The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING

PHYSICS

Tuesday, August 13, 2002 — 12:30 to 3:30 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 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 anwser sheet, the *number* of the word or expression that, of those given, best completes the statement or answers the question.

1 A net force of 25 newtons is applied horizontally to a 10.-kilogram block resting on a table. What is the magnitude of the acceleration of the block?

(1) 0.0 m/s^2 (3) 0.40 m/s^2
(2) 0.26 m/s^2 (4) 2.5 m/s^2

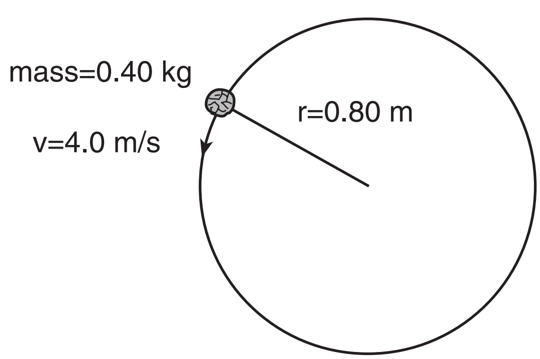
2 The speed of a car is increased uniformly from 20. meters per second to 30. meters per second in 4.0 seconds. The magnitude of the car's average acceleration in this 4.0-second interval is

(1) 0.40 m/s^2 (3) 10 m/s^2
(2) 2.5 m/s^2 (4) 13 m/s^2

3 A roller coaster, traveling with an initial speed of 15 meters per second, decelerates uniformly at –7.0 meters per second^2 to a full stop. Approximately how far does the roller coaster travel during its deceleration?

(1) 1.0 m (3) 16 m
(2) 2.0 m (4) 32 m

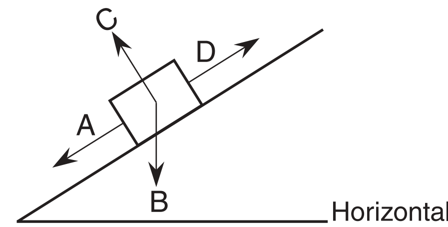
4 The diagram below represents a 0.40-kilogram stone attached to a string. The stone is moving at a constant speed of 4.0 meters per second in a horizontal circle having a radius of 0.80 meter.



The magnitude of the centripetal acceleration of the stone is

(1) 0.0 m/s^2 (3) 5.0 m/s^2
(2) 2.0 m/s^2 (4) 20. m/s^2

5 In the diagram below, a box is at rest on an inclined plane.



Which vector best represents the direction of the normal force acting on the box?

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

Note that question 6 has only three choices.

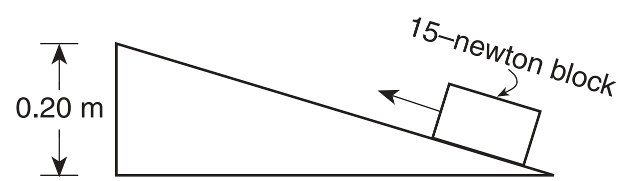
6 If the magnitude of the gravitational force of Earth on the Moon is *F*, the magnitude of the gravitational force of the Moon on Earth is

(1) smaller than *F*
(2) larger than *F*
(3) equal to *F*

7 Which term represents a scalar quantity?

(1) distance (3) force
(2) displacement (4) weight

8 A block weighing 15 newtons is pulled to the top of an incline that is 0.20 meter above the ground, as shown below.



If 4.0 joules of work are needed to pull the block the full length of the incline, how much work is done against friction?

(1) 1.0 J (3) 3.0 J
(2) 0.0 J (4) 7.0 J

9 A 1.0-kilogram rubber ball traveling east at 4.0 meters per second hits a wall and bounces back toward the west at 2.0 meters per second. Compared to the kinetic energy of the ball before it hits the wall, the kinetic energy of the ball after it bounces off the wall is

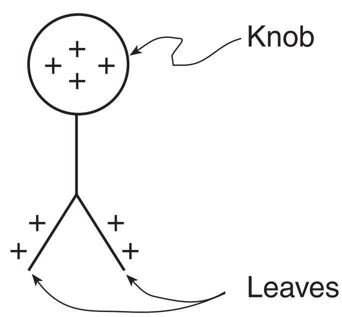
(1) one-fourth as great (3) the same
(2) one-half as great (4) four times as great

Note that questions 10 and 11 have only three choices.

10 As a spring is stretched, its elastic potential energy

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

11 An electroscope is a device with a metal knob, a metal stem, and freely hanging metal leaves used to detect charges. The diagram below shows a positively charged leaf electroscope.



As a positively charged glass rod is brought near the knob of the electroscope, the separation of the electroscope leaves will

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

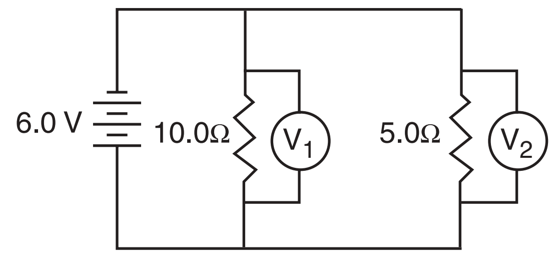
12 A catapult with a spring constant of 1.0×10^4 newtons per meter is required to launch an airplane from the deck of an aircraft carrier. The plane is released when it has been displaced 0.50 meter from its equilibrium position by the catapult. The energy acquired by the airplane from the catapult during takeoff is approximately

(1) 1.3×10^3 J (3) 2.5×10^3 J
(2) 2.0×10^4 J (4) 1.0×10^4 J

13 A 10.-ohm resistor and a 20.-ohm resistor are connected in series to a voltage source. When the current through the 10.-ohm resistor is 2.0 amperes, what is the current through the 20.-ohm resistor?

(1) 1.0 A (3) 0.50 A
(2) 2.0 A (4) 4.0 A

14 In the circuit diagram below, what are the correct readings of voltmeters V_1 and V_2?



(1) V_1 reads 2.0 V and V_2 reads 4.0 V
(2) V_1 reads 4.0 V and V_2 reads 2.0 V
(3) V_1 reads 3.0 V and V_2 reads 3.0 V
(4) V_1 reads 6.0 V and V_2 reads 6.0 V

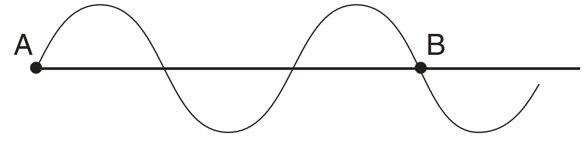
15 A physics student notices that 4.0 waves arrive at the beach every 20. seconds. The frequency of these waves is

(1) 0.20 Hz (3) 16 Hz
(2) 5.0 Hz (4) 80. Hz

16 An electric guitar is generating a sound of constant frequency. An increase in which sound wave characteristic would result in an increase in loudness?

(1) speed (3) wavelength
(2) period (4) amplitude

17 The diagram below shows two points, A and B, on a wave train.



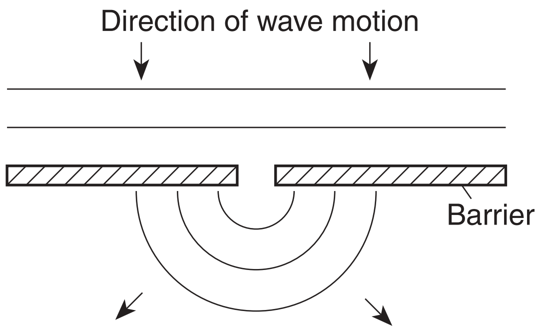
How many wavelengths separate point A and point B?

(1) 1.0 (3) 3.0
(2) 1.5 (4) 0.75

18 In a demonstration, a vibrating tuning fork causes a nearby second tuning fork to begin to vibrate with the same frequency. Which wave phenomenon is illustrated by this demonstration?

(1) the Doppler effect
(2) nodes
(3) resonance
(4) interference

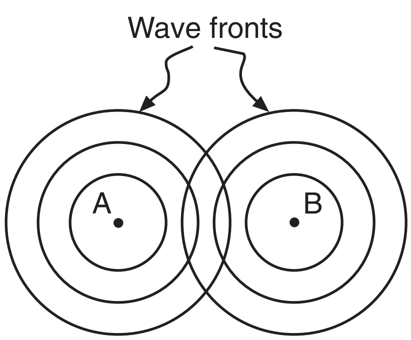
19 The diagram below shows wave fronts spreading into the region behind a barrier.



Which wave phenomenon is represented in the diagram?

(1) reflection
(2) refraction
(3) diffraction
(4) standing waves

20 The diagram below represents the wave pattern produced by two sources located at points *A* and *B*.



Which phenomenon occurs at the intersections of the circular wave fronts?

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

21 How much work is required to move a single electron through a potential difference of 100. volts?

(1) 1.6×10^{-21} J
(2) 1.6×10^{-19} J
(3) 1.6×10^{-17} J
(4) 1.0×10^{2} J

22 An object can *not* have a charge of

(1) 3.2×10^{-19} C
(2) 4.5×10^{-19} C
(3) 8.0×10^{-19} C
(4) 9.6×10^{-19} C

23 After electrons in hydrogen atoms are excited to the $n = 3$ energy state, how many different frequencies of radiation can be emitted as the electrons return to the ground state?

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

24 What type of nuclear force holds the protons and neutrons in an atom together?

(1) a strong force that acts over a short range
(2) a strong force that acts over a long range
(3) a weak force that acts over a short range
(4) a weak force that acts over a long range

25 Which is an acceptable unit for impulse?

(1) N•m
(2) J/s
(3) J•s
(4) kg•m/s

26 The centers of two 15.0-kilogram spheres are separated by 3.00 meters. The magnitude of the gravitational force between the two spheres is approximately

(1) 1.11×10^{-10} N
(2) 3.34×10^{-10} N
(3) 1.67×10^{-9} N
(4) 5.00×10^{-9} N

27 During a collision, an 84-kilogram driver of a car moving at 24 meters per second is brought to rest by an inflating air bag in 1.2 seconds. The magnitude of the force exerted on the driver by the air bag is approximately

(1) 7.0×10^{1} N
(2) 8.2×10^{2} N
(3) 1.7×10^{3} N
(4) 2.0×10^{3} N

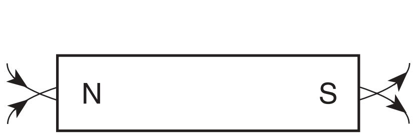
28 An apple weighing 1 newton on the surface of Earth has a mass of approximately

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

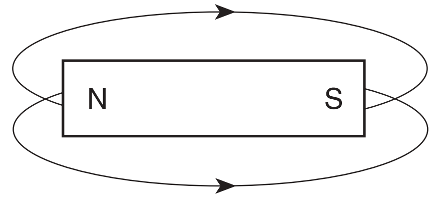
29 In raising an object vertically at a constant speed of 2.0 meters per second, 10. watts of power is developed. The weight of the object is

(1) 5.0 N
(2) 20. N
(3) 40. N
(4) 50. N

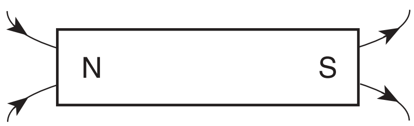
30 Which diagram best represents magnetic flux lines around a bar magnet?



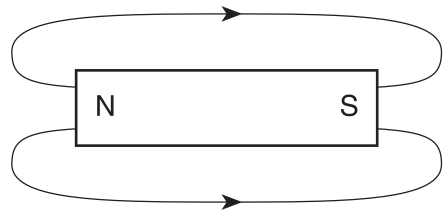
(1)



(3)



(2)



(4)

31 In which situation is the net force on the object equal to zero?

(1) a satellite moving at constant speed around Earth in a circular orbit
(2) an automobile braking to a stop
(3) a bicycle moving at constant speed on a straight, level road
(4) a pitched baseball being hit by a bat

Base your answers to questions 32 and 33 on the information below.

A 2.00×10^6-hertz radio signal is sent a distance of 7.30×10^{10} meters from Earth to a spaceship orbiting Mars.

32 Approximately how much time does it take the radio signal to travel from Earth to the spaceship?

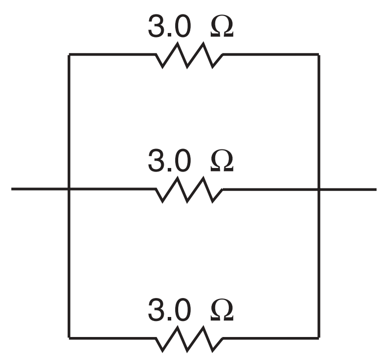
(1) 4.11×10^{-3} s
(2) 2.43×10^2 s
(3) 2.19×10^8 s
(4) 1.46×10^{17} s

Note that question 33 has only three choices.

33 The spaceship is moving away from Earth when the radio signal is received. Compared to the frequency of the signal sent from Earth, the frequency of the signal received by the spaceship is

(1) lower
(2) higher
(3) the same

34 What is the total resistance of the circuit segment shown in the diagram below?



(1) 1.0 Ω
(2) 9.0 Ω
(3) 3.0 Ω
(4) 27 Ω

35 What is the approximate electrostatic force between two protons separated by a distance of 1.0×10^{-6} meter?

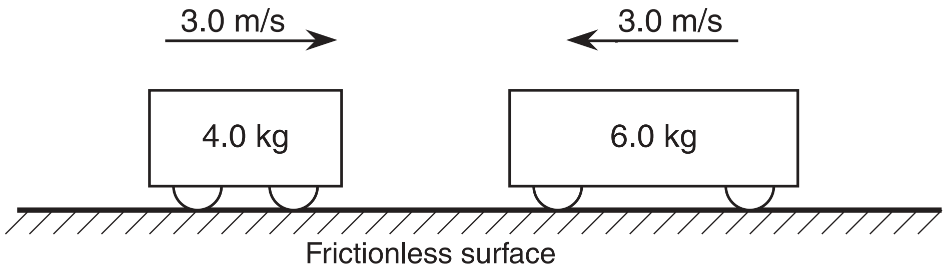
(1) 2.3×10^{-16} N and repulsive
(2) 2.3×10^{-16} N and attractive
(3) 9.0×10^{21} N and repulsive
(4) 9.0×10^{21} N and attractive

Part B–1

Answer all questions in this part.

Directions (36–47): 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.

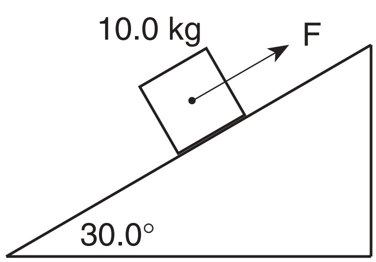
36 The diagram below shows a 4.0-kilogram cart moving to the right and a 6.0-kilogram cart moving to the left on a horizontal frictionless surface.



When the two carts collide they lock together. The magnitude of the total momentum of the two-cart system after the collision is

(1) 0.0 kg•m/s
(2) 6.0 kg•m/s
(3) 15 kg•m/s
(4) 30. kg•m/s

37 The diagram below shows a 10.0-kilogram mass held at rest on a frictionless 30.0° incline by force *F*.



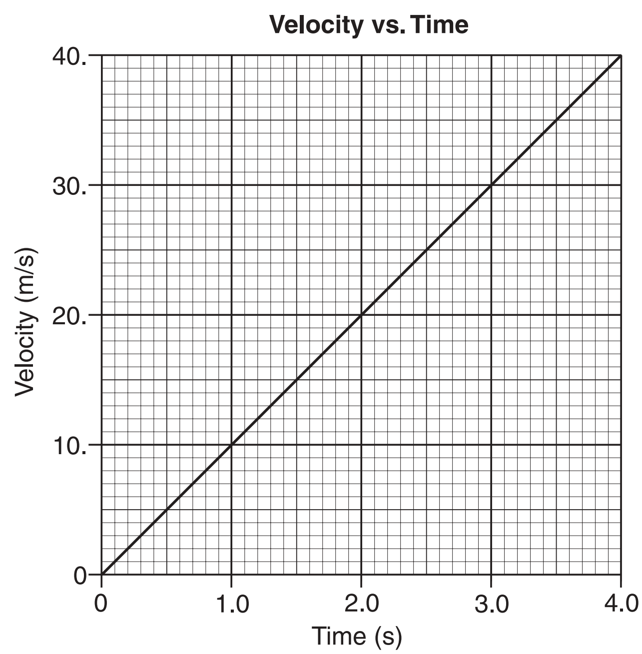
What is the approximate magnitude of force *F*?

(1) 9.81 N
(2) 49.1 N
(3) 85.0 N
(4) 98.1 N

38 An archer uses a bow to fire two similar arrows with the same string force. One arrow is fired at an angle of 60.° with the horizontal, and the other is fired at an angle of 45° with the horizontal. Compared to the arrow fired at 60.°, the arrow fired at 45° has a

(1) longer flight time and longer horizontal range
(2) longer flight time and shorter horizontal range
(3) shorter flight time and longer horizontal range
(4) shorter flight time and shorter horizontal range

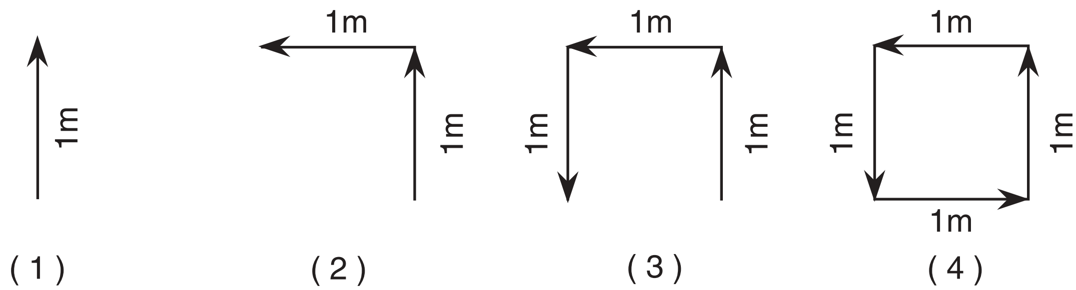
39 The graph below shows the velocity of a race car moving along a straight line as a function of time.



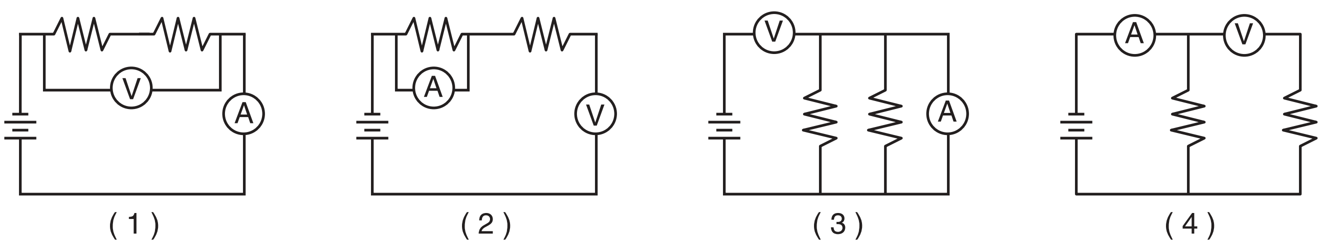
What is the magnitude of the displacement of the car from t = 2.0 seconds to t = 4.0 seconds?

(1) 20. m
(2) 40. m
(3) 60. m
(4) 80. m

40 Which vector diagram represents the greatest magnitude of displacement for an object?



41 Which circuit diagram shows voltmeter V and ammeter A correctly positioned to measure the total potential difference of the circuit and the current through each resistor?



42 A monochromatic ray of light ($f = 5.09 \times 10^{14}$ hertz) traveling in air is incident upon medium A at an angle of 45°. If the angle of refraction is 29°, medium A could be

(1) water
(2) fused quartz
(3) Lucite
(4) flint glass

43 What is the total electrical energy used by a 1500-watt hair dryer operating for 6.0 minutes?

(1) 4.2 J
(2) 250 J
(3) 9.0×10^3 J
(4) 5.4×10^5 J

44 Which combination of quarks would produce a neutral baryon?

(1) uud
(2) udd
(3) $\bar{u}\bar{u}d$
(4) $\bar{u}dd$

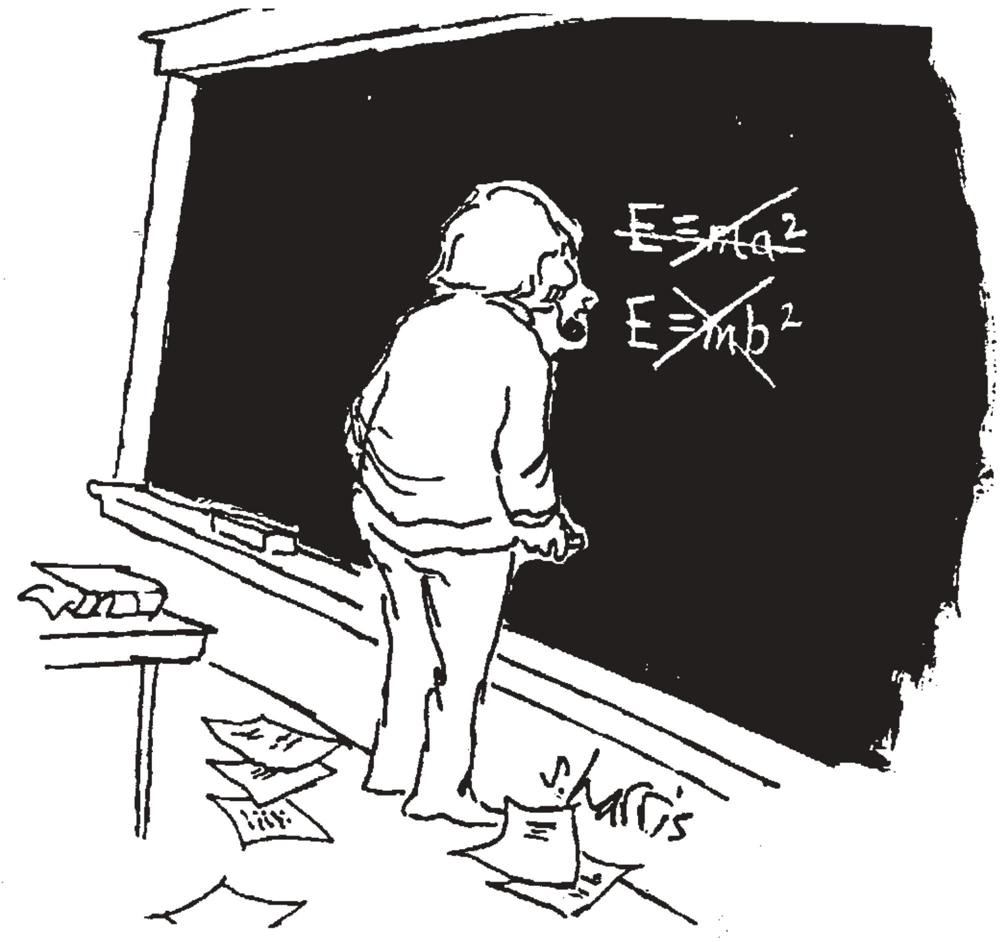
45 A 12.0-meter length of copper wire has a resistance of 1.50 ohms. How long must an aluminum wire with the same cross-sectional area be to have the same resistance?

(1) 7.32 m
(2) 8.00 m
(3) 12.0 m
(4) 19.7 m

46 A 0.500-meter length of wire with a cross-sectional area of 3.14×10^{-6} meters squared is found to have a resistance of 2.53×10^{-3} ohms. According to the resistivity chart, the wire could be made of

(1) aluminum
(2) copper
(3) nichrome
(4) silver

Base your answer to question 47 on the cartoon below and your knowledge of physics.



47 In the cartoon, Einstein is contemplating the equation for the principle that

(1) the fundamental source of all energy is the conversion of mass into energy
(2) energy is emitted or absorbed in discrete packets called photons
(3) mass always travels at the speed of light in a vacuum
(4) the energy of a photon is proportional to its frequency

Part B–2

Answer all questions in this part.

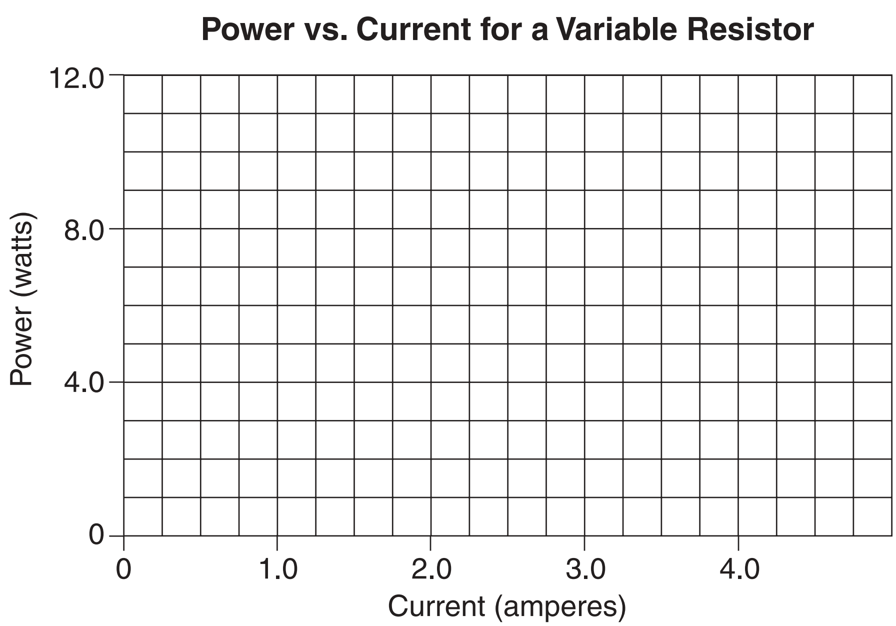
Directions (48–60): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 48 through 52 on the information and data table below.

A variable resistor was connected to a battery. As the resistance was adjusted, the current and power in the circuit were determined. The data are recorded in the table below.

Current (amperes)	**Power** (watts)
0.75	2.27
1.25	3.72
2.25	6.75
3.00	9.05
4.00	11.9

48–49 Using the information in the data table, construct a line graph on the grid provided *in your answer booklet,* following the directions below. The grid below is provided for practice purposes only. Be sure your final answer appears *in your answer booklet.*



48 Plot the data points for power versus current. [1]

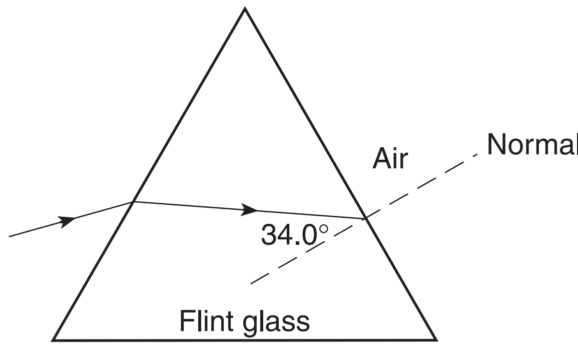
49 Draw the best-fit line. [1]

50 Using your graph, determine the power delivered to the circuit at a current of 3.5 amperes. [1]

51 Calculate the slope of the graph. [Show all calculations, including the equation and substitution with units.] [2]

52 What is the physical significance of the slope of the graph? [1]

Base your answers to questions 53 through 55 on the diagram below which shows a ray of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) passing through a flint glass prism. [The same diagram appears in your answer booklet.]



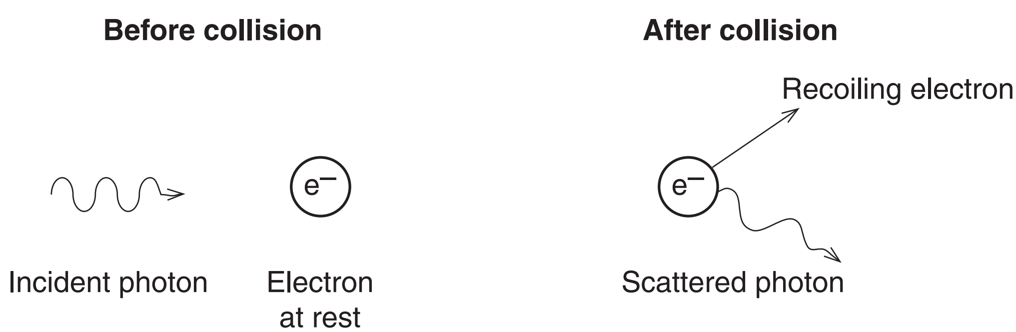
53 Calculate the angle of refraction (in degrees) of the light ray as it enters the air from the flint glass prism. [Show all calculations, including the equation and substitution with units.] [2]

54 Using a protractor and a straightedge, construct the refracted light ray in the air on the diagram *in your answer booklet.* [2]

55 What is the speed of the light ray in flint glass?

(1) 5.53×10^{-9} m/s
(2) 1.81×10^{8} m/s
(3) 3.00×10^{8} m/s
(4) 4.98×10^{8} m/s

Base your answers to questions 56 and 57 on the information and diagram below. The diagram shows the collision of an incident photon having a frequency of 2.00×10^{19} hertz with an electron initially at rest.



56 Calculate the initial energy of the photon. [Show all calculations, including the equation and substitution with units.] [2]

57 What is the total energy of the two-particle system after the collision? [1]

58 Determine the color of a ray of light with a wavelength of 6.21×10^{-7} meter. [1]

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

A periodic transverse wave has an amplitude of 0.20 meter and a wavelength of 3.0 meters.

59 On the grid provided *in your answer booklet,* draw at least one cycle of this periodic wave. [2]

60 If the frequency of this wave is 12 Hz, what is its speed?

(1) 0.25 m/s
(2) 12 m/s
(3) 36 m/s
(4) 4.0 m/s

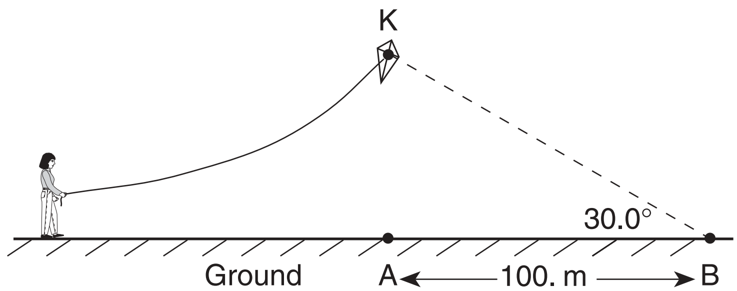
Part C

Answer all questions in this part.

Directions (61–68): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 61 through 63 on the information and diagram below.

A child is flying a kite, *K*. A student at point *B*, located 100. meters away from point *A* (directly underneath the kite), measures the angle of elevation of the kite from the ground as 30.°.



61 *In your answer booklet,* use a metric ruler and protractor to draw a triangle representing the positions of the kite, *K*, and point *A* relative to point *B* that is given. Label points *A* and *K*. Use a scale of 1.0 centimeter = 10. meters. [2]

62 Use a metric ruler and your scale diagram to determine the height, *AK*, of the kite. [1]

63 A small lead sphere is dropped from the kite. Calculate the amount of time required for the sphere to fall to the ground. [Show all calculations, including the equation and substitution with units. Neglect air resistance.] [2] ______

Base your answers to questions 64 and 65 on the information given below.

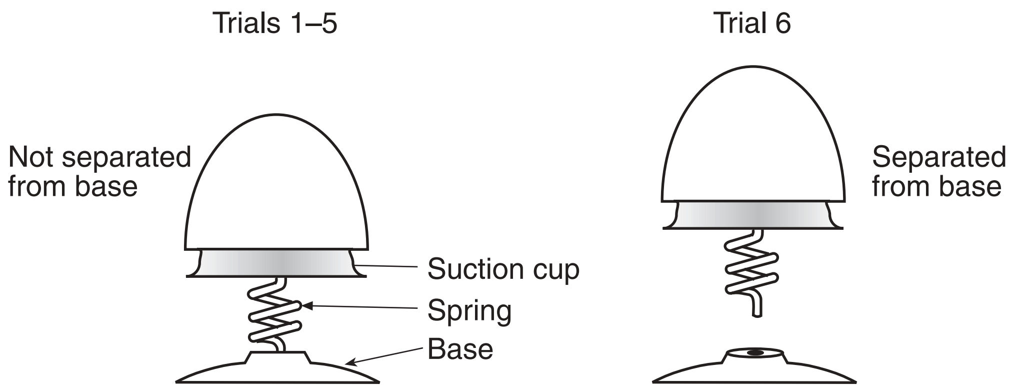
Friction provides the centripetal force that allows a car to round a circular curve.

64 Find the minimum coefficient of friction needed between the tires and the road to allow a 1600-kilogram car to round a curve of radius 80. meters at a speed of 20. meters per second. [Show all work, including formulas and substitutions with units.] [4]

65 If the mass of the car were increased, how would that affect the maximum speed at which it could round the curve? [1] ______

Base your answers to questions 66 and 67 on the information below and on your knowledge of physics.

Using a spring toy like the one shown in the diagram, a physics teacher pushes on the toy, compressing the spring, causing the suction cup to stick to the base of the toy.



When the teacher removes her hand, the toy pops straight up and just brushes against the ceiling. She does this demonstration five times, always with the same result.

When the teacher repeats the demonstration for the sixth time the toy crashes against the ceiling with considerable force. The students notice that in this trial, the spring and toy separated from the base at the moment the spring released.

The teacher puts the toy back together, repeats the demonstration and the toy once again just brushes against the ceiling.

66 Describe the conversions that take place between pairs of the three forms of mechanical energy, beginning with the work done by the teacher on the toy and ending with the form(s) of energy possessed by the toy as it hits the ceiling. [Neglect friction.] [3]

67 Explain, in terms of mass and energy, why the spring toy hits the ceiling in the sixth trial and not in the other trials. [2]

68 Your school's physics laboratory has the following equipment available for conducting experiments:

accelerometers	lasers	stopwatches
ammeters	light bulbs	thermometers
bar magnets	meter sticks	voltmeters
batteries	power supplies	wires
electromagnets	spark timers	

Explain how you would find the resistance of an unknown resistor in the laboratory. Your explanation must include:

a Measurements required [1]
b Equipment needed [1]
c Complete circuit diagram [2]
d Any equation(s) needed to calculate the resistance [1]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Tuesday, August 13, 2002 — 12:30 to 3:30 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 . . . .

37 . . . .

38 . . . .

39 . . . .

40 . . . .

41 . . . .

42 . . . .

43 . . . .

44 . . . .

45 . . . .

46 . . . .

47 . . . .

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

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING PHYSICS

Tuesday, August 13, 2002 — 12:30 to 3:30 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	12	
B–2	18	
C	20	

Total Written Test Score (Maximum Raw Score: 85) ☐

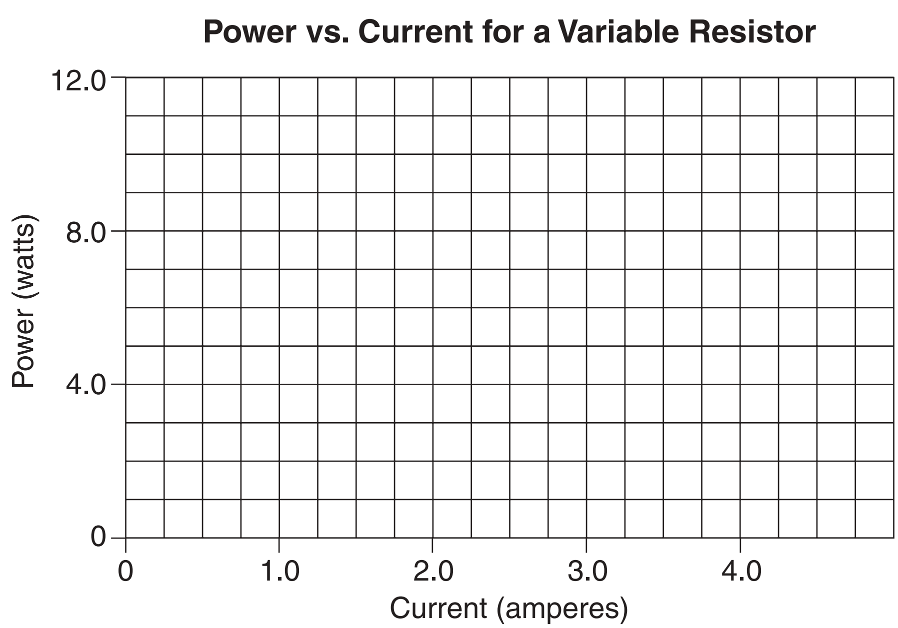
Final Score (from conversion chart) ☐

Raters' Initials:

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

Part B–2

48–49



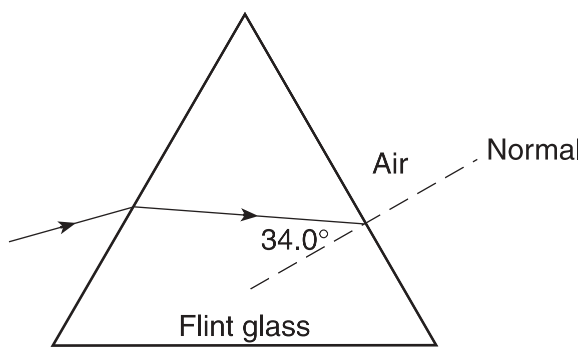
50 ______________ **W**

51

52 ______________________________

53

54



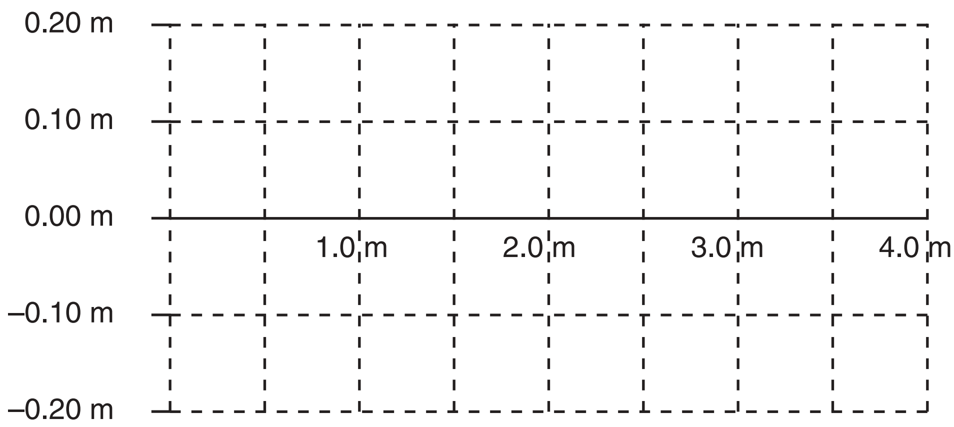
55 ______________________

56

57 ____

58 ______________________________

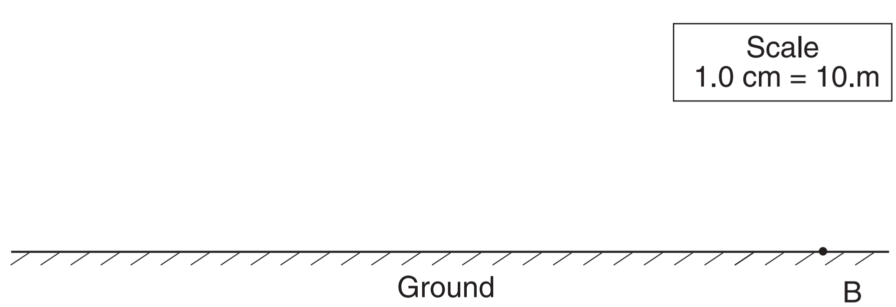
59



60 ____________________

Part C

61



62 ________________ **m**

63

64

65

66

67

68*a*

b

c

d

FOR TEACHERS ONLY

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

PS–P

PHYSICAL SETTING/PHYSICS

Tuesday, August 13, 2002 — 12:30 to 3:30 p.m., only

SCORING KEY AND RATING GUIDE

Directions to the Teacher:
Refer to the directions on page 3 before rating student papers.

Part A and Part B–1
Allow 1 credit for each correct response.

Part A			Part B–1
1 . . . . . 4	13 . . . . . 2	25 . . . . 4	36 . . . . 2 . . . . . .
2 . . . . . 2	14 . . . . . 4	26 . . . . 3	37 . . . . 2 . . . . . .
3 . . . . . 3	15 . . . . . 1	27 . . . . 3	38 . . . . 3 . . . . . .
4 . . . . . 4	16 . . . . . 4	28 . . . . 1	39 . . . . 3 . . . . . .
5 . . . . . 3	17 . . . . . 2	29 . . . . 1	40 . . . . 2 . . . . . .
6 . . . . . 3	18 . . . . . 3	30 . . . . 4	41 . . . . 1 . . . . . .
7 . . . . . 1	19 . . . . . 3	31 . . . . 3	42 . . . . 2 . . . . . .
8 . . . . . 1	20 . . . . . 2	32 . . . . 2	43 . . . . 4 . . . . . .
9 . . . . . 1	21 . . . . . 3	33 . . . . 1	44 . . . . 2 . . . . . .
10 . . . . . 2	22 . . . . . 2	34 . . . . 1	45 . . . . 1 . . . . . .
11 . . . . . 2	23 . . . . . 3	35 . . . . 1	46 . . . . 4 . . . . . .
12 . . . . . 1	24 . . . . . 1		47 . . . . 1 . . . . . .

Directions to the Teacher

Follow the procedures below for scoring student answer papers for the Physical Setting/Physics examination. Additional information about scoring is provided in the publication *Information Booklet for Administering and Scoring Regents Examinations in the Sciences*.

Use only *red* ink or *red* pencil in rating Regents papers. Do *not* correct the student's work by making insertions or changes of any kind.

On the detachable answer sheet for Part A and Part B–1, indicate by means of a checkmark each incorrect or omitted answer. In the box provided at the end of each part, record the number of questions the student answered correctly for that part.

At least two science teachers must participate in the scoring of each student's responses to the Part B–2 and Part C open-ended questions. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score all the open-ended questions on a student's answer paper.

Students' responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. In the student's answer booklet, record the number of credits earned for each answer in the box printed to the right of the answer lines or spaces for that question.

Fractional credit is *not* allowed. Only whole-number credit may be given to a response. Units need not be given when the wording of the questions allows such omissions.

Raters should enter the scores earned for Part A, Part B–1, Part B–2, and Part C on the appropriate lines in the box printed on the answer booklet and then should add these four scores and enter the total in the box labeled "Total Written Test Score." Then, the student's raw scores on the written test should be converted to a scaled score by using the conversion chart printed at the end of this Scoring Key and Rating Guide. The student's scaled score should be entered in the labeled box on the student's answer booklet. The scaled score is the student's final examination score.

All student answer papers that receive a scaled score of 60 through 64 **must** be scored a second time. For the second scoring, a different committee of teachers may score the student's paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student's final examination score is based on a fair, accurate, and reliable scoring of the student's answer paper.

Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided in the scoring key for that administration be used to determine the student's final score. The chart in this scoring key is usable only for this administration of the examination.

Please refer to the Department publication *Regents Examination in Physical Setting/Physics: Rating Guide for Parts B–2 and C*. Teachers should become familiar with this guide before rating students' papers.

Scoring Criteria for Calculations

For each question requiring the student to show *all calculations, including the equation and substitution with units*, apply the following scoring criteria:

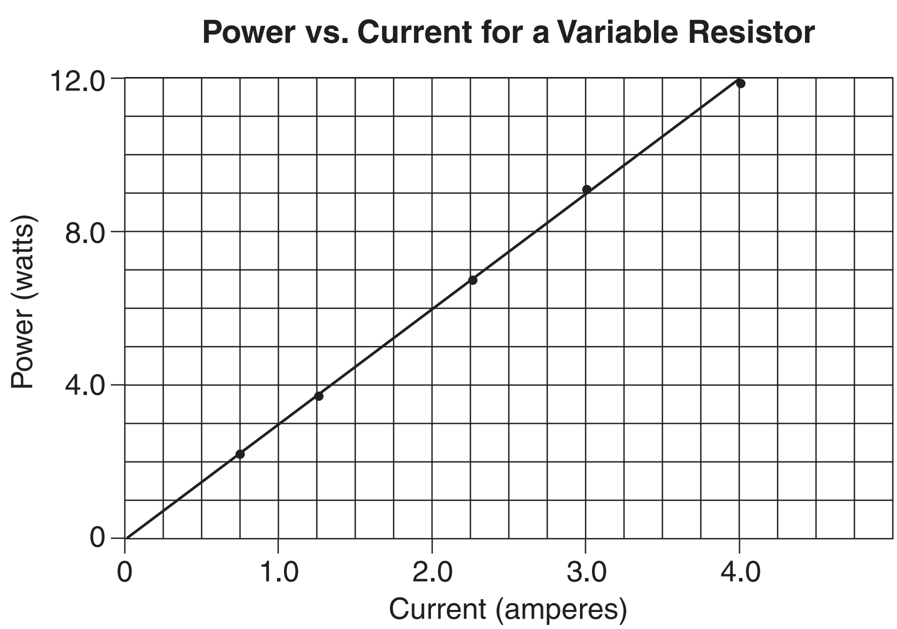
- Allow 1 credit for the equation and substitution of values with units. If the equation and/or substitution with units is not shown, do *not* allow this credit.
- Allow 1 credit for the correct answer (number and unit). If the number is given without the unit, do *not* allow this credit.
- Penalize a student only once per equation for omitting units.
- Allow full credit even if the answer is not expressed with the correct number of significant figures.

Part B–2

48 Allow 1 credit for accurately plotting the data points (±0.3 grid space) for power vs. current.

49 Allow 1 credit for drawing a straight best-fit line. If one or more points are plotted incorrectly in question 48, but a best-fit line is drawn, allow this credit.

48–49 Example of Acceptable Response



50 Allow 1 credit for determining the power delivered to the circuit.

Example of Acceptable Response

10.5 W ± 0.3 W

Allow credit for an answer that is consistent with the student's answer to question 49.

51 Allow a maximum of 2 credits for determining the slope of the graph. Refer to *Scoring Criteria for Calculations* in this scoring key. Allow credit for an answer that is consistent with the student's graph, unless the student receives no credit for questions 49 and 50. In that case, credit may be awarded if the student correctly calculates the slope using data in the table.

Note: The slope may be determined by direct substitution of data points only if the data values are on the best-fit line.

Examples of Acceptable Responses

$$\text{slope} = \frac{\Delta P}{\Delta I}$$

or

$$\text{slope} = \frac{\Delta Y}{\Delta X}$$

$$\text{slope} = \frac{10.5\text{ W} - 0.0\text{ W}}{3.5\text{ A} - 0.0\text{ A}}$$

$$\text{slope} = 3.0\text{ V}$$

or

$$\text{slope} = 3\,\frac{\text{W}}{\text{A}}$$

52 Allow 1 credit for stating the physical significance of the slope of the graph.

Examples of acceptable responses include, but are not limited to:

— voltage
— potential difference

53 Allow a maximum of 2 credits for calculating the angle of refraction. Refer to *Scoring Criteria for Calculations* in this scoring key.

Example of Acceptable Response

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$$

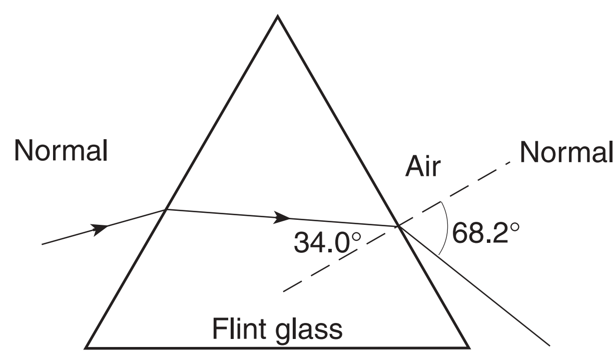
$$\sin \theta_2 = \frac{1.66 \sin 34.0°}{1.00}$$

$$= 68.2° \textit{ or } = 68°$$

54 Allow a maximum of 2 credits for constructing the refracted light ray.

- Allow 1 credit if the angle between the normal and the ray is equal to the angle (±2°) the student calculated in question 53.
- Allow 1 credit for a straight line originating at the point where the ray inside the flint glass meets the right side of the prism drawn to the right of the normal in air.

Example of Acceptable Response



55 2

56 Allow a maximum of 2 credits for calculating the initial energy of the photon. Refer to *Scoring Criteria for Calculations* in this scoring key.

Example of Acceptable Response

$E_{photon} = hf$

$E = (6.63 \times 10^{-34}\ \text{J•s})(2.00 \times 10^{19}\ \text{Hz})$

$E = 1.33 \times 10^{-14}\ \text{J}$ *or* $E = 13.3 \times 10^{-15}\ \text{J•s•Hz}$

57 Allow 1 credit for stating the total energy of the two-particle system after the collision.

Examples of acceptable responses include, but are not limited to:

— The energy of the system after the collision is 1.3×10^{-14} J, or a value consistent with the student's answer to question 56.

Note: Do *not* deduct credit if the unit is not included.

— It is the same as the energy of the system before the collision.
— Energy is conserved.
— The energy is the same as before the collision.

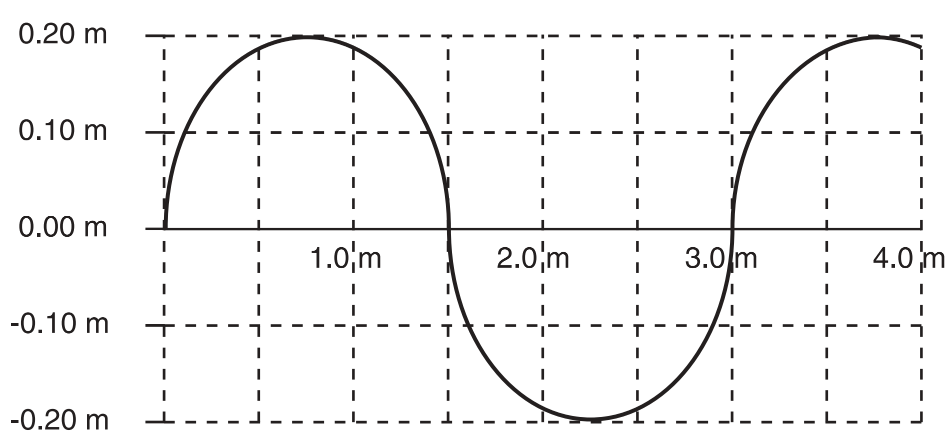
58 Allow 1 credit for **orange**.

59 Allow a maximum of 2 credits for drawing at least one complete cycle of the periodic wave.

- Allow 1 credit for a wavelength of 3 meters (± 0.2 grid space).
- Allow 1 credit for an amplitude of .2 meter (± 0.2 grid space).

Note: The waveform may be another shape (e.g. triangular), provided that it is periodic and has the required amplitude and wavelength (± 0.2 grid space).

Example of Acceptable Response



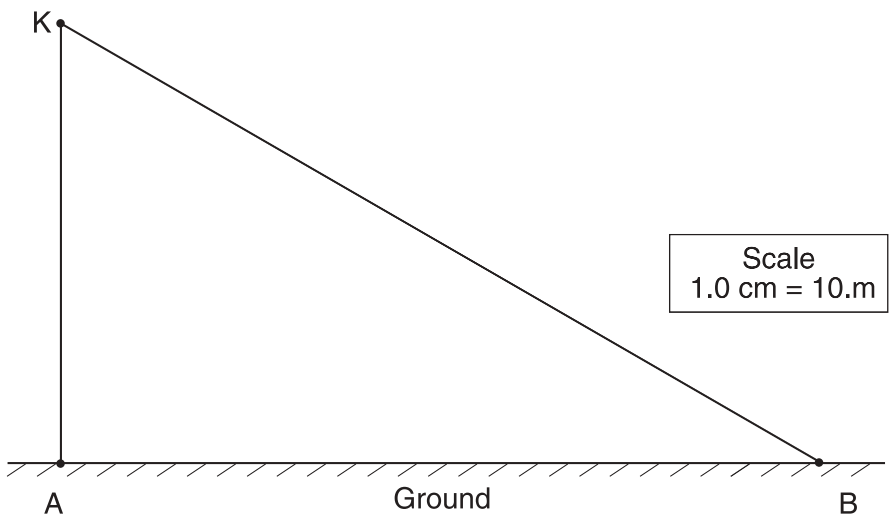
60 3

Part C

61 Allow a maximum of 2 credits for drawing and labeling the triangle.

- Allow 1 credit for a straight line segment 10.0 cm (±0.2 cm) drawn from point *B* and a 30.° (±2°) angle at point *B*.
- Allow 1 credit for a properly drawn right triangle with *A* and *K* labeled correctly.

Example of Acceptable Response



62 Allow 1 credit for determining the height, *AK*, of the kite to be a value consistent with the student's answer to question 61. The answer should be 58 m (±2 m) if the answer to question 61 is drawn correctly. Do *not* allow credit for an answer of 58 m if the answer to question 61 is drawn incorrectly or missing.

63 Allow a maximum of 2 credits for calculating the amount of time required for the sphere to fall to the ground. Refer to *Scoring Criteria for Calculations* in this scoring key.

Example of Acceptable Response

$$d = v_i t + \frac{1}{2}at^2 \quad or \quad d = \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2d}{a}}$$

$$t = \sqrt{\frac{2(58\text{ m})}{9.81\text{ m/s}^2}}$$

$$t = 3.4\text{ s}$$

Allow credit for an answer that is consistent with the student's answer to question 62.

Note: The use of 9.8 m/s^2 in the equation is also acceptable.

64 Allow a maximum of 4 credits for finding the minimum coefficient of friction.

Examples of acceptable responses and allocation of credits include, but are not limited to:

Formulas: $F_f = \mu F_N$ $F_N = mg$ $F_c = \frac{mv^2}{r}$ [1]

Rearrangement: $\mu = \frac{v^2}{rg}$ [1]

Substitution: $\mu = \frac{(20.\ \text{m/s})^2}{(80.\ \text{m})(9.8\ \text{m/s}^2)}$ [1]

Answer: $\mu = 0.51$ [1]

or

$F_c = ma_c$ $a_c = \frac{v^2}{r}$

$F_c = \frac{mv^2}{r} = \frac{(1{,}600\ \text{kg})(20.\ \text{m/s})^2}{80.\ \text{m}} = 8.0 \times 10^3\ \text{N}$ [1]

$F_N = mg = (1{,}600\ \text{kg})(9.81\ \text{m/s}^2) = 1.6 \times 10^4\ \text{N}$ [1]

$F_f = F_c$ [1]

$F_f = \mu F_N$ $\mu = \frac{F_f}{F_N} = \frac{8.0 \times 10^3\ \text{N}}{1.6 \times 10^4\ \text{N}} = 0.50$ [1]

65 Allow 1 credit for indicating that changing the mass of the car would have no effect on the maximum speed at which it could round the curve.

66 Allow a maximum of 3 credits, 1 for each correct energy conversion.

Examples of Acceptable Responses

work into
potential energy (spring) into
kinetic energy into
potential energy (gravity)

67 Allow a maximum of 2 credits.

- Allow 1 credit for indicating the toy has less mass.
- Allow 1 credit for indicating the toy has the same energy.

Examples of acceptable responses include, but are not limited to:

— The toy has less mass without the base but the same energy. Therefore it can go higher.
— The work put into the toy is the same but the mass is less. With less mass the toy could go higher because it is moving faster.

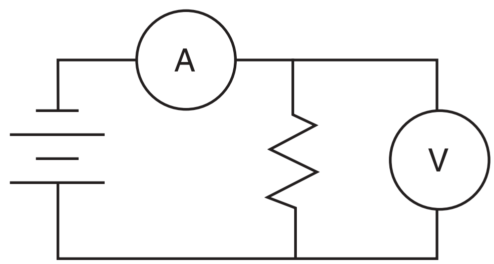
68 Allow a maximum of 5 credits for explaining how to find the resistance of an unknown resistor, allocated as follows:

a Allow 1 credit for listing the necessary measurements (voltage and current).
b Allow 1 credit for listing the necessary equipment (ammeter, voltmeter, battery or power supply, and wires).
c Allow a maximum of 2 credits for completing the circuit diagram.
- Allow 1 credit for drawing the ammeter in series with the resistor.
- Allow 1 credit for drawing the voltmeter in parallel with the resistor.

d Allow 1 credit for listing the necessary formula (R = V/I).

Example of Acceptable Response

a To determine the resistance of an unknown resistor, I would need to measure the current and potential difference for the resistor in a circuit.
b The equipment I would need would be the resistor, an ammeter, a voltmeter, a battery or power supply, and connecting wires.
c The circuit would be connected as in the diagram below.



d Once I measured the current and potential for the resistor, I would use the formula for Ohm's law (R = V/I) to calculate the resistance.

Regents Examination in Physical Setting/Physics
August 2002
Chart for Converting Total Raw Scores to
Final Examination Scores (Scaled Scores)

Raw Score	NYSED Scaled	Raw Score	NYSED Scaled	Raw Score	NYSED Scaled	Raw Score	NYSED Scaled
85	100	63	73	41	47	19	22
84	99	62	72	40	46	18	20
83	98	61	71	39	45	17	19
82	96	60	70	38	44	16	18
81	95	59	68	37	42	15	17
80	94	58	67	36	41	14	16
79	93	57	66	35	40	13	15
78	91	56	65	34	39	12	14
77	90	55	64	33	38	11	12
76	89	54	62	32	37	10	11
75	88	53	61	31	35	9	10
74	86	52	60	30	34	8	9
73	85	51	59	29	33	7	8
72	84	50	58	28	32	6	7
71	83	49	56	27	31	5	6
70	82	48	55	26	30	4	5
69	80	47	54	25	29	3	3
68	79	46	53	24	27	2	2
67	78	45	52	23	26	1	1
66	77	44	51	22	25	0	0
65	76	43	49	21	24		
64	74	42	48	20	23		

To determine the student's final examination score, find the student's total test raw score in the column labeled "Raw Score" and then locate the scaled score that corresponds to that raw score. The scaled score is the student's final examination score. Enter this score in the space labeled "Final Score" on the student's answer sheet.

All student answer papers that receive a scaled score of 60 through 64 must be scored a second time. For the second scoring, a different committee of teachers may score the student's paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student's final examination score is based on a fair, accurate, and reliable scoring of the student's answer paper.

Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided in the scoring key for the administration be used to determine the student's final score. The chart above is usable only for this administration of the physical setting/physics examination.

Map to Core Curriculum

August 2002 Physical Setting/ Physics			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1	1-4, 6, 8, 9, 12, 15, 21, 25, 26-29, 32, 34, 35	36, 42, 43, 45, 46, 48-53, 55, 56, 58, 59,60	61-65, 67
Math Key Idea 2		50	
Math Key Idea 3		52	
Sci. Inq Key Idea 1			
Sci. Inq Key Idea 2			
Sci. Inq Key Idea 3	17, 19, 20, 30	44, 47, 58	65
Eng. Des. Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Standard 6			
Key Idea 1			
Key Idea 2			66
Key Idea 3	22, 28		
Key Idea 4	31		
Key Idea 5	11		
Key Idea 6			
Standard 7			
Key Idea 1			66
Key Idea 2			
Standard 4 Process Skills			
4.1	10, 12-14, 30, 34	41, 46, 57	66, 67, 68a, 68b, 68c, 68d
4.3	16, 19, 20	42, 53 - 55, 59	
5.1	5	37-40	64
5.3	23		
Standard 4			
4.1	8, 9, 12-14, 21, 29, 34	41, 43,45,46,48-52	
4.3	15-20, 32, 33	42, 53-55, 58-60	66-68
5.1	1–7, 10, 11, 25-28, 30, 31, 35	36-40	61-65
5.3	22-24	44, 47, 56, 57	

Attachment B

University of the State of New York
State Education Department

New Scoring Chart for August 2002 Physics Regents Exam

Physics 2002		Physics 2002		Physics 2002	
Original Scaled Score	Revised Scaled Score	Original Scaled Score	Revised Scaled Score	Original Scaled Score	Revised Scaled Score
0	0	33	48	67	77
1	2	34	49	68	78
2	4	35	50	70	79
3	6	37	51	71	80
5	8	38	52	72	81
6	10	39	54	73	81
7	12	40	55	74	82
8	14	41	56	76	83
9	16	42	57	77	84
10	17	44	58	78	85
11	19	45	59	79	86
12	21	46	60	80	86
14	23	47	61	82	87
15	24	48	62	83	88
16	26	49	63	84	89

17	28	51	64	85	90
18	29	52	65	86	91
19	31	53	66	88	91
20	32	54	67	89	92
22	34	55	68	90	93
23	35	56	69	91	94
24	37	58	70	93	95
25	38	59	71	94	96
26	40	60	72	95	96
27	41	61	73	96	97
29	42	62	74	98	98
30	44	64	75	99	99
31	45	65	75	100	100
32	46	66	76		

Back to:
Field Memo
Attachment A: June 2002 Conversion Chart
Attachment C: January 03 Conversion Chart
Attachment D: June 03 Conversion Chart