The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, January 29, 2009 — 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 answers to the questions in Part B–2 and Part C are to be written in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

You are to answer *all* questions in all parts of this examination according to the directions provided in the examination booklet. Record your answers to the Part A and Part B–1 multiple-choice questions on your separate answer sheet. Write your answers to the Part B–2 and Part C questions in your answer booklet. All work should be written in pen, except for graphs and drawings, which should be done in pencil. You may use scrap paper to work out the answers to the questions, but be sure to record all your answers on the answer sheet and in the answer booklet.

When you have completed the examination, you must sign the statement printed at the end of your separate answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet and answer booklet cannot be accepted if you fail to sign this declaration.

Notice. . .

A scientific or graphing calculator, a centimeter ruler, a protractor, and a copy of the *2006 Edition Reference Tables for Physical Setting/Physics,* which you may need to answer some questions in this examination, must be available for your use while taking this examination.

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

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

Part A

Answer all questions in this part.

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

1 A force of 25 newtons east and a force of 25 newtons west act concurrently on a 5.0-kilogram cart. What is the acceleration of the cart?

(1) 1.0 m/s^2 west
(2) 0.20 m/s^2 east
(3) 5.0 m/s^2 east
(4) 0 m/s^2

2 An unstretched spring has a length of 10. centimeters. When the spring is stretched by a force of 16 newtons, its length is increased to 18 centimeters. What is the spring constant of this spring?

(1) 0.89 N/cm
(2) 2.0 N/cm
(3) 1.6 N/cm
(4) 1.8 N/cm

3 What is the acceleration due to gravity at a location where a 15.0-kilogram mass weighs 45.0 newtons?

(1) 675 m/s^2
(2) 9.81 m/s^2
(3) 3.00 m/s^2
(4) 0.333 m/s^2

4 As a car is driven south in a straight line with *decreasing* speed, the acceleration of the car must be

(1) directed northward
(2) directed southward
(3) zero
(4) constant, but not zero

5 A baseball dropped from the roof of a tall building takes 3.1 seconds to hit the ground. How tall is the building? [Neglect friction.]

(1) 15 m
(2) 30. m
(3) 47 m
(4) 94 m

6 Which object has the greatest inertia?

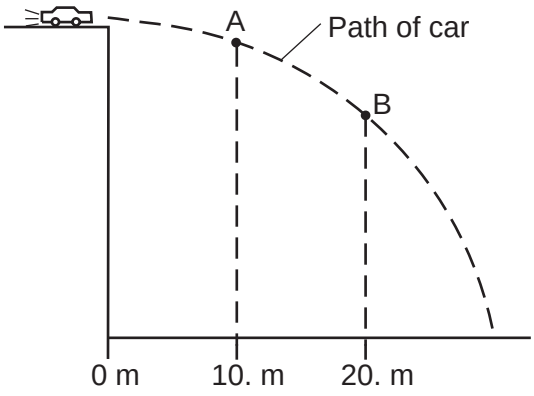
(1) a falling leaf
(2) a softball in flight
(3) a seated high school student
(4) a rising helium-filled toy balloon

7 Centripetal force F_c acts on a car going around a curve. If the speed of the car were twice as great, the magnitude of the centripetal force necessary to keep the car moving in the same path would be

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

Note that question 8 has only three choices.

8 The diagram below represents the path of a stunt car that is driven off a cliff, neglecting friction.



Compared to the horizontal component of the car's velocity at point *A*, the horizontal component of the car's velocity at point *B* is

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

9 What is the average power required to raise a 1.81×10^4-newton elevator 12.0 meters in 22.5 seconds?

(1) 8.04×10^2 W
(2) 9.65×10^3 W
(3) 2.17×10^5 W
(4) 4.89×10^6 W

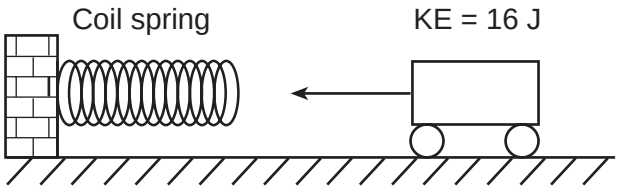
10 If the speed of a moving object is doubled, the kinetic energy of the object is

(1) halved
(2) doubled
(3) unchanged
(4) quadrupled

11 Which statement best explains why a "wet saw" used to cut through fine optical crystals is constantly lubricated with oil?

(1) Lubrication decreases friction and minimizes the increase of internal energy.
(2) Lubrication decreases friction and maximizes the increase of internal energy.
(3) Lubrication increases friction and minimizes the increase of internal energy.
(4) Lubrication increases friction and maximizes the increase of internal energy.

12 The diagram below shows a toy cart possessing 16 joules of kinetic energy traveling on a frictionless, horizontal surface toward a horizontal spring.



Frictionless, horizontal surface

If the cart comes to rest after compressing the spring a distance of 1.0 meter, what is the spring constant of the spring?

(1) 32 N/m
(2) 16 N/m
(3) 8.0 N/m
(4) 4.0 N/m

13 How much work is required to lift a 10.-newton weight from 4.0 meters to 40. meters above the surface of Earth?

(1) 2.5 J
(2) 3.6 J
(3) 3.6×10^2 J
(4) 4.0×10^2 J

14 Which situation describes a system with *decreasing* gravitational potential energy?

(1) a girl stretching a horizontal spring
(2) a bicyclist riding up a steep hill
(3) a rocket rising vertically from Earth
(4) a boy jumping down from a tree limb

15 If 20 joules of work is used to transfer 20 coulombs of charge through a 20-ohm resistor, the potential difference across the resistor is

(1) 1 V
(2) 20 V
(3) 0.05 V
(4) 400 V

16 At 20°C, four conducting wires made of different materials have the same length and the same diameter. Which wire has the *least* resistance?

(1) aluminum
(2) gold
(3) nichrome
(4) tungsten

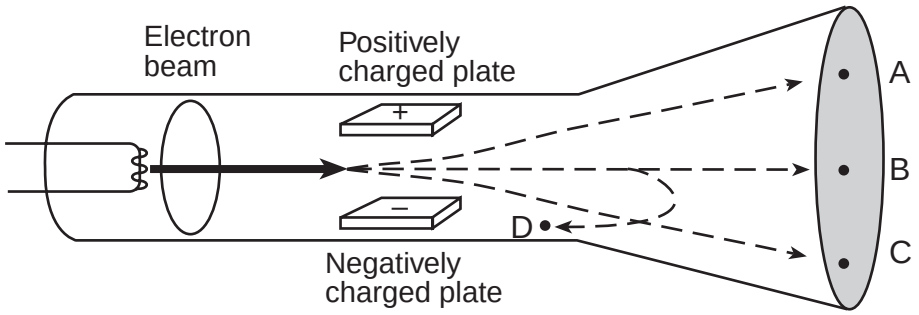
17 Three identical lamps are connected in parallel with each other. If the resistance of each lamp is X ohms, what is the equivalent resistance of this parallel combination?

(1) $X\ \Omega$
(2) $\frac{X}{3}\Omega$
(3) $3X\ \Omega$
(4) $\frac{3}{X}\Omega$

18 A 2.0-ohm resistor and a 4.0-ohm resistor are connected in series with a 12-volt battery. If the current through the 2.0-ohm resistor is 2.0 amperes, the current through the 4.0-ohm resistor is

(1) 1.0 A
(2) 2.0 A
(3) 3.0 A
(4) 4.0 A

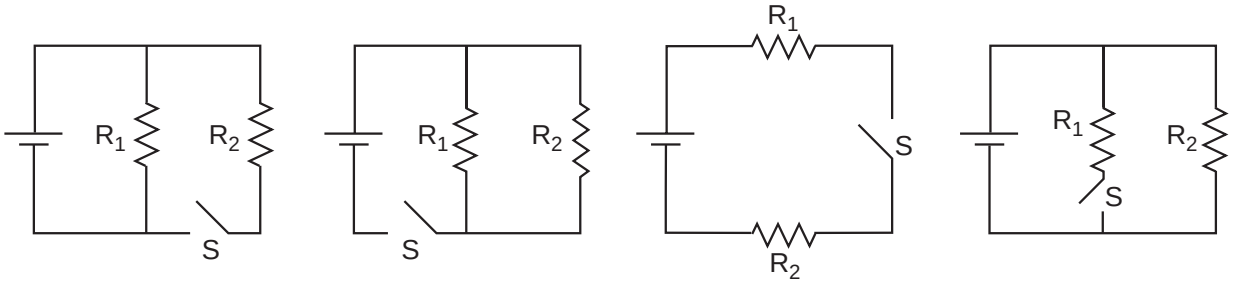
19 The diagram below shows a beam of electrons fired through the region between two oppositely charged parallel plates in a cathode ray tube.



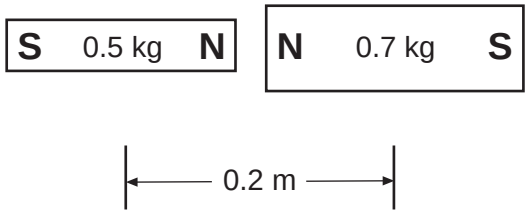
After passing between the charged plates, the electrons will most likely travel path

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

20 In which circuit would current flow through resistor R_1, but *not* through resistor R_2 while switch *S* is open?



21 The diagram below represents a 0.5-kilogram bar magnet and a 0.7-kilogram bar magnet with a distance of 0.2 meter between their centers.



Which statement best describes the forces between the bar magnets?

(1) Gravitational force and magnetic force are both repulsive.
(2) Gravitational force is repulsive and magnetic force is attractive.
(3) Gravitational force is attractive and magnetic force is repulsive.
(4) Gravitational force and magnetic force are both attractive.

22 A dampened fingertip rubbed around the rim of a crystal stemware glass causes the glass to vibrate and produce a musical note. This effect is due to

(1) resonance
(2) refraction
(3) reflection
(4) rarefaction

23 Which type of wave requires a material medium through which to travel?

(1) radio wave
(2) microwave
(3) light wave
(4) mechanical wave

Note that question 24 has only three choices.

24 Compared to the speed of a sound wave in air, the speed of a radio wave in air is

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

Note that question 25 has only three choices.

25 If the amplitude of a wave is increased, the frequency of the wave will

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

26 Which unit is equivalent to meters per second?

(1) Hz•s
(2) Hz•m
(3) s/Hz
(4) m/Hz

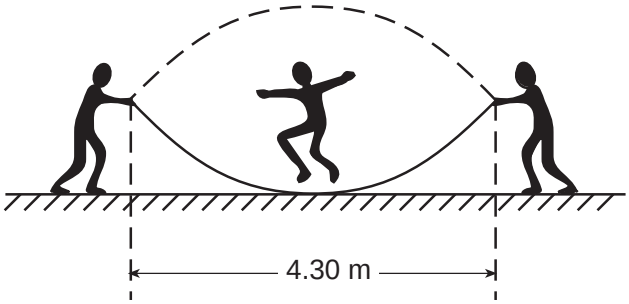
27 Which characteristic is the same for every color of light in a vacuum?

(1) energy
(2) frequency
(3) speed
(4) period

28 What is the speed of light ($f = 5.09 \times 10^{14}$ Hz) in flint glass?

(1) 1.81×10^8 m/s
(2) 1.97×10^8 m/s
(3) 3.00×10^8 m/s
(4) 4.98×10^8 m/s

29 While playing, two children create a standing wave in a rope, as shown in the diagram below. A third child participates by jumping the rope.



What is the wavelength of this standing wave?

(1) 2.15 m
(2) 4.30 m
(3) 6.45 m
(4) 8.60 m

30 A television remote control is used to direct pulses of electromagnetic radiation to a receiver on a television. This communication from the remote control to the television illustrates that electromagnetic radiation

(1) is a longitudinal wave
(2) possesses energy inversely proportional to its frequency
(3) diffracts and accelerates in air
(4) transfers energy without transferring mass

Note that question 31 has only three choices.

31 A wave of constant wavelength diffracts as it passes through an opening in a barrier. As the size of the opening is increased, the diffraction effects

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

32 A car's horn produces a sound wave of constant frequency. As the car speeds up going away from a stationary spectator, the sound wave detected by the spectator

(1) decreases in amplitude and decreases in frequency
(2) decreases in amplitude and increases in frequency
(3) increases in amplitude and decreases in frequency
(4) increases in amplitude and increases in frequency

33 An electron in a mercury atom drops from energy level *f* to energy level *c* by emitting a photon having an energy of

(1) 8.20 eV
(2) 5.52 eV
(3) 2.84 eV
(4) 2.68 eV

34 If an object has a net negative charge of 4.0 coulombs, the object possesses

(1) 6.3×10^{18} more electrons than protons
(2) 2.5×10^{19} more electrons than protons
(3) 6.3×10^{18} more protons than electrons
(4) 2.5×10^{19} more protons than electrons

35 Moving electrons are found to exhibit properties of

(1) particles, only
(2) waves, only
(3) both particles and waves
(4) neither particles nor waves

Part B–1

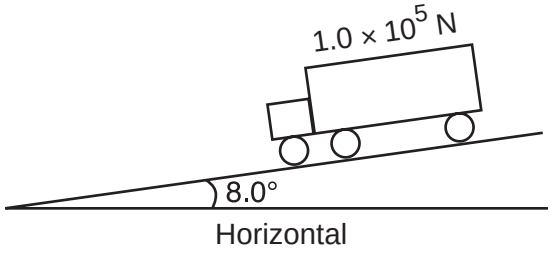
Answer all questions in this part.

Directions (36–46): For *each* statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

36 The weight of a typical high school physics student is closest to

(1) 1500 N
(2) 600 N
(3) 120 N
(4) 60 N

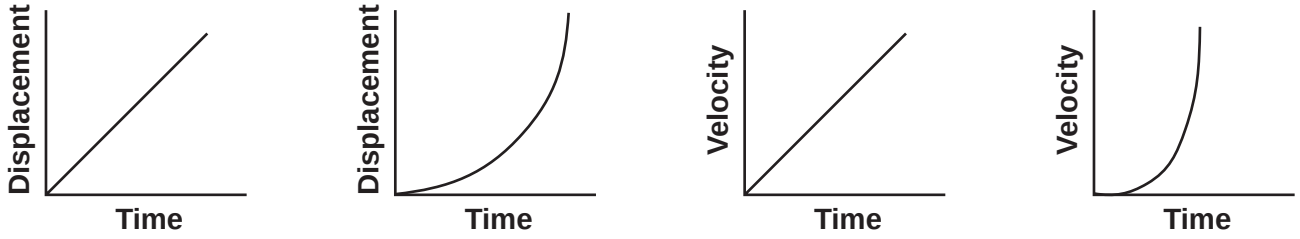
37 The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.



What is the component of the truck's weight parallel to the hill?

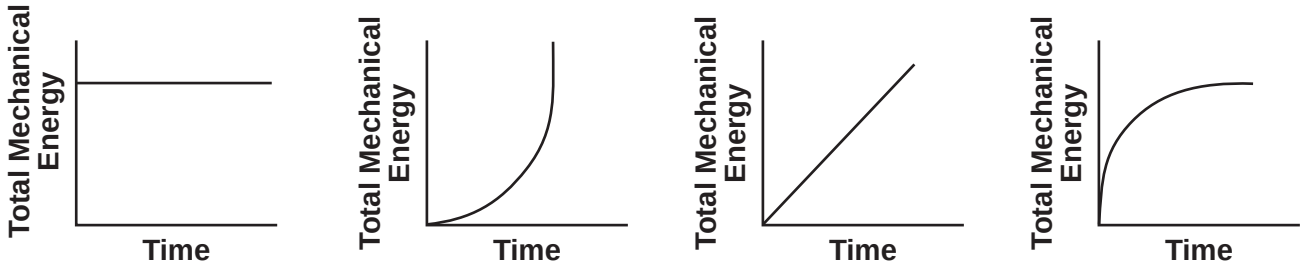
(1) 1.4×10^3 N
(2) 1.0×10^4 N
(3) 1.4×10^4 N
(4) 9.9×10^4 N

38 Which graph best represents the motion of an object in equilibrium?



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

39 A wooden crate is pushed at constant speed across a level wooden floor. Which graph best represents the relationship between the total mechanical energy of the crate and the duration of time the crate is pushed?



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

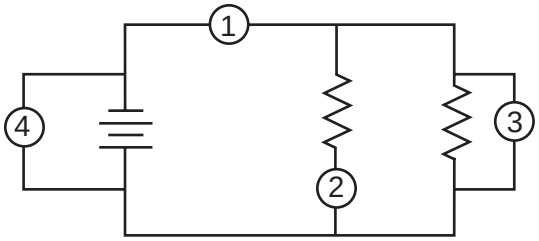
40 A child does 0.20 joule of work to compress the spring in a pop-up toy. If the mass of the toy is 0.010 kilogram, what is the maximum vertical height that the toy can reach after the spring is released?

(1) 20. m
(2) 2.0 m
(3) 0.20 m
(4) 0.020 m

41 A book of mass m falls freely from rest to the floor from the top of a desk of height h. What is the speed of the book upon striking the floor?

(1) $\sqrt{2gh}$
(2) $2gh$
(3) mgh
(4) mh

42 In the electric circuit diagram below, possible locations of an ammeter and a voltmeter are indicated by circles 1, 2, 3, and 4.



Where should an ammeter be located to correctly measure the total current and where should a voltmeter be located to correctly measure the total voltage?

(1) ammeter at 1 and voltmeter at 4
(2) ammeter at 2 and voltmeter at 3
(3) ammeter at 3 and voltmeter at 4
(4) ammeter at 1 and voltmeter at 2

43 What is the current in a 100.-ohm resistor connected to a 0.40-volt source of potential difference?

(1) 250 mA
(2) 40. mA
(3) 2.5 mA
(4) 4.0 mA

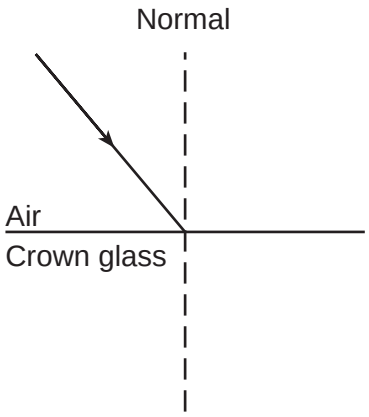
44 A 150-watt lightbulb is brighter than a 60.-watt lightbulb when both are operating at a potential difference of 110 volts. Compared to the resistance of and the current drawn by the 150-watt lightbulb, the 60.-watt lightbulb has

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

45 What is the minimum equipment needed to determine the power dissipated in a resistor of unknown value?

(1) a voltmeter, only
(2) an ammeter, only
(3) a voltmeter and an ammeter, only
(4) a voltmeter, an ammeter, and a stopwatch

46 A ray of light ($f = 5.09 \times 10^{14}$ Hz) traveling in air is incident at an angle of 40.° on an air-crown glass interface as shown below.



What is the angle of refraction for this light ray?

(1) 25°
(2) 37°
(3) 40°
(4) 78°

Part B–2

Answer all questions in this part.

Directions (47–58): Record your answers in the spaces provided in your answer booklet.

47 A person walks 150. meters due east and then walks 30. meters due west. The entire trip takes the person 10. minutes. Determine the magnitude and the direction of the person's total displacement. [2]

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

The instant before a batter hits a 0.14-kilogram baseball, the velocity of the ball is 45 meters per second west. The instant after the batter hits the ball, the ball's velocity is 35 meters per second east. The bat and ball are in contact for 1.0×10^{-2} second.

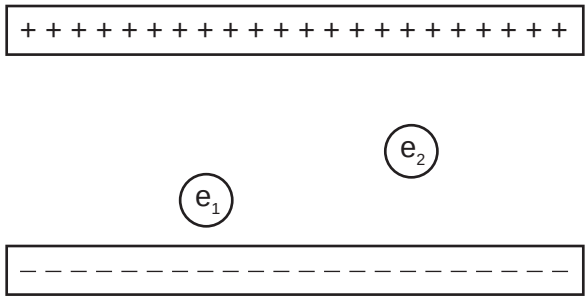
48 Determine the magnitude and direction of the average acceleration of the baseball while it is in contact with the bat. [2]

49 Calculate the magnitude of the average force the bat exerts on the ball while they are in contact. [Show all work, including the equation and substitution with units.] [2]

50 A car travels at constant speed around a section of horizontal, circular track. On the diagram *in your answer booklet,* draw an arrow at point *P* to represent the direction of the centripetal acceleration of the car when it is at point *P.* [1]

51 Calculate the magnitude of the impulse applied to a 0.75-kilogram cart to change its velocity from 0.50 meter per second east to 2.00 meters per second east. [Show all work, including the equation and substitution with units.] [2]

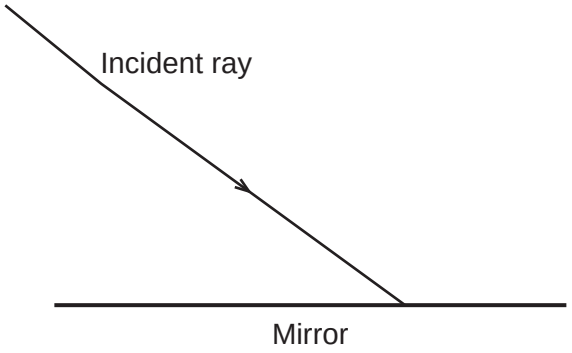
52 The diagram below represents two electrons, e_1 and e_2, located between two oppositely charged parallel plates.



Compare the magnitude of the force exerted by the electric field on e_1 to the magnitude of the force exerted by the electric field on e_2. [1]

53 A length of copper wire and a 1.00-meter-long silver wire have the same cross-sectional area and resistance at 20°C. Calculate the length of the copper wire. [Show all work, including the equation and substitution with units.] [2]

54 The diagram below represents a ray of light incident on a plane mirror.



Using a protractor and straightedge, on the diagram *in your answer booklet,* construct the reflected ray for the incident ray shown. [1]

55 A periodic wave travels at speed v through medium *A*. The wave passes with all its energy into medium *B*. The speed of the wave through medium *B* is $\frac{v}{2}$. On the diagram *in your answer booklet*, draw the wave as it travels through medium *B*. [Show at least one full wave.] [1]

56 A beam of monochromatic light has a wavelength of 5.89×10^{-7} meter in air. Calculate the wavelength of this light in diamond. [Show all work, including the equation and substitution with units.] [2]

57 Calculate the wavelength of a photon having 3.26×10^{-19} joule of energy. [Show all work, including the equation and substitution with units.] [2]

58 A box at the top of a rough incline possesses 981 joules more gravitational potential energy than it does at the bottom. As the box slides to the bottom of the incline, 245 joules of heat is produced. Determine the kinetic energy of the box at the bottom of the incline. [1]

Part C

Answer all questions in this part.

Directions (59–72): Record your answers in the spaces provided in your answer booklet.

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

A 1200-kilogram car moving at 12 meters per second collides with a 2300-kilogram car that is waiting at rest at a traffic light. After the collision, the cars lock together and slide. Eventually, the combined cars are brought to rest by a force of kinetic friction as the rubber tires slide across the dry, level, asphalt road surface.

59 Calculate the speed of the locked-together cars immediately after the collision. [Show all work, including the equation and substitution with units.] [2]

60 Calculate the magnitude of the frictional force that brings the locked-together cars to rest. [Show all work, including the equation and substitution with units.] [2]

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

The centers of two small charged particles are separated by a distance of 1.2×10^{-4} meter. The charges on the particles are $+8.0 \times 10^{-19}$ coulomb and $+4.8 \times 10^{-19}$ coulomb, respectively.

61 Calculate the magnitude of the electrostatic force between these two particles. [Show all work, including the equation and substitution with units.] [2]

62 On the axes *in your answer booklet*, sketch a graph showing the relationship between the magnitude of the electrostatic force between the two charged particles and the distance between the centers of the particles. [1]

63 On the diagram *in your answer booklet*, draw *at least four* electric field lines in the region between the two positively charged particles. [1]

Base your answers to questions 64 through 66 on the information below.

A stationary research ship uses sonar to send a 1.18×10^3-hertz sound wave down through the ocean water. The reflected sound wave from the flat ocean bottom 324 meters below the ship is detected 0.425 second after it was sent from the ship.

64 Calculate the speed of the sound wave in the ocean water. [Show all work, including the equation and substitution with units.] [2]

65 Calculate the wavelength of the sound wave in the ocean water. [Show all work, including the equation and substitution with units.] [2]

66 Determine the period of the sound wave in the ocean water. [1]

Base your answers to questions 67 through 69 on the information below.

A 5.0-ohm resistor, a 10.0-ohm resistor, and a 15.0-ohm resistor are connected in parallel with a battery. The current through the 5.0-ohm resistor is 2.4 amperes.

67 In the space *in your answer booklet,* using the circuit symbols found in the *Reference Tables for Physical Setting/Physics,* draw a diagram of this electric circuit. [1]

68 Calculate the amount of electrical energy expended in the 5.0-ohm resistor in 2.0 minutes. [Show all work, including the equation and substitution with units.] [2]

69 A 20.0-ohm resistor is added to the circuit in parallel with the other resistors. Describe the effect the addition of this resistor has on the amount of electrical energy expended in the 5.0-ohm resistor in 2.0 minutes. [1]

Base your answers to questions 70 through 72 on the passage below.

For years, theoretical physicists have been refining a mathematical method called lattice quantum chromodynamics to enable them to predict the masses of particles consisting of various combinations of quarks and antiquarks. They recently used the theory to calculate the mass of the rare B_c particle, consisting of a charm quark and a bottom antiquark. The predicted mass of the B_c particle was about six times the mass of a proton.

Shortly after the prediction was made, physicists working at the Fermi National Accelerator Laboratory, Fermilab, were able to measure the mass of the B_c particle experimentally and found it to agree with the theoretical prediction to within a few tenths of a percent. In the experiment, the physicists sent beams of protons and antiprotons moving at 99.999% the speed of light in opposite directions around a ring 1.0 kilometer in radius. The protons and antiprotons were kept in their circular paths by powerful electromagnets. When the protons and antiprotons collided, their energy produced numerous new particles, including the elusive B_c.

These results indicate that lattice quantum chromodynamics is a powerful tool not only for confirming the masses of existing particles, but also for predicting the masses of particles that have yet to be discovered in the laboratory.

70 Identify the class of matter to which the B_c particle belongs. [1]

71 Determine both the sign and the magnitude of the charge of the B_c particle in elementary charges. [1]

72 Explain how it is possible for a colliding proton and antiproton to produce a particle with six times the mass of either. [1]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, January 29, 2009 — 1:15 to 4:15 p.m., only

ANSWER SHEET

Student ..... Sex: ☐ Male ☐ Female Grade .....

Teacher ..... School .....

Record your answers to Part A and Part B–1 on this answer sheet.

Part A

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

Part A Score

Part B–1

36	42 .....
37	43 .....
38	44 .....
39	45 .....
40	46 .....
41	

Part B–1 Score

Write your answers to Part B–2 and Part C in your answer booklet.

The declaration below should be signed when you have completed the examination.

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

Signature

Tear Here

PS/PHYSICS

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, January 29, 2009 — 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	11	
B–2	19	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

Final Score (from conversion chart)

Raters' Initials:

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

Part B–2

47 Magnitude: _____ **m**

Direction: _____

48 Magnitude: _____ **m/s^2**

Direction: _____

49

For Raters Only

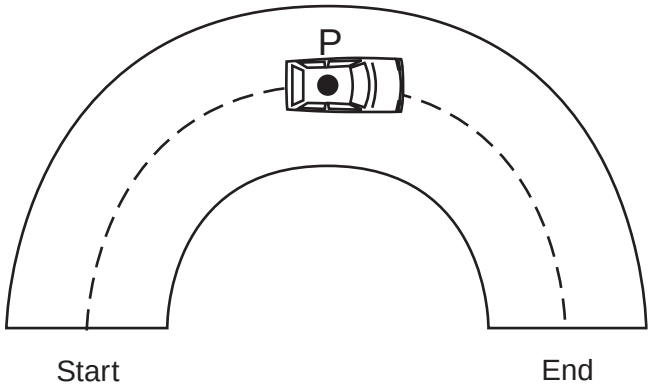
47 ☐

48 ☐

49 ☐

For Raters Only

50



50 ☐

51

51 ☐

52 _____

_____

52 ☐

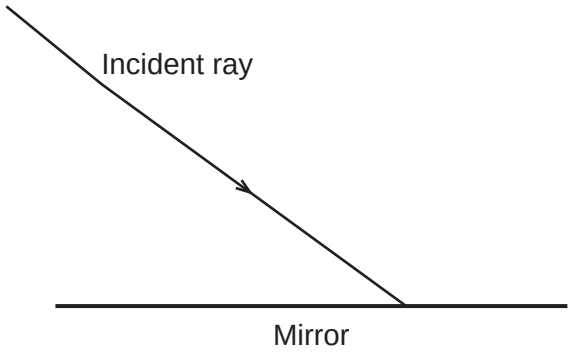
[2]

For Raters Only

53

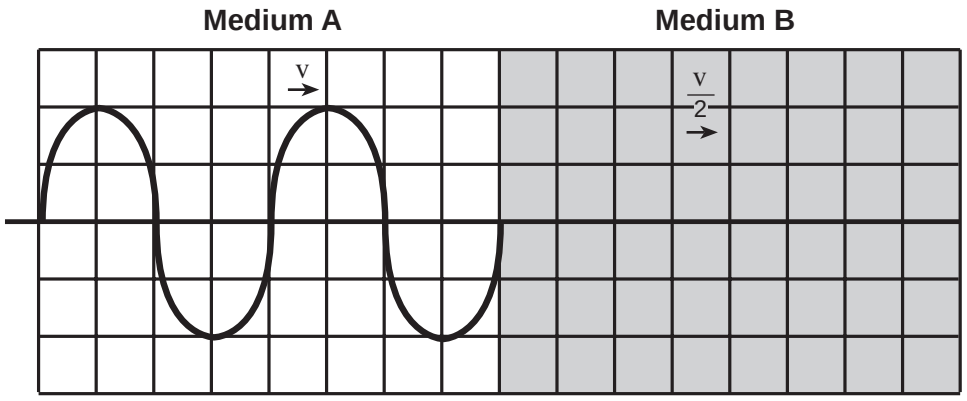
53

54



54

55



55

[3]

For Raters Only

56

56

57

57

58 _____ **J**

58

Total Score for Part B–2

Part C

For Raters Only

59

59

60

60

For Raters Only

61

61

62

62

63

8.0×10^{-19} C +

+ 4.8×10^{-19} C

63

For Raters Only

64

64

65

65

66 _____ **s**

66

For Raters Only

67

67

68

68

69 _____

_____

69

70 _____

70

71 _____ **e**

71

72 _____

_____

72

[8]

Total Score for Part C

FOR TEACHERS ONLY

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

PS–P

PHYSICAL SETTING/PHYSICS

Thursday, January 29, 2009 — 1:15 to 4:15 p.m., only

SCORING KEY AND RATING GUIDE

Directions to the Teacher:

Refer to the directions on page 2 before rating student papers. Updated information regarding the rating of this examination may be posted on the New York State Education Department's web site during the rating period. Check this web site http://www.emsc.nysed.gov/osa/ and select the link "Examination Scoring Information" for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents examination period.

Part A and Part B–1

Allow 1 credit for each correct response.

Part A

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

Part B–1

36 . . . . . **2**	42 . . . . . **1**
37 . . . . . **3**	43 . . . . . **4**
38 . . . . . **1**	44 . . . . . **4**
39 . . . . . **1**	45 . . . . . **3**
40 . . . . . **2**	46 . . . . . **1**
41 . . . . . **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 for Scoring Regents Examinations in the Sciences.*

Use only *red* ink or *red* pencil in rating Regents papers. Do not attempt to *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 check mark 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.

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.

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 score on the written test should be converted to a scaled score by using the conversion chart that will be posted on the Department's web site: http://www.emsc.nysed.gov/osa/ on Thursday, January 29, 2009. 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 for that administration be used to determine the student's final score.

Please refer to the Department publication *Regents Examination in Physical Setting/Physics: Rating Guide for Parts B–2 and C*. This publication can be found on the New York State Education Department web site http://www.emsc.nysed.gov/osa/scire/scirearch/phyratg02.pdf. 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

47 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for a magnitude of 120. m.
- Allow 1 credit for a direction of east.

48 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for a magnitude of 8.0×10^3 m/s^2.
- Allow 1 credit for a direction of east.

49 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 2-credit responses:

$$a = \frac{F_{net}}{m}$$
$$F_{net} = ma$$
$$F_{net} = (0.14 \text{ kg})(8.0 \times 10^3 \text{ m/s}^2)$$
$$F_{net} = 1.1 \times 10^3 \text{ N}$$

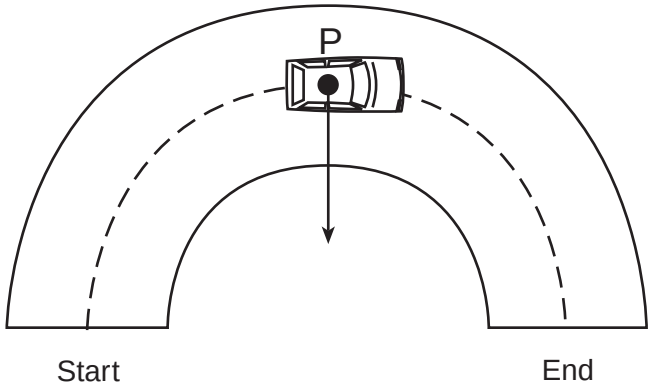
or

$$J = F_{net}\,t = \Delta p$$
$$F_{net} = \frac{m\Delta v}{t}$$
$$F_{net} = \frac{(0.14 \text{ kg})(80 \text{ m/s})}{1.0 \times 10^{-2} \text{s}}$$
$$F_{net} = 1.1 \times 10^3 \text{ N}$$

Note: Allow credit for an answer that is consistent with the student's response to question 48.

50 [1] Allow 1 credit for an arrow at *P* directed toward the center of curvature.

Example of a 1-credit response:



51 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

$J = \Delta p = m\Delta v$
$J = (0.75 \text{ kg})(1.50 \text{ m/s})$
$J = 1.1 \text{ N} \bullet \text{s}$

52 [1] Allow 1 credit for indicating that the magnitude of the force on each electron is the same.

53 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

$$R = \left(\frac{\rho L}{A}\right)_{copper} = \left(\frac{\rho L}{A}\right)_{silver}$$

$$R = \frac{\rho_{copper}\ L_{copper}}{A} = \frac{\rho_{silver}\ L_{silver}}{A}$$

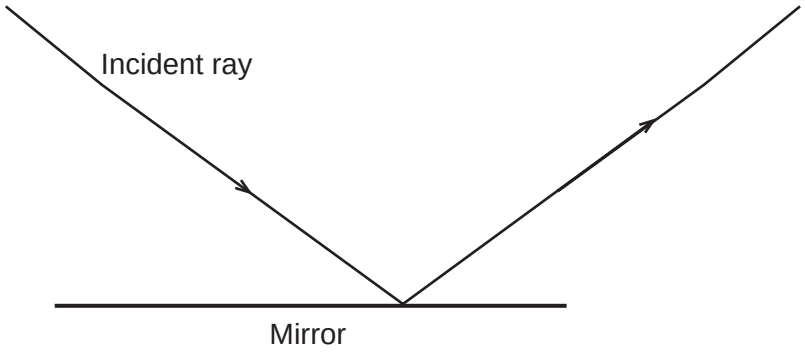
$$L_{copper} = \frac{\rho_{silver}\ L_{silver}}{\rho_{copper}}$$

$$L_{copper} = \frac{\left((1.59 \times 10^{-8}\ \Omega \bullet \text{m})(1.00 \text{ m})\right)}{1.72 \times 10^{-8}\ \Omega \bullet \text{m}}$$

$$L_{copper} = 0.924 \text{ m}$$

54 [1] Allow 1 credit for a reflected ray at $36° \pm 2°$ to the mirror.

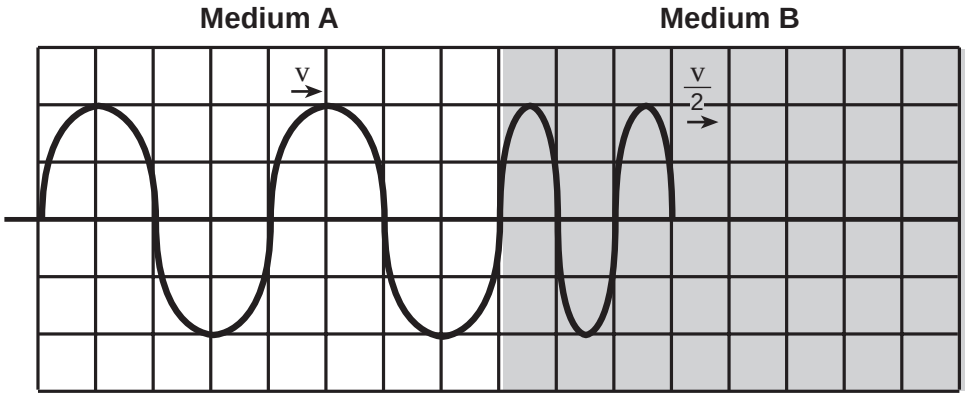
Example of a 1-credit response:



Note: Allow credit even if the reflected ray does *not* have an arrowhead. No normal needs to be drawn.

55 [1] Allow 1 credit for *at least one* full wave with a wavelength one-half as great. If the wavelength is *not* constant, do *not* allow credit.

Example of a 1-credit response:



Note: Allow this credit even if the amplitude is *not* the same as the original wave.

56 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

$$\frac{n_2}{n_1} = \frac{\lambda_1}{\lambda_2}$$
$$\lambda_2 = \frac{n_1\,\lambda_1}{n_2}$$
$$\lambda_2 = \frac{(1.00)(5.89 \times 10^{-7}\ \text{m})}{2.42}$$
$$\lambda_2 = 2.43 \times 10^{-7}\ \text{m}$$

57 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

$$E_{photon} = \frac{hc}{\lambda}$$
$$\lambda = \frac{hc}{E_{photon}}$$
$$\lambda = \frac{(6.63 \times 10^{-34}\ \text{J•s})(3.00 \times 10^{8}\ \text{m/s})}{3.26 \times 10^{-19}\ \text{J}}$$
$$\lambda = 6.10 \times 10^{-7}\ \text{m}$$

58 [1] Allow 1 credit for 736 J.

Part C

59 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 2-credit responses:

$p_{before} = p_{after}$

$(m_1 v_1 + m_2 v_2)_{before} = (m_1 + m_2) v_{after}$

$v_{after} = \dfrac{(m_1 v_1 + m_2 v_2)_{before}}{(m_1 + m_2)}$

$v_{after} = \dfrac{(1200\ \text{kg})(12\ \text{m/s}) + (2300\ \text{kg})(0\ \text{m/s})}{1200\ \text{kg} + 2300\ \text{kg}}$

$v_{after} = 4.1\ \text{m/s}$

or

$p_{before} = p_{after}$

$(1200\ \text{kg})(12\ \text{m/s}) = (3500\ \text{kg}) v$

$v = 4.1\ \text{m/s}$

60 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

$F_f = \mu F_N \quad F_N = mg$

$F_f = \mu mg$

$F_f = (0.67)(1200\ \text{kg} + 2300\ \text{kg})(9.81\ \text{m/s}^2)$

$F_f = 2.3 \times 10^4\ \text{N}$

61 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

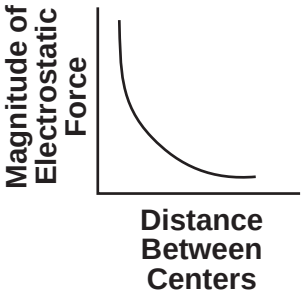
$F = \dfrac{k q_1 q_2}{r^2}$

$F = \dfrac{(8.99 \times 10^9\ \text{N} \bullet \text{m}^2/\text{C}^2)(8.0 \times 10^{-19}\ \text{C})(4.8 \times 10^{-19}\ \text{C})}{(1.2 \times 10^{-4}\ \text{m})^2}$

$F = 2.4 \times 10^{-19}\ \text{N}$

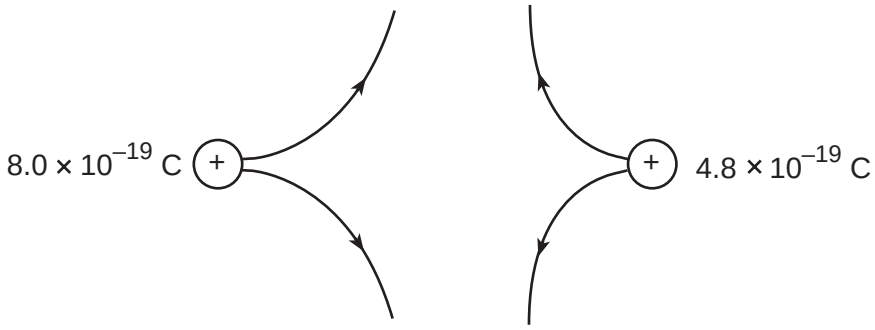
62 [1] Allow 1 credit for a graph showing an inverse square relationship.

Example of a 1-credit response:



63 [1] Allow 1 credit.

Example of a 1-credit response:



Note: Allow credit even if the lines are drawn symmetrically.

64 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

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

$$\bar{v} = \frac{2(324\,\text{m})}{0.425\,\text{s}}$$

$$\bar{v} = 1520\ \text{m/s}$$

65 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 2-credit response:

$v = f\lambda$

$\lambda = \dfrac{v}{f}$

$\lambda = \dfrac{1520 \text{ m/s}}{1.18 \times 10^{3} \text{ Hz}}$

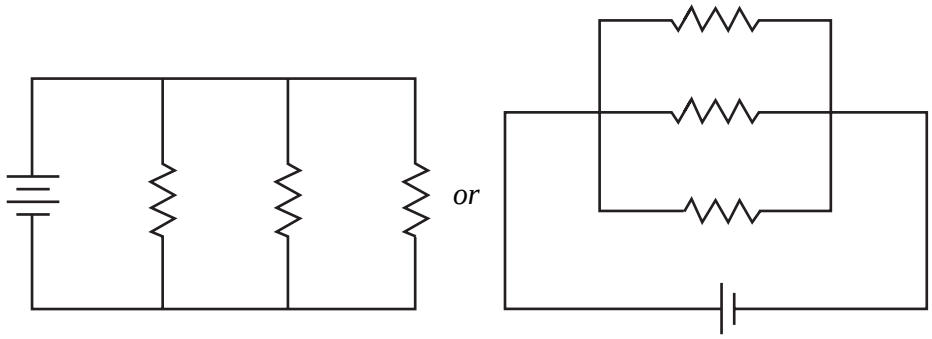
$\lambda = 1.29 \text{ m}$

Note: Allow credit for an answer that is consistent with the student's response to question 64.

66 [1] Allow 1 credit for 8.47×10^{-4} s.

67 [1] Allow 1 credit.

Examples of 1-credit responses:



Note: Allow credit even if the student uses the symbol for a cell in place of the symbol for a battery.

68 [2] Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 2-credit responses:

$W = I^2Rt$

$W = (2.4\,\text{A})^2\,(5.0\ \Omega)\,(120\,\text{s})$

$W = 3.5 \times 10^{3}$ J

or

$W = VIt$

$W = (12\,\text{V})(2.4\,\text{A})(120\,\text{s})$

$W = 3500$ J

69 [1] Allow 1 credit for indicating that the energy expended in the 5.0-ohm resistor remains the same.

Note: Allow credit for an answer that is consistent with the student's circuit diagram in question 67.

70 [1] Allow 1 credit for meson *or* hadron.

71 [1] Allow 1 credit for +1e *or* 1e.

72 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The particles have enough (kinetic) energy to be converted to that much mass.
— Energy is converted to mass.

Regents Examination in Physical Setting/Physics

January 2009

Chart for Converting Total Test Raw Scores to Final Examination Scores (Scaled Scores)

The *Chart for Determining the Final Examination Score for the January 2009 Regents Examination in Physical Setting/Physics* will be posted on the Department's web site http://www.emsc.nysed.gov/osa/ on Thursday, January 29, 2009. Conversion charts provided for previous administrations of the Regents Examination in Physical Setting/Physics must NOT be used to determine students' final scores for this administration.

Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:

1. Go to www.emsc.nysed.gov/osa/exameval.
2. Select the test title.
3. Complete the required demographic fields.
4. Complete each evaluation question and provide comments in the space provided.
5. Click the SUBMIT button at the bottom of the page to submit the completed form.

Map to Core Curriculum

January 2009 Physical Setting/Physics			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1	2,3,5,9,12,13,15	41,43,44,45,46,48,49, 51,53,56,57	59,60,61,64,65, 66,68
Math Key Idea 2		38,39	
Math Key Idea 3			
Sci. Inq. Key Idea 1		55	
Sci. Inq. Key Idea 2			
Sci. Inq. Key Idea 3		52	62
Eng. Des. Key Idea 1			
Standard 2			
Key Idea 1			70
Key Idea 2			
Standard 6			
Key Idea 1			
Key Idea 2		50	63
Key Idea 3		36	71,72
Key Idea 4			
Key Idea 5			
Key Idea 6			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
4.1		40,41,42,44,53,58	67,68,69
4.3		54	
5.1	8	37,47	
5.3			
Standard 4			
4.1	9,10,11,12,13,14,15,17,18,20,21	39,40,41,42,43,44,45, 53,58	67,68,69
4.3	22,23,24,25,26,27,28,29,30,31,32	46,54,55,56	65,66
5.1	1,2,3,4,5,6,7,8,16,19	36,37,38,47,48,49,50, 51,52	59,60,61,62,63, 64
5.3	33,34,35	57	70,71,72

University of the State of New York
State Education Department

Regents Examination in Physical Setting / Physics
January 2009

Chart for Converting Total Test Raw Scores to Final Examination Scores (Scale Scores)

Raw Score	Scale Score	Raw Score	Scale Score	Raw Score	Scale Score	Raw Score	Scale Score
85	100	63	81	41	60	19	32
84	99	62	80	40	59	18	31
83	98	61	79	39	58	17	30
82	97	60	79	38	57	16	28
81	97	59	78	37	56	15	27
80	96	58	77	36	55	14	25
79	95	57	76	35	53	13	23
78	94	56	75	34	52	12	22
77	93	55	74	33	51	11	20
76	92	54	73	32	50	10	19
75	91	53	72	31	48	9	17
74	91	52	71	30	47	8	15
73	90	51	70	29	46	7	14
72	89	50	69	28	45	6	12
71	88	49	68	27	43	5	10
70	87	48	67	26	42	4	8
69	86	47	66	25	41	3	6
68	86	46	65	24	39	2	4
67	85	45	64	23	38	1	2
66	84	44	63	22	37	0	0
65	83	43	62	21	35		
64	82	42	61	20	34		

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 scale score that corresponds to that raw score. The scale 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 scale 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 scale 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 for that 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.