The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 22, 2023 — 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 pair of quantities are both scalar quantities?

(1) speed and mass
(2) speed and momentum
(3) momentum and displacement
(4) mass and displacement

2 In an attempt to get ketchup out of a bottle, a student takes off the cap, turns the bottle upside down, accelerates it downward, and then suddenly stops it. Ketchup is released from the open bottle because the ketchup doesn't stop moving when the bottle does. The ketchup leaving the bottle illustrates

(1) inertia
(2) resistivity
(3) resonance
(4) mass being converted to energy

3 The same net force is applied to object *A* and object *B*. The mass of *B* is three times greater than the mass of *A*. Compared to the acceleration of *A*, the acceleration of *B* is

(1) the same
(2) one-third as great
(3) three times as great
(4) one-ninth as great

4 What is the mass equivalent of 3.37×10^{-19} joule?

(1) 1.26×10^{-54} kg
(2) 3.74×10^{-36} kg
(3) 1.12×10^{-27} kg
(4) 5.08×10^{14} kg

5 Which object is in equilibrium?

(1) Earth orbiting the Sun
(2) a thrown baseball at its highest point above the ground
(3) a car moving at a constant speed in a straight line
(4) a bicycle skidding to a stop in a straight line

6 A race car travels around a flat circular track at constant speed. The net force on the car acts

(1) perpendicular to the car's velocity and toward the center of the circle
(2) perpendicular to the car's velocity and away from the center of the circle
(3) parallel to the car's velocity and in the same direction as the velocity
(4) parallel to the car's velocity and in the opposite direction as the velocity

7 An object is traveling in a horizontal, circular path at a constant speed. If the radius of the path were doubled while the speed remained constant, the centripetal acceleration would be

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

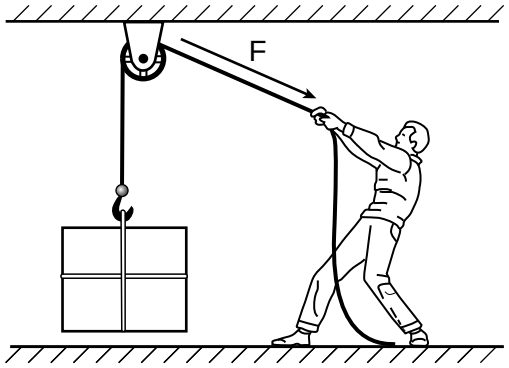
8 A 600.-newton student pushes on a vertical wall for 20.0 seconds with a constant force having a magnitude of 100. newtons. What is the magnitude of the force that the wall exerts on the student?

(1) 0.00 N
(2) 5.00 N
(3) 100. N
(4) 600. N

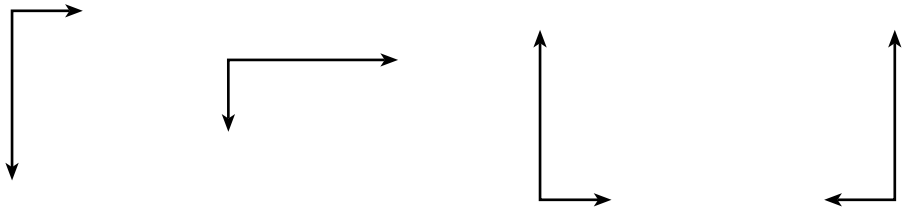
9 An unbalanced force of 20. newtons is applied to a mass of 1.0×10^3 kilograms. After 10. seconds, the momentum of the mass will have changed by

(1) 2.0×10^2 kg•m/s
(2) 2.0×10^3 kg•m/s
(3) 1.0×10^4 kg•m/s
(4) 2.0×10^4 kg•m/s

10 To lift a heavy block off the floor, a student pulls with force F on a rope that passes over a pulley, as shown in the diagram below.

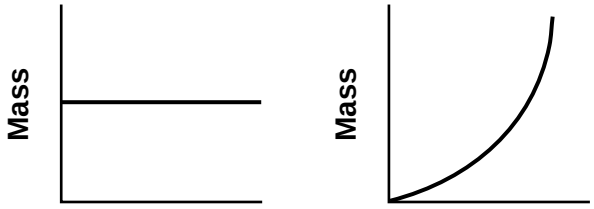


Which pair of vectors represents the perpendicular components of the force the student exerts on the rope?



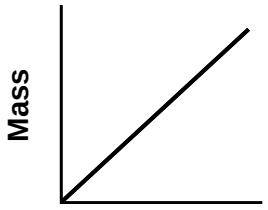
(1) (2) (3) (4)

11 Which graph best represents the relationship between the mass of an object and its distance from Earth's surface?

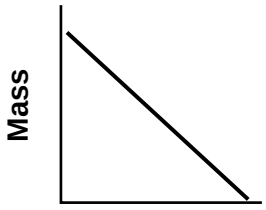


(1)

(3)

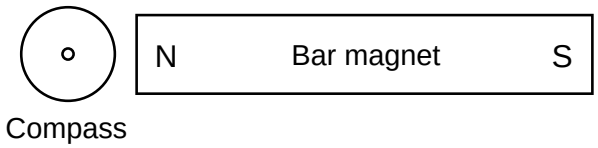


(2)

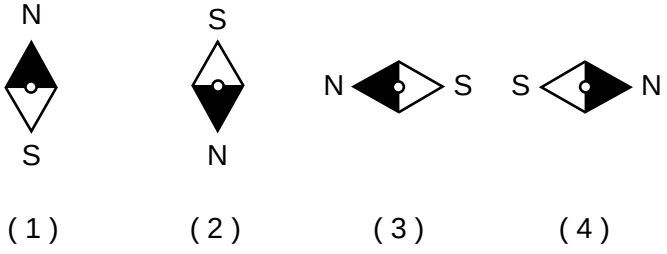


(4)

12 A compass is placed near a strong bar magnet as represented in the diagram below.



Which diagram best represents the direction of the compass needle?



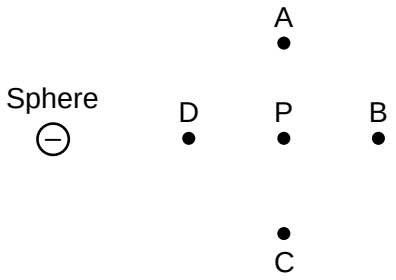
13 As Earth orbits the Sun in its elliptical orbit, the gravitational force between the Sun and Earth is

(1) always attractive
(2) attractive as the Sun and Earth get closer together and repulsive as the Sun and Earth get farther apart
(3) repulsive as the Sun and Earth get closer together and attractive as the Sun and Earth get farther apart
(4) always repulsive

14 Which unit is used to measure the work per unit charge required to move a charge in an electric field?

(1) ampere
(2) coulomb
(3) volt
(4) watt

15 The diagram below shows a negatively charged sphere and a point, *P*, located within the electric field produced by the charge on the sphere.



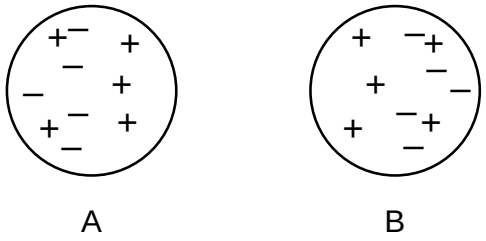
The direction of the electric field at point *P* is toward point

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

16 Two point charges, q_1 and q_2, are initially a distance, *d*, apart. Which change will cause the greatest increase in the electrostatic force between the two point charges, q_1 and q_2?

(1) double q_1
(2) halve q_2
(3) double *d*
(4) halve *d*

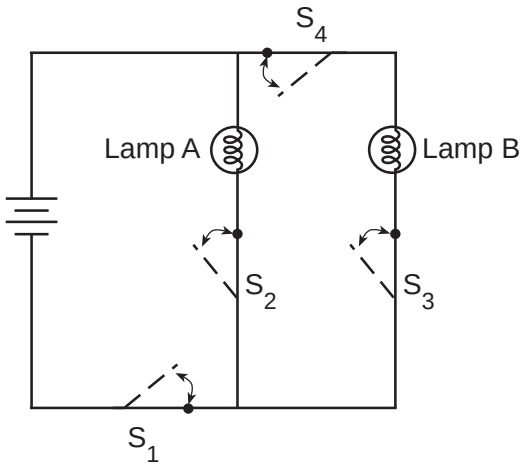
17 The diagram below represents two identical conducting spheres.



Which statement could be the correct explanation for the charge distribution on the spheres?

(1) A small positively charged object is located between sphere *A* and sphere *B*.
(2) A small negatively charged object is located between sphere *A* and sphere *B*.
(3) A small positively charged object is located to the right of sphere *B*.
(4) A small negatively charged object is located to the right of sphere *B*.

18 The diagram below represents a circuit containing a battery, two operating lamps, *A* and *B*, and four closed switches, S_1, S_2, S_3, and S_4.



Which switch, when opened, causes both lamps to turn off?

(1) S_1
(2) S_2
(3) S_3
(4) S_4

19 What is the resistance of a 100.-watt bulb when operating a potential difference of 120. volts?

(1) 1.20 Ω
(2) 100. Ω
(3) 120. Ω
(4) 144 Ω

20 The interaction that is most responsible for binding three quarks together in a proton is the

(1) strong force
(2) electromagnetic force
(3) weak force
(4) gravitational force

21 One example of a force doing work is the force exerted by

(1) Earth on a high diver falling toward a pool from a platform above
(2) a hook on an engine held stationary above a car
(3) a frictionless horizontal air hockey table on a puck moving across the table at a constant velocity
(4) a weightlifter on a barbell he holds motionless over his head

22 A ball falls freely from a rooftop to the street below. The ball starts from rest with 20. joules of gravitational potential energy with respect to the street. The total mechanical energy of the ball just before it hits the street is

(1) 0 J
(2) 5.0 J
(3) 10. J
(4) 20. J

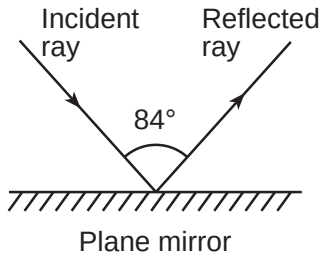
23 Which statement describes the gravitational potential energy (*PE*), kinetic energy (*KE*), and internal (thermal) energy (*Q*), of a wooden crate as it is pushed across a level classroom floor at constant speed?

(1) The *PE* decreases, *KE* remains the same, and *Q* decreases.
(2) The *PE* increases, *KE* increases, and *Q* decreases.
(3) The *PE* remains the same, *KE* decreases, and *Q* increases.
(4) The *PE* remains the same, *KE* remains the same, and *Q* increases.

24 The oscillation of electrons up and down a metal antenna produces waves. These waves are

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

25 The diagram below shows an incident light ray reflecting from a plane mirror.



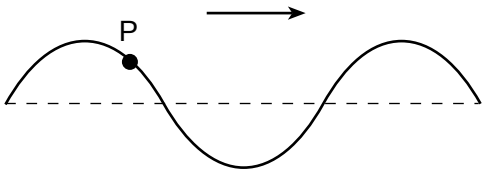
What is the angle of reflection?

(1) 96°
(2) 84°
(3) 48°
(4) 42°

26 A characteristic common to both sound waves and x rays is that they both

(1) travel fastest in a vacuum
(2) cause particles to vibrate in a direction parallel to the wave's direction of motion
(3) transmit energy without transmitting matter
(4) are mechanical

27 The diagram below represents a wave moving to the right through a rope.



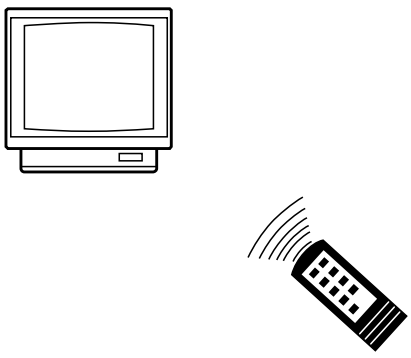
Point *P* in the rope is moving toward the

(1) top of the page
(2) bottom of the page
(3) right
(4) left

28 What is the wavelength of a 300.-hertz sound wave in air at STP?

(1) 0.906 m
(2) 1.10 m
(3) 3.00×10^2 m
(4) 1.00×10^6 m

29 In the diagram below, a remote control is aimed at a television.



When the signal from the remote reaches the sensor on the television, the signal will most likely be

(1) neither reflected nor absorbed
(2) partially absorbed and partially reflected
(3) completely reflected
(4) completely absorbed

30 Compared to waves of blue light traveling in a vacuum, waves of red light traveling in a vacuum have

(1) a lower frequency and a lower speed
(2) a lower frequency and the same speed
(3) the same frequency and a lower speed
(4) the same frequency and the same speed

31 Earthquakes often cause buildings between twelve and forty stories high to vibrate at an amplitude high enough to be destructive. Buildings are often designed to absorb this vibrational energy that might cause them to vibrate at their natural frequency. This tendency for an earthquake to cause a building to vibrate at a large amplitude is an example of

(1) resonance
(2) the Doppler effect
(3) refraction
(4) diffraction

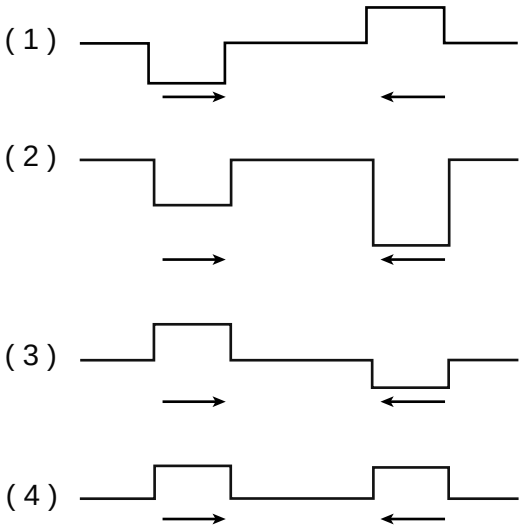
32 During the radioactive decay of a uranium-238 atom, a thorium-234 atom and an alpha particle are produced. During this process, there is conservation of

(1) charge, only
(2) mass-energy, only
(3) both charge and mass-energy
(4) neither charge nor mass-energy

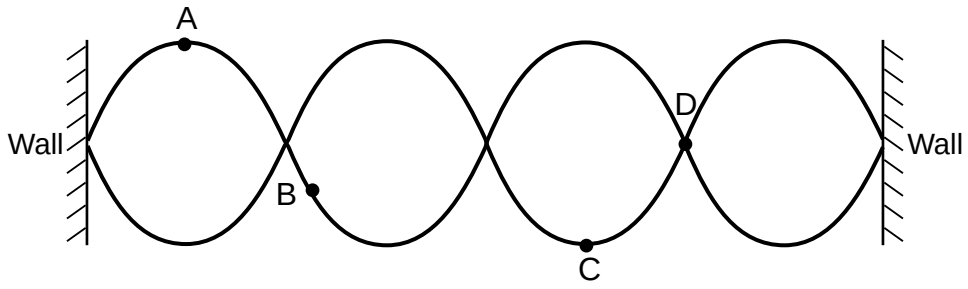
33 An antiproton has a charge of

(1) $+1e$
(2) $+\frac{2}{3}e$
(3) 0
(4) $-1e$

34 Two pulses approach each other in the same medium. Which pair of pulses will result in the largest magnitude displacement of the medium as the pulses pass through each other?



35 Two waves of the same wavelength interfere to form a standing wave pattern as represented in the diagram below.



Which point on the diagram represents a node?

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

Part B–1

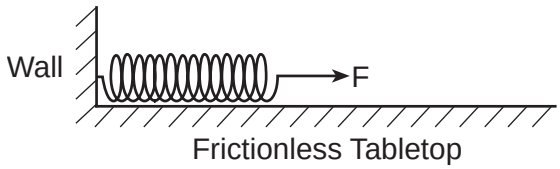
Answer all questions in this part.

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 A round dinner plate has a diameter closest to

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

37 Several springs are lying on frictionless tabletops with one end attached to a wall and a variable force F applied to the free end of each spring. The springs have different spring constants, k. The diagram below shows the setup for one of the springs.



The elongation of the springs produced by force F depends

(1) directly on both F and k
(2) directly on F and inversely on k
(3) inversely on F and directly on k
(4) inversely on both F and k

38 The table below shows the weight of four athletes (A, B, C, and D) and the time required for each athlete to run from the base of a hill to its top.

Athlete	**Weight** (N)	**Time** (s)
A	600.	11.8
B	650.	10.7
C	700.	10.8
D	750.	11.9

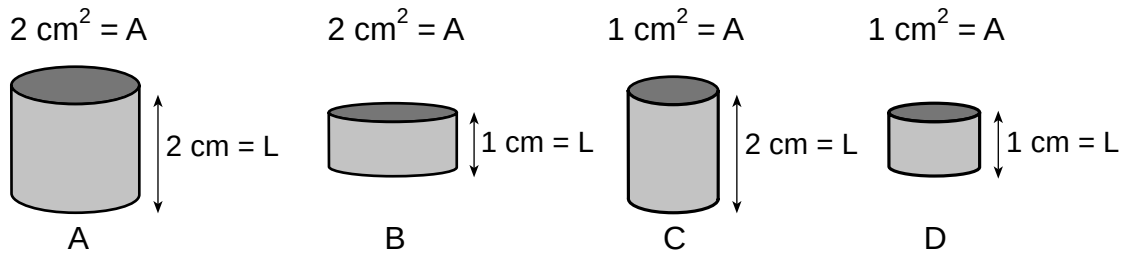
Which athlete ran up the hill with the greatest average power?

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

39 A copper wire carries 2.8 amperes of current. The total amount of charge that passes a point in the wire in 1.3 milliseconds is

(1) 4.6×10^{-4} C
(2) 3.6×10^{-3} C
(3) 3.6 C
(4) 2.2×10^{3} C

40 The diagram below represents four solid copper wire segments at 20°C with different lengths (L) and cross-sectional areas (A).



Which two segments have the same resistance?

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

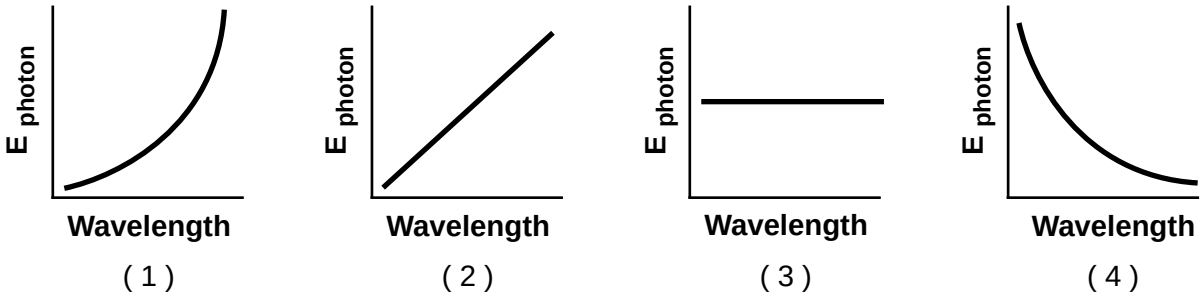
41 In substance X, a ray of light with a frequency of 5.09×10^{14} hertz has a speed of 2.04×10^{8} meters per second. Substance X could be

(1) diamond
(2) water
(3) zircon
(4) glycerol

42 Which could *not* be the charge on a particle?

(1) 3.2×10^{-19} C
(2) 4.5×10^{-19} C
(3) 4.8×10^{-19} C
(4) 6.4×10^{-19} C

43 Which graph best represents the relationship between photon energy (E_{photon}) and wavelength?



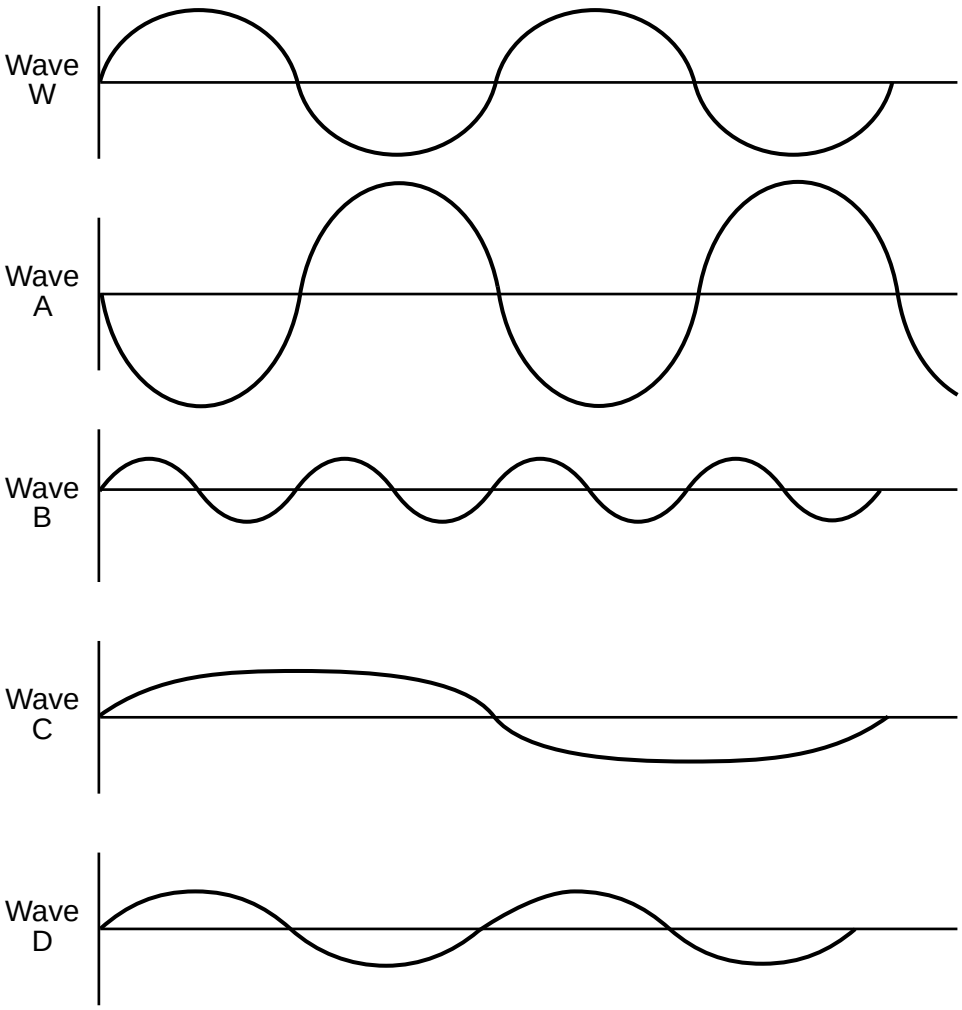
44 Light travels from air into another medium with an index of refraction of n. The light has a wavelength of 6.0×10^{-7} meter in the new medium. Which expression represents the wavelength of this light in air?

(1) $n(6.0 \times 10^{-7}\text{m})$
(2) $\dfrac{6.0 \times 10^{-7}\text{m}}{n}$
(3) $\dfrac{n}{6.0 \times 10^{-7}\text{m}}$
(4) $(6.0 \times 10^{-7}\text{m}) - n$

45 If 80. joules of electrical energy is dissipated by a 10.-ohm resistor in 2.0 seconds, the current in the resistor is

(1) 5.0 A
(2) 2.0 A
(3) 8.0 A
(4) 4.0 A

Base your answers to questions 46 and 47 on the diagrams below, and on your knowledge of physics. The diagrams represent waves *W*, *A*, *B*, *C*, and *D* traveling through the same uniform medium.



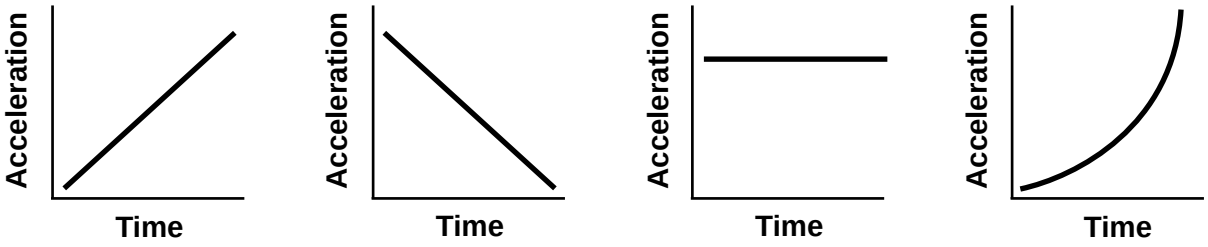
46 Which wave has a period that is twice that of wave *W*?

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

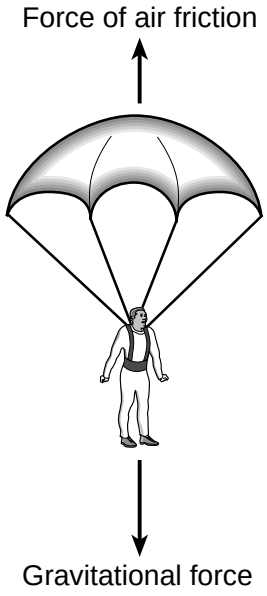
47 Which wave is always 180 degrees out of phase with wave *W*?

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

48 Which graph best represents the relationship between acceleration and time for a freely falling object as the object falls near the surface of Earth?



49 The diagram below represents the forces acting on a skydiver with his parachute.



The total mass of the skydiver with his parachute is 85.0 kilograms. If the magnitude of the gravitational force is 834 newtons, and the magnitude of the force of air friction is 652 newtons, the acceleration of the skydiver at the time shown is

(1) 2.14 m/s^2 up
(2) 2.14 m/s^2 down
(3) 7.67 m/s^2 up
(4) 9.81 m/s^2 down

50 A 15.0-gram air hockey puck sliding on a horizontal surface at a velocity of 7.00 meters per second north collides with a 15.0-gram air hockey puck traveling at a velocity of 8.00 meters per second south. The momentum of the system of pucks after the collision is

(1) 0.0150 kg•m/s north
(2) 0.0150 kg•m/s south
(3) 0.225 kg•m/s north
(4) 0.225 kg•m/s south

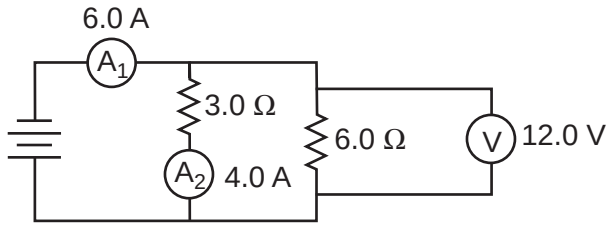
Part B–2

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*.

Base your answers to questions 51 through 54 on the information and circuit diagram below and on your knowledge of physics.

An electric circuit contains a battery, a 3.0-ohm resistor, a 6.0-ohm resistor, and three meters. Ammeter A_1 reads 6.0 amperes, ammeter A_2 reads 4.0 amperes, and the voltmeter reads 12.0 volts.



51 Determine the potential difference across the battery. [1]

52 Determine the current through the 6.0-ohm resistor. [1]

53–54 Calculate the equivalent resistance of the circuit. [Show all work, including the equation and substitution with units.] [2]

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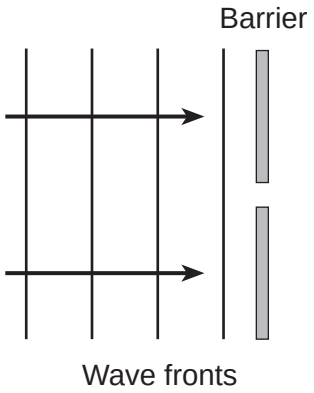
55 The diagram below shows parallel straight wave fronts approaching a rigid barrier that has a small opening in its center.



On the diagram *in your answer booklet*, draw *three* wave fronts after they have passed through the opening. [1]

Base your answers to questions 56 through 59 on the information below and on your knowledge of physics.

A projectile is launched from level ground with an initial vertical speed of 26 meters per second upward and an initial horizontal speed of 15 meters per second. [Neglect friction.]

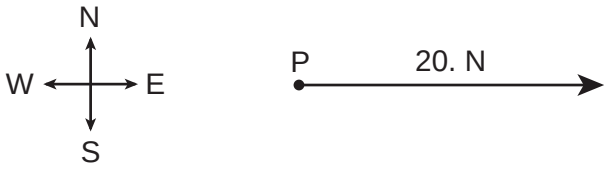
56–57 Calculate the total time the projectile is in the air before the projectile returns to the level ground. [Show all work, including the equation and substitution with units.] [2]

58 Determine the total horizontal distance the projectile travels before the projectile returns to the ground. [1]

59 Determine the angle above the horizontal at which the projectile is launched. [1]

Base your answers to question 60 through 62 on the information below and on your knowledge of physics.

A 20.-newton force due east and a 25-newton force due south act concurrently at point *P*. The diagram shows a vector drawn to scale representing the 20.-newton force due east.



60 Using a ruler, determine the scale used in the diagram. [1]

61 On the diagram in *your answer booklet*, use a metric ruler and the scale shown in the diagram to draw a vector to represent the 25 newton force due south acting at point *P*. Begin the vector at point *P* and label its magnitude in newtons. [1]

62 Determine the magnitude of the resultant force acting at point *P*. [1]

---

63 Determine the amount of energy, in electronvolts, that must be absorbed by a hydrogen atom to excite the atom from the $n = 1$ energy level directly to the n = 4 energy level. [1]

64 Determine the sign and magnitude of the net charge, in coulombs, of a particle that has a quark composition of *bbb*. [1]

65 What type of electromagnetic radiation would contain photons each having an energy of 2.65×10^{-20} joule? [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 below and on your knowledge of physics.

A car, initially traveling at a velocity of 25 meters per second west, accelerates uniformly at a rate of 1.5 meters per second squared east for 6.0 seconds.

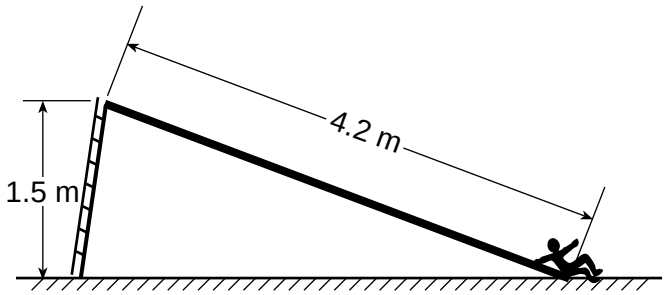
66–67 Calculate the magnitude of the car's velocity after the 6.0 seconds. [Show all work, including the equation and substitution with units.] [2]

68 Determine the direction of the car's velocity after the 6.0 seconds. [1]

69–70 Calculate the total distance traveled by the car during the 6.0 seconds. [Show all work, including the equation and substitution with units.] [2]

Base your answer to questions 71 through 76 on the information and diagram below and on your knowledge of physics.

Starting from rest at the top of the slide, a 40.-kilogram child accelerates uniformly along the surface of a 4.2-meter-long slide at a rate of 0.30 meter per second squared until she reaches the bottom of the slide.



71–72 Calculate the speed of the child at the instant she reaches the bottom of the slide. [Show all work, including the equation and substitution with units.] [2]

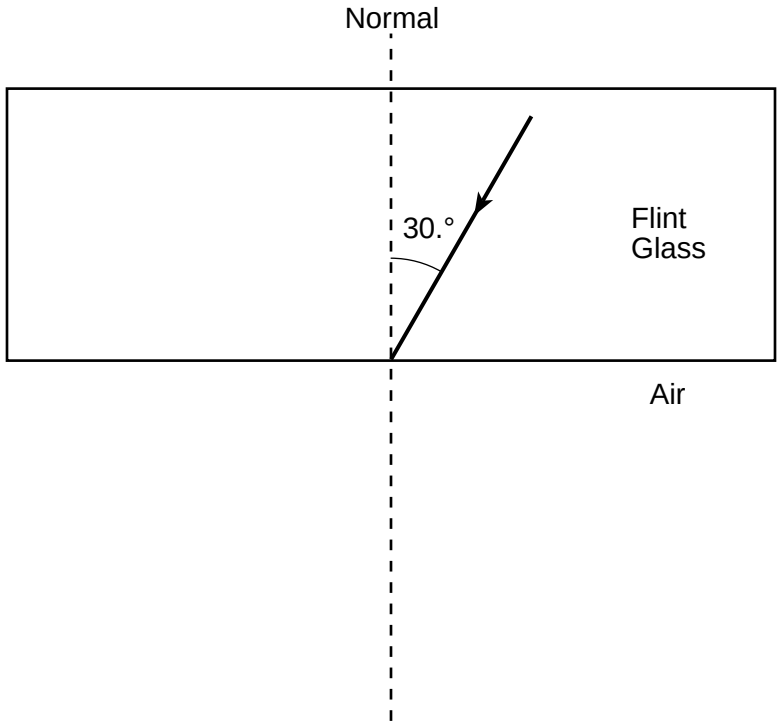
73–74 Calculate the child's kinetic energy at the bottom of the slide. [Show all work, including the equation and substitution with units.] [2]

75 Determine the total gravitational potential energy gained by the child when climbing 1.5 meters vertically from the bottom to the top of the slide. [1]

76 Determine the total amount of mechanical energy lost by the child–slide system as the child slides from the top to the bottom of the slide. [1]

Base your answer to questions 77 through 80 on the information and diagram below and on your knowledge of physics.

The diagram below represents a ray of light ($f = 5.09 \times 10^{14}$ Hz) in flint glass incident on air at an angle of incidence of 30.°.



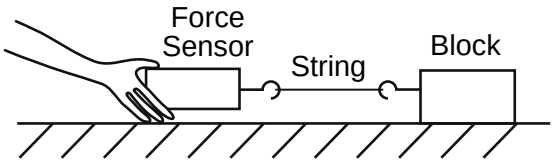
77–78 Calculate the angle of refraction of the light ray in the air. [Show all work, including the equation and substitution with units.] [2]

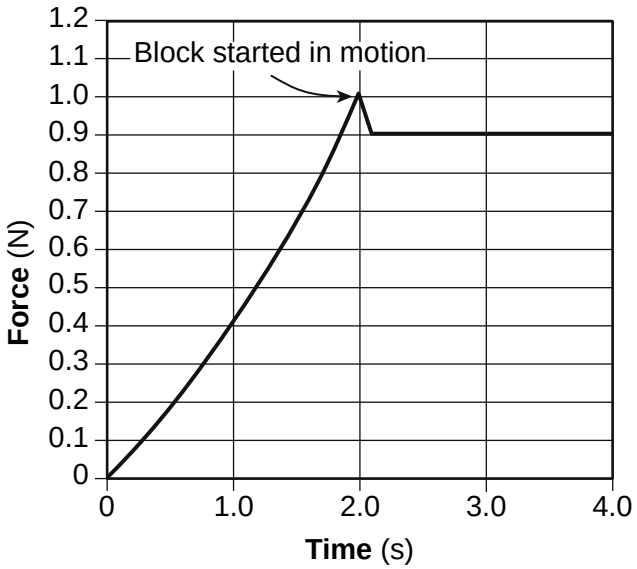
79 Using a protractor and a straightedge, draw the refracted light ray on the diagram i*n your answer booklet*. [1]

80 State what happens to the wavelength of the light ray as the light ray passes into the air from the flint glass. [1]

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

A student pulls a block weighing 2.0 newtons, resting on a horizontal laboratory table, with a string and force sensor. The sensor measures the force applied to the block when the block is at rest and when the block is moving. The force applied to the block is plotted against time on the graph.





81 Based on the graph, determine the force of kinetic friction acting on the block as it is pulled at constant velocity across the laboratory table. [1]

82–83 Calculate the coefficient of kinetic friction between the block and the laboratory table. [Show all work, including the equation and substitution with units.] [2]

84 At the instant the block begins to move, what happens to the value of the coefficient of friction? [1]

85 How would the coefficient of kinetic friction (μ) between the block and the laboratory table be affected if a 0.50-kilogram mass were placed on the block? [1]

P.S./PHYSICS

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 22, 2023 — 9:15 a.m. to 1:15 p.m., only

ANSWER BOOKLET

Student . . . . . .

Teacher . . . . . .

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

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

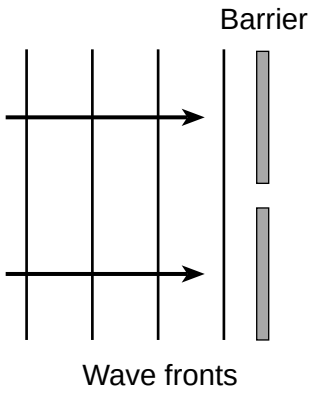
Part B–2

51 _____ **V**

52 _____ **A**

53-54

55



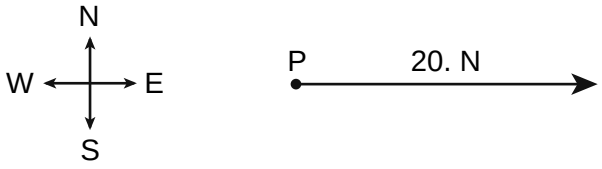
56–57

58 _____ **m**

59 _____ °

60 1.0 cm =_____ **N**

61



62 _____ **N**

63 _____ **eV**

64 _____ **C**

65 _____

Part C

66–67

68 _____

69–70

71–72

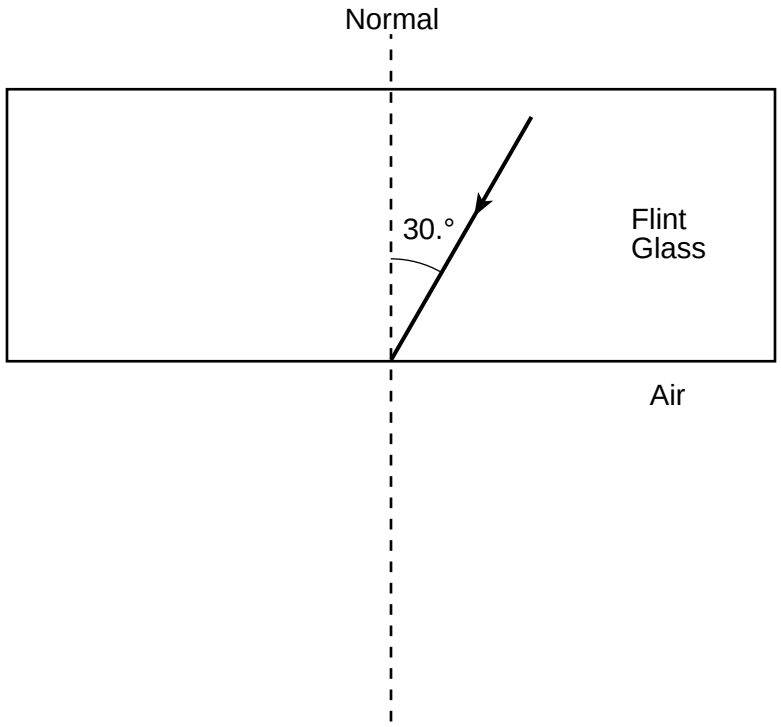
73–74

75 _____ **J**

76 _____ **J**

77–78

79



80 _____

_____

81 _____ **N**

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 2023

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

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

Regents Examination in Physical Setting/Physics – June 2023

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

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Physics	June '23	**51**	-	CR	1	1
Physical Setting/Physics	June '23	**52**	-	CR	1	1
Physical Setting/Physics	June '23	**53**	-	CR	1	1
Physical Setting/Physics	June '23	**54**	-	CR	1	1
Physical Setting/Physics	June '23	**55**	-	CR	1	1
Physical Setting/Physics	June '23	**56**	-	CR	1	1
Physical Setting/Physics	June '23	**57**	-	CR	1	1
Physical Setting/Physics	June '23	**58**	-	CR	1	1
Physical Setting/Physics	June '23	**59**	-	CR	1	1
Physical Setting/Physics	June '23	**60**	-	CR	1	1
Physical Setting/Physics	June '23	**61**	-	CR	1	1
Physical Setting/Physics	June '23	**62**	-	CR	1	1
Physical Setting/Physics	June '23	**63**	-	CR	1	1
Physical Setting/Physics	June '23	**64**	-	CR	1	1
Physical Setting/Physics	June '23	**65**	-	CR	1	1
Physical Setting/Physics	June '23	**66**	-	CR	1	1
Physical Setting/Physics	June '23	**67**	-	CR	1	1
Physical Setting/Physics	June '23	**68**	-	CR	1	1
Physical Setting/Physics	June '23	**69**	-	CR	1	1
Physical Setting/Physics	June '23	**70**	-	CR	1	1
Physical Setting/Physics	June '23	**71**	-	CR	1	1
Physical Setting/Physics	June '23	**72**	-	CR	1	1
Physical Setting/Physics	June '23	**73**	-	CR	1	1
Physical Setting/Physics	June '23	**74**	-	CR	1	1
Physical Setting/Physics	June '23	**75**	-	CR	1	1
Physical Setting/Physics	June '23	**76**	-	CR	1	1
Physical Setting/Physics	June '23	**77**	-	CR	1	1
Physical Setting/Physics	June '23	**78**	-	CR	1	1
Physical Setting/Physics	June '23	**79**	-	CR	1	1
Physical Setting/Physics	June '23	**80**	-	CR	1	1
Physical Setting/Physics	June '23	**81**	-	CR	1	1
Physical Setting/Physics	June '23	**82**	-	CR	1	1
Physical Setting/Physics	June '23	**83**	-	CR	1	1
Physical Setting/Physics	June '23	**84**	-	CR	1	1
Physical Setting/Physics	June '23	**85**	-	CR	1	1

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

The chart for determining students' final examination scores for the **June 2023 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 22, 2023 — 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: https://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 or Scoring Regents Examinations in the Sciences,* which may be found on the Department web site at https://www.nysed.gov/common/nysed/files/programs/state-assessment/info-booklet-sciences-2023pdf.

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: https://www.nysed.gov/state-assessment/high-school-regents-examinations on Thursday, June 22, 2023. 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 https://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 s*how 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 12.0 V or 12 V.

52 [1] Allow 1 credit for 2.0 A *or* for an answer that is consistent with the student's response to question 51.

53 [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 51 and/or 52. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 1-credit responses:

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

$$\frac{1}{R_{eq}} = \frac{1}{3.0\ \Omega} + \frac{1}{6.0\ \Omega} \qquad R = \frac{12\ \text{V}}{6.0\ \text{A}} \qquad R_{eq} = \frac{(3.0\ \Omega)\ (6.0\ \Omega)}{3.0\ \Omega + 6.0\ \Omega}$$

54 [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 53.

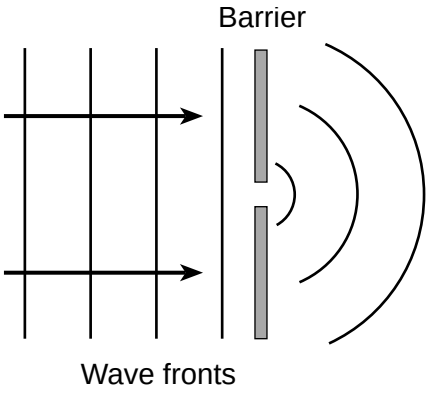
Example of a 1-credit response:

$R_{eq} = 2.0\ \Omega$

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 53 and 54.

55 [1] Allow 1 credit if the student draws circular wave fronts with a center located at the opening. There must be *at least* three wave fronts to receive credit.

Example of a 1-credit response:



Note: Do *not* penalize the student for an incorrect wavelength. Wave fronts may or may not touch the barrier.

56 [1] Allow 1 credit for the equation and substitution with units. Refer to *Scoring Criteria for Calculations* in the rating guide.

Examples of 1-credit responses:

$v_f = v_i + at$

$t = \dfrac{v_f - v_i}{a}$

$t = \dfrac{0 - 26\ \text{m/s}}{-9.81\ \text{m/s}^2}$

$t_{total} = 2t$

or

$a = \dfrac{\Delta v}{t}$

$t = \dfrac{\Delta v}{a}$

$t = \dfrac{-26\ \text{m/s} - (+26\ \text{m/s})}{-9.81\ \text{m/s}^2}$

or

$g = \dfrac{\Delta v}{t}$

$t = \dfrac{\Delta v}{g}$

$t = \dfrac{52\ \text{m/s}}{9.81\ \text{m/s}^2}$

or

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

$0 = 26\text{m/s}\ (t) + \dfrac{1}{2}(-9.8\ \text{m/s}^2)(t)^2$

57 [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 56.

Example of a 1-credit response:

$t = 5.3\ \text{s} \pm 0.1\ \text{s}$

Note: Do *not* penalize the student more than 1 credit for errors in units in questions 56 and 57.

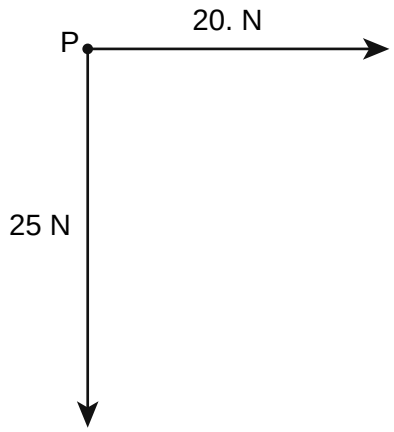
58 [1] Allow 1 credit for 80. m *or* for an answer that is consistent with the student's response to question 57.

59 [1] Allow 1 credit for 60.° ± 2°.

60 [1] Allow 1 credit for 5.0 N ± 0.3 N.

61 [1] Allow 1 credit for a vector of length 5.0 cm ± 0.2 cm directed south, *or* for an answer that is consistent with the student's response to question 60.

Example of a 1-credit response:



Note: Do *not* allow this credit if the arrowhead is missing. Do *not* deduct credit if the 25 N vector is not labeled. Do *not* deduct credit if the 25 N does not start at point *P*.

62 [1] Allow 1 credit for 32 N ± 3 N *or* for an answer that is consistent with the student's responses to questions 60 and 61.

63 [1] Allow 1 credit for 12.75 eV.

64 [1] Allow 1 credit for -1.60×10^{-19} C.

Note: Do *not* allow credit for 1.60×10^{-19} C or $+1.60 \times 10^{-19}$ C.

65 [1] Allow 1 credit for infrared or IR.

Part C

66 [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 67 and 70. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 1-credit responses:

$v_f = v_i + at$
$v_f = 25 \text{ m/s} + (-1.5 \text{ m/s}^2)(6.0 \text{ s})$

or

$v_f = v_i + at$
$v_f = -25 \text{ m/s} + (+1.5 \text{ m/s}^2)(6.0 \text{ s})$

or

$v_f^2 = v_i^2 + 2ad$
$v_f = \sqrt{(25 \text{ m/s})^2 + 2(-1.5 \text{ m/s}^2)(120 \text{ m})}$

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:

$v_f = 16 \text{ m/s}$

Note: Do *not* penalize the student for an answer of –16 m/s. Do *not* penalize the student more than 1 credit for errors in units in questions 66 and 67.

68 [1] Allow 1 credit for west or for an answer that is consistent with the student's response to question 67.

69 [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 67. Refer to *Scoring Criteria for Calculations* in this rating guide.

Examples of 1-credit responses:

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

$$d = (25\text{ m/s})(6.0\text{ s}) + \frac{1}{2}(-1.5\text{ m/s}^2)(6.0\text{ s})^2$$

or

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

$$d = (-25\text{ m/s})(6.0\text{ s}) + \frac{1}{2}(+1.5\text{ m/s}^2)(6.0\text{ s})^2$$

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

$$d = \frac{v_f{}^2 - v_i^2}{2a}$$

$$d = \frac{(16\text{ m/s})^2 - (25\text{ m/s})^2}{(2)(-1.5\text{ m/s}^2)}$$

or

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

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

$$d = \frac{(25\text{ m/s}) + (16\text{ m/s})}{2}\ (6.0\text{s})$$

70 [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 69.

Example of a 1-credit response:

d = 120 m

Note: Do *not* penalize the student for an answer of –120 m. Do *not* penalize the student more than 1 credit for errors in units in questions 69 and 70.

71 [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:

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

$$v_f = \sqrt{v_i^2 + 2ad}$$

$$v_f = \sqrt{(0\text{ m/s})^2 + 2(0.30\text{ m/s}^2)(4.2\text{ m})}$$

or

$$v_f = v_i + at$$

$$v_f = 0\text{ m/s} + (0.30\text{ m/s}^2)(5.3\text{ s})$$

72 [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 71.

Example of a 1-credit response:

$v_f = 1.6$ m/s

Note: Do *not* penalize a student more than 1 credit for errors in units in questions 71 and 72.

73 [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 72. Refer to *Scoring Criteria for Calculations* in this rating guide.

Example of a 1-credit response:

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

$$KE = \frac{1}{2}(40.\text{ kg})(1.6\text{ m/s})^2$$

74 [1] Allow 1 credit for the correct answer with units *or* for an answer, with units, that is consistent with student's response to question 73.

Example of a 1-credit response:

$KE = 51$ J

Note: Do *not* penalize a student more than 1 credit for errors in units in questions 73 and 74.

75 [1] Allow 1 credit for 590 J *or* 589 J *or* 588 J.

76 [1] Allow 1 credit for 540 J *or* for an answer that is consistent with the student's responses to questions 74 and 75.

77 [1] Allow 1 credit for the equation and substitution with units. Refer to *Scoring Criteria for Calculations* in the rating guide.

Example of a 1-credit response:

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

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

$$\sin\theta_2 = \frac{(1.66)\sin 30.^\circ}{1.00}$$

78 [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 77.

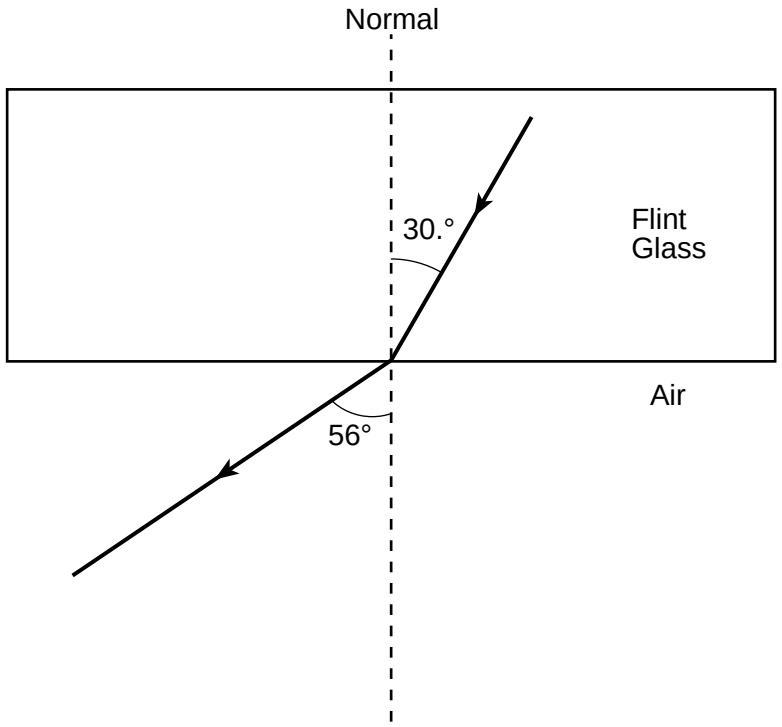
Example of a 1-credit response:

$\theta_2 = 56°$

Note: Do *not* penalize a student more than 1 credit for errors in units in questions 77 and 78.

79 [1] Allow 1 credit for drawing the refracted light ray in air at an angle of 56° ± 2° from the normal, *or* for an answer that is consistent with the student's response to question 78.

Example of a 1-credit response:



Note: Allow credit even if the arrowhead is missing. The refracted angle does *not* have to be labeled in order to receive credit.

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

Examples of 1-credit responses:

— The wavelength increases.

— increases

— gets longer

81 [1] Allow 1 credit for 0.90 N

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 this rating guide.

Example of a 1-credit response:

$$F_f = \mu F_N$$

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

$$\mu = \frac{0.90\,\text{N}}{2.0\,\text{N}}$$

83 [1] Allow 1 credit for the correct answer, without units *or* for an answer, without units, that is consistent with the student's response to question 82.

Example of a 1-credit response:

$\mu = 0.45$

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 an answer indicating the coefficient of friction decreases.

85 [1] Allow 1 credit for an answer indicating the coefficient of friction remains the same.

Regents Examination in Physical Setting/Physics

June 2023

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

The *Chart for Determining the Final Examination Score for the June 2023 Regents Examination in Physical Setting/Physics* will be posted on the Department's web site at: https://www.nysed.gov/state-assessment/high-school-regents-examinations on Thursday, June 22, 2023. 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 https://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 2023 Physical Setting/Physics			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1	4, 7	38, 39, 41, 45, 49, 50, 56, 57, 58, 59, 60, 62, 64, 65	66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 82, 83
Math Key Idea 2		43	81, 84
Math Key Idea 3		37, 42, 44	
Science Inquiry Key Idea 1			
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3			
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Standard 6			
Key Idea 1			
Key Idea 2	20, 34		80
Key Idea 3		36	
Key Idea 4			
Key Idea 5			
Key Idea 6			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
4.1		38, 40, 51, 52, 53, 54	
4.3	25	46, 47, 55	
5.1	2	48, 50, 60, 61, 62	82, 83, 84
5.3		63	
Standard 4			
4.1	14, 18, 19, 21, 22, 23	38, 39, 40, 45, 51, 52, 53, 54	73, 74, 75, 76
4.3	24, 25, 26, 27, 28, 29, 30, 31, 34, 35	41, 44, 46, 47, 55, 65	77, 78, 79, 80
5.1	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17	37, 48, 49, 50, 56, 57, 58, 59, 60, 61, 62	66, 67, 68, 69, 70, 71, 72, 81, 82, 83, 84, 85
5.3	4, 20, 32, 33	42, 43, 63, 64, 65	

Regents Examination in Physical Setting/Physics – June 2023

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

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

Raw Score Score	Scale Score
63	**80**
62	**79**
61	**78**
60	**77**
59	**76**
58	**75**
57	**74**
56	**73**
55	**72**
54	**71**
53	**70**
52	**69**
51	**67**
50	**66**
49	**65**
48	**64**
47	**63**
46	**62**
45	**61**
44	**60**
43	**59**
42	**57**

Raw Score Score	Scale Score
41	**56**
40	**55**
39	**54**
38	**53**
37	**52**
36	**51**
35	**49**
34	**48**
33	**47**
32	**46**
31	**45**
30	**43**
29	**42**
28	**41**
27	**40**
26	**38**
25	**37**
24	**36**
23	**35**
22	**33**
21	**32**
20	**31**

Raw Score Score	Scale Score
19	**29**
18	**28**
17	**27**
16	**25**
15	**24**
14	**23**
13	**21**
12	**20**
11	**18**
10	**17**
9	**15**
8	**14**
7	**12**
6	**11**
5	**9**
4	**7**
3	**6**
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.