The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, June 16, 2004 — 1:15 to 4:15 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

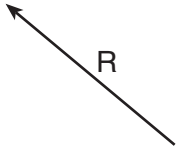
Answer all questions in this part.

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.

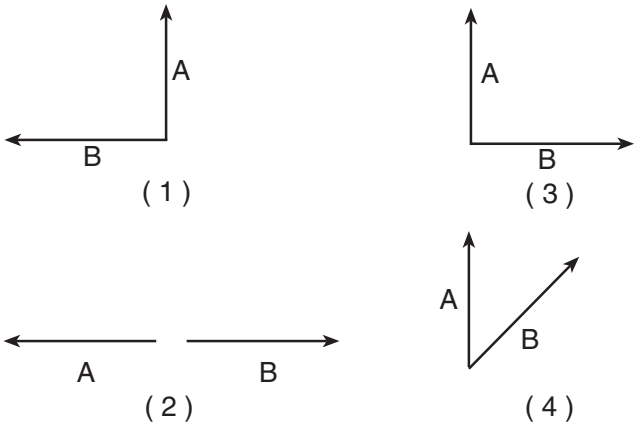
1 Velocity is to speed as displacement is to

(1) acceleration
(2) time
(3) momentum
(4) distance

2 The diagram below shows a resultant vector, *R*.



Which diagram best represents a pair of component vectors, *A* and *B*, that would combine to form resultant vector *R*?

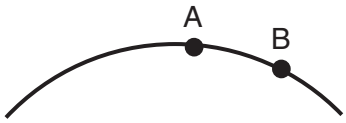


3 A person is standing on a bathroom scale in an elevator car. If the scale reads a value greater than the weight of the person at rest, the elevator car could be moving

(1) downward at constant speed
(2) upward at constant speed
(3) downward at increasing speed
(4) upward at increasing speed

Note that question 4 has only three choices.

4 The diagram below represents the path of an object after it was thrown.



What happens to the object's acceleration as it travels from *A* to *B*? [Neglect friction.]

(1) It decreases.
(2) It increases.
(3) It remains the same.

5 A 0.2-kilogram red ball is thrown horizontally at a speed of 4 meters per second from a height of 3 meters. A 0.4-kilogram green ball is thrown horizontally from the same height at a speed of 8 meters per second. Compared to the time it takes the red ball to reach the ground, the time it takes the green ball to reach the ground is

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

6 The acceleration due to gravity on the surface of planet *X* is 19.6 meters per second^2. If an object on the surface of this planet weighs 980. newtons, the mass of the object is

(1) 50.0 kg
(2) 100. kg
(3) 490. N
(4) 908 N

7 A basketball player jumped straight up to grab a rebound. If she was in the air for 0.80 second, how high did she jump?

(1) 0.50 m
(2) 0.78 m
(3) 1.2 m
(4) 3.1 m

8 The force required to start an object sliding across a uniform horizontal surface is larger than the force required to keep the object sliding at a constant velocity. The magnitudes of the required forces are different in these situations because the force of kinetic friction

(1) is greater than the force of static friction
(2) is less than the force of static friction
(3) increases as the speed of the object relative to the surface increases
(4) decreases as the speed of the object relative to the surface increases

9 A 50.-kilogram student threw a 0.40-kilogram ball with a speed of 20. meters per second. What was the magnitude of the impulse that the student exerted on the ball?

(1) 8.0 N•s
(2) 78 N•s
(3) 4.0×10^2 N•s
(4) 1.0×10^3 N•s

10 A man is pushing a baby stroller. Compared to the magnitude of the force exerted on the stroller by the man, the magnitude of the force exerted on the man by the stroller is

(1) zero
(2) smaller, but greater than zero
(3) larger
(4) the same

11 The work done in moving a block across a rough surface and the heat energy gained by the block can both be measured in

(1) watts
(2) degrees
(3) newtons
(4) joules

Note that question 12 has only three choices.

12 Two weightlifters, one 1.5 meters tall and one 2.0 meters tall, raise identical 50.-kilogram masses above their heads. Compared to the work done by the weightlifter who is 1.5 meters tall, the work done by the weightlifter who is 2.0 meters tall is

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

13 A 45.0-kilogram boy is riding a 15.0-kilogram bicycle with a speed of 8.00 meters per second. What is the combined kinetic energy of the boy and the bicycle?

(1) 240. J
(2) 480. J
(3) 1440 J
(4) 1920 J

14 A 5-newton force causes a spring to stretch 0.2 meter. What is the potential energy stored in the stretched spring?

(1) 1 J
(2) 0.5 J
(3) 0.2 J
(4) 0.1 J

15 A 40.-kilogram student runs up a staircase to a floor that is 5.0 meters higher than her starting point in 7.0 seconds. The student's power output is

(1) 29 W
(2) 280 W
(3) 1.4×10^3 W
(4) 1.4×10^4 W

16 Which type of field is present near a moving electric charge?

(1) an electric field, only
(2) a magnetic field, only
(3) both an electric field and a magnetic field
(4) neither an electric field nor a magnetic field

17 A negatively charged plastic comb is brought close to, but does not touch, a small piece of paper. If the comb and the paper are attracted to each other, the charge on the paper

(1) may be negative or neutral
(2) may be positive or neutral
(3) must be negative
(4) must be positive

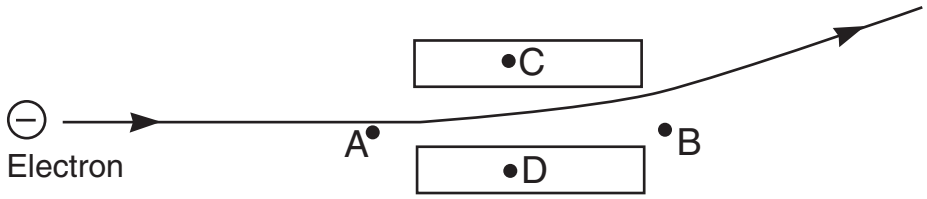
18 If a 1.5-volt cell is to be completely recharged, each electron must be supplied with a minimum energy of

(1) 1.5 eV
(2) 1.5 J
(3) 9.5×10^{18} eV
(4) 9.5×10^{18} J

19 The current traveling from the cathode to the screen in a television picture tube is 5.0×10^{-5} ampere. How many electrons strike the screen in 5.0 seconds?

(1) 3.1×10^{24}
(2) 6.3×10^{18}
(3) 1.6×10^{15}
(4) 1.0×10^5

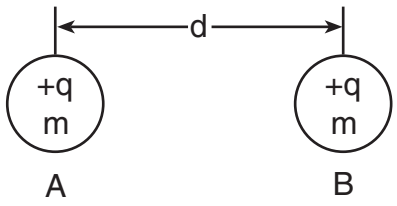
20 A moving electron is deflected by two oppositely charged parallel plates, as shown in the diagram below.



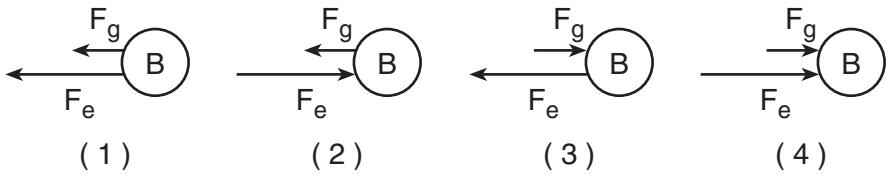
The electric field between the plates is directed from

(1) A to B
(2) B to A
(3) C to D
(4) D to C

21 The diagram below shows two identical metal spheres, A and B, separated by distance d. Each sphere has mass m and possesses charge q.



Which diagram best represents the electrostatic force F_e and the gravitational force F_g acting on sphere B due to sphere A?



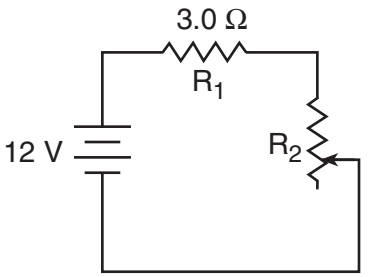
22 The table below lists various characteristics of two metallic wires, A and B.

Wire	Material	Temperature (°C)	Length (m)	Cross-Sectional Area (m^2)	Resistance (Ω)
A	silver	20.	0.10	0.010	R
B	silver	20.	0.20	0.020	???

If wire A has resistance R, then wire B has resistance

(1) R
(2) $2R$
(3) $\frac{R}{2}$
(4) $4R$

23 The diagram below represents an electric circuit consisting of a 12-volt battery, a 3.0-ohm resistor, R_1, and a variable resistor, R_2.



At what value must the variable resistor be set to produce a current of 1.0 ampere through R_1?

(1) 6.0 Ω
(2) 9.0 Ω
(3) 3.0 Ω
(4) 12 Ω

24 The energy of a photon is inversely proportional to its

(1) wavelength
(2) speed
(3) frequency
(4) phase

25 The energy equivalent of the rest mass of an electron is approximately

(1) 5.1×10^{5} J
(2) 8.2×10^{-14} J
(3) 2.7×10^{-22} J
(4) 8.5×10^{-28} J

26 A single vibratory disturbance moving through a medium is called

(1) a node
(2) an antinode
(3) a standing wave
(4) a pulse

27 An electric bell connected to a battery is sealed inside a large jar. What happens as the air is removed from the jar?

(1) The electric circuit stops working because electromagnetic radiation can *not* travel through a vacuum.
(2) The bell's pitch decreases because the frequency of the sound waves is lower in a vacuum than in air.
(3) The bell's loudness increases because of decreased air resistance.
(4) The bell's loudness decreases because sound waves can *not* travel through a vacuum.

28 As a sound wave passes from water, where the speed is 1.49×10^{3} meters per second, into air, the wave's speed

(1) decreases and its frequency remains the same
(2) increases and its frequency remains the same
(3) remains the same and its frequency decreases
(4) remains the same and its frequency increases

29 Which phenomenon occurs when an object absorbs wave energy that matches the object's natural frequency?

(1) reflection
(2) diffraction
(3) resonance
(4) interference

30 A ray of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) in air is incident at an angle of 30.° on a boundary with corn oil. What is the angle of refraction, to the nearest degree, for this light ray in the corn oil?

(1) 6°
(2) 20.°
(3) 30.°
(4) 47°

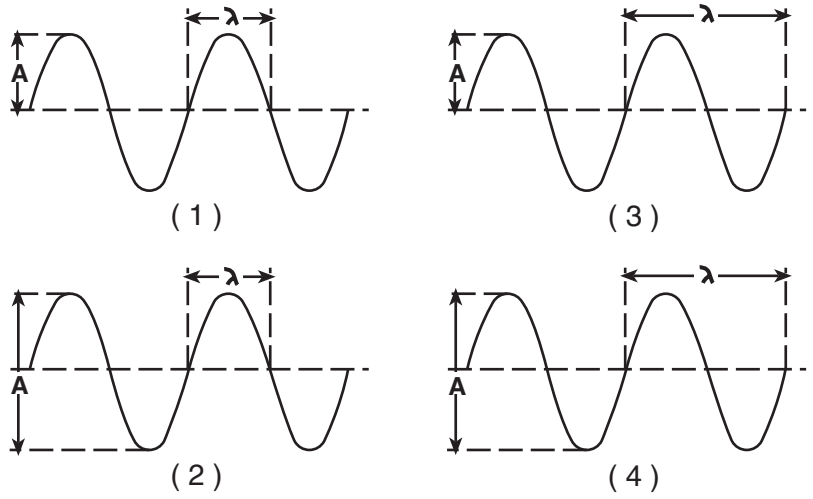
31 A wave is diffracted as it passes through an opening in a barrier. The amount of diffraction that the wave undergoes depends on both the

(1) amplitude and frequency of the incident wave
(2) wavelength and speed of the incident wave
(3) wavelength of the incident wave and the size of the opening
(4) amplitude of the incident wave and the size of the opening

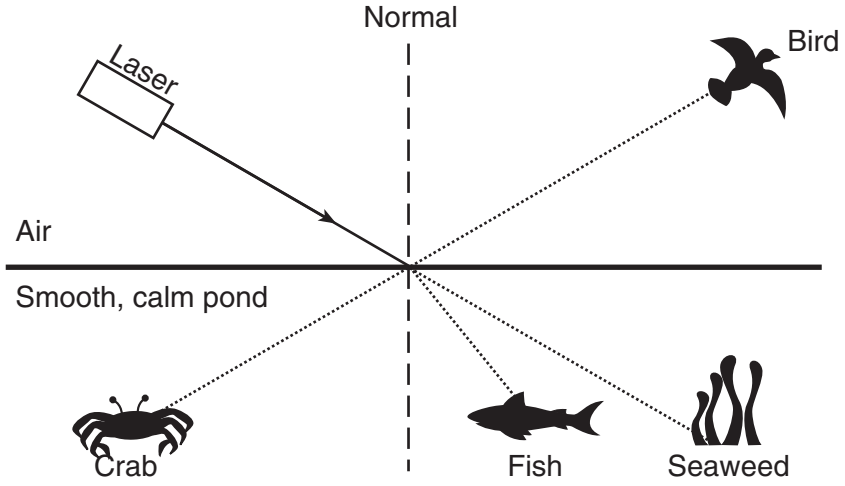
32 A source of waves and an observer are moving relative to each other. The observer will detect a steadily increasing frequency if

(1) he moves toward the source at a constant speed
(2) the source moves away from him at a constant speed
(3) he accelerates toward the source
(4) the source accelerates away from him

33 Which wave diagram has *both* wavelength (λ) and amplitude (*A*) labeled correctly?



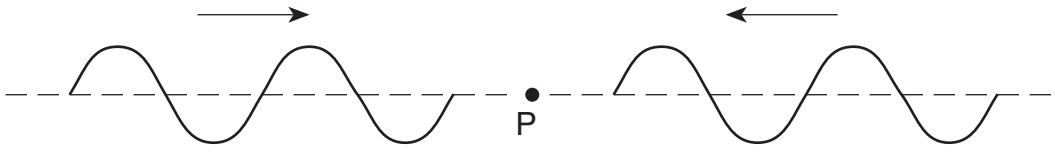
34 A laser beam is directed at the surface of a smooth, calm pond as represented in the diagram below.



Which organisms could be illuminated by the laser light?

(1) the bird and the fish
(2) the bird and the seaweed
(3) the crab and the seaweed
(4) the crab and the fish

35 The diagram below represents two waves of equal amplitude and frequency approaching point *P* as they move through the same medium.



As the two waves pass through each other, the medium at point *P* will

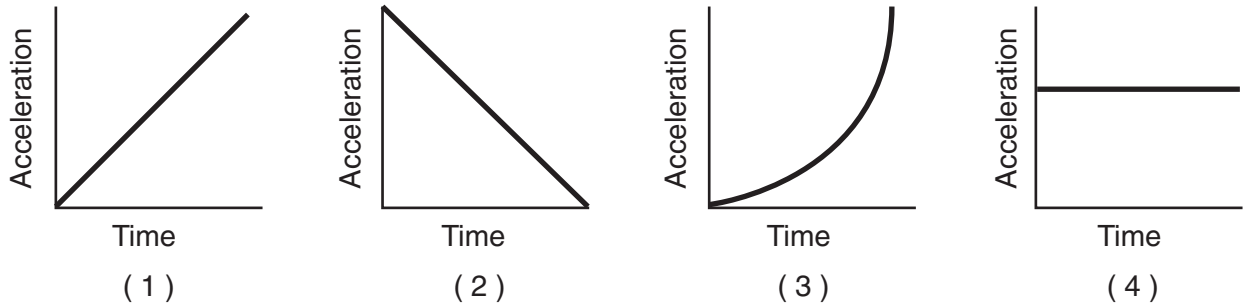
(1) vibrate up and down
(2) vibrate left and right
(3) vibrate into and out of the page
(4) remain stationary

Part B–1

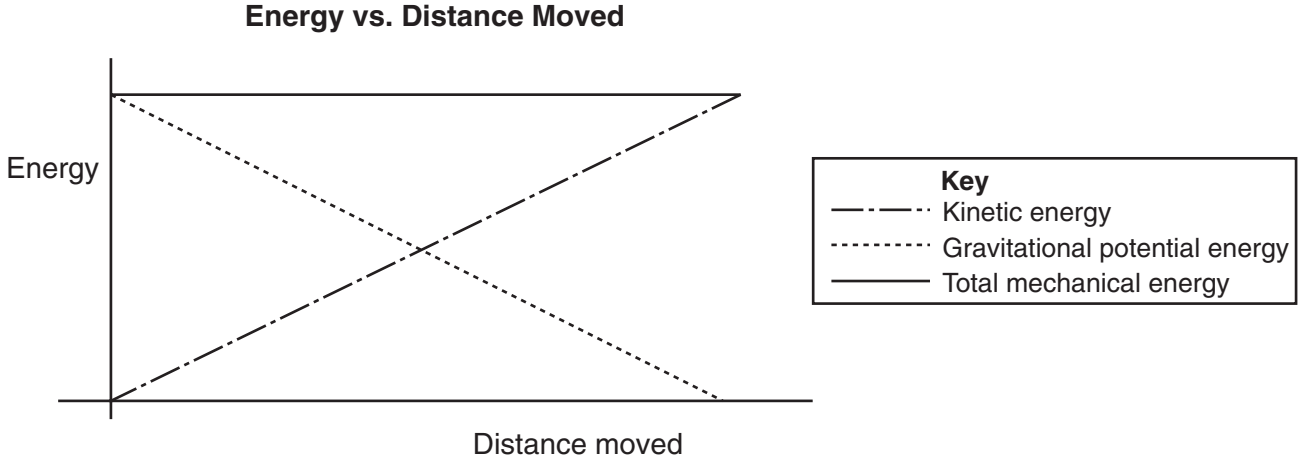
Answer all questions in this part.

Directions (36–46): 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 A constant unbalanced force is applied to an object for a period of time. Which graph best represents the acceleration of the object as a function of elapsed time?



37 The graph below represents the kinetic energy, gravitational potential energy, and total mechanical energy of a moving block.



Which best describes the motion of the block?

(1) accelerating on a flat horizontal surface
(2) sliding up a frictionless incline
(3) falling freely
(4) being lifted at constant velocity

38 The diameter of a United States penny is closest to

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

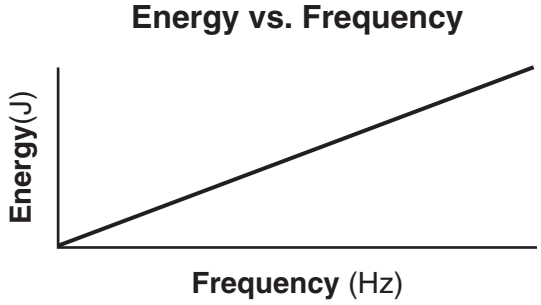
Base your answers to questions 39 and 40 on the data table below. The data table lists the energy and corresponding frequency of five photons.

Photon	Energy (J)	Frequency (Hz)
A	6.63×10^{-15}	1.00×10^{19}
B	1.99×10^{-17}	3.00×10^{16}
C	3.49×10^{-19}	5.26×10^{14}
D	1.33×10^{-20}	2.00×10^{13}
E	6.63×10^{-26}	1.00×10^{8}

39 In which part of the electromagnetic spectrum would photon *D* be found?

(1) infrared
(2) visible
(3) ultraviolet
(4) x ray

40 The graph below represents the relationship between the energy and the frequency of photons.



The slope of the graph would be

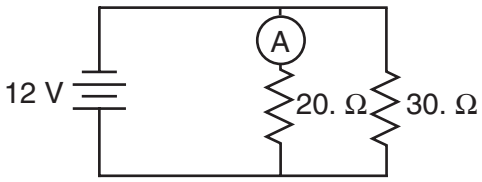
(1) 6.63×10^{-34} J•s
(2) 6.67×10^{-11} N•m^2/kg^2
(3) 1.60×10^{-19} J
(4) 1.60×10^{-19} C

41 Which combination of quarks could produce a neutral baryon?

(1) *cdt*
(2) *cts*
(3) *cdb*
(4) *cdu*

Base your answers to questions 42 through 44 on the information and diagram below.

A 20.-ohm resistor and a 30.-ohm resistor are connected in parallel to a 12-volt battery as shown. An ammeter is connected as shown.



42 What is the equivalent resistance of the circuit?

(1) 10. Ω
(2) 12 Ω
(3) 25 Ω
(4) 50. Ω

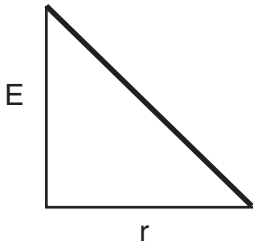
43 What is the current reading of the ammeter?

(1) 1.0 A
(2) 0.60 A
(3) 0.40 A
(4) 0.20 A

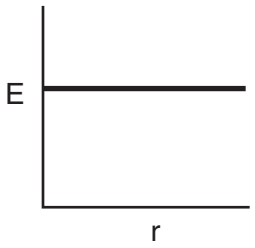
44 What is the power of the 30.-ohm resistor?

(1) 4.8 W
(2) 12 W
(3) 30. W
(4) 75 W

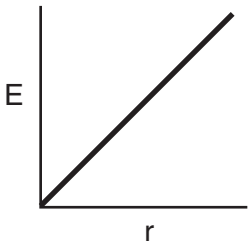
45 Which graph best represents the relationship between the magnitude of the electric field strength, E, around a point charge and the distance, r, from the point charge?



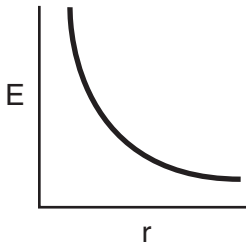
(1)



(2)

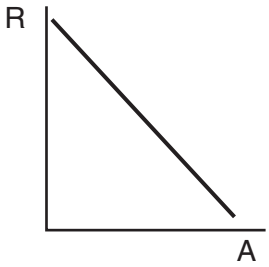


(3)

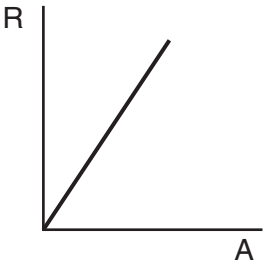


(4)

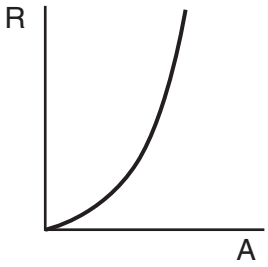
46 Several pieces of copper wire, all having the same length but different diameters, are kept at room temperature. Which graph best represents the resistance, R, of the wires as a function of their cross-sectional areas, A?



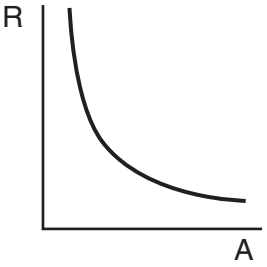
(1)



(2)



(3)



(4)

Part B–2

Answer all questions in this part.

Directions (47–59): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 47 through 49 on the information below.

The combined mass of a race car and its driver is 600. kilograms. Traveling at constant speed, the car completes one lap around a circular track of radius 160 meters in 36 seconds.

47 Calculate the speed of the car. [Show all work, including the equation and substitution with units.] [2]

48 On the diagram *on your answer sheet*, draw an arrow to represent the direction of the net force acting on the car when it is in position *A*. [1]

49 Calculate the magnitude of the centripetal acceleration of the car. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 50 and 51 on the information below.

An 8.00-kilogram ball is fired horizontally from a 1.00×10^3-kilogram cannon initially at rest. After having been fired, the momentum of the ball is 2.40×10^3 kilogram•meters per second east. [Neglect friction.]

50 Calculate the magnitude of the cannon's velocity after the ball is fired. [Show all work, including the equation and substitution with units.] [2]

51 Identify the direction of the cannon's velocity after the ball is fired. [1]

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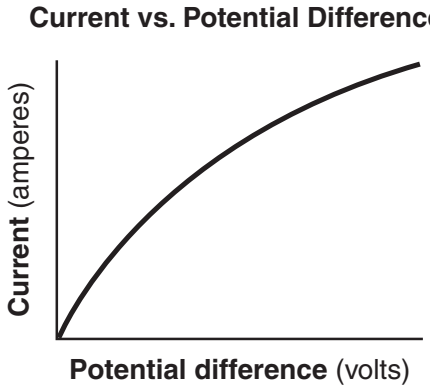
52 During a 5.0-second interval, an object's velocity changes from 25 meters per second east to 15 meters per second east. Determine the magnitude and direction of the object's acceleration. [2]

Base your answers to questions 53 through 55 on the information and graph below.

A student conducted an experiment to determine the resistance of a lightbulb. As she applied various potential differences to the bulb, she recorded the voltages and corresponding currents and constructed the graph below.



53 The student concluded that the resistance of the lightbulb was not constant. What evidence from the graph supports the student's conclusion? [1]

Note that question 54 has only three choices.

54 According to the graph, as the potential difference increased, the resistance of the lightbulb

(1) decreased
(2) increased
(3) changed, but there is not enough information to know which way

55 While performing the experiment the student noticed that the lightbulb began to glow and became brighter as she increased the voltage. Of the factors affecting resistance, which factor caused the greatest change in the resistance of the bulb during her experiment? [1]

Base your answers to questions 56 and 57 on the information below.

A student plucks a guitar string and the vibrations produce a sound wave with a frequency of 650 hertz.

56 The sound wave produced can best be described as a

(1) transverse wave of constant amplitude
(2) longitudinal wave of constant frequency
(3) mechanical wave of varying frequency
(4) electromagnetic wave of varying wavelengths

57 Calculate the wavelength of the sound wave in air at STP. [Show all work, including the equation and substitution with units.] [2]

58 A beam of light travels through medium *X* with a speed of 1.80×10^8 meters per second. Calculate the absolute index of refraction of medium *X*. [Show all work, including the equation and substitution with units.] [2]

59 A projectile has an initial horizontal velocity of 15 meters per second and an initial vertical velocity of 25 meters per second. Determine the projectile's horizontal displacement if the total time of flight is 5.0 seconds. [Neglect friction.] [1]

Part C

Answer all questions in this part.

Directions (60–73): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 60 through 62 on the information and data table below.

In an experiment, a student applied various forces to a spring and measured the spring's corresponding elongation. The table below shows his data.

Force (newtons)	**Elongation** (meters)
0	0
1.0	0.30
3.0	0.67
4.0	1.00
5.0	1.30
6.0	1.50

60 On the grid provided *in your answer booklet,* plot the data points for force versus elongation. [1]

61 Draw the best-fit line. [1]

62 Using your graph, calculate the spring constant of the spring. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 63 and 64 on the information below.

A physics class is to design an experiment to determine the acceleration of a student on in-line skates coasting straight down a gentle incline. The incline has a constant slope. The students have tape measures, traffic cones, and stopwatches.

63 Describe a procedure to obtain the measurements necessary for this experiment. [2]

64 Indicate which equation(s) they should use to determine the student's acceleration. [1]

Base your answers to questions 65 through 68 on the information below.

The driver of a car made an emergency stop on a straight horizontal road. The wheels locked and the car skidded to a stop. The marks made by the rubber tires on the dry asphalt are 16 meters long, and the car's mass is 1200 kilograms.

65 Determine the weight of the car. [1]

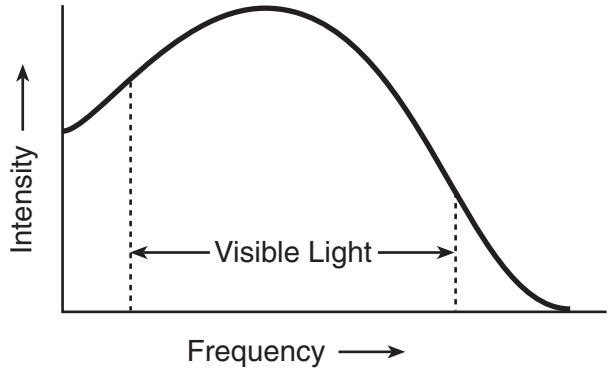
66 Calculate the magnitude of the frictional force the road applied to the car in stopping it. [Show all work, including the equation and substitution with units.] [2]

67 Calculate the work done by the frictional force in stopping the car. [Show all work, including the equation and substitution with units.] [2]

68 Assuming that energy is conserved, calculate the speed of the car before the brakes were applied. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 69 and 70 on the information and graph below.

Sunlight is composed of various intensities of all frequencies of visible light. The graph represents the relationship between light intensity and frequency.



69 Based on the graph, which color of visible light has the lowest intensity? [1]

70 It has been suggested that fire trucks be painted yellow green instead of red. Using information from the graph, explain the advantage of using yellow-green paint. [1]

Base your answers to questions 71 through 73 on the information below.

The alpha line in the Balmer series of the hydrogen spectrum consists of light having a wavelength of 6.56×10^{-7} meter.

71 Calculate the frequency of this light. [Show all work, including the equation and substitution with units.] [2]

72 Determine the energy in joules of a photon of this light. [1]

73 Determine the energy in electronvolts of a photon of this light. [1]

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The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, June 16, 2004 — 1:15 to 4:15 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	42 .....
37	43 .....
38	44 .....
39	45 .....
40	46 .....
41	

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

PS/PHYSICS

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, June 16, 2004 — 1:15 to 4:15 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	11	
B–2	19	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

Final Score (From Conversion Chart)

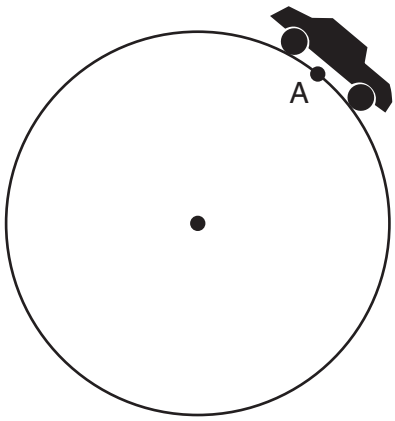
Raters' Initials:

Rater 1 . . . . . **Rater 2** . . . . .

Part B–2

47

48



49

50

51 _____

52 _____ **m/s^2** _____

53 _____

54 _____

55 _____

56 _____

57

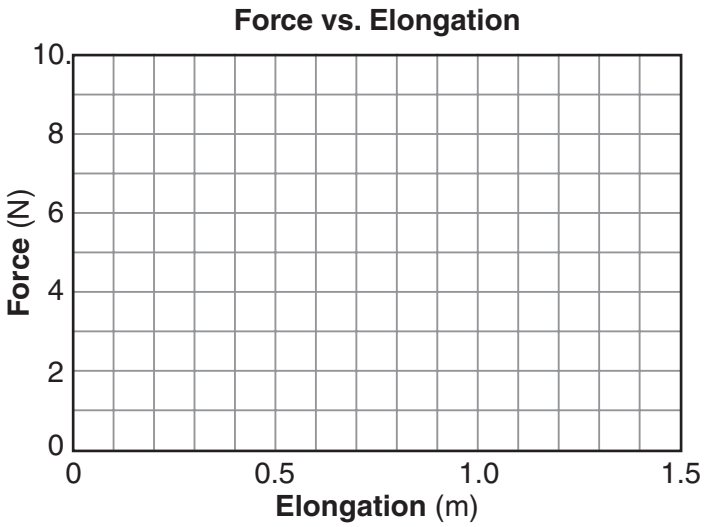
[b]

58

59 _____ **m**

Part C

60–61



62

63 _____

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64

65 _____ **N**

66

67

68

69 _____

70 _____

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_____

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71

72 _____ **J**

73 _____ **eV**