eastward.
 - (2) Wave Y must have a frequency of $2f$, an amplitude of $3A$, and be traveling eastward.
 - (3) Wave Y must have a frequency of $3f$, an amplitude of $2A$, and be traveling westward.
 - (4) Wave Y must have a frequency of f , an amplitude of A , and be traveling westward.

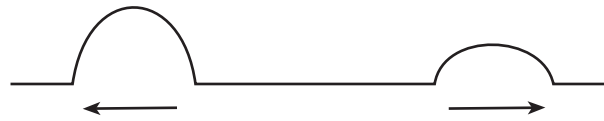
31 The diagram below represents two pulses approaching each other from opposite directions in the same medium.



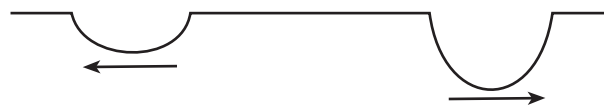
Which diagram best represents the medium after the pulses have passed through each other?



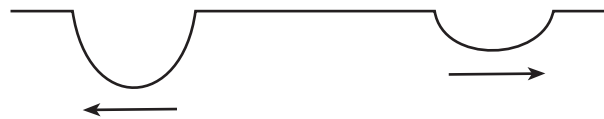
(1)



(2)



(3)



(4)

32 A car's horn is producing a sound wave having a constant frequency of 350 hertz. If the car moves toward a stationary observer at constant speed, the frequency of the car's horn detected by this observer may be

- (1) 320 Hz (3) 350 Hz
 (2) 330 Hz (4) 380 Hz

33 A mercury atom in the ground state absorbs 20.00 electronvolts of energy and is ionized by losing an electron. How much kinetic energy does this electron have after the ionization?

- (1) 6.40 eV (3) 10.38 eV
 (2) 9.62 eV (4) 13.60 eV

34 Which fundamental force is primarily responsible for the attraction between protons and electrons?

- (1) strong (3) gravitational
 (2) weak (4) electromagnetic

35 The total conversion of 1.00 kilogram of the Sun's mass into energy yields

- (1) 9.31×10^2 MeV (3) 3.00×10^8 J
 (2) 8.38×10^{19} MeV (4) 9.00×10^{16} J

Part B-1

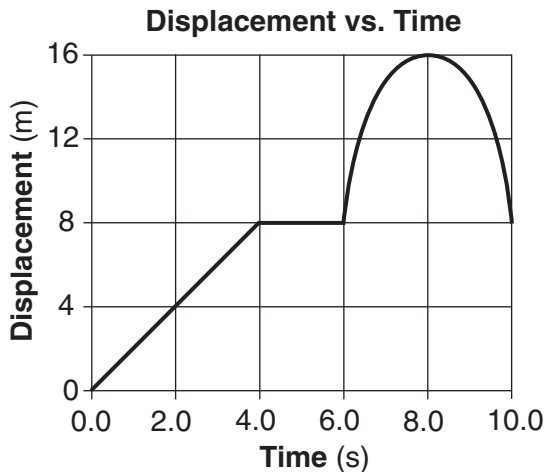
Answer all questions in this part.

Directions (36–51): 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 The mass of a paper clip is approximately

- (1) 1×10^6 kg (3) 1×10^{-3} kg
 (2) 1×10^3 kg (4) 1×10^{-6} kg

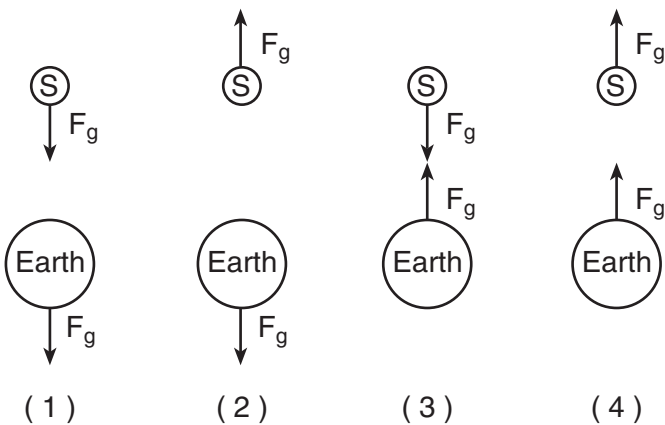
37 The graph below represents the displacement of an object moving in a straight line as a function of time.



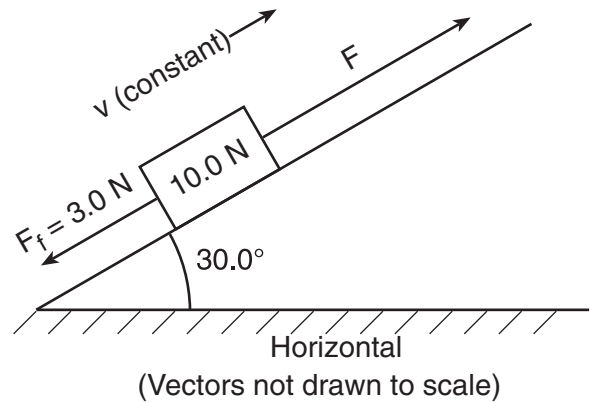
What was the total distance traveled by the object during the 10.0-second time interval?

- (1) 0 m (3) 16 m
 (2) 8 m (4) 24 m

38 Which diagram best represents the gravitational forces, F_g , between a satellite, S, and Earth?



39 A block weighing 10.0 newtons is on a ramp inclined at 30.0° to the horizontal. A 3.0-newton force of friction, F_f , acts on the block as it is pulled up the ramp at constant velocity with force F , which is parallel to the ramp, as shown in the diagram below.



What is the magnitude of force F ?

- (1) 7.0 N (3) 10. N
 (2) 8.0 N (4) 13 N

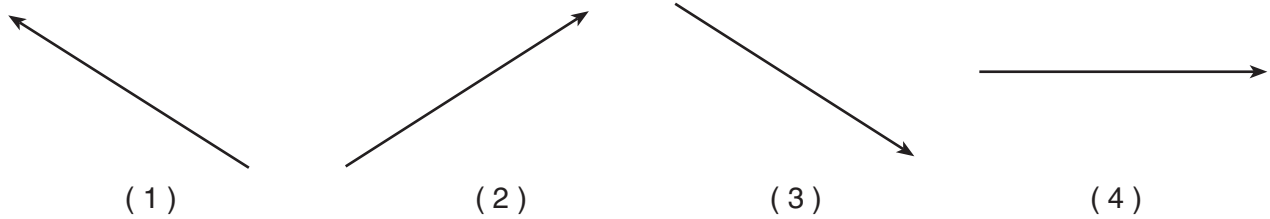
40 A 25-newton horizontal force northward and a 35-newton horizontal force southward act concurrently on a 15-kilogram object on a frictionless surface. What is the magnitude of the object's acceleration?

- (1) 0.67 m/s^2 (3) 2.3 m/s^2
 (2) 1.7 m/s^2 (4) 4.0 m/s^2

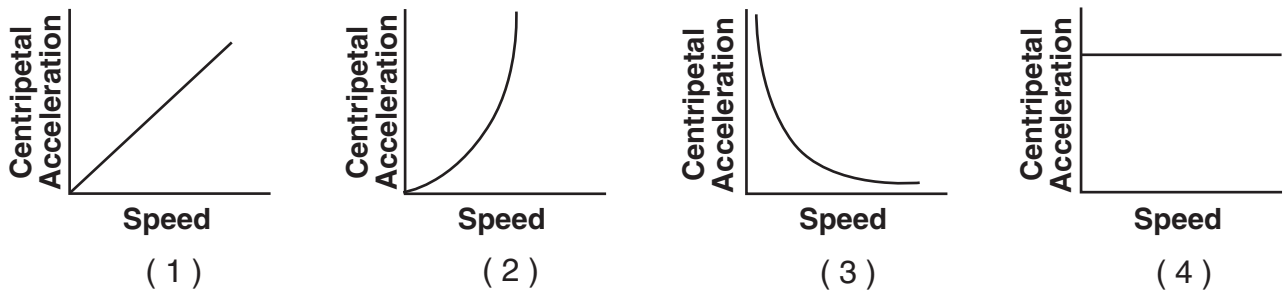
41 The diagram below represents two concurrent forces.



Which vector represents the force that will produce equilibrium with these two forces?

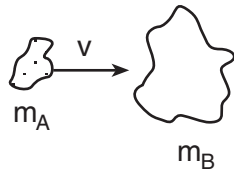


42 Which graph best represents the relationship between the magnitude of the centripetal acceleration and the speed of an object moving in a circle of constant radius?

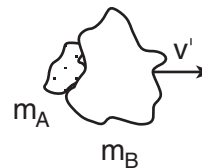


43 The diagram below represents two masses before and after they collide. Before the collision, mass m_A is moving to the right with speed v , and mass m_B is at rest. Upon collision, the two masses stick together.

Before Collision



After Collision



Which expression represents the speed, v' , of the masses after the collision? [Assume no outside forces are acting on m_A or m_B .]

(1) $\frac{m_A + m_B v}{m_A}$

(3) $\frac{m_B v}{m_A + m_B}$

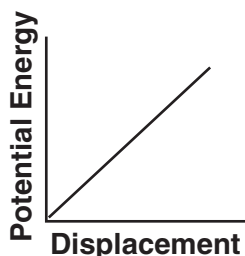
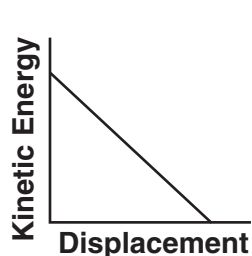
(2) $\frac{m_A + m_B}{m_A v}$

(4) $\frac{m_A v}{m_A + m_B}$

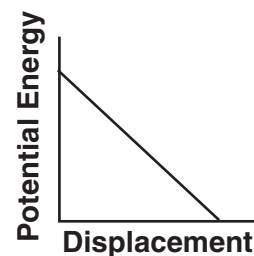
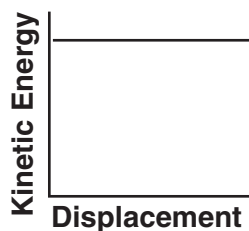
44 Which combination of fundamental units can be used to express energy?

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

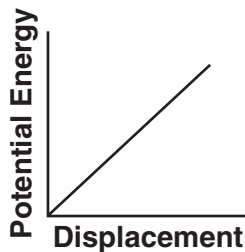
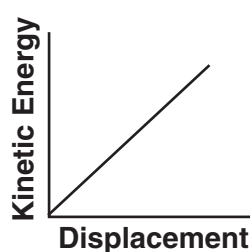
45 An object is thrown vertically upward. Which pair of graphs best represents the object's kinetic energy and gravitational potential energy as functions of its displacement while it rises?



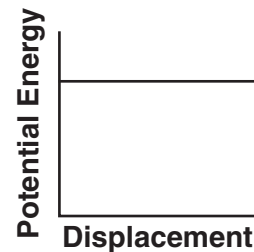
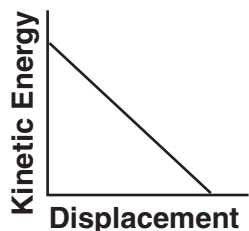
(1)



(3)



(2)



(4)

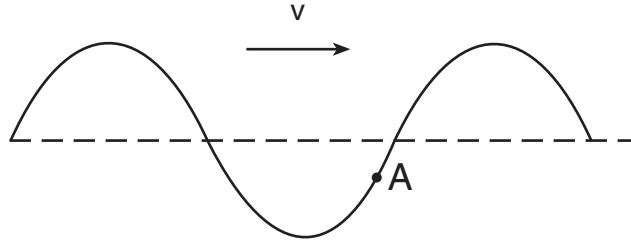
46 Charge flowing at the rate of 2.50×10^{16} elementary charges per second is equivalent to a current of

- (1) 2.50×10^{13} A (3) 4.00×10^{-3} A
 (2) 6.25×10^5 A (4) 2.50×10^{-3} A

47 An electric drill operating at 120. volts draws a current of 3.00 amperes. What is the total amount of electrical energy used by the drill during 1.00 minute of operation?

- (1) 2.16×10^4 J (3) 3.60×10^2 J
 (2) 2.40×10^3 J (4) 4.00×10^1 J

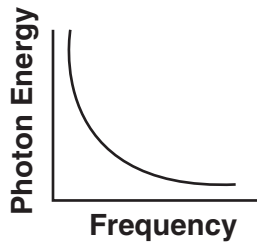
48 The diagram below represents a transverse wave traveling to the right through a medium. Point A represents a particle of the medium.



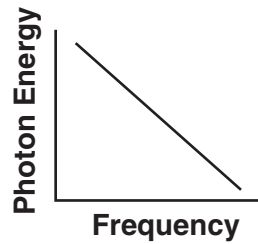
In which direction will particle A move in the next instant of time?

- (1) up (3) left
 (2) down (4) right

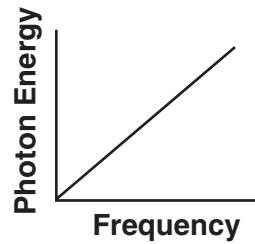
49 Which graph best represents the relationship between photon energy and photon frequency?



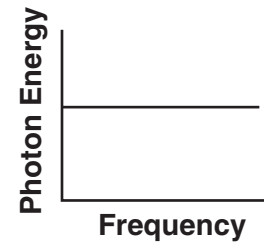
(1)



(2)



(3)



(4)

Base your answers to questions 50 and 51 on the table below, which shows data about various subatomic particles.

Subatomic Particle Table

Symbol	Name	Quark Content	Electric Charge	Mass (GeV/c^2)
p	proton	uud	+1	0.938
\bar{p}	antiproton	$\bar{u}\bar{u}\bar{d}$	-1	0.938
n	neutron	udd	0	0.940
λ	lambda	uds	0	1.116
Ω^-	omega	sss	-1	1.672

50 Which particle listed on the table has the opposite charge of, and is more massive than, a proton?

- (1) antiproton (3) lambda
 (2) neutron (4) omega

51 All the particles listed on the table are classified as

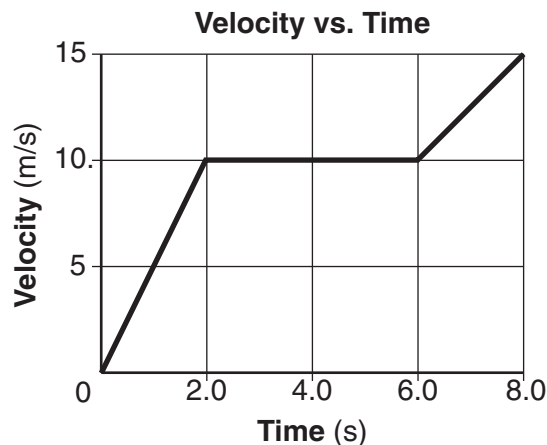
- (1) mesons (3) antimatter
 (2) hadrons (4) leptons

Part B-2

Answer all questions in this part.

Directions (52–61): Record your answers in the spaces provided in your answer booklet.

- 52 The graph below represents the velocity of an object traveling in a straight line as a function of time.



Determine the magnitude of the total displacement of the object at the end of the first 6.0 seconds. [1]

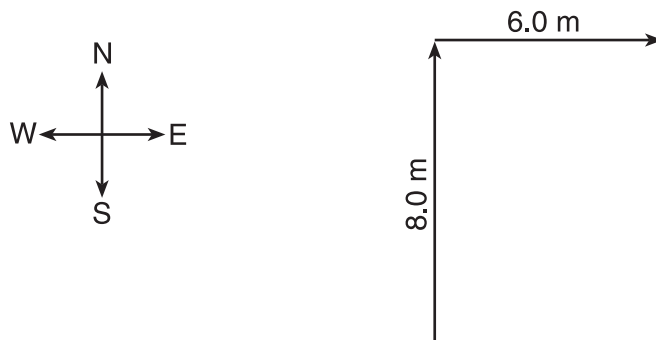
Base your answers to questions 53 and 54 on the information below.

A 65-kilogram pole vaulter wishes to vault to a height of 5.5 meters.

- 53 Calculate the *minimum* amount of kinetic energy the vaulter needs to reach this height if air friction is neglected and all the vaulting energy is derived from kinetic energy. [Show all work, including the equation and substitution with units.] [2]
- 54 Calculate the speed the vaulter must attain to have the necessary kinetic energy. [Show all work, including the equation and substitution with units.] [2]
-

Base your answers to questions 55 through 57 on the information and vector diagram below.

A dog walks 8.0 meters due north and then 6.0 meters due east.



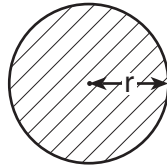
- 55 Using a metric ruler and the vector diagram, determine the scale used in the diagram. [1]
- 56 On the diagram *in your answer booklet*, construct the resultant vector that represents the dog's total displacement. [1]
- 57 Determine the magnitude of the dog's total displacement. [1]

-
- 58 Two small identical metal spheres, *A* and *B*, on insulated stands, are each given a charge of $+2.0 \times 10^{-6}$ coulomb. The distance between the spheres is 2.0×10^{-1} meter. Calculate the magnitude of the electrostatic force that the charge on sphere *A* exerts on the charge on sphere *B*. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 59 and 60 on the information and diagram below.

A 10.0-meter length of copper wire is at 20°C. The radius of the wire is 1.0×10^{-3} meter.

Cross Section of Copper Wire



$$r = 1.0 \times 10^{-3} \text{ m}$$

59 Determine the cross-sectional area of the wire. [1]

60 Calculate the resistance of the wire. [Show all work, including the equation and substitution with units.] [2]

61 The diagram in your answer booklet represents a transverse wave moving on a uniform rope with point A labeled as shown. On the diagram *in your answer booklet*, mark an **X** at the point on the wave that is 180° out of phase with point A. [1]

Part C

Answer all questions in this part.

Directions (62–76): Record your answers in the spaces provided in your answer booklet.

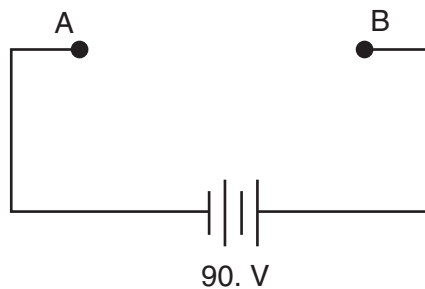
Base your answers to questions 62 through 64 on the information below.

A kicked soccer ball has an initial velocity of 25 meters per second at an angle of $40.^\circ$ above the horizontal, level ground. [Neglect friction.]

- 62 Calculate the magnitude of the vertical component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]
- 63 Calculate the maximum height the ball reaches above its initial position. [Show all work, including the equation and substitution with units.] [2]
- 64 On the diagram *in your answer booklet*, sketch the path of the ball's flight from its initial position at point *P* until it returns to level ground. [1]
-

Base your answers to questions 65 through 67 on the information and diagram below.

A 15-ohm resistor, R_1 , and a 30.-ohm resistor, R_2 , are to be connected in parallel between points *A* and *B* in a circuit containing a 90.-volt battery.



- 65 Complete the diagram *in your answer booklet* to show the two resistors connected in parallel between points *A* and *B*. [1]
- 66 Determine the potential difference across resistor R_1 . [1]
- 67 Calculate the current in resistor R_1 . [Show all work, including the equation and substitution with units.] [2]
-

Base your answers to questions 68 through 71 on the information and data table below.

The spring in a dart launcher has a spring constant of 140 newtons per meter. The launcher has six power settings, 0 through 5, with each successive setting having a spring compression 0.020 meter beyond the previous setting. During testing, the launcher is aligned to the vertical, the spring is compressed, and a dart is fired upward. The maximum vertical displacement of the dart in each test trial is measured. The results of the testing are shown in the table below.

Data Table

Power Setting	Spring Compression (m)	Dart's Maximum Vertical Displacement (m)
0	0.000	0.00
1	0.020	0.29
2	0.040	1.14
3	0.060	2.57
4	0.080	4.57
5	0.100	7.10

Directions (68–69): Using the information in the data table, construct a graph on the grid *in your answer booklet*, following the directions below.

68 Plot the data points for the dart's maximum vertical displacement versus spring compression. [1]

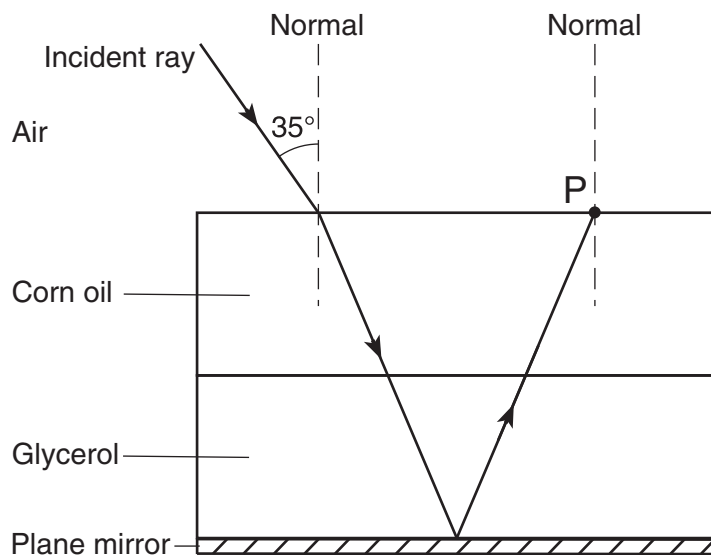
69 Draw the line or curve of best fit. [1]

70 Using information from your graph, calculate the energy provided by the compressed spring that causes the dart to achieve a maximum vertical displacement of 3.50 meters. [Show all work, including the equation and substitution with units.] [2]

71 Determine the magnitude of the force, in newtons, needed to compress the spring 0.040 meter. [1]

Base your answers to questions 72 through 74 on the information and diagram below.

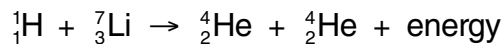
A ray of monochromatic light having a frequency of 5.09×10^{14} hertz is incident on an interface of air and corn oil at an angle of 35° as shown. The ray is transmitted through parallel layers of corn oil and glycerol and is then reflected from the surface of a plane mirror, located below and parallel to the glycerol layer. The ray then emerges from the corn oil back into the air at point P .



- 72 Calculate the angle of refraction of the light ray as it enters the corn oil from air. [Show all work, including the equation and the substitution with units.] [2]
- 73 Explain why the ray does *not* bend at the corn oil-glycerol interface. [1]
- 74 On the diagram *in your answer booklet*, use a protractor and straightedge to construct the refracted ray representing the light emerging at point P into air. [1]
-

Base your answers to questions 75 and 76 on the information and data table below.

In the first nuclear reaction using a particle accelerator, accelerated protons bombarded lithium atoms, producing alpha particles and energy. The energy resulted from the conversion of mass into energy. The reaction can be written as shown below.



Data Table

Particle	Symbol	Mass (u)
proton	${}^1_1\text{H}$	1.007 83
lithium atom	${}^7_3\text{Li}$	7.016 00
alpha particle	${}^4_2\text{He}$	4.002 60

75 Determine the difference between the total mass of a proton plus a lithium atom, ${}^1_1\text{H} + {}^7_3\text{Li}$, and the total mass of two alpha particles, ${}^4_2\text{He} + {}^4_2\text{He}$, in universal mass units. [1]

76 Determine the energy in megaelectronvolts produced in the reaction of a proton with a lithium atom. [1]

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, June 25, 2008 — 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 44
- 37 45
- 38 46
- 39 47
- 40 48
- 41 49
- 42 50
- 43 51

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

Tear Here