The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Tuesday, June 18, 2002 — 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 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

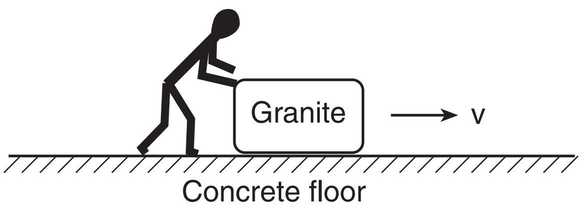
Answer all questions in this part.

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 Which is a vector quantity?

(1) distance (3) power
(2) speed (4) force

2 The diagram below shows a granite block being slid at constant speed across a horizontal concrete floor by a force parallel to the floor.



Which pair of quantities could be used to determine the coefficient of friction for the granite on the concrete?

(1) mass and speed of the block
(2) mass and normal force on the block
(3) frictional force and speed of the block
(4) frictional force and normal force on the block

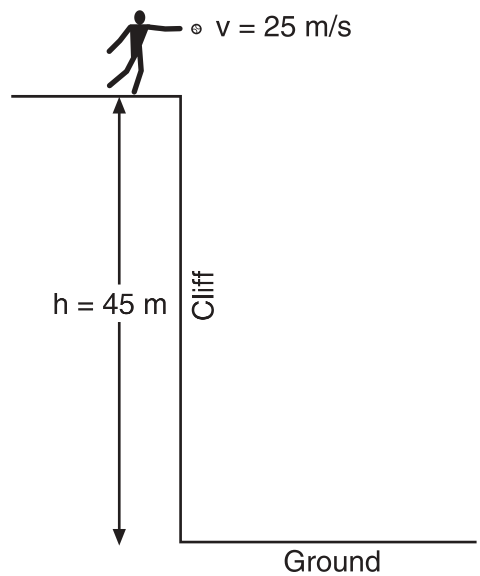
3 An object with an initial speed of 4.0 meters per second accelerates uniformly at 2.0 meters per second^2 in the direction of its motion for a distance of 5.0 meters. What is the final speed of the object?

(1) 6.0 m/s (3) 14 m/s
(2) 10. m/s (4) 36 m/s

4 After a model rocket reached its maximum height, it then took 5.0 seconds to return to the launch site. What is the approximate maximum height reached by the rocket? [Neglect air resistance.]

(1) 49 m (3) 120 m
(2) 98 m (4) 250 m

5 The diagram below shows a student throwing a baseball horizontally at 25 meters per second from a cliff 45 meters above the level ground.



Approximately how far from the base of the cliff does the ball hit the ground? [Neglect air resistance.]

(1) 45 m (3) 140 m
(2) 75 m (4) 230 m

6 A projectile is fired from a gun near the surface of Earth. The initial velocity of the projectile has a vertical component of 98 meters per second and a horizontal component of 49 meters per second. How long will it take the projectile to reach the highest point in its path?

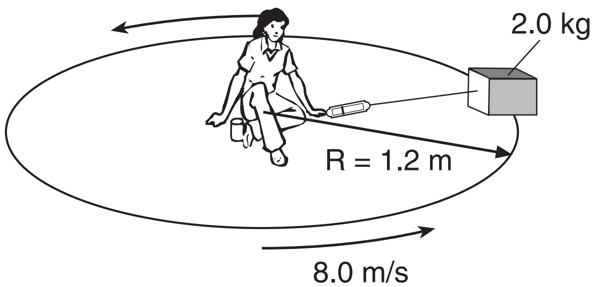
(1) 5.0 s (3) 20. s
(2) 10. s (4) 100. s

7 A 70.-kilogram astronaut has a weight of 560 newtons on the surface of planet Alpha. What is the acceleration due to gravity on planet Alpha?

(1) 0.0 m/s^2 (3) 9.8 m/s^2
(2) 8.0 m/s^2 (4) 80. m/s^2

Base your answers to questions 8 and 9 on the diagram and information below.

The diagram shows a student seated on a rotating circular platform, holding a 2.0-kilogram block with a spring scale. The block is 1.2 meters from the center of the platform. The block has a constant speed of 8.0 meters per second. [Frictional forces on the block are negligible.]



8 Which statement best describes the block's movement as the platform rotates?

(1) Its velocity is directed tangent to the circular path, with an inward acceleration.
(2) Its velocity is directed tangent to the circular path, with an outward acceleration.
(3) Its velocity is directed perpendicular to the circular path, with an inward acceleration.
(4) Its velocity is directed perpendicular to the circular path, with an outward acceleration.

9 The reading on the spring scale is approximately

(1) 20. N
(2) 53 N
(3) 110 N
(4) 130 N

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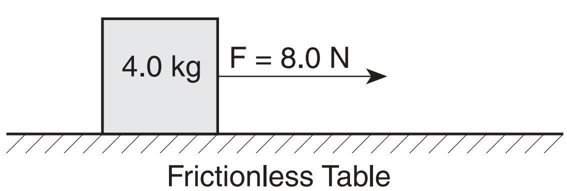
10 The diagram below shows a horizontal 8.0-newton force applied to a 4.0-kilogram block on a frictionless table.



What is the magnitude of the block's acceleration?

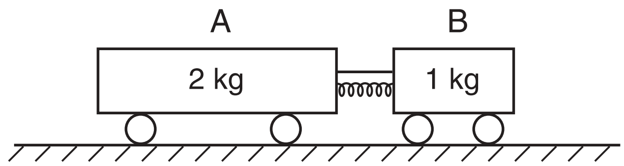
(1) 0.50 m/s^2
(2) 2.0 m/s^2
(3) 9.8 m/s^2
(4) 32 m/s^2

11 A 0.10-kilogram model rocket's engine is designed to deliver an impulse of 6.0 newton-seconds. If the rocket engine burns for 0.75 second, what average force does it produce?

(1) 4.5 N
(2) 8.0 N
(3) 45 N
(4) 80. N

Base your answers to questions 12 and 13 on the information and diagram below.

The diagram shows a compressed spring between two carts initially at rest on a horizontal frictionless surface. Cart *A* has a mass of 2 kilograms and cart *B* has a mass of 1 kilogram. A string holds the carts together.



12 What occurs when the string is cut and the carts move apart?

(1) The magnitude of the acceleration of cart *A* is one-half the magnitude of the acceleration of cart *B*.
(2) The length of time that the force acts on cart *A* is twice the length of time the force acts on cart *B*.
(3) The magnitude of the force exerted on cart *A* is one-half the magnitude of the force exerted on cart *B*.
(4) The magnitude of the impulse applied to cart *A* is twice the magnitude of the impulse applied to cart *B*.

13 After the string is cut and the two carts move apart, the magnitude of which quantity is the same for both carts?

(1) momentum
(2) velocity
(3) inertia
(4) kinetic energy

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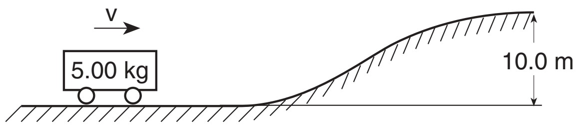
14 An object moving at a constant speed of 25 meters per second possesses 450 joules of kinetic energy. What is the object's mass?

(1) 0.72 kg
(2) 1.4 kg
(3) 18 kg
(4) 36 kg

15 The diagram below shows a moving, 5.00-kilogram cart at the foot of a hill 10.0 meters high. For the cart to reach the top of the hill, what is the minimum kinetic energy of the cart in the position shown? [Neglect energy loss due to friction.]



(1) 4.91 J
(2) 50.0 J
(3) 250. J
(4) 491 J

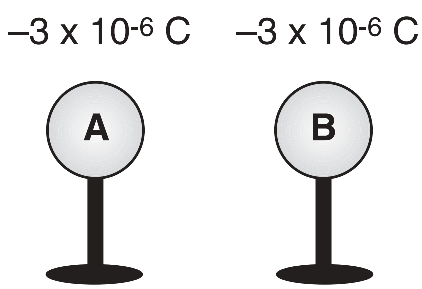
16 A constant force of 1900 newtons is required to keep an automobile having a mass of 1.0×10^3 kilograms moving at a constant speed of 20. meters per second. The work done in moving the automobile a distance of 2.0×10^3 meters is

(1) 2.0×10^4 J
(2) 3.8×10^4 J
(3) 2.0×10^6 J
(4) 3.8×10^6 J

17 The energy required to move one elementary charge through a potential difference of 5.0 volts is

(1) 8.0 J
(2) 5.0 J
(3) 8.0×10^{-19} J
(4) 1.6×10^{-19} J

18 The diagram below shows two identical metal spheres, *A* and *B*, on insulated stands. Each sphere possesses a net charge of -3×10^{-6} coulomb.



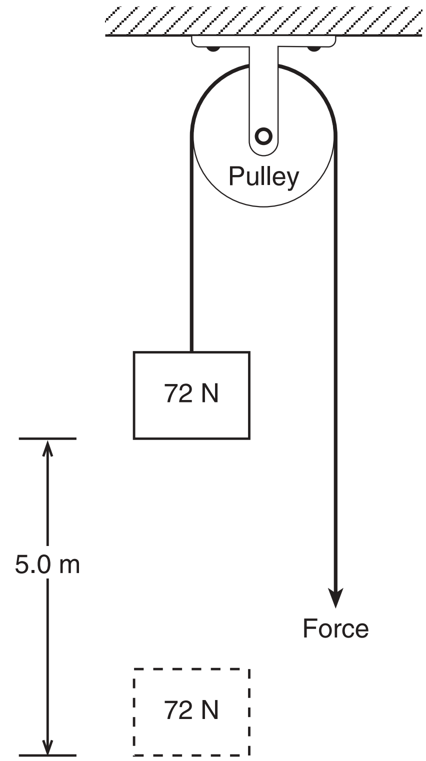
If the spheres are brought into contact with each other and then separated, the charge on sphere *A* will be

(1) 0 C
(2) $+3 \times 10^{-6}$ C
(3) -3×10^{-6} C
(4) -6×10^{-6} C

19 In a vacuum, light with a frequency of 5.0×10^{14} hertz has a wavelength of

(1) 6.0×10^{-21} m
(2) 6.0×10^{-7} m
(3) 1.7×10^{6} m
(4) 1.5×10^{23} m

20 In the diagram below, 400. joules of work is done raising a 72-newton weight a vertical distance of 5.0 meters.



How much work is done to overcome friction as the weight is raised?

(1) 40. J
(2) 360 J
(3) 400. J
(4) 760 J

21 An incandescent light bulb is supplied with a constant potential difference of 120 volts. As the filament of the bulb heats up, its resistance

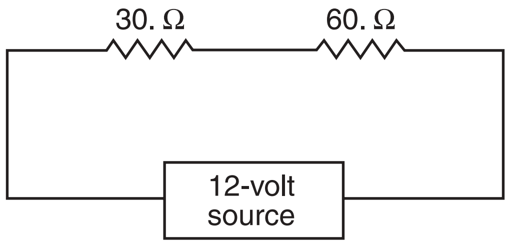
(1) increases and the current through it decreases
(2) increases and the current through it increases
(3) decreases and the current through it decreases
(4) decreases and the current through it increases

22 During a thunderstorm, a lightning strike transfers 12 coulombs of charge in 2.0×10^{-3} second. What is the average current produced in this strike?

(1) 1.7×10^{-4} A
(2) 2.4×10^{-2} A
(3) 6.0×10^{3} A
(4) 9.6×10^{3} A

Note that question 23 has only three choices.

23 A 30.-ohm resistor and a 60.-ohm resistor are connected in an electric circuit as shown below.



Compared to the electric current through the 30.-ohm resistor, the electric current through the 60.-ohm resistor is

(1) smaller
(2) larger
(3) the same

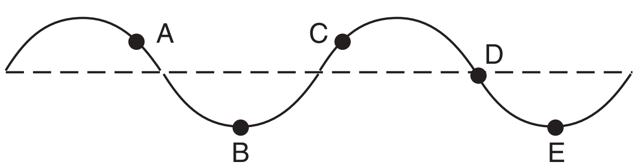
24 An operating electric heater draws a current of 10. amperes and has a resistance of 12 ohms. How much energy does the heater use in 60. seconds?

(1) 120 J
(2) 1200 J
(3) 7200 J
(4) 72,000 J

25 If the charge on each of two small charged metal spheres is doubled and the distance between the spheres remains fixed, the magnitude of the electric force between the spheres will be

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

26 The diagram below represents a periodic wave.



Which two points on the wave are in phase?

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

27 A beam of monochromatic light travels through flint glass, crown glass, Lucite, and water. The speed of the light beam is slowest in

(1) flint glass
(2) crown glass
(3) Lucite
(4) water

28 A standing wave pattern is produced when a guitar string is plucked. Which characteristic of the standing wave immediately begins to decrease?

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

29 A source of sound waves approaches a stationary observer through a uniform medium. Compared to the frequency and wavelength of the emitted sound, the observer would detect waves with a

(1) higher frequency and shorter wavelength
(2) higher frequency and longer wavelength
(3) lower frequency and shorter wavelength
(4) lower frequency and longer wavelength

30 What is the smallest electric charge that can be put on an object?

(1) 9.11×10^{-31} C
(2) 1.60×10^{-19} C
(3) 9.00×10^{9} C
(4) 6.25×10^{18} C

31 Which characteristic of electromagnetic radiation is directly proportional to the energy of a photon?

(1) wavelength
(2) period
(3) frequency
(4) path

32 What is the maximum height to which a 1200-watt motor could lift an object weighing 200. newtons in 4.0 seconds?

(1) 0.67 m
(2) 1.5 m
(3) 6.0 m
(4) 24 m

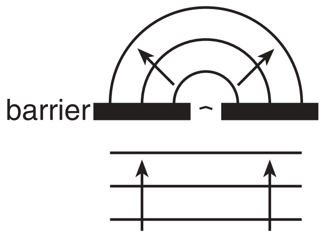
33 A spring of negligible mass has a spring constant of 50. newtons per meter. If the spring is stretched 0.40 meter from its equilibrium position, how much potential energy is stored in the spring?

(1) 20. J
(2) 10. J
(3) 8.0 J
(4) 4.0 J

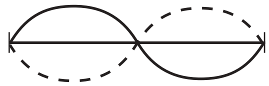
34 How much current flows through a 12-ohm flashlight bulb operating at 3.0 volts?

(1) 0.25 A
(2) 0.75 A
(3) 3.0 A
(4) 4.0 A

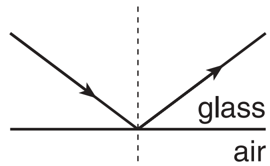
35 Which diagram below best represents the phenomenon of diffraction?



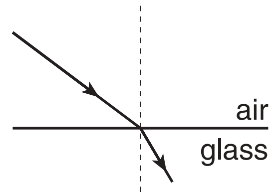
(1)



(2)



(3)



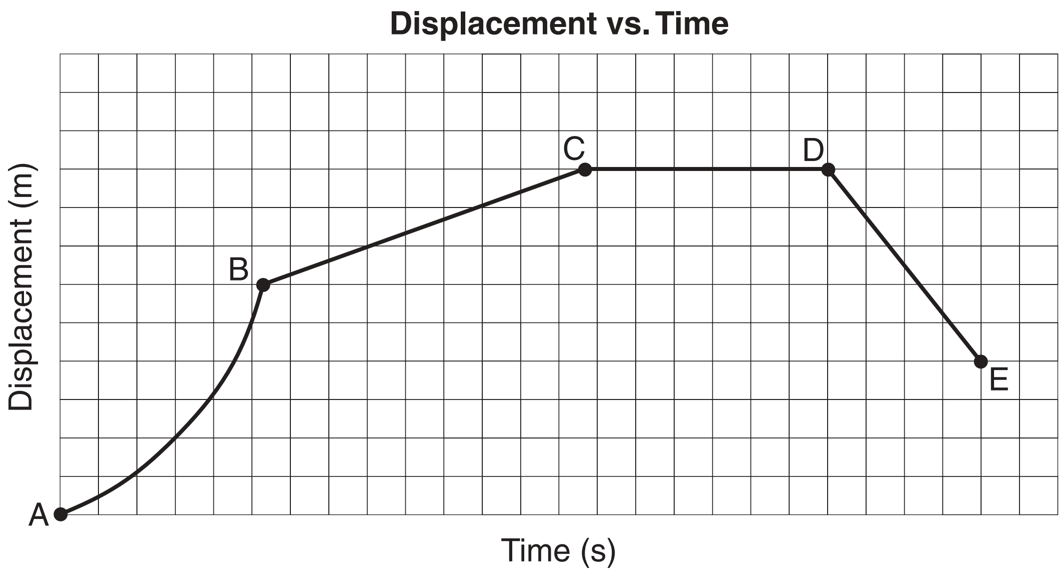
(4)

Part B–1

Answer all questions in this part.

Directions (36–45): 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.

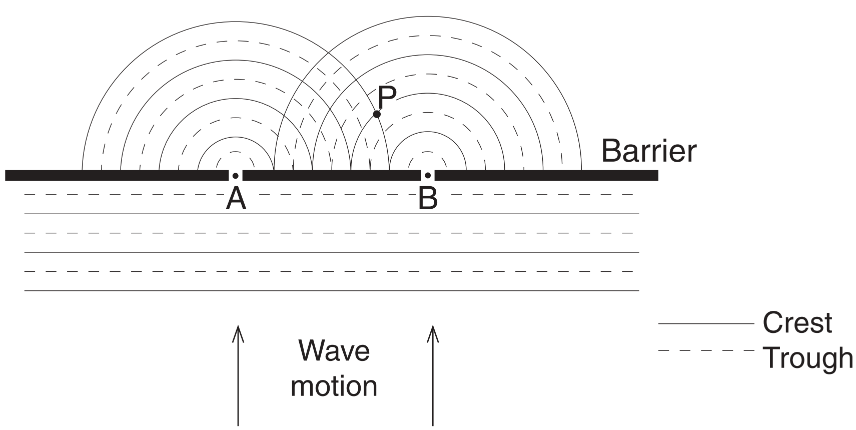
36 The displacement-time graph below represents the motion of a cart initially moving forward along a straight line.



During which interval is the cart moving forward at constant speed?

(1) *AB*
(2) *BC*
(3) *CD*
(4) *DE*

37 The diagram below represents shallow water waves of wavelength λ passing through two small openings, *A* and *B*, in a barrier.

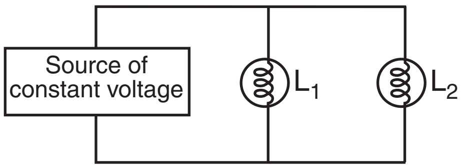


How much longer is the length of path *AP* than the length of path *BP*?

(1) 1λ
(2) 2λ
(3) 3λ
(4) 4λ

Note that question 38 has only three choices.

38 In the diagram below, lamps L_1 and L_2 are connected to a constant voltage power supply.



If lamp L_1 burns out, the brightness of L_2 will

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

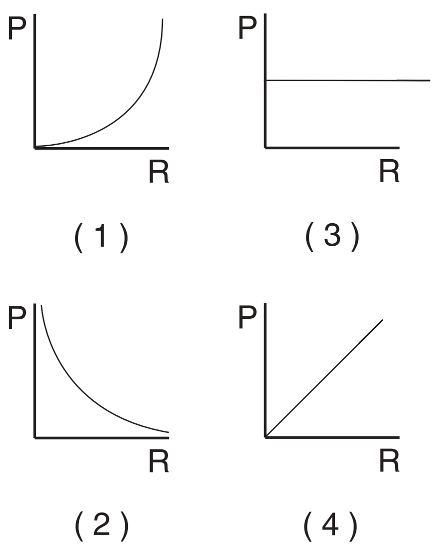
39 What is the approximate mass of a pencil?

(1) 5.0×10^{-3} kg
(2) 5.0×10^{-1} kg
(3) 5.0×10^{0} kg
(4) 5.0×10^{1} kg

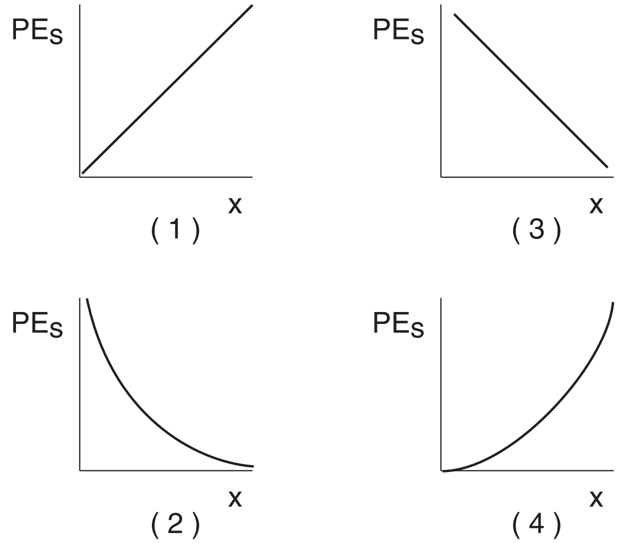
40 What is the minimum energy needed to ionize a hydrogen atom in the n = 2 energy state?

(1) 13.6 eV
(2) 10.2 eV
(3) 3.40 eV
(4) 1.89 eV

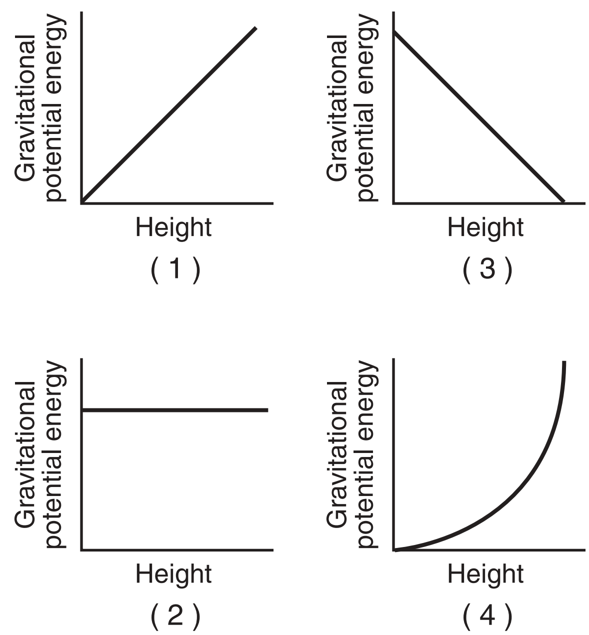
41 The potential difference applied to a circuit element remains constant as the resistance of the element is varied. Which graph best represents the relationship between power *(P)* and resistance *(R)* of this element?



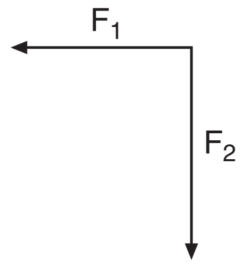
42 Which graph best represents the elastic potential energy stored in a spring (PE_s) as a function of its elongation, *x*?



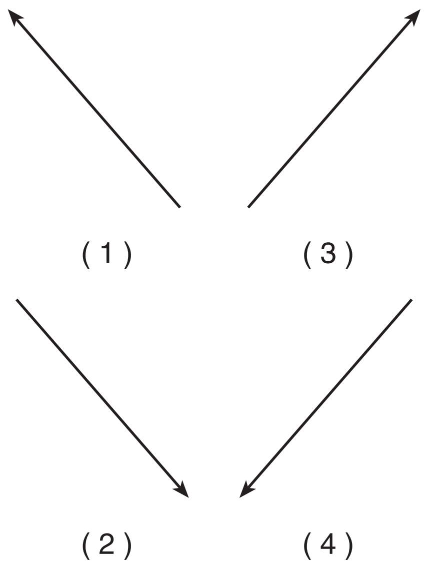
43 Which graph best represents the relationship between the gravitational potential energy of a freely falling object and the object's height above the ground near the surface of Earth?



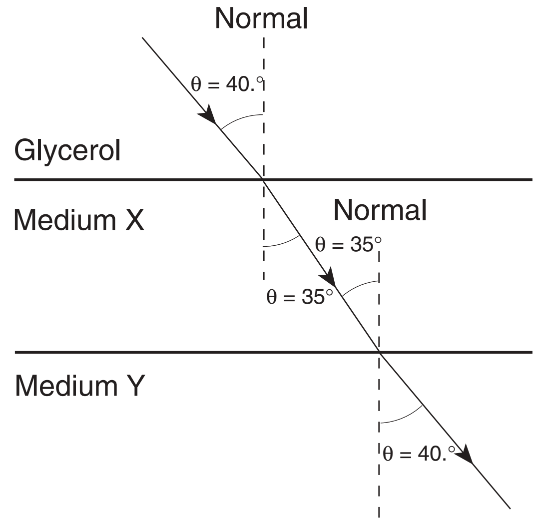
44 A force vector was resolved into two perpendicular components, F_1 and F_2, as shown in the diagram below.



Which vector best represents the original force?



45 A beam of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) passes through parallel sections of glycerol, medium *X*, and medium *Y* as shown in the diagram below.



What could medium *X* and medium *Y* be?

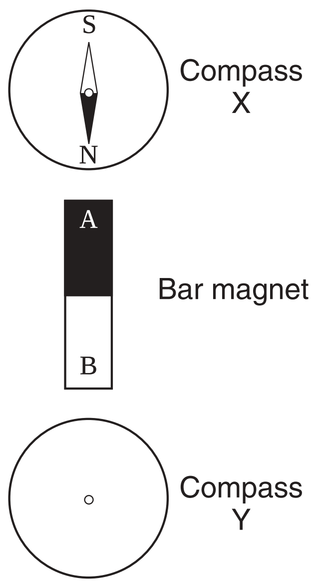
(1) *X* could be flint glass and *Y* could be corn oil.
(2) *X* could be corn oil and *Y* could be flint glass.
(3) *X* could be water and *Y* could be glycerol.
(4) *X* could be glycerol and *Y* could be water.

Part B–2

Answer all questions in this part.

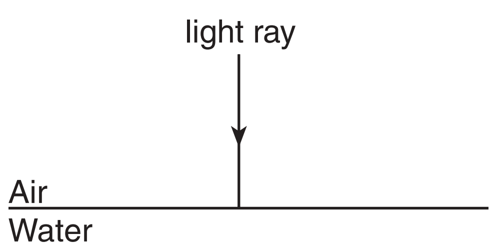
Directions (46–59): Record your answers in the spaces provided in your answer booklet.

46 The diagram below shows two compasses located near the ends of a bar magnet. The north pole of compass *X* points toward end *A* of the magnet.



On the diagram provided *in your answer booklet*, draw the correct orientation of the needle of compass *Y* and label its polarity. [1]

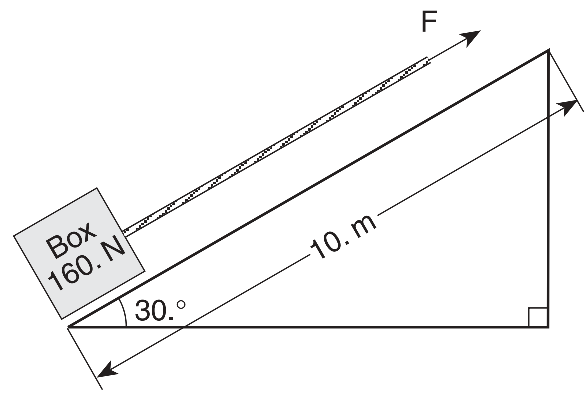
47 A ray of light traveling in air is incident on an air-water boundary as shown below.



On the diagram provided *in your answer booklet*, draw the path of the ray in the water. [1]

Base your answers to questions 48 and 49 on the information and diagram below.

A 160.-newton box sits on a 10.-meter-long frictionless plane inclined at an angle of 30.° to the horizontal as shown. Force (*F*) applied to a rope attached to the box causes the box to move with a constant speed up the incline.



48 On the diagram *in your answer booklet*, construct a vector to represent the weight of the box. Use a metric ruler and a scale of 1.0 centimeter = 40. newtons. Begin the vector at point *B* and label its magnitude in newtons. [2]

49 Calculate the amount of work done in moving the box from the bottom to the top of the inclined plane. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 50 through 53 on the information and table below.

The table lists the kinetic energy of a 4.0-kilogram mass as it travels in a straight line for 12.0 seconds.

Time (seconds)	**Kinetic Energy** (joules)
0.0	0.0
2.0	8.0
4.0	18
6.0	32
10.0	32
12.0	32

Directions (50–51): Using the information in the data table, construct a graph on the grid provided *in your answer booklet*, following the directions below.

50 Mark an appropriate scale on the axis labeled "Kinetic Energy (J)." [1]

51 Plot the data points for kinetic energy versus time. [1]

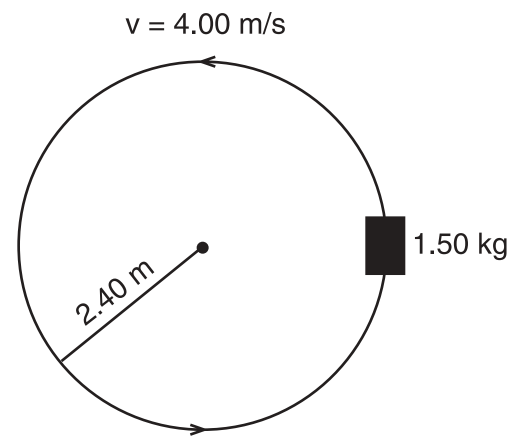
52 Calculate the speed of the mass at 10.0 seconds. [Show all work, including the equation and substitution with units.] [2]

53 Compare the speed of the mass at 6.0 seconds to the speed of the mass at 10.0 seconds. [1]

54 Using dimensional analysis, show that the expression v^2/d has the same units as acceleration. [Show all the steps used to arrive at your answer.] [2]

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

A 1.50-kilogram cart travels in a horizontal circle of radius 2.40 meters at a constant speed of 4.00 meters per second.



55 Calculate the time required for the cart to make one complete revolution. [Show all work, including the equation and substitution with units.] [2]

56 Describe a change that would quadruple the magnitude of the centripetal force. [1]

57 On the diagram *in your answer booklet*, draw an arrow to represent the direction of the acceleration of the cart in the position shown. Label the arrow *a*. [1]

Base your answers to questions 58 and 59 on the information below.

When an electron and its antiparticle (positron) combine, they annihilate each other and become energy in the form of gamma rays.

58 The positron has the same mass as the electron. Calculate how many joules of energy are released when they annihilate. [Show all work, including the equation and substitution with units.] [2]

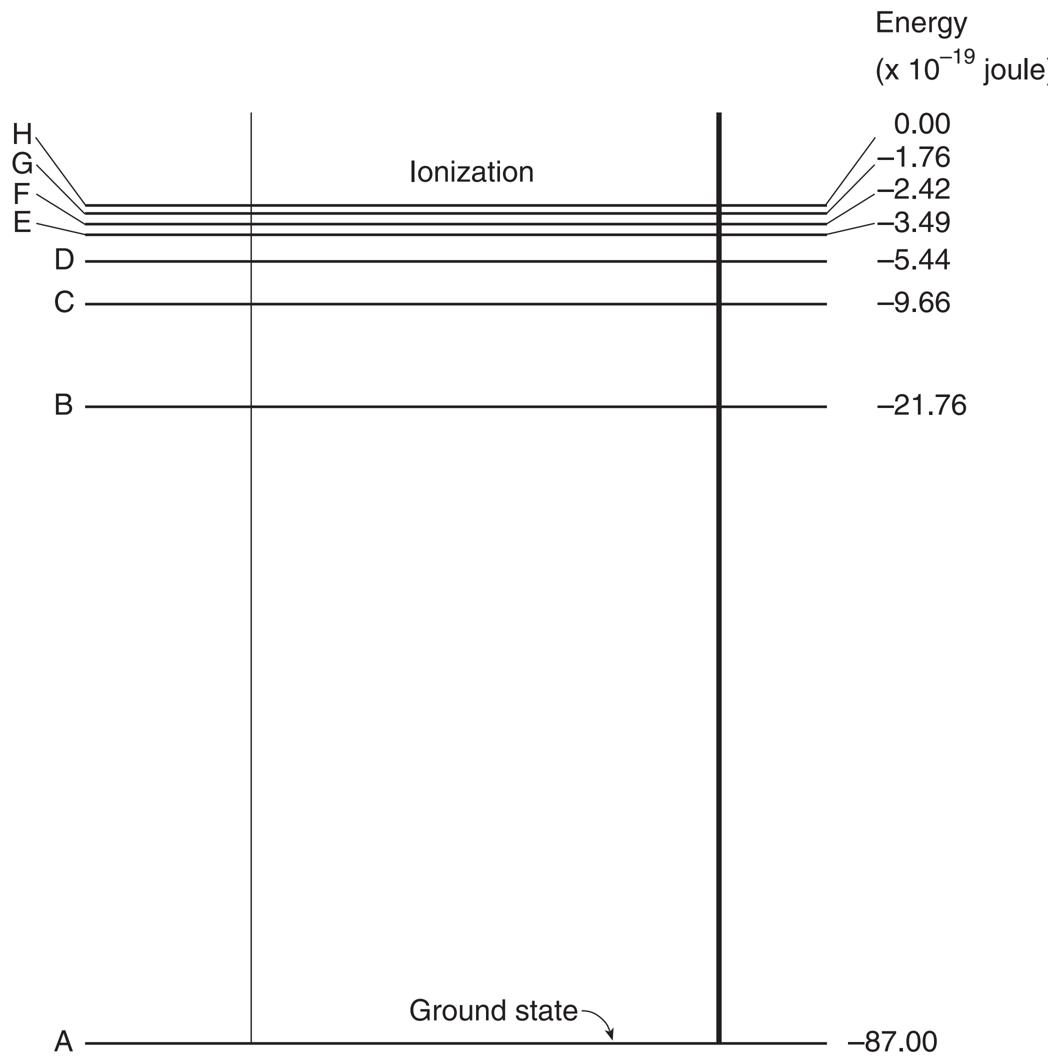
59 What conservation law prevents this from happening with two electrons? [1]

Part C

Answer all questions in this part.

Directions (60–69): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 60 and 61 on the diagram below, which shows some energy levels for an atom of an unknown substance.



60 Determine the minimum energy necessary for an electron to change from the *B* energy level to the *F* energy level. [1]

61 Calculate the frequency of the photon emitted when an electron in this atom changes from the *F* energy level to the *B* energy level. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 62 and 63 on the information below.

An electric circuit contains two 3.0-ohm resistors connected in parallel with a battery. The circuit also contains a voltmeter that reads the potential difference across one of the resistors.

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

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

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64 Explain how to find the coefficient of kinetic friction between a wooden block of unknown mass and a tabletop in the laboratory. Include the following in your explanation:

- Measurements required [1]
- Equipment needed [1]
- Procedure [1]
- Equation(s) needed to calculate the coefficient of friction [1]

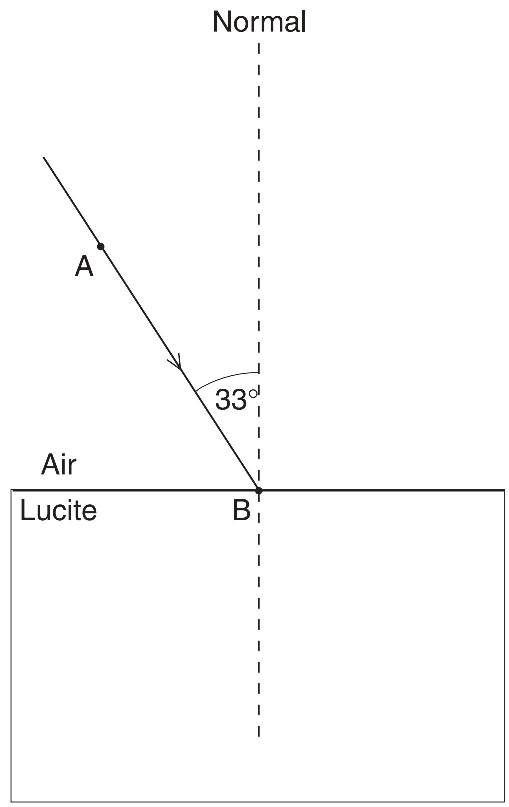
Base your answers to questions 65 and 66 on the information below.

A toaster having a power rating of 1050 watts is operated at 120. volts.

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

66 The toaster is connected in a circuit protected by a 15-ampere fuse. (The fuse will shut down the circuit if it carries more than 15 amperes.) Is it possible to simultaneously operate the toaster and a microwave oven that requires a current of 10.0 amperes on this circuit? Justify your answer mathematically. [2]

Base your answers to questions 67 through 69 on the information and diagram below. A monochromatic beam of yellow light, *AB*, is incident upon a Lucite block in air at an angle of 33°.



67 Calculate the angle of refraction for incident beam *AB*. [Show all work, including the equation and substitution with units.] [2]

68 Using a straightedge, a protractor, and your answer from question 67, draw an arrow to represent the path of the refracted beam. [2]

69 Compare the speed of the yellow light in air to the speed of the yellow light in Lucite. [1]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Tuesday, June 18, 2002 — 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 . . . .
37 . . . .
38 . . . .
39 . . . .
40 . . . .
41 . . . .
42 . . . .
43 . . . .
44 . . . .
45 . . . .

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, June 18, 2002 — 1:15 to 4:15 p.m., only

ANSWER BOOKLET

☐ Male

Student . . . . Sex: ☐ 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	10	
B–2	20	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

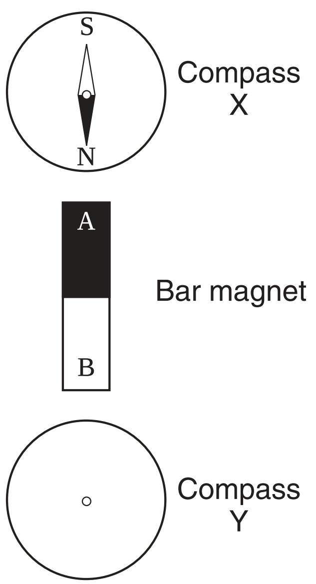
Final Score (from conversion chart)

Raters' Initials:

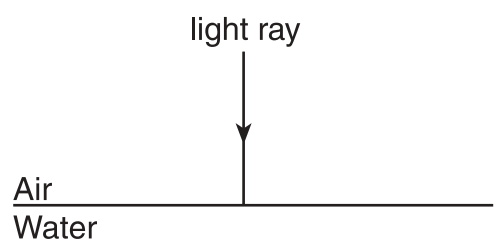
Rater 1 . . . . **Rater 2** . . . .

Part B–2

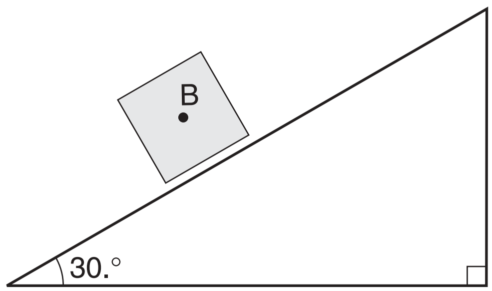
46



47

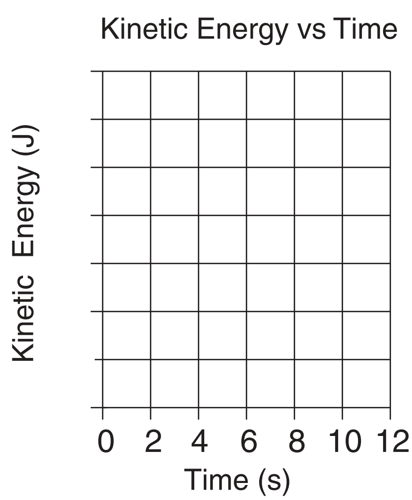


48



49

50–51



52

53

54

55

58

56 ______________________________

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59 ______________________________

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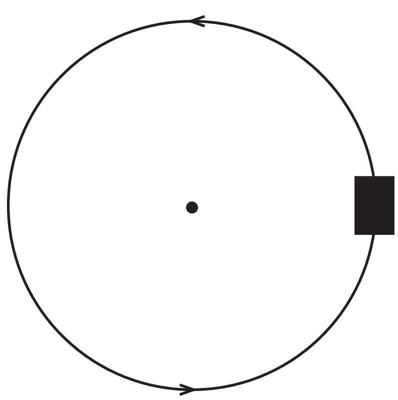
Part C

60 ____________ J

61

57



62

63

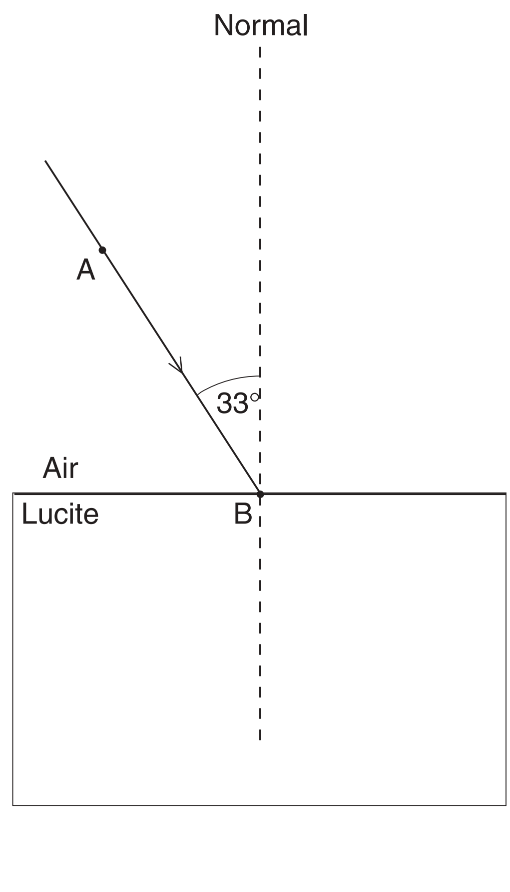
64

65

66

67

68



69

FOR TEACHERS ONLY

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

PS–P

PHYSICAL SETTING/PHYSICS

Tuesday, June 18, 2002 — 1:15 to 4:15 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

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

Part B–1

36	2
37	2
38	3
39	1
40	3
41	2
42	4
43	1
44	4
45	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.

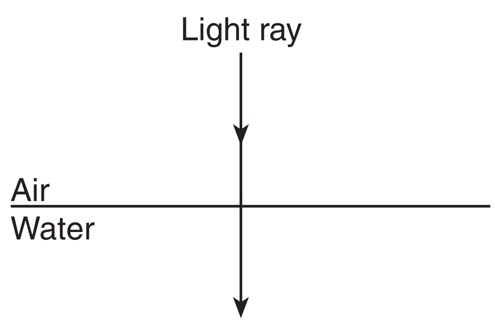
Part B

46 Allow 1 credit for drawing the correct orientation of the needle of compass *Y* and labeling its polarity.

Example of Acceptable Response

47 Allow 1 credit for extending the line straight into the water (±2°) as shown below. Do *not* penalize the student if there is no arrowhead.

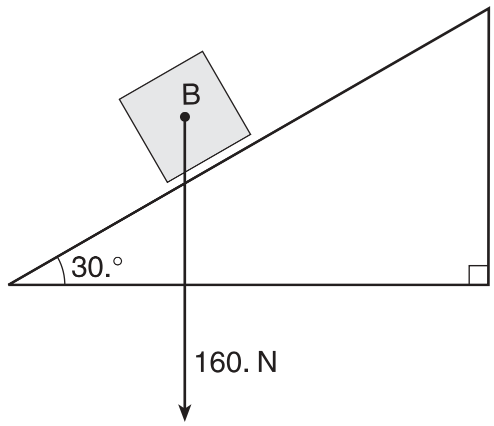
Example of Acceptable Response



48 Allow a maximum of 2 credits.

- Allow 1 credit for a line originating at point *B* and having an arrowhead indicating the correct direction with a label.
- Allow 1 credit if the vector, including its arrowhead, is drawn to the proper length (4.0 cm ±0.2 cm).

Example of Acceptable Response



49 Allow a maximum of 2 credits for determining the amount of work done. Refer to *Scoring Criteria for Calculations* in this scoring key.

Examples of Acceptable Responses

$F_y = F\sin\theta$ and $w = Fd$

$F_y = (160.\ \text{N})(\sin 30.°) = 80.\ \text{N}$

$w = (80.\ \text{N})(10.\ \text{m}) = 800\ \text{J}$

or

$w = Fd\sin\theta$

$w = (160.\ \text{N})(10.\ \text{m})(\sin 30.°)$

$w = 800\ \text{J}$

or

$w = Fd = \triangle E_T = mgh$ and $h = d\sin\theta$

$w = mgd\sin\theta$

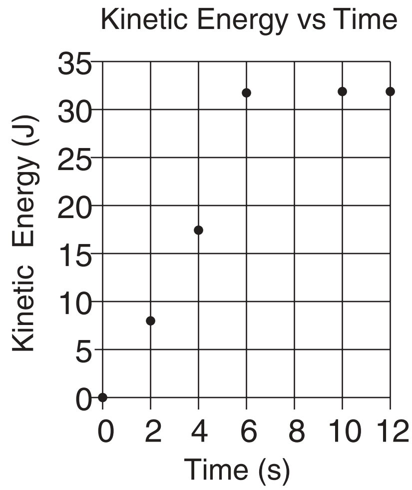
$w = (160.\ \text{N})(10.\ \text{m})(\sin 30.°)$

$w = 800\ \text{J}$

50 Allow 1 credit for a scale that is linear and has appropriate divisions.

51 Allow 1 credit for plotting all points accurately (±0.3 grid space). Allow credit if the student correctly uses his or her response to question 50. Do *not* penalize the student if no line is drawn.

50–51 Example of Acceptable Response



52 Allow a maximum of 2 credits for calculating the speed of the mass. Refer to *Scoring Criteria for Calculations* in this scoring key.

Example of Acceptable Response

$KE = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2\,KE}{m}}$

$v = \sqrt{\frac{2\ (32\ \text{J})}{4.0\ \text{kg}}}$

$v = \sqrt{16\,\frac{m^2}{s^2}}$

$v = 4.0\ \text{m/s}$ *or* $v = 4.0\sqrt{\frac{\text{J}}{\text{kg}}}$

53 Allow 1 credit for indicating that the speed of the mass at 6.0 seconds and the speed of the mass at 10.0 seconds are equal.

Examples of Acceptable Responses

The speeds are the same.

or

The speed of the mass at 6.0 seconds and the speed of the mass at 10.0 seconds are both 4.0 m/s.

Allow credit for an answer that is consistent with the student's response to question 52.

54 Allow a maximum of 2 credits.

- Allow 1 credit for the substitutions $\frac{\text{m}}{\text{s}}$ for v and m for d.
- Allow 1 credit for the answer $\frac{\text{m}}{\text{s}^2}$.

Example of Acceptable Response

$$\frac{v^2}{d} = \frac{(\text{m/s})^2}{\text{m}} = \frac{\text{m}^2/\text{s}^2}{\text{m}} = \frac{\text{m}}{\text{s}^2}$$

Note: Credit should *not* be allowed for merely giving acceleration units as m/s^2.

Examples of *Unacceptable* Responses:

$$\frac{v^2}{d} = \frac{\text{m}}{\text{s}^2}$$

or

$$\frac{v^2}{d} = \frac{\text{m/s}}{\text{s}}$$

55 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in the scoring key.

Examples of Acceptable Responses

$$v = \frac{d}{t}$$

$$t = \frac{d}{v}$$

$$t = \frac{2\pi r}{v}$$

$$t = \frac{2\pi(2.40\text{m})}{4.00 \text{ m/s}}$$

$$t = 3.77 \text{ s}$$

or

$$\overline{v} = \frac{d}{t}$$

$$4.00 \text{ m/s} = \frac{15.08\text{m}}{t}$$

$$t = 3.77 \text{ s}$$

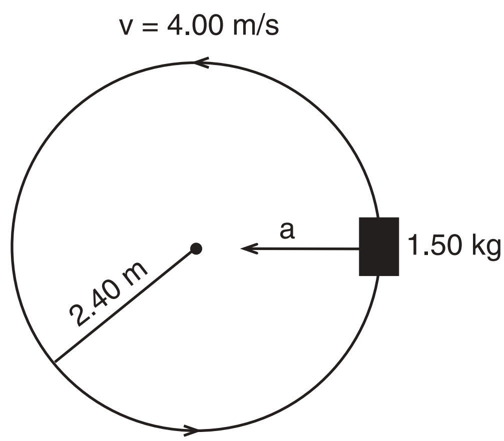
56 Allow 1 credit for describing a change that would quadruple the magnitude of the centripetal force.

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

— double the speed of the car
— reduce the radius to 0.60 m
— quadruple the mass
— double the mass of the cart and halve the radius
— increase the speed of the cart to 5.66 m/s and double the mass of the cart
— increase the speed of the cart to 5.66 m/s and halve the radius

57 Allow 1 credit for drawing and labeling an arrow that represents the direction of the acceleration of the cart.

Example of Acceptable Response



Note: The label must be included to receive credit.

58 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

Example of Acceptable Response

$E = mc^2$

$E = 2(9.11 \times 10^{-31}\text{ kg})\,(3.00 \times 10^8\text{ m/s})^2$

$E = 1.64 \times 10^{-13}\text{ J}$

59 Allow 1 credit for **conservation of charge.**

Part C

60 Allow 1 credit for determining the minimum energy necessary for an electron to change from the *B* energy level to the *F* energy level.

Examples of Acceptable Responses

19.34×10^{-19} J

or

1.934×10^{-18} J

Allow this credit if the answer above is negative.

61 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

Examples of Acceptable Responses

$E = hf$

$f = \dfrac{E}{h}$

$f = \dfrac{19.34 \times 10^{-19}\ \text{J}}{6.63 \times 10^{-34}\ \text{J}\bullet\text{s}}$

$f = 2.92 \times 10^{15}$ Hz

or

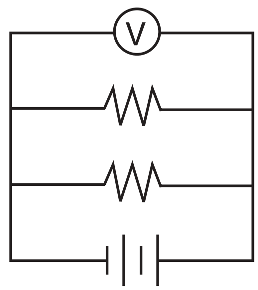
$f = 2.92 \times 10^{15}$ 1/s

Allow credit for an answer that is consistent with the student's response to question 60.

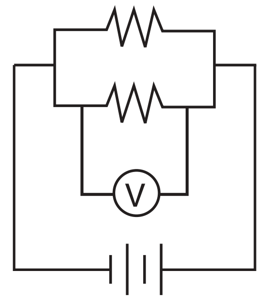
62 Allow a maximum of 2 credits.

- Allow 1 credit for a circuit containing two resistors connected in parallel with a battery.
- Allow 1 credit for a voltmeter connected in parallel with either resistor, or the battery. If the student has drawn a series circuit and the voltmeter is properly placed to measure the potential difference across either resistor, allow this credit.

Examples of Acceptable Responses



or



63 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

Examples of Acceptable Responses

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{eq}} = \frac{1}{3.0\Omega} + \frac{1}{3.0\Omega}$$

$$\frac{1}{R_{eq}} = \frac{2}{3.0\Omega}$$

$$R_{eq} = 1.5\Omega$$

or

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_{eq} = \frac{(3.0\Omega)(3.0\Omega)}{3.0\Omega + 3.0\Omega}$$

$$R_{eq} = 1.5\Omega$$

Allow credit if the student correctly uses his or her responses to question 62. That is, if the student connected the resistors in series in question 62, then the following answer is acceptable.

$$R_{eq} = R_1 + R_2$$

$$R_{eq} = 3.0\Omega + 3.0\Omega$$

$$R_{eq} = 6.0\Omega$$

64 Allow a maximum of 4 credits for explaining how to find the coefficient of kinetic friction between a wooden block of unknown mass and a table top in the laboratory. The response must include:

- Measurements needed: normal force (weight or mass) of block, friction force [1]
- Equipment needed: spring scale (and balance if mass of block is used) or computer force sensor [1]
- Procedure: The procedure must include a means of finding the normal force and the force of friction, *and* a means of using them to determine the coefficient of friction, e.g., using the equation *or* finding the slope of a graph. [1]
- Equation: $F_f = \mu F_N$ (and $F_g = mg$ if mass is found first) [1]

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

To determine the coefficient of friction between a block and the table, I would need to measure the normal force or weight of the block, and the force of friction. The equipment needed is a spring scale. First I would hang the block on the scale to find its weight. Then I would pull the block smoothly (or at constant speed) across the table with the spring scale to find the force of friction. Once I measured the weight and friction forces, I would use the formula $F_f = \mu F_N$ to calculate the coefficient of friction.

or

Use another device for measuring force (e.g., a computer force sensor).

Use a balance to find the mass of the block, then $g = \frac{F_g}{m}$ to find the weight. Then proceed as above.

or

Load various weights onto the block, find the friction for each weight, plot a graph of friction *vs* weight, and find the slope of the graph.

65 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in the scoring key.

Examples of Acceptable Responses

$P = \frac{V^2}{R}$

$R = \frac{V^2}{P}$

$R = \frac{(120.\text{V})^2}{1050\text{ W}}$

$R = 13.7\Omega$

or

$P = \text{V}I$

$I = \frac{P}{V}$

$I = \frac{1050\text{ W}}{120\text{ V}}$

$I = 8.75\text{ A}$

$R = \frac{V}{I}$

$I = \frac{120\text{ V}}{8.75\text{ A}}$

$R = 13.7\Omega$

66 Allow a maximum of 2 credits.

- Allow 1 credit for correctly indicating the total current.
- Allow 1 credit for stating whether it is possible to operate the toaster and the microwave simultaneously. If the current indicated is greater than 15 A, the answer should be no. If the current indicated is less than 15 A, the answer should be yes.

Example of Acceptable Response

$I = \frac{P}{V} = \frac{1050\text{ W}}{120\text{ V}} = 8.75\text{ A}$

$I_{\text{total}} = 8.75\text{ A} + 10.0\text{ A} = 18.8\text{ A}$

Answer: No

Do *not* penalize student for incorrect or missing units.

Note: Allow no credit for a yes or no answer with no mathematical justification.

67 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

Examples of Acceptable Responses

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

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

$\sin \theta_2 = \dfrac{1.00 \sin 33°}{1.50}$

$\sin \theta_2 = \dfrac{1.00(0.5446)}{1.50}$

$\sin \theta_2 = 0.363$

$\theta_2 = 21°$

or

$n_1 \sin i = n_2 \sin r$

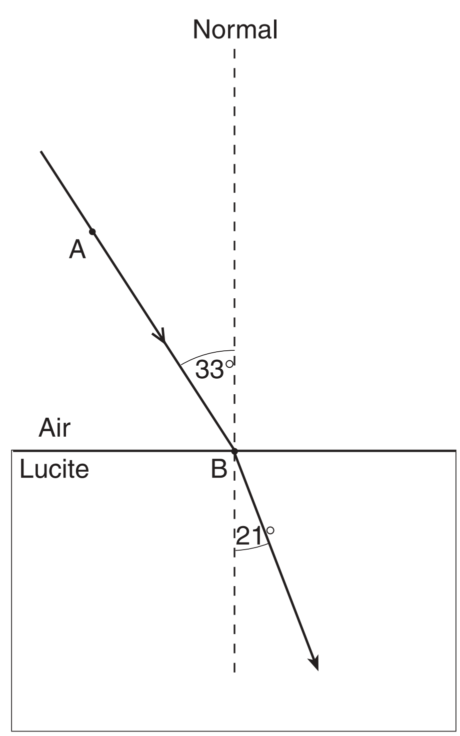
$(1.00)(\sin 33°) = (1.50) \sin r$

$r = 21°$

68 Allow a maximum of 2 credits.

- Allow 1 credit if the angle between the normal and the ray is equal to the angle the student calculated in question 67 (±2°).
- Allow 1 credit for an arrow originating at point *B*, drawn to the right of the normal in Lucite, and directed away from point *B*.

Example of Acceptable Response



69 Allow 1 credit for indicating that yellow light travels faster in air than in Lucite.

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

Light travels faster in air than in Lucite.

or

Yellow light travels slower in Lucite than in air.

Allow credit if the student calculates and identifies the numerical values.

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

Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score
85	100	63	70	41	49	19	27
84	98	62	69	40	48	18	26
83	97	61	68	39	47	17	25
82	95	60	67	38	47	16	24
81	93	59	66	37	46	15	23
80	92	58	65	36	45	14	21
79	90	57	64	35	44	13	20
78	89	56	63	34	43	12	19
77	87	55	62	33	42	11	17
76	86	54	61	32	41	10	16
75	85	53	60	31	40	9	14
74	83	52	59	30	39	8	13
73	82	51	58	29	38	7	11
72	81	50	57	28	37	6	10
71	79	49	56	27	36	5	8
70	78	48	56	26	35	4	7
69	77	47	55	25	34	3	5
68	76	46	54	24	33	2	3
67	75	45	53	23	32	1	2
66	73	44	52	22	31	0	0
65	72	43	51	21	30		
64	71	42	50	20	29		

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

June 2002 Physical Setting/ Physics			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1	3-7, 9-11, 14-17, 19, 20, 22, 24, 32-34	41, 44, 49-52 54 - 56, 58	61,63 - 65, 67, 69
Math Key Idea 2		41- 43, 53	
Math Key Idea 3		36	
Sci. Inq Key Idea 1			62
Sci. Inq Key Idea 2			
Sci. Inq Key Idea 3			
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		39	
Key Idea 4			
Key Idea 5		56	
Key Idea 6			
Standard 7			
Key Idea 1			66
Key Idea 2			
Standard 4 Process Skills			
4.1		38, 42, 46, 49 - 52	62
4.3		37, 45, 47	68
5.1		44, 48, 57	64
5.3		40, 41	60
Standard 4			
4.1	14 -17,21-24, 32, 33, 34	38, 41- 44, 49 - 53	62,63, 65, 66
4.3	19,20,26-29,35	37, 45, 47, 48	67 - 69
5.1	1-13,25	36, 46, 54-57	64
5.3	18,30,31	40, 58, 59	60, 61

Attachment A

University of the State of New York
State Education Department

New Scoring Chart for June 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	37	45	65	74
2	2	38	46	66	75
3	4	39	47	67	76
5	6	40	48	68	77
7	8	41	49	69	78
8	10	42	50	70	79
10	12	43	51	71	79
11	14	44	53	72	80
13	15	45	54	73	81
14	17	46	55	75	82
16	19	47	57	76	83
17	21	48	58	77	84
19	22	49	59	78	85
20	24	50	60	79	86
21	25	51	61	81	87

23	27		52	62		82	88
24	28		53	62		83	89
25	30		54	63		85	90
26	31		55	64		86	91
27	33		56	65		87	92
29	34		57	67		89	93
30	36		58	68		90	94
31	37		59	69		92	95
32	38		60	70		93	96
33	40		61	71		95	97
34	41		62	71		97	98
35	42		63	72		98	99
36	43		64	73		100	100

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