The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 23, 2022 — 9:15 a.m. to 12:15 p.m., only

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

Answer all questions in all parts of this examination according to the directions provided in the examination booklet.

A separate answer sheet for Part A and Part B–1 has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers to the Part A and Part B–1 multiple-choice questions on this separate answer sheet. Record your answers for the questions in Part B–2 and Part C in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All answers in your answer booklet 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 your separate answer sheet or in your answer booklet as directed.

When you have completed the examination, you must sign the statement printed on 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.

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, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics.* Record your answers on your separate answer sheet.

1 Which terms identify two scalar quantities?

(1) force and acceleration
(2) impulse and distance
(3) mass and velocity
(4) energy and time

2 A motorcyclist, initially traveling east at 15 meters per second, accelerates uniformly at a rate of 3.0 meters per second squared east to a velocity of 21 meters per second east. How far does the motorcyclist travel while accelerating?

(1) 1.0 m
(2) 2.0 m
(3) 36 m
(4) 72 m

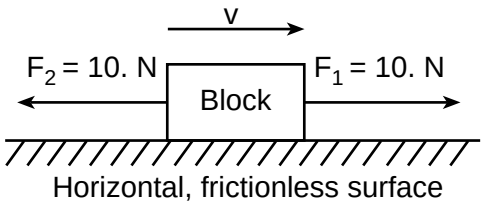
3 A battery-powered electric motor is used to cause the wheels of a toy car to rotate. In this motor, there is a conversion of

(1) mechanical energy to electric energy
(2) electric energy to chemical energy
(3) thermal energy to electric energy
(4) electric energy to mechanical energy

4 A projectile is launched horizontally from a height of 65 meters with an initial horizontal speed of 35 meters per second. What is the projectile's horizontal speed after it has fallen 25 meters? [Neglect friction.]

(1) 22 m/s
(2) 35 m/s
(3) 41 m/s
(4) 280 m/s

5 The diagram below represents two forces, F_1 and F_2, acting concurrently on a block sliding on a horizontal, frictionless surface.



Which statement describes the motion of the block?

(1) The block is accelerating to the right.
(2) The block is accelerating to the left.
(3) The block is moving to the right with constant speed.
(4) The block is moving to the left with decreasing speed.

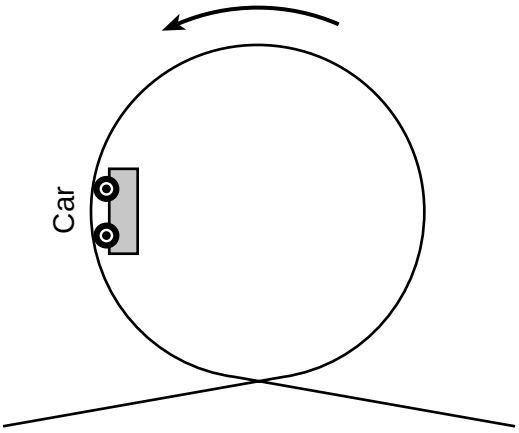
6 The magnitude of an unbalanced force applied to a 4.0-kilogram crate is 10. newtons. If the magnitude of this applied unbalanced force is doubled, the inertia of the crate is

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

7 A 60.-kilogram man is pushing a 30.-kilogram lawn mower. Compared to the magnitude of the force exerted on the lawn mower by the man, the magnitude of the force exerted on the man by the lawn mower is

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

8 The diagram below represents a roller coaster car traveling counterclockwise in a vertical circle.



When the car is in the position shown, what are the directions of the centripetal force acting on the car and the velocity of the car?

(1) The centripetal force is directed to the right and the velocity is directed downward.
(2) The centripetal force is directed downward and the velocity is directed to the right.
(3) The centripetal force and velocity are both directed to the right.
(4) The centripetal force and velocity are both directed downward.

9 An electric motor with a power rating of 6.48×10^4 watts is used to raise an elevator weighing 2.80×10^4 newtons at constant speed. What is the total time required for the motor to raise the elevator a vertical distance of 20.0 meters?

(1) 0.116 s
(2) 2.31 s
(3) 8.64 s
(4) 46.3 s

10 A person standing on a sidewalk hears the siren of an ambulance as it approaches, passes by, and goes away from the person. Compared to the frequency of the sound emitted by the siren, the frequency of the sound observed by the person during this event is

(1) higher, only
(2) lower, only
(3) first higher and then lower
(4) first lower and then higher

11 Which particles exhibit properties of waves in some experiments?

(1) photons, only
(2) electrons, only
(3) both photons and electrons
(4) neither photons nor electrons

12 The direction of the electric field at a point in space is defined as the direction of the force exerted by the field on a

(1) test mass located at that point
(2) magnetic north pole located at that point
(3) negative test charge located at that point
(4) positive test charge located at that point

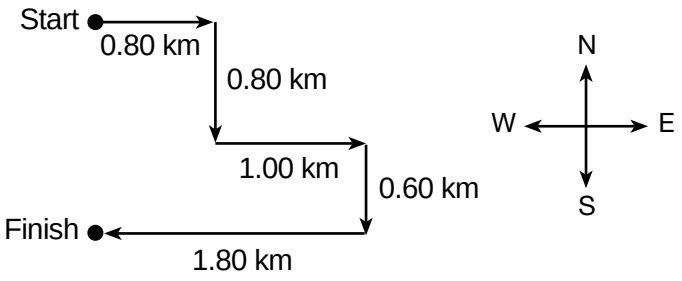
13 A net force of one newton will

(1) accelerate a 1-kg mass at 1.0 m/s^2
(2) accelerate a 1-kg mass at 9.8 m/s^2
(3) lift a l-kg mass vertically at a constant speed of 1.0 m/s
(4) lift a 1-kg mass vertically at a constant speed of 9.8 m/s

14 The elongation of a spring will be quadrupled if the magnitude of the force elongating the spring is

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

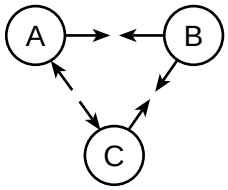
15 The vector diagram below represents the path and distances run by a student in a cross-country race.



The displacement of the student from start to finish is

(1) 1.40 km north
(2) 1.40 km south
(3) 5.00 km north
(4) 5.00 km south

16 The diagram below shows the arrangement of three charged hollow metal spheres, *A*, *B*, and *C*. The arrows indicate the direction of the electric forces acting between the spheres.



What spheres have static charges of the same sign?

(1) *A* and *B*, only
(2) *A* and *C*, only
(3) *B* and *C*, only
(4) *A*, *B*, and *C*

17 Two small charged spheres are located distance *d* from each other and experience an electrostatic force of attraction, F_e. If the magnitude of charge of each sphere is tripled and F_e is unchanged, what other change must have occurred?

(1) The signs of both charges are changed.
(2) The sign of only one charge is changed.
(3) Distance *d* was increased by a factor of three.
(4) Distance *d* was increased by a factor of nine.

18 Compared to the resistance of an aluminum wire at 20°C, the resistance of a tungsten wire of the same length and diameter at 20°C is approximately

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

19 How much energy is expended when a current of 5.00 amperes is in a 5.00 ohm resistor for 5.00 seconds?

(1) 25.0 J
(2) 125 J
(3) 625 J
(4) 3130 J

20 The amount of electric current through an unknown resistor may be measured by connecting

(1) an ammeter in series with the resistor
(2) an ammeter in parallel with the resistor
(3) a voltmeter in series with the resistor
(4) a voltmeter in parallel with the resistor

21 Which phenomenon represents a wave spreading out behind a barrier as the wave passes by the edge of the barrier?

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

22 A 1.00 kilometer length of copper wire, *A*, with a cross-sectional area of 1.00×10^{-4} meter squared has a resistance of 0.172 ohm at 20°C. Another copper wire, *B*, is half as long and has twice the cross-sectional area of wire *A*. What is the resistance of copper wire *B* at 20°C?

(1) 0.0430 Ω
(2) 0.0860 Ω
(3) 0.172 Ω
(4) 0.344 Ω

23 The magnitude of electric force exerted on a small positive charge located between two oppositely charged parallel plates is

(1) smallest near the positive plate
(2) smallest near the negative plate
(3) greatest midway between the plates
(4) the same everywhere between the plates

24 An acoustic organ is a musical instrument with pipes. The oscillation of air molecules in the pipes of the organ produces sound waves that are

(1) electromagnetic and longitudinal
(2) electromagnetic and transverse
(3) mechanical and longitudinal
(4) mechanical and transverse

25 Which list identifies portions of the electromagnetic spectrum in order of increasing frequency?

(1) gamma ray, infrared, visible, ultraviolet
(2) ultraviolet, visible, infrared, gamma ray
(3) infrared, visible, ultraviolet, gamma ray
(4) gamma ray, ultraviolet, visible, infrared

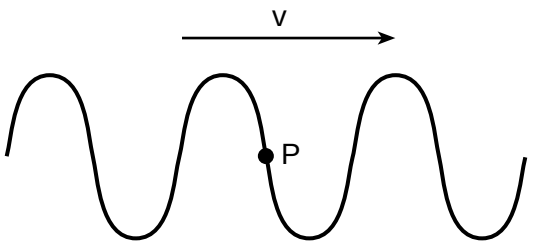
26 A tuning fork is used to produce a sound wave having a frequency of 512 hertz. What is the wavelength of the sound wave in air at STP?

(1) 0.646 m
(2) 1.55 m
(3) 3.31×10^2 m
(4) 5.86×10^5 m

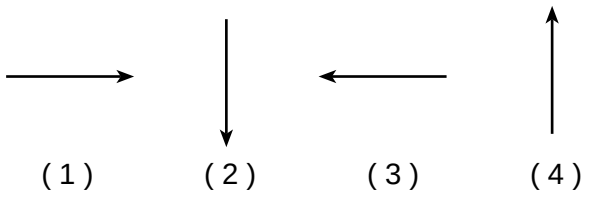
27 An amplified sound wave produced by an opera singer shatters a glass. Which phenomenon best explains this event?

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

28 The diagram below represents a wave traveling in a rope in the direction indicated.



Which arrow represents the motion of a particle at point *P* at the instant shown?



29 If several resistors are connected in series in an electrical circuit, the potential difference across each resistor

(1) varies directly with the resistance of each resistor
(2) varies inversely with the resistance of each resistor
(3) varies inversely with the square of the resistance of each resistor
(4) is independent of the resistance of each resistor

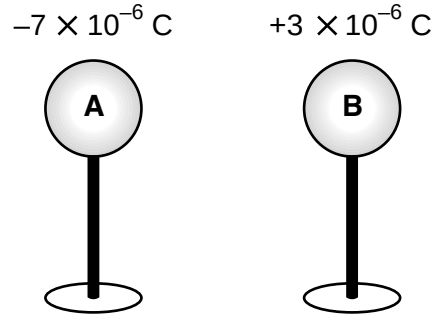
30 In medium *X*, light with a wavelength of 3.44×10^{-7} meter travels at 2.20×10^{8} meters per second. In medium *Y*, this light has a wavelength of 3.12×10^{-7} meter. What is the speed of this light in medium *Y*?

(1) 2.00×10^{8} m/s
(2) 2.20×10^{8} m/s
(3) 2.43×10^{8} m/s
(4) 3.00×10^{8} m/s

31 A nuclear reactor produces 2.7×10^{16} joules of energy per year. How much mass is converted to energy by the reactor in one year?

(1) 0.30 kg
(2) 0.90 kg
(3) 9.0×10^{7} kg
(4) 2.4×10^{33} kg

32 The diagram below shows the initial charge and position of two identical conducting spheres on insulating stands.



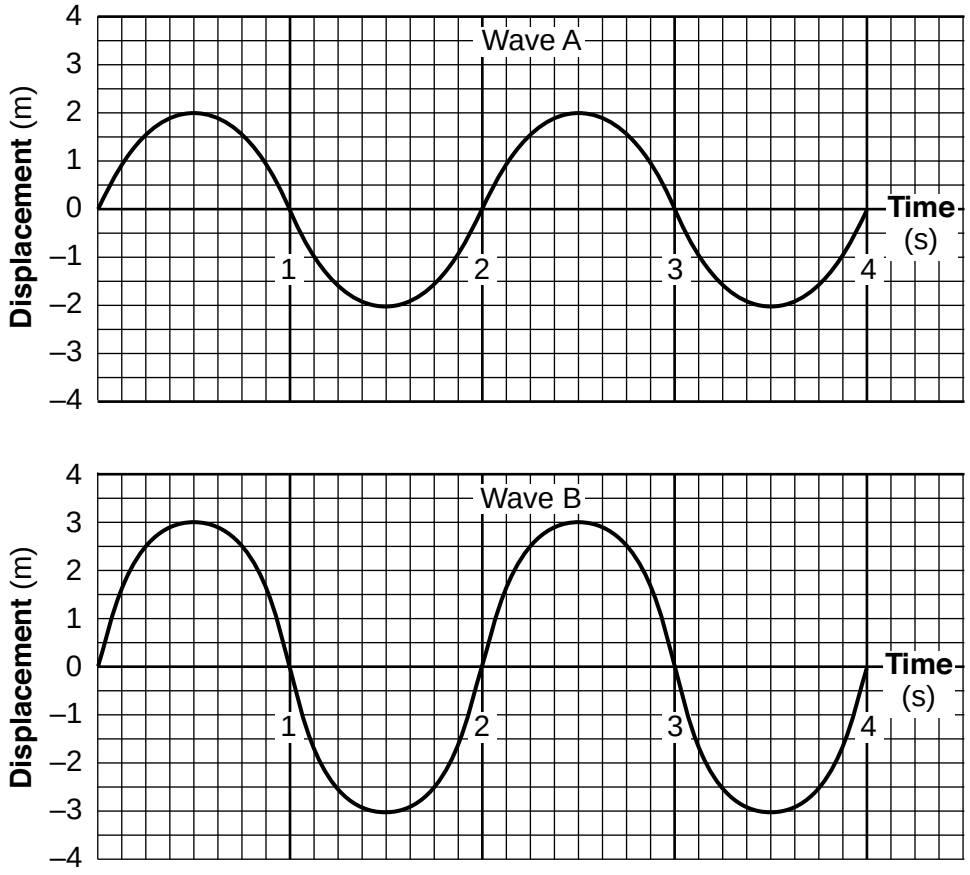
If the spheres are brought into contact with each other and separated, sphere *B* will have a net charge of

(1) -5×10^{-6} C
(2) -2×10^{-6} C
(3) $+5 \times 10^{-6}$ C
(4) -4×10^{-6} C

33 An antimuon neutrino is a

(1) lepton with a –le charge
(2) lepton with 0 charge
(3) meson with a –le charge
(4) meson with 0 charge

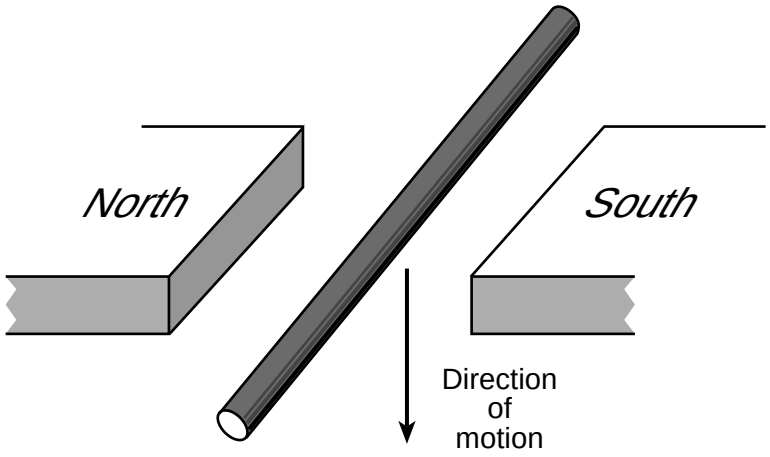
34 The graphs below show the displacement of a certain particle in a medium versus time due to two periodic waves, *A* and *B*, traveling through the medium.



The superposition of the two waves will cause the particle of the medium to have a maximum displacement of

(1) 1.0 m
(2) 2.0 m
(3) 2.5 m
(4) 5.0 m

35 The diagram below represents a wire that is *not* part of a complete circuit, just above the poles of two magnets.



Moving the wire downward between the poles in the direction shown in the diagram will

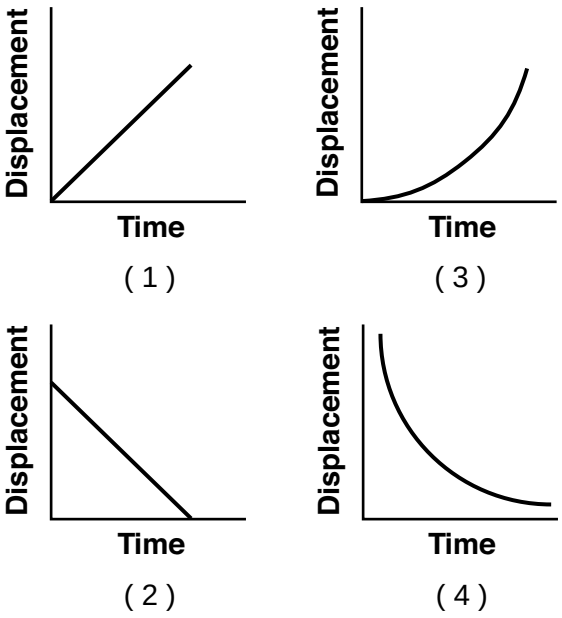
(1) induce an alternating magnetic field between the poles of the magnets
(2) induce a potential difference between the ends of the wire
(3) decrease the wire's resistivity
(4) reverse the direction of the magnetic field

Part B–1

Answer all questions in this part.

Directions (36–50): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*. Record your answers on your separate answer sheet.

36 Which graph best represents the motion of an object traveling at a constant positive velocity?



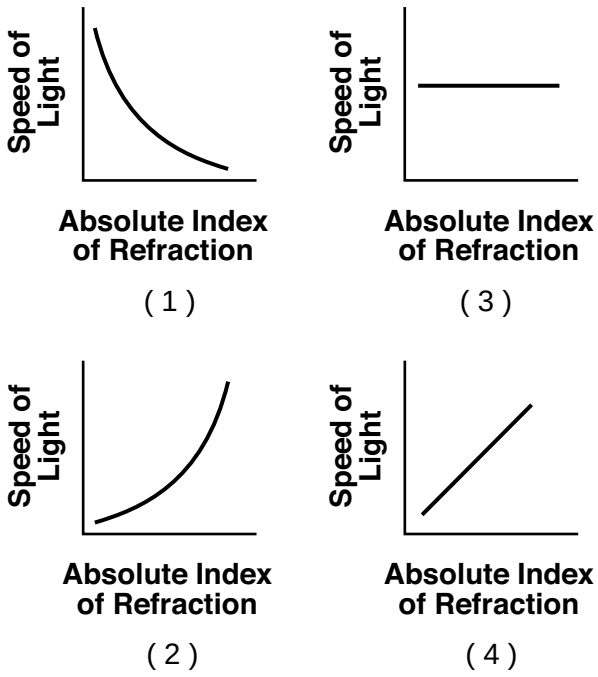
37 A cannonball is fired with an initial velocity of 100. meters per second at an angle of 15.0° above the horizontal. What are the horizontal (v_x) and vertical (v_y) components of this velocity?

(1) v_x = 96.6 m/s, v_y = 25.9 m/s
(2) v_x = 25.9 m/s, v_y = 96.6 m/s
(3) v_x = 76.0 m/s, v_y = 65.0 m/s
(4) v_x = 65.0 m/s, v_y = 76.0 m/s

38 A 1200-kilogram car is moving at 10. meters per second when a braking force of 3000. newtons is applied. How much time is required to bring the car to rest?

(1) 0.40 s
(2) 2.5 s
(3) 25 s
(4) 4.0 s

39 Which graph best represents the relationship between the speed of light ($f = 5.09 \times 10^{14}$ Hz) in a transparent medium and the absolute index of refraction of the medium?



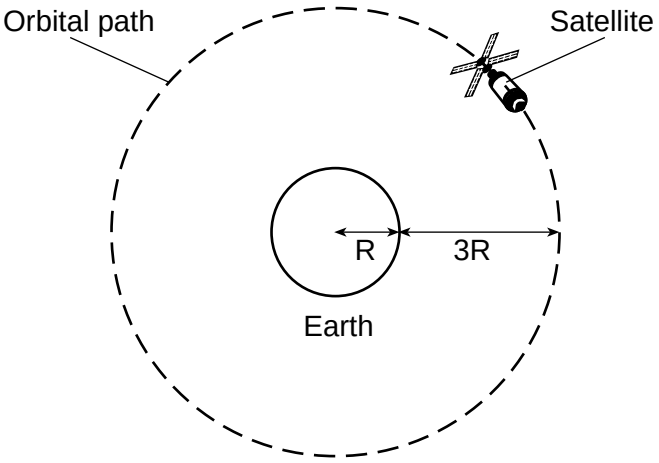
40 A student uses a string to whirl a 0.25-kilogram mass in a horizontal circular path that has a 0.80-meter radius. If the magnitude of the centripetal force exerted on the mass with the string is 25 newtons, the speed of the mass is

(1) 2.8 m/s
(2) 8.9 m/s
(3) 11 m/s
(4) 80. m/s

41 A deuteron is formed by combining a proton and a neutron. The mass of a deuteron is 2.39×10^{-3} universal mass unit less than the combined masses of a proton and a neutron. This mass difference is equivalent to

(1) 2.56×10^{-6} MeV
(2) 2.23 MeV
(3) 2.39 MeV
(4) 2.15×10^{14} MeV

42 A gravitational force of magnitude F exists between Earth and a satellite on Earth's surface. The satellite is sent into orbit at a distance of three Earth radii above Earth's surface, as shown in the diagram below.



What is the magnitude of the gravitational force between Earth and the satellite when the satellite is in orbit?

(1) $\frac{1}{16}F$
(2) $\frac{1}{9}F$
(3) $3F$
(4) $4F$

43 As part of an investigation on quantization, a student measured and recorded the mass of five identical containers, each holding a different number of pennies. The table shows the student's data.

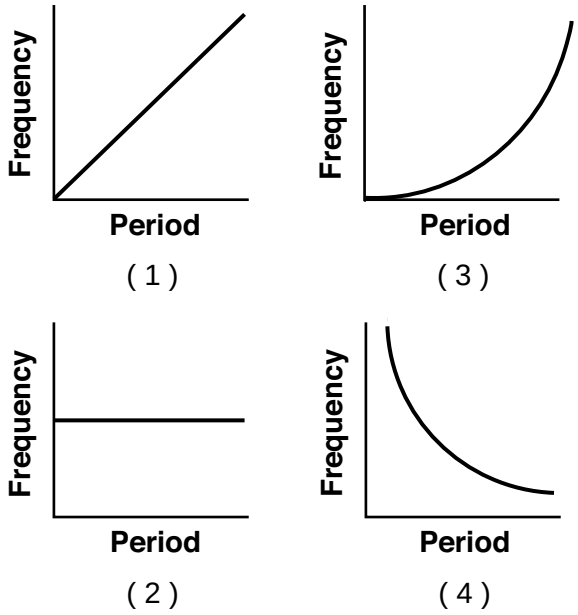
Data Table

Container	Mass (g)
1	35.2
2	64.0
3	48.0
4	38.4
5	41.6

Based on the data, what is the most likely mass of one penny?

(1) 3.2 g
(2) 6.4 g
(3) 9.6 g
(4) 12.8 g

44 Which graph represents the relationship between the frequency and period of a wave?



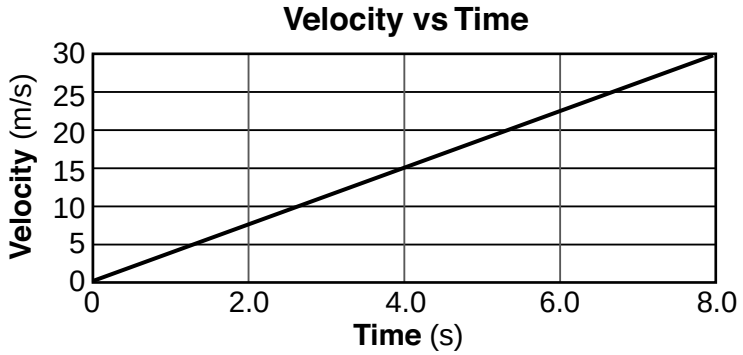
45 What is the current in a conductor if 3.15×10^{18} electrons pass a given point in the conductor in 10. seconds?

(1) 0.050 A
(2) 2.0 A
(3) 0.50 A
(4) 0.20 A

46 A particle with a charge of +3.0 nanocoulombs is placed in an electric field with a magnitude of 1500 newtons per coulomb. What is the magnitude of the electrostatic force exerted on the particle by the electric field?

(1) 4.5×10^{-6} N
(2) 5.0×10^{2} N
(3) 4.5×10^{11} N
(4) 5.0×10^{12} N

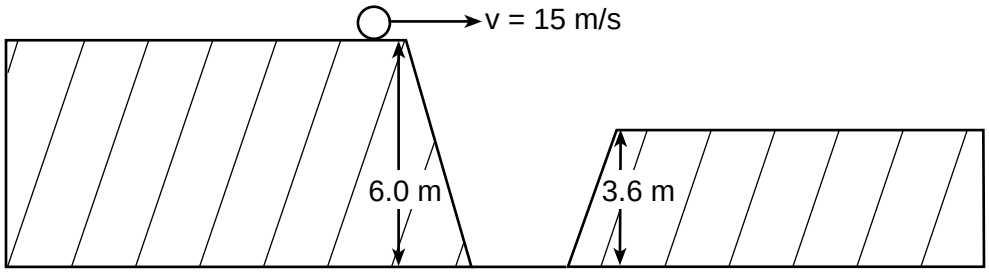
47 The graph below represents the motion of an airplane that starts from rest and takes off from a straight runway.



Which quantity is represented by the slope of the graph?

(1) total distance traveled
(2) displacement
(3) average speed
(4) acceleration

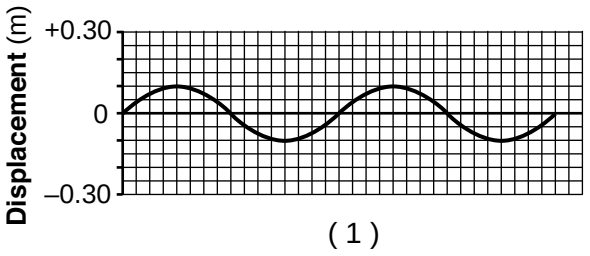
48 The diagram below represents two horizontal platforms that are at different heights above level ground. A ball rolls off the taller platform with a horizontal speed of 15 meters per second and travels through the air, landing on the top of the shorter platform.



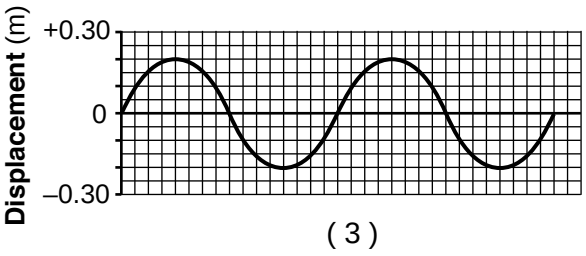
What is the total time the ball is in the air? [Neglect friction.]

(1) 0.16 s
(2) 0.49 s
(3) 0.70 s
(4) 1.1 s

49 Four mechanical waves are created in the same medium over the same time interval. Which diagram represents the wave that transfers the greatest amount of energy?



(1)



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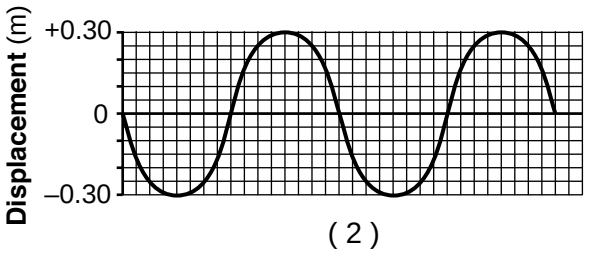

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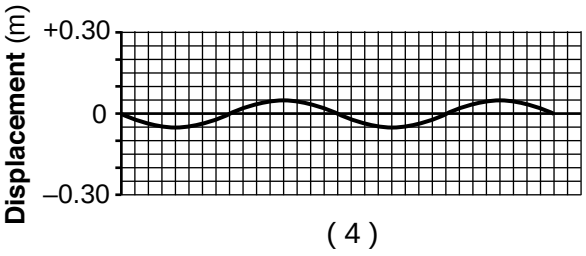
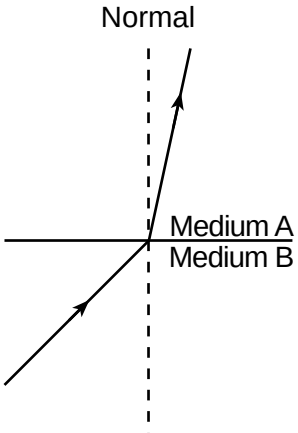
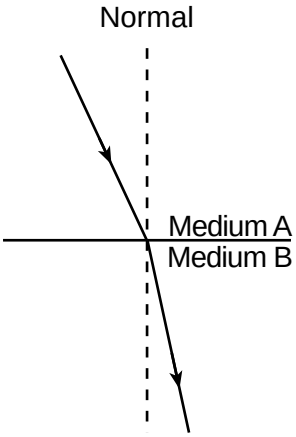


(4)

50 Which diagram represents a light ray increasing in speed as it travels from one medium to another?



(1)



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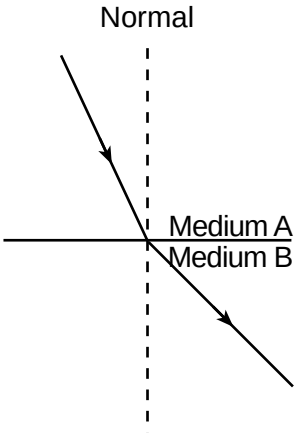
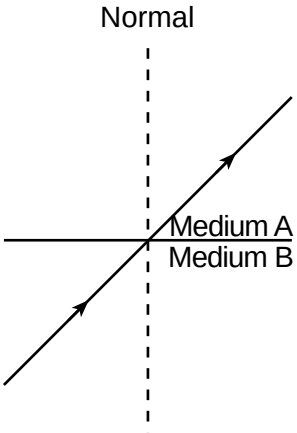


(3)



(4)

Part B–2

Answer all questions in this part.

Directions (51–65): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*.

51–52 To charge a cell-phone battery, 3.69×10^3 coulombs of charge is moved through a potential difference of 3.70 volts. Calculate the maximum amount of electrical energy gained by the battery. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 53 through 55 on the information below and on your knowledge of physics.

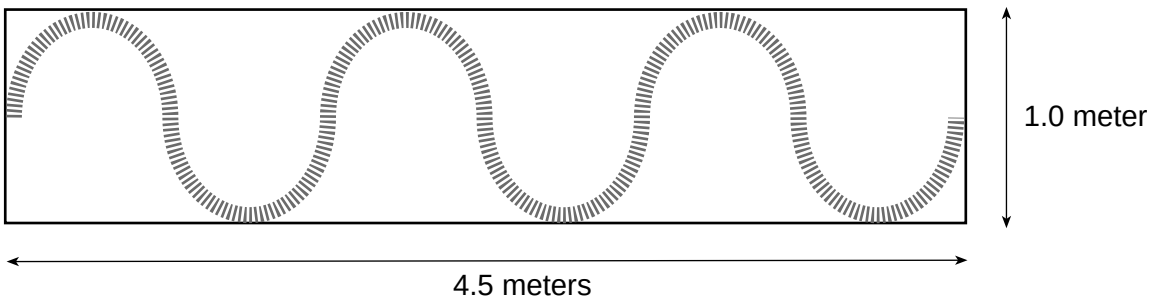
A 55-kilogram ice skater slides across a level ice surface and the force of friction acting on the skates has a magnitude of 11 newtons.

53 Determine the magnitude of the weight of the ice skater. [1]

54–55 Calculate the coefficient of kinetic friction between the ice skater and the ice. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 56 and 57 on the information and diagram below and on your knowledge of physics.

A student produces a wave in a flexible spring stretched along a tabletop by shaking one end of the spring at a frequency of 2.0 hertz.

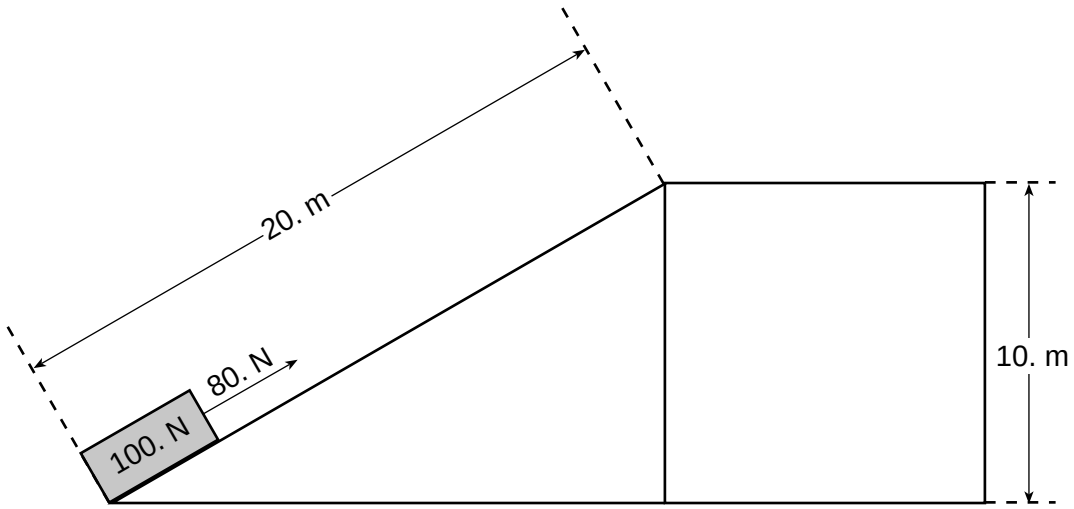


56 Determine the amplitude of the wave produced in the spring. [1]

57 Determine the wavelength of the wave produced in the spring. [1]

Base your answers to questions 58 through 60 on the information and diagram below and on your knowledge of physics.

A 100.-newton box is pulled up a 20.-meter-long incline by a constant force of 80. newtons. The vertical height gained by the box is 10. meters.



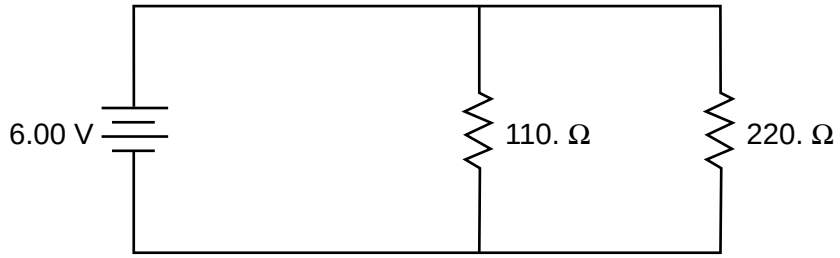
58 Determine the total work done, in joules, by the 80.-newton force in pulling the box to the top of the incline. [1]

59 Determine the total amount of gravitational potential energy, in joules, gained by the box as it is pulled to the top of the incline. [1]

60 Explain why there is a difference between the total work done by the 80.-newton force in pulling the box to the top of the incline and the amount of gravitational potential energy gained by the box as it was pulled to the top of the incline. [1]

Base your answers to questions 61 through 65 on the information and diagram below and on your knowledge of physics.

The diagram below represents an electric circuit consisting of a 110.-ohm resistor and a 220.-ohm resistor connected to a source of potential difference.



61–62 Calculate the equivalent resistance of the circuit. [Show all work, including the equation and substitution with units.] [2]

63–64 Calculate the total current in the circuit. [Show all work, including the equation and substitution with units.] [2]

65 Compare the power dissipated by the 110.-ohm resistor to the power dissipated by the 220.-ohm resistor. [1]

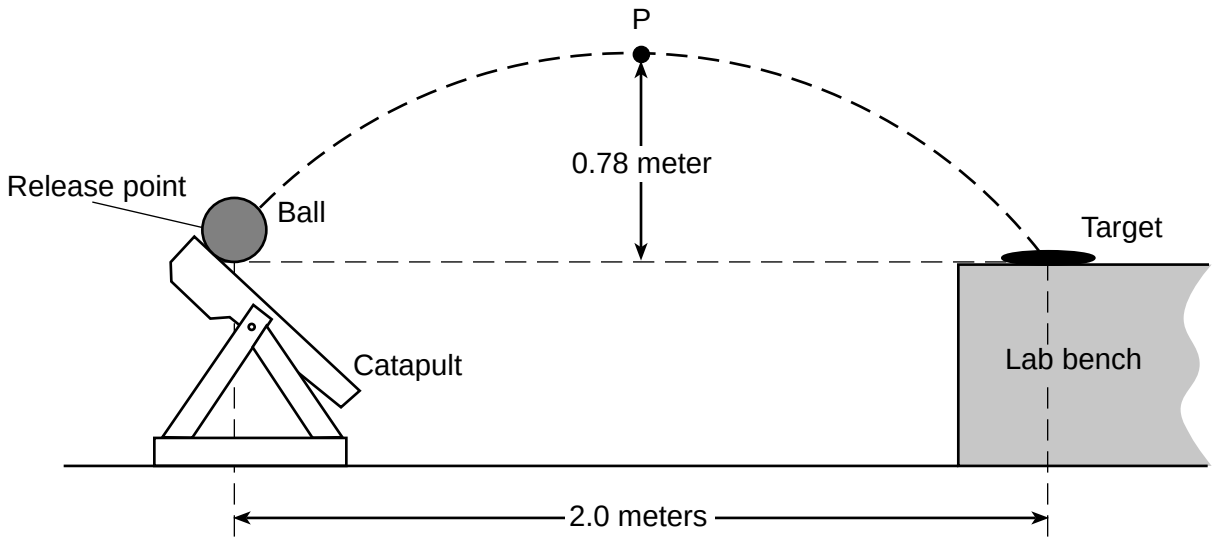
Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*.

Base your answers to questions 66 through 70 on the information and diagram below and on your knowledge of physics.

A group of students constructs a catapult that launches a ball at a target placed on a lab bench. The students measure 0.80 second from the time the ball is released until it strikes the target, located a horizontal distance of 2.0 meters from the release point. The ball reaches a maximum height at point *P*, which is 0.78 meter above the ball's release point. The target is at the same height as the release point. [Neglect friction.]



(Not drawn to scale)

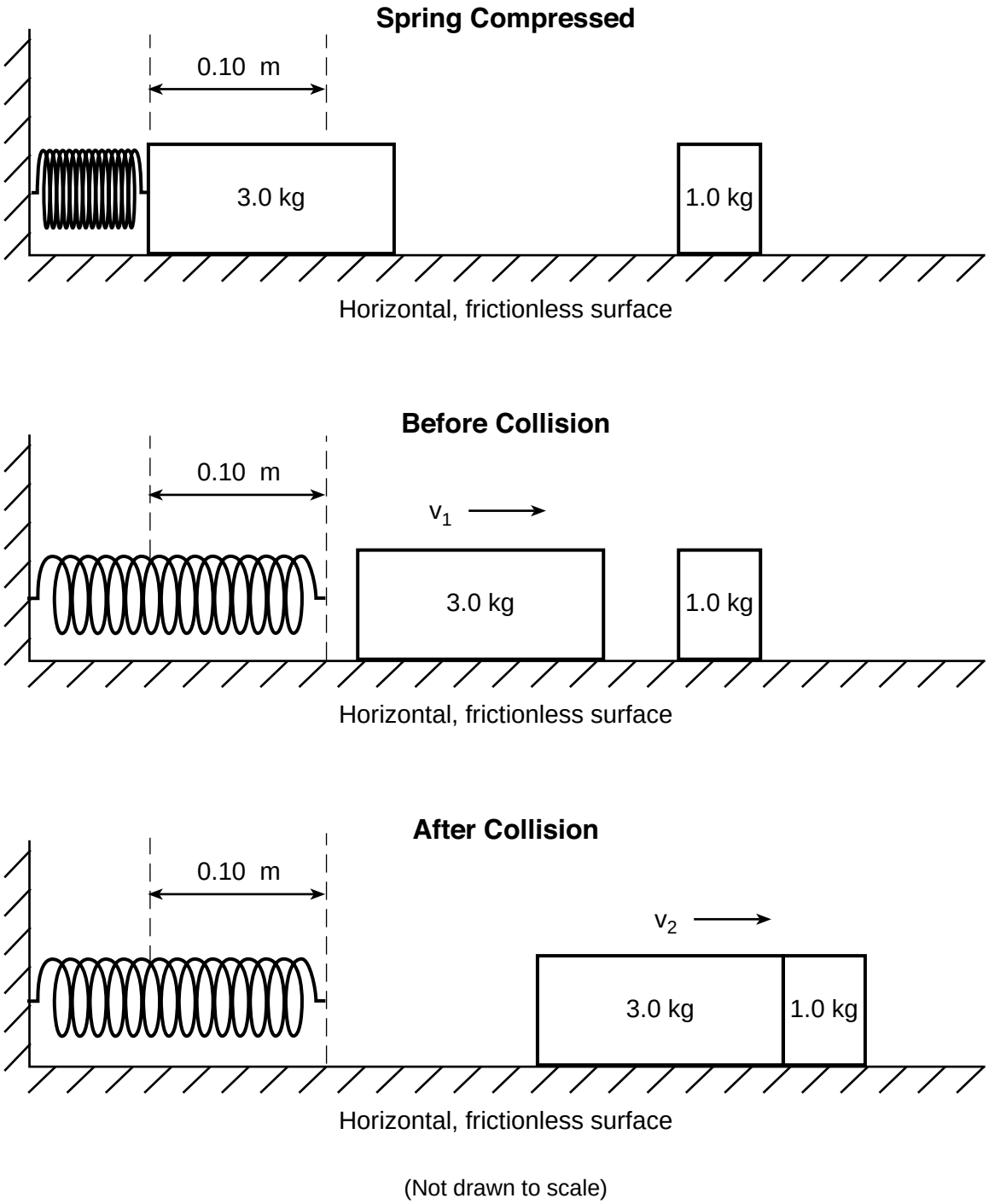
66–67 Calculate the horizontal component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

68–69 Calculate the vertical component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

70 On the diagram *in your answer booklet*, draw an arrow originating at point *P* that represents the direction of the ball's acceleration at point *P*. [1]

Base your answers to questions 71 through 75 on the information and diagram below and on your knowledge of physics.

A spring with a spring constant of 2600 newtons per meter is compressed 0.10 meter from its unstretched position. The spring is released, propelling a 3.0-kilogram block along a horizontal, frictionless surface. This block then collides with a stationary 1.0-kilogram block. The blocks remain joined and move together as shown in the diagram below.



(Not drawn to scale)

71 Determine the total amount of elastic potential energy stored in the spring when the spring is compressed 0.10 meter. [1]

72–73 Assuming all of the spring's energy is transferred to the 3.0-kilogram block, calculate the speed, v_1, of the 3.0-kilogram block immediately after it is propelled by the spring. [Show all work, including the equation and substitution with units.] [2]

74–75 Calculate the speed, v_2, of the two blocks after the collision. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 76 through 80 on the information below and on your knowledge of physics.

A mercury atom emits a photon when an electron in the atom moves from energy level *f* to energy level *d*.

76 Determine the energy of the emitted photon, in electronvolts. [1]

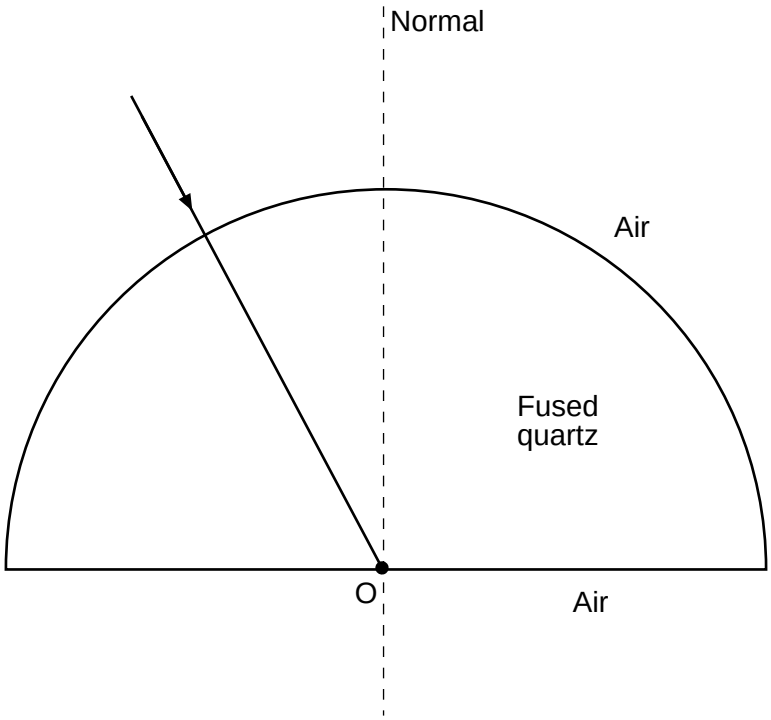
77 Determine the energy of the emitted photon, in joules. [1]

78–79 Calculate the frequency of the emitted photon. [Show all work, including the equation and substitution with units.] [2]

80 Based on your calculated value of the frequency of the emitted photon, determine its classification in the electromagnetic spectrum. [1]

Base your answers to questions 81 through 85 on the information and diagram below, and on your knowledge of physics.

The diagram represents the path followed by a ray of light ($f = 5.09 \times 10^{14}$ Hz) as it strikes a semicircular block of fused quartz perpendicular to its curved surface.



81 Use a protractor to determine the angle of incidence of the light ray at point *O*. [1]

82–83 Calculate the angle of refraction as the light ray leaves the fused quartz at point *O* and enters the air. [Show all work, including the equation and substitution with units.] [2]

84 Starting at point *O* and using a protractor and ruler, draw the refracted ray at the appropriate angle of refraction on the diagram *in your answer booklet*. [1]

85 Compare the frequency of the light in fused quartz to the frequency of the light in air. [1]

P.S./PHYSICS

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 23, 2022 — 9:15 a.m. to 12:15 p.m., only

ANSWER BOOKLET

Student . . . . . .

Teacher . . . . . .

School . . . . . Grade . . . . . .

Record your answers for Part B–2 and Part C in this booklet.

Part B–2

51–52

53 _____ **N**

54–55

56 _____ **m**

57 _____ **m**

58 _____ **J**

59 _____ **J**

60 _____

_____

_____

61–62

63-64

65 _____

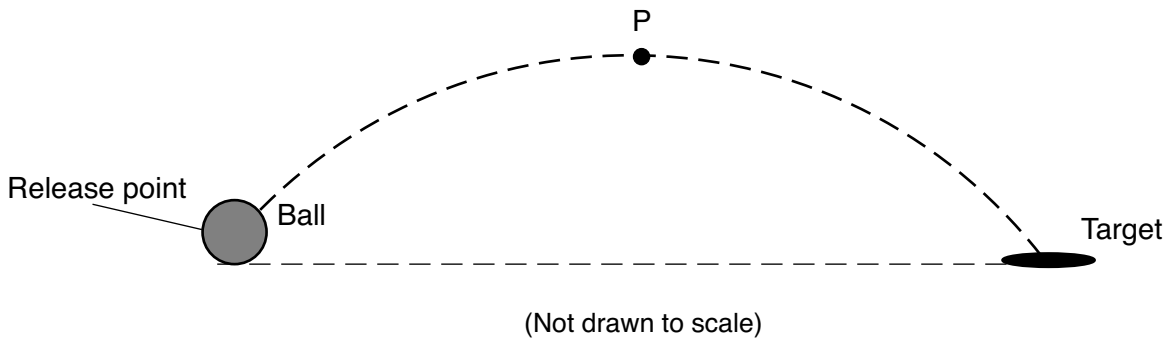
_____

Part C

66–67

68–69

70



(Not drawn to scale)

71 _____ **J**

72–73

74–75

76 _____ **eV**

77 _____ **J**

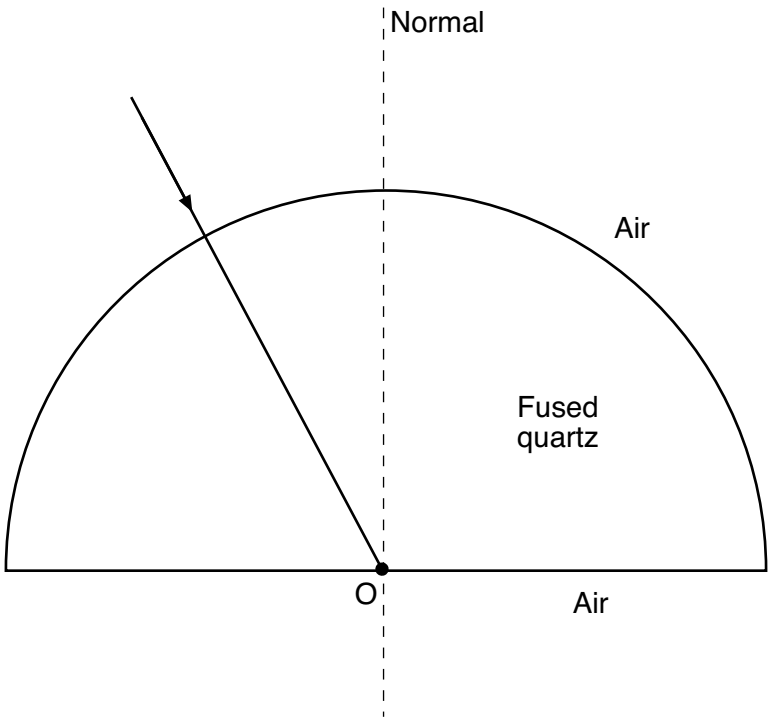
78–79

80 _____

81 _____ °

82–83

84



85 _____

_____

P.S./PHYSICS

The State Education Department / The University of the State of New York

Regents Examination in Physical Setting/Physics – June 2022

Scoring Key: Parts A and B-1 (Multiple-Choice Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Physics	June '22	**1**	**4**	MC	1	1
Physical Setting/Physics	June '22	**2**	**3**	MC	1	1
Physical Setting/Physics	June '22	**3**	**4**	MC	1	1
Physical Setting/Physics	June '22	**4**	**2**	MC	1	1
Physical Setting/Physics	June '22	**5**	**3**	MC	1	1
Physical Setting/Physics	June '22	**6**	**2**	MC	1	1
Physical Setting/Physics	June '22	**7**	**3**	MC	1	1
Physical Setting/Physics	June '22	**8**	**1**	MC	1	1
Physical Setting/Physics	June '22	**9**	**3**	MC	1	1
Physical Setting/Physics	June '22	**10**	**3**	MC	1	1
Physical Setting/Physics	June '22	**11**	**3**	MC	1	1
Physical Setting/Physics	June '22	**12**	**4**	MC	1	1
Physical Setting/Physics	June '22	**13**	**1**	MC	1	1
Physical Setting/Physics	June '22	**14**	**4**	MC	1	1
Physical Setting/Physics	June '22	**15**	**2**	MC	1	1
Physical Setting/Physics	June '22	**16**	**2**	MC	1	1
Physical Setting/Physics	June '22	**17**	**3**	MC	1	1
Physical Setting/Physics	June '22	**18**	**2**	MC	1	1
Physical Setting/Physics	June '22	**19**	**3**	MC	1	1
Physical Setting/Physics	June '22	**20**	**1**	MC	1	1
Physical Setting/Physics	June '22	**21**	**1**	MC	1	1
Physical Setting/Physics	June '22	**22**	**1**	MC	1	1
Physical Setting/Physics	June '22	**23**	**4**	MC	1	1
Physical Setting/Physics	June '22	**24**	**3**	MC	1	1
Physical Setting/Physics	June '22	**25**	**3**	MC	1	1
Physical Setting/Physics	June '22	**26**	**1**	MC	1	1
Physical Setting/Physics	June '22	**27**	**4**	MC	1	1
Physical Setting/Physics	June '22	**28**	**4**	MC	1	1
Physical Setting/Physics	June '22	**29**	**1**	MC	1	1
Physical Setting/Physics	June '22	**30**	**1**	MC	1	1
Physical Setting/Physics	June '22	**31**	**1**	MC	1	1
Physical Setting/Physics	June '22	**32**	**2**	MC	1	1
Physical Setting/Physics	June '22	**33**	**2**	MC	1	1
Physical Setting/Physics	June '22	**34**	**4**	MC	1	1
Physical Setting/Physics	June '22	**35**	**2**	MC	1	1
Physical Setting/Physics	June '22	**36**	**1**	MC	1	1
Physical Setting/Physics	June '22	**37**	**1**	MC	1	1
Physical Setting/Physics	June '22	**38**	**4**	MC	1	1
Physical Setting/Physics	June '22	**39**	**1**	MC	1	1
Physical Setting/Physics	June '22	**40**	**2**	MC	1	1
Physical Setting/Physics	June '22	**41**	**2**	MC	1	1
Physical Setting/Physics	June '22	**42**	**1**	MC	1	1
Physical Setting/Physics	June '22	**43**	**1**	MC	1	1
Physical Setting/Physics	June '22	**44**	**4**	MC	1	1
Physical Setting/Physics	June '22	**45**	**1**	MC	1	1
Physical Setting/Physics	June '22	**46**	**1**	MC	1	1
Physical Setting/Physics	June '22	**47**	**4**	MC	1	1
Physical Setting/Physics	June '22	**48**	**3**	MC	1	1
Physical Setting/Physics	June '22	**49**	**2**	MC	1	1
Physical Setting/Physics	June '22	**50**	**3**	MC	1	1

Regents Examination in Physical Setting/Physics – June 2022

Scoring Key: Parts B-2 and C (Constructed-Response Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Physics	June '22	**51**	-	CR	1	1
Physical Setting/Physics	June '22	**52**	-	CR	1	1
Physical Setting/Physics	June '22	**53**	-	CR	1	1
Physical Setting/Physics	June '22	**54**	-	CR	1	1
Physical Setting/Physics	June '22	**55**	-	CR	1	1
Physical Setting/Physics	June '22	**56**	-	CR	1	1
Physical Setting/Physics	June '22	**57**	-	CR	1	1
Physical Setting/Physics	June '22	**58**	-	CR	1	1
Physical Setting/Physics	June '22	**59**	-	CR	1	1
Physical Setting/Physics	June '22	**60**	-	CR	1	1
Physical Setting/Physics	June '22	**61**	-	CR	1	1
Physical Setting/Physics	June '22	**62**	-	CR	1	1
Physical Setting/Physics	June '22	**63**	-	CR	1	1
Physical Setting/Physics	June '22	**64**	-	CR	1	1
Physical Setting/Physics	June '22	**65**	-	CR	1	1
Physical Setting/Physics	June '22	**66**	-	CR	1	1
Physical Setting/Physics	June '22	**67**	-	CR	1	1
Physical Setting/Physics	June '22	**68**	-	CR	1	1
Physical Setting/Physics	June '22	**69**	-	CR	1	1
Physical Setting/Physics	June '22	**70**	-	CR	1	1
Physical Setting/Physics	June '22	**71**	-	CR	1	1
Physical Setting/Physics	June '22	**72**	-	CR	1	1
Physical Setting/Physics	June '22	**73**	-	CR	1	1
Physical Setting/Physics	June '22	**74**	-	CR	1	1
Physical Setting/Physics	June '22	**75**	-	CR	1	1
Physical Setting/Physics	June '22	**76**	-	CR	1	1
Physical Setting/Physics	June '22	**77**	-	CR	1	1
Physical Setting/Physics	June '22	**78**	-	CR	1	1
Physical Setting/Physics	June '22	**79**	-	CR	1	1
Physical Setting/Physics	June '22	**80**	-	CR	1	1
Physical Setting/Physics	June '22	**81**	-	CR	1	1
Physical Setting/Physics	June '22	**82**	-	CR	1	1
Physical Setting/Physics	June '22	**83**	-	CR	1	1
Physical Setting/Physics	June '22	**84**	-	CR	1	1
Physical Setting/Physics	June '22	**85**	-	CR	1	1

Key
MC = Multiple-choice question
CR = Constructed-response question

The chart for determining students' final examination scores for the **June 2022 Regents Examination in Physical Setting/Physics** will be posted on the Department's web site at https://www.nysedregents.org/Physics/ on the day of the examination. Conversion charts provided for the previous administrations of the Physical Setting/Physics examination must NOT be used to determine students' final scores for this administration.

FOR TEACHERS ONLY

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

PHYSICAL SETTING/PHYSICS

Thursday, June 23, 2022 — 9:15 a.m. to 12:15 p.m., only

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 at: http://www.nysed.gov/state-assessment/high-school-regents-examinations and select the link "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.

Directions to the Teacher

Follow the procedures below for scoring student answer papers for the Regents Examination in PhysicalSetting/Physics. Additional information about scoring is provided in the publication *Information Booklet for Scoring Regents Examinations in the Sciences,* which may be found on the Department web site at http://www.nysed.gov/common/nysed/files/programs/state-assessment/info-booklet-sciences-2022 pdf.

Allow 1 credit for a correct response to each item.

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 on a student's paper. 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 more than approximately one-half of the open-ended questions on a student's answer paper. Teachers may not score their own students' answer papers.

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. Do not attempt to correct the student's work by making insertions or changes of any kind. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Fractional credit is *not* allowed. Only whole-number credit may be given for a response. If the student gives more than one answer to a question, only the first answer should be rated. Units need not to be given when the wording of the question allows such omissions.

For hand scoring, raters should enter the scores earned in the appropriate boxes printed on the separate answer sheet. Next, the rater should add these scores and enter the total in the box labeled "Total Raw Score." Then the student's raw score on the written test should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: http://www.nysed.gov/state-assessment/high-school-regents-examinations on Thursday, June 23, 2022. The student's scale score should be entered in the box labeled "Scale Score"on the student's answer booklet. The scale score is the student's final examination score.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart may change from one administration 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.

Teachers should become familiar with 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's web site http://www.nysed.gov/common/nysed/files/programs/state-assessment/physics-rating-guide.pdf. This guide provides a set of directions, along with some examples, to assist teachers in rating parts B–2 and C of the Regents Examination in Physical Setting/Physics.

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 credit if the student has listed the values with units and written a correct equation.
- Allow 1 credit for the correct answer (number and unit). If the number is given without the unit, allow credit if the credit for units was previously deducted for this calculation problem.
- Penalize a student only once per calculation problem for incorrect or omitted units.
- Allow credit if the answer is not expressed with the correct number of significant figures.

Part B–2

51 [1] Allow 1 credit for the equation and substitution with units. Refer to S*coring Criteria for Calculations* in this rating guide.

Example of a 1-credit response:

$V = \frac{W}{q}$

$W = Vq$

$W = (3.70\ \text{V})(3.69 \times 10^3\ \text{C})$

52 [1] Allow 1 credit for a correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 51.

Example of a 1-credit response:

$W = 1.37 \times 10^4\ \text{J}$

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 51 and 52.

53 [1] Allow 1 credit for 540 N *or* 550 N.

54 [1] Allow 1 credit for the equation and substitution with the units *or* for an answer, with units, that is consistent with the student's response to question 53. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 1-credit response:

$F_f = \mu F_N$

$\mu = \frac{F_f}{F_N}$

$\mu = \frac{11\,\text{N}}{540\,\text{N}}$

55 [1] Allow 1 credit for a correct answer, without units, *or* for an answer, without units, that is consistent with the student's response to question 54.

Example of a 1-credit response:

$\mu = 0.020$

Note: Do *no*t penalize the student more than 1 credit for errors in units in questions 54 and 55.

56 [1] Allow 1 credit for 0.50 m *or* 0.5 m.

57 [1] Allow 1 credit for 1.5 m.

58 [1] Allow 1 credit for 1.6×10^3 J *or* 1600 J.

59 [1] Allow 1 credit for 1.0×10^3 J *or* 1000 J.

60 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The work is converted into forms of energy other than gravitational potential energy (e.g. thermal or kinetic energy).

— Friction causes internal energy to increase, so not all the work done becomes gravitational potential energy.

— friction

Note: Allow credit for an answer consistent with the student's responses to questions 58 and 59.

61 [1] Allow 1 credit for the equation and substitution with units. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 1-credit responses:

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \qquad R = \frac{V}{I} \qquad R_{eq} = \frac{(R_1)(R_2)}{R_1 + R_2}$$

or *or*

$$\frac{1}{R_{eq}} = \frac{1}{110.\ \Omega} + \frac{1}{220.\ \Omega} \qquad R = \frac{6.00\ \text{V}}{0.0818\ \text{A}} \qquad R_{eq} = \frac{(110.\ \Omega)(220.\ \Omega)}{110.\ \Omega + 220.\ \Omega}$$

62 [1] Allow 1 credit for the correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 61.

Example of a 1-credit response:

$R_{eq} = 73.3\ \Omega$

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 61 and 62.

63 [1] Allow 1 credit for the equation and substitution with units *or* for an answer, with units, that is consistent with the student's response to question 62. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 1-credit responses:

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

$$I = \frac{V}{R_{eq}} \qquad \textit{or} \qquad I = I_1 + I_2$$

$$I = 5.45 \times 10^{-2}\ \text{A} + 2.73 \times 10^{-2}\ \text{A}$$

$$I = \frac{6.00\ \text{V}}{73.3\ \Omega}$$

64 [1] Allow 1 credit for the correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 63.

Examples of 1-credit responses:

$I = 8.19 \times 10^{-2}\ \text{A}$ *or* $8.18 \times 10^{-2}\ \text{A}$

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 63 and 64.

65 [1] Allow 1 credit for indicating that the power dissipated by the 110.-Ω resistor is greater than the power dissipated by the 220.-Ω resistor *or* for an answer that is consistent with the student's responses to questions 62 and 64.

Part C

66 [1] Allow 1 credit for the equation and substitutions with units. Refer to *Scoring Criteria for Calculations* in the rating guide.

Examples of 1-credit responses:

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

$\overline{v} = \dfrac{2.0\text{ m}}{0.80\text{ s}}$

or

$d = v_i t + \dfrac{1}{2}at^2$

$v_i = \dfrac{d - \frac{1}{2}at^2}{t}$

$v_i = \dfrac{2.0\text{ m} - \frac{1}{2}(0\text{m/s}^2)(0.80\text{ s})^2}{0.80\text{ s}}$

67 [1] Allow 1 credit for the correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 66.

Example of a 1-credit response:

$v = 2.5$ m/s

Note: Do *not* penalize a student more than 1 credit for errors in units in questions 66 and 67.

68 [1] Allow 1 credit for the equation and substitutions with units. Refer to *Scoring Criteria for Calculations* in the rating guide.

Examples of 1-credit responses:

$d = v_i t + \dfrac{1}{2}at^2$

$v_i = \dfrac{d - \frac{1}{2}at^2}{t}$

$v_i = \dfrac{0.78\text{ m} - \frac{1}{2}(-9.81\text{ m/s}^2)(0.40\text{ s})^2}{0.40\text{ s}}$

or

$v_f = v_i + at$

$v_i = v_f - at$

$v_i = 0 - (-9.81\text{ m/s}^2)(0.40\text{ s})$

$v_f^2 = v_i^2 + 2ad$

$v_i^2 = v_f^2 - 2ad$

$v_i = \sqrt{-2(-9.8\text{ m/s}^2)(0.78\text{ m})}$

or

$v_f = v_i + at$

$-v_i = v_i + (-9.81\text{ m/s}^2)(0.80\text{ s})$

69 [1] Allow 1 credit for the correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 68.

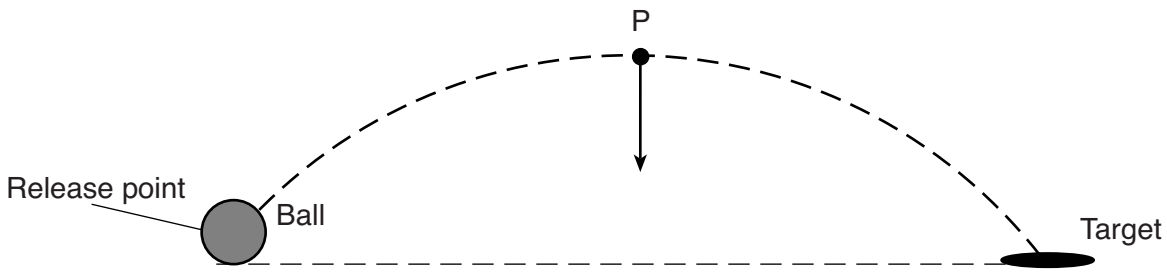
Example of a 1-credit response:

v_i = 3.9 m/s

Note: Do *not* penalize a student more than 1 credit for errors in units for questions 68 and 69.

70 [1] Allow 1 credit for drawing an arrow directed straight down.

Example of a 1-credit response:



(Not drawn to scale)

Note: Do *not* allow credit if the arrowhead is missing. Allow credit if the arrow does *not* begin at point *P*.

71 [1] Allow 1 credit for 13 J.

72 [1] Allow 1 credit for the equation and substitution with units *or* for an answer, with units, that is consistent with the student's response to question 71. Refer to *Scoring Criteria for Calculations* in the rating guide.

Example of a 1-credit response:

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

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

$$v = \sqrt{\frac{2(13\,\text{J})}{3.0\,\text{kg}}}$$

73 [1] Allow 1 credit for a correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 72.

Example of a 1-credit response:

$v = 2.9$ m/s

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 72 and 73.

74 [1] Allow 1 credit for the equation and substitution with units *or* for an answer, with units, that is consistent with the student's response to question 73. Refer to *Scoring Criteria for Calculations* in the rating guide.

Example of a 1-credit response:

$$p_{before} = p_{after}$$

$$m_1v_1 = (m_1 + m_2)v_2$$

$$v_2 = \frac{m_1v_1}{m_1 + m_2}$$

$$v_2 = \frac{(3.0\,\text{kg})(2.9\,\text{m/s})}{3.0\,\text{kg} + 1.0\,\text{kg}}$$

75 [1] Allow 1 credit for a correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 74.

Example of a 1-credit response:

$v_2 = 2.2$ m/s

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 74 and 75.

76 [1] Allow 1 credit for 2.27 eV.

Note: Do *not* allow credit for –2.27 eV because $E_{photon} = E_i - E_f = -2.68 \text{ eV} - (-4.95 \text{ eV})$.

77 [1] Allow 1 credit for 3.63×10^{-19} J *or* for an answer that is consistent with the student's response to question 76.

78 [1] Allow 1 credit for the equation and substitution with units *or* for an answer, with units, that is consistent with the student's response to questions 77 or 76. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of 1-credit response:

$$E_{photon} = hf$$

$$f = \frac{E_{photon}}{h}$$

$$f = \frac{3.63 \times 10^{-19}\text{J}}{6.63 \times 10^{-34}\text{J} \cdot \text{s}}$$

79 [1] Allow 1 credit for the correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 78.

Example of 1-credit response:

$f = 5.48 \times 10^{14}$ Hz

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 78 and 79.

80 [1] Allow 1 credit for green *or* visible light *or* for an answer that is consistent with the student's response to question 79.

81 [1] Allow 1 credit for 28° ± 2°.

82 [1] Allow 1 credit for the equation and substitution with units *or* for an answer, with units, that is consistent with the student's response to question 81. Refer to *Scoring Criteria for Calculations* in the rating guide.

Example of a 1-credit response:

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

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

$$\sin\theta_2 = \frac{1.46(\sin 28°)}{1.00}$$

83 [1] Allow 1 credit for a correct answer with units *or* for an answer, with units, that is consistent with the student's response to question 82.

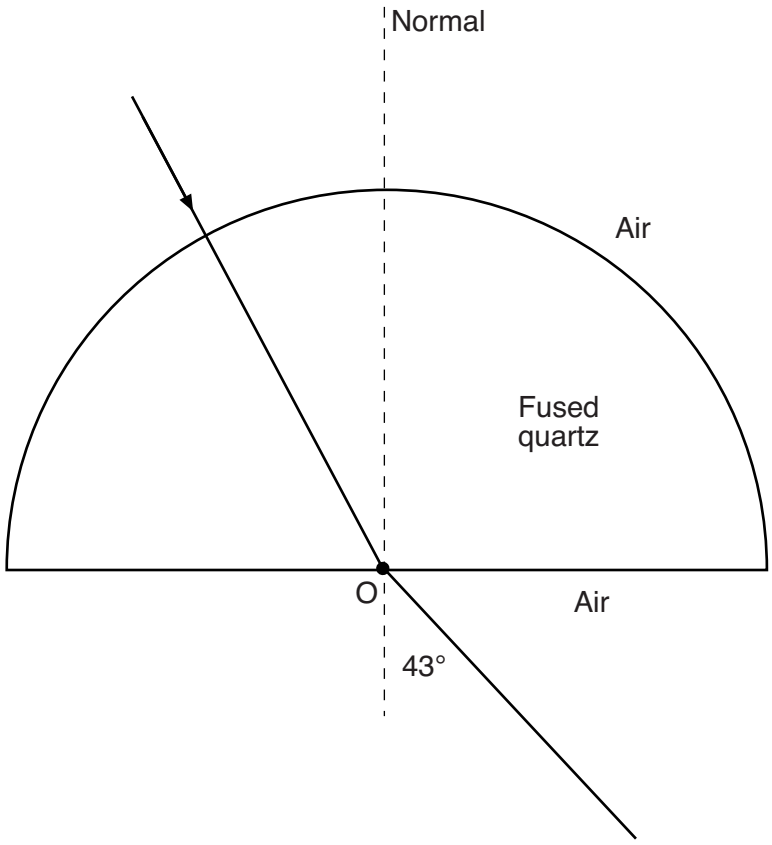
Examples of 1-credit responses:

$\theta_2 = 43°$ *or* $44°$

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 82 and 83.

84 [1] Allow 1 credit for drawing the refracted ray at 43° ± 2° to the normal, *or* for an answer that is consistent with the student's response to question 83.

Example of a 1-credit response:



Note: The refracted angle does *not* have to be labeled in order to receive credit.

85 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The frequency does not change.

— The frequencies are the same.

Regents Examination in Physical Setting/Physics

June 2022

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

The *Chart for Determining the Final Examination Score for the June 2022 Regents Examination in Physical Setting/Physics* will be posted on the Department's web site at: http://www.nysed.gov/state-assessment/high-school-regents-examinations on Thursday, June 23, 2022. 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 http://www.nysed.gov/state-assessment/teacher-feedback-state-assessments.
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

June 2022 Physical Setting/Physics			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1	2, 4, 7, 9, 15, 19, 22, 26, 30, 31, 32	37, 38, 40, 41, 45, 46, 48, 51, 52, 53, 54, 55, 58, 59, 61, 62, 63, 64	66, 67, 68, 69, 71, 72, 73, 74, 75, 76, 77, 78, 79, 82, 83
Math Key Idea 2	6, 14, 17	44, 47, 50, 56, 57, 65	70, 85
Math Key Idea 3		36, 39, 42	
Science Inquiry Key Idea 1			80
Science Inquiry Key Idea 2		60	
Science Inquiry Key Idea 3		43	
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Standard 6			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Key Idea 4			
Key Idea 5			
Key Idea 6			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
4.1	3, 14, 20		71
4.3	34	49	81, 84
5.1	15	36	
5.3			
Standard 4			
4.1	3, 9, 18, 19, 20, 22, 29, 35	45, 46, 51, 52, 58, 59, 60, 61, 62, 63, 64, 65	71, 72, 73
4.3	10, 21, 24, 25, 26, 27, 28, 30, 34	39, 44, 49, 50, 56, 57	81, 82, 83, 84, 85
5.1	1, 2, 4, 5, 6, 7, 8, 12, 13, 14, 15, 16, 17,23	36, 37, 38, 40, 42, 47, 48, 53, 54, 55	66, 67, 68, 69, 70, 74, 75
5.3	11, 31, 32, 33	41, 43	76, 77, 78, 79, 80

Regents Examination in Physical Setting/Physics – June 2022

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

Raw Score	Scale Score
85	**100**
84	**99**
83	**98**
82	**98**
81	**97**
80	**96**
79	**95**
78	**94**
77	**94**
76	**93**
75	**92**
74	**91**
73	**90**
72	**89**
71	**88**
70	**87**
69	**86**
68	**86**
67	**85**
66	**84**
65	**83**
64	**82**

Raw Score	Scale Score
63	**81**
62	**80**
61	**79**
60	**78**
59	**77**
58	**76**
57	**75**
56	**74**
55	**73**
54	**72**
53	**70**
52	**69**
51	**68**
50	**67**
49	**66**
48	**65**
47	**64**
46	**63**
45	**62**
44	**61**
43	**60**
42	**58**

Raw Score	Scale Score
41	**57**
40	**56**
39	**55**
38	**54**
37	**53**
36	**51**
35	**50**
34	**49**
33	**48**
32	**46**
31	**45**
30	**44**
29	**43**
28	**41**
27	**40**
26	**39**
25	**38**
24	**36**
23	**35**
22	**34**
21	**32**
20	**31**

Raw Score	Scale Score
19	**29**
18	**28**
17	**27**
16	**25**
15	**24**
14	**22**
13	**21**
12	**19**
11	**18**
10	**16**
9	**15**
8	**13**
7	**12**
6	**10**
5	**9**
4	**7**
3	**5**
2	**4**
1	**2**
0	**0**

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 "Scale Score" on the student's answer sheet.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart change from one administration 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 Regents Examination in Physical Setting/Physics.