The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, January 29, 2003 — 9:15 a.m. to 12:15 p.m., only

The answer sheet for Part A and Part B–1 is the last page of this examination booklet. Turn to the last page and fold it along the perforations. Then, slowly and carefully, tear off the answer sheet and fill in the heading.

The answer booklet for Part B–2 and Part C is stapled in the center of this examination booklet. Open the examination booklet, carefully remove the answer booklet, and close the examination booklet. Then fill in the heading of your answer booklet.

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

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

Notice. . .

A scientific or graphing calculator, a centimeter ruler, a protractor, and a copy of the *2002 Edition Reference Tables for Physical Setting/Physics*, which you may need to answer some questions in this examination, must be available for your use while taking this examination.

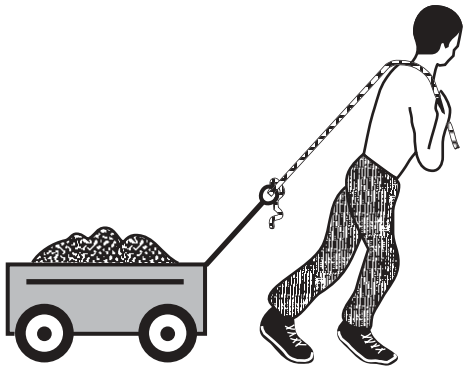
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

Answer all questions in this part.

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

1 The diagram below shows a worker using a rope to pull a cart.



The worker's pull on the handle of the cart can best be described as a force having

(1) magnitude, only
(2) direction, only
(3) both magnitude and direction
(4) neither magnitude nor direction

2 A car travels 90. meters due north in 15 seconds. Then the car turns around and travels 40. meters due south in 5.0 seconds. What is the magnitude of the average velocity of the car during this 20.-second interval?

(1) 2.5 m/s
(2) 5.0 m/s
(3) 6.5 m/s
(4) 7.0 m/s

3 How far will a brick starting from rest fall freely in 3.0 seconds?

(1) 15 m
(2) 29 m
(3) 44 m
(4) 88 m

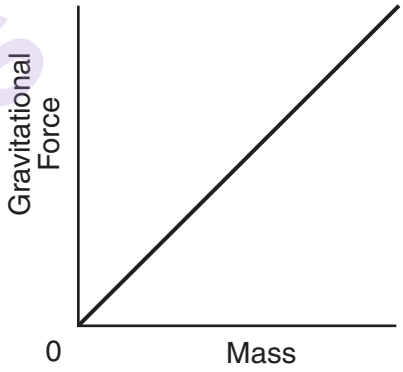
4 If the sum of all the forces acting on a moving object is zero, the object will

(1) slow down and stop
(2) change the direction of its motion
(3) accelerate uniformly
(4) continue moving with constant velocity

5 A net force of 10. newtons accelerates an object at 5.0 meters per second^2. What net force would be required to accelerate the same object at 1.0 meter per second^2?

(1) 1.0 N
(2) 2.0 N
(3) 5.0 N
(4) 50. N

6 The graph below represents the relationship between gravitational force and mass for objects near the surface of Earth.



The slope of the graph represents the

(1) acceleration due to gravity
(2) universal gravitational constant
(3) momentum of objects
(4) weight of objects

7 A 1,200-kilogram car traveling at 10. meters per second hits a tree and is brought to rest in 0.10 second. What is the magnitude of the average force acting on the car to bring it to rest?

(1) 1.2×10^2 N
(2) 1.2×10^3 N
(3) 1.2×10^4 N
(4) 1.2×10^5 N

8 A spring scale reads 20. newtons as it pulls a 5.0-kilogram mass across a table. What is the magnitude of the force exerted by the mass on the spring scale?

(1) 49 N
(2) 20. N
(3) 5.0 N
(4) 4.0 N

Base your answers to questions 9 and 10 on the information below.

A 2.0×10^3-kilogram car travels at a constant speed of 12 meters per second around a circular curve of radius 30. meters.

9 What is the magnitude of the centripetal acceleration of the car as it goes around the curve?

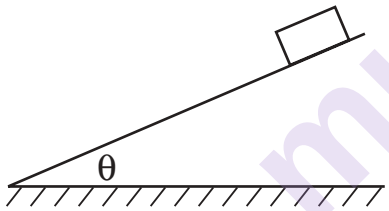
(1) 0.40 m/s^2
(2) 4.8 m/s^2
(3) 800 m/s^2
(4) 9,600 m/s^2

10 As the car goes around the curve, the centripetal force is directed

(1) toward the center of the circular curve
(2) away from the center of the circular curve
(3) tangent to the curve in the direction of motion
(4) tangent to the curve opposite the direction of motion

Note that question 11 has only three choices.

11 The diagram below shows a block sliding down a plane inclined at angle θ with the horizontal.



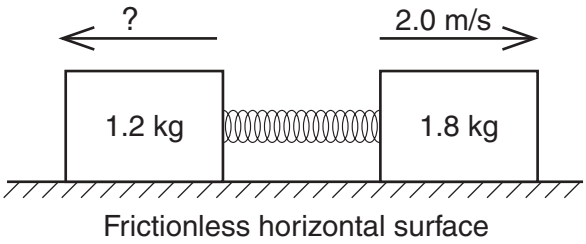
As angle θ is increased, the coefficient of kinetic friction between the bottom surface of the block and the surface of the incline will

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

12 The amount of work done against friction to slide a box in a straight line across a uniform, horizontal floor depends most on the

(1) time taken to move the box
(2) distance the box is moved
(3) speed of the box
(4) direction of the box's motion

13 A 1.2-kilogram block and a 1.8-kilogram block are initially at rest on a frictionless, horizontal surface. When a compressed spring between the blocks is released, the 1.8-kilogram block moves to the right at 2.0 meters per second, as shown.



What is the speed of the 1.2-kilogram block after the spring is released?

(1) 1.4 m/s
(2) 2.0 m/s
(3) 3.0 m/s
(4) 3.6 m/s

14 An object weighs 100. newtons on Earth's surface. When it is moved to a point one Earth radius above Earth's surface, it will weigh

(1) 25.0 N
(2) 50.0 N
(3) 100. N
(4) 400. N

15 An object weighing 15 newtons is lifted from the ground to a height of 0.22 meter. The increase in the object's gravitational potential energy is approximately

(1) 310 J
(2) 32 J
(3) 3.3 J
(4) 0.34 J

Note that question 16 has only three choices.

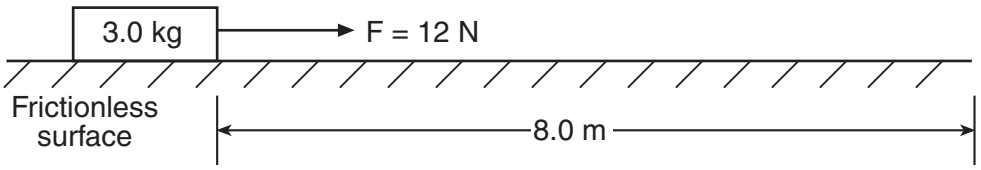
16 As an object falls freely, the kinetic energy of the object

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

17 Moving 2.5×10^{-6} coulomb of charge from point A to point B in an electric field requires 6.3×10^{-4} joule of work. The potential difference between points A and B is approximately

(1) 1.6×10^{-9} V
(2) 4.0×10^{-3} V
(3) 2.5×10^{2} V
(4) 1.0×10^{14} V

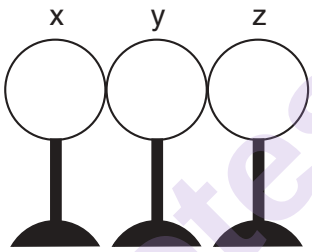
18 A 3.0-kilogram block is initially at rest on a frictionless, horizontal surface. The block is moved 8.0 meters in 2.0 seconds by the application of a 12-newton horizontal force, as shown in the diagram below.



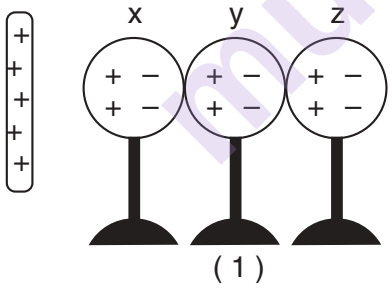
What is the average power developed while moving the block?

(1) 24 W
(2) 32 W
(3) 48 W
(4) 96 W

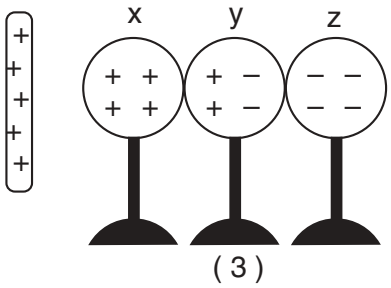
19 The diagram below shows three neutral metal spheres, *x*, *y*, and *z*, in contact and on insulating stands.



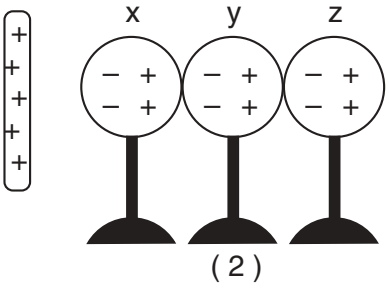
Which diagram best represents the charge distribution on the spheres when a positively charged rod is brought near sphere *x*, but does not touch it?



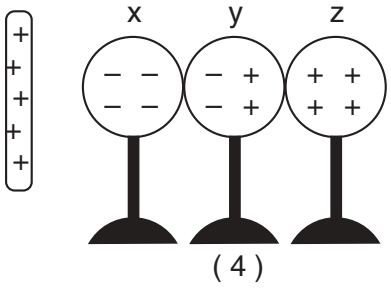
(1)



(3)

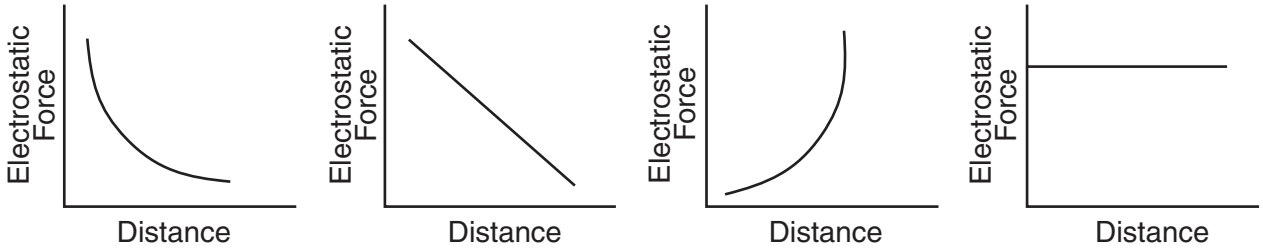


(2)



(4)

20 Which graph best represents the electrostatic force between an alpha particle with a charge of +2 elementary charges and a positively charged nucleus as a function of their distance of separation?



21 When a neutral metal sphere is charged by contact with a positively charged glass rod, the sphere

(1) loses electrons
(2) gains electrons
(3) loses protons
(4) gains protons

22 If 10. coulombs of charge are transferred through an electric circuit in 5.0 seconds, then the current in the circuit is

(1) 0.50 A
(2) 2.0 A
(3) 15 A
(4) 50. A

23 The diagram below represents a source of potential difference connected to two large, parallel metal plates separated by a distance of 4.0×10^{-3} meter.

Which statement best describes the electric field strength between the plates?

(1) It is zero at point *B*.
(2) It is a maximum at point *B*.
(3) It is a maximum at point *C*.
(4) It is the same at points *A*, *B*, and *C*.

24 A periodic wave transfers

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

Note that question 25 has only three choices.

25 As the potential difference across a given resistor is increased, the power expended in moving charge through the resistor

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

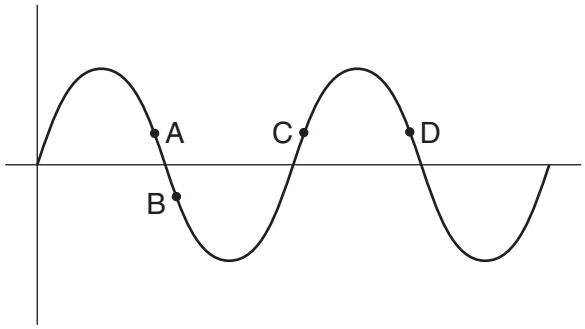
26 An electric iron operating at 120 volts draws 10. amperes of current. How much heat energy is delivered by the iron in 30. seconds?

(1) 3.0×10^2 J
(2) 1.2×10^3 J
(3) 3.6×10^3 J
(4) 3.6×10^4 J

27 A motor is used to produce 4.0 waves each second in a string. What is the frequency of the waves?

(1) 0.25 Hz
(2) 15 Hz
(3) 25 Hz
(4) 4.0 Hz

28 The diagram below shows a periodic wave.



Which points are in phase with each other?

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

29 A surfacing whale in an aquarium produces water wave crests having an amplitude of 1.2 meters every 0.40 second. If the water wave travels at 4.5 meters per second, the wavelength of the wave is

(1) 1.8 m
(2) 2.4 m
(3) 3.0 m
(4) 11 m

30 In a certain material, a beam of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) has a speed of 2.25×10^{8} meters per second. The material could be

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

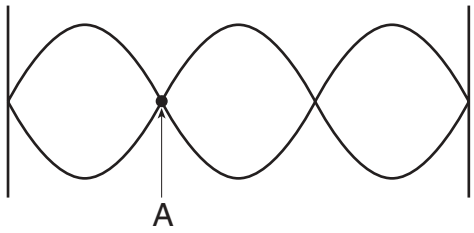
31 Orange light has a frequency of 5.0×10^{14} hertz in a vacuum. What is the wavelength of this light?

(1) 1.5×10^{23} m
(2) 1.7×10^{6} m
(3) 6.0×10^{-7} m
(4) 2.0×10^{-15} m

32 A radar gun can determine the speed of a moving automobile by measuring the difference in frequency between emitted and reflected radar waves. This process illustrates

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

33 The diagram below shows a standing wave.



Point *A* on the standing wave is

(1) a node resulting from constructive interference
(2) a node resulting from destructive interference
(3) an antinode resulting from constructive interference
(4) an antinode resulting from destructive interference

34 An object possessing an excess of 6.0×10^{6} electrons has a net charge of

(1) 2.7×10^{-26} C
(2) 5.5×10^{-24} C
(3) 3.8×10^{-13} C
(4) 9.6×10^{-13} C

35 One watt is equivalent to one

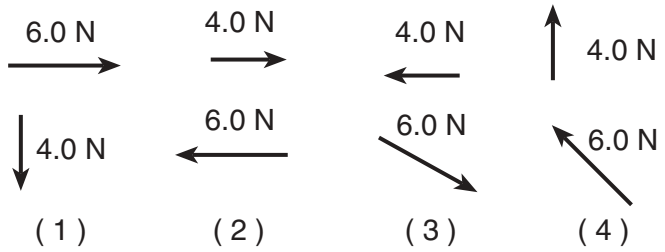
(1) N•m
(2) N/m
(3) J•s
(4) J/s

Part B–1

Answer all questions in this part.

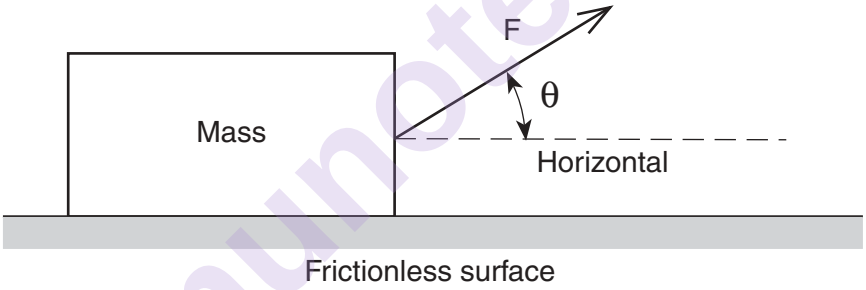
Directions (36–50): For *each* statement or question, write on the separate answer sheet, the *number* of the word or expression that, of those given, best completes the statement or answers the question.

36 Which pair of forces acting concurrently on an object will produce the resultant of greatest magnitude?



Note that question 37 has only three choices.

37 The diagram below shows a force of magnitude *F* applied to a mass at angle θ relative to a horizontal frictionless surface.



As angle θ is increased, the horizontal acceleration of the mass

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

38 The mass of a high school football player is approximately

(1) 10^0 kg
(2) 10^1 kg
(3) 10^2 kg
(4) 10^3 kg

39 A constant force is used to keep a block sliding at constant velocity along a rough horizontal track. As the block slides, there could be an increase in its

(1) gravitational potential energy, only
(2) internal energy, only
(3) gravitational potential energy and kinetic energy
(4) internal energy and kinetic energy

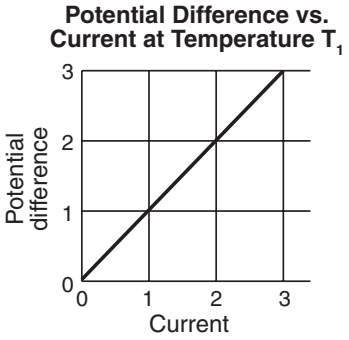
40 A photon of which electromagnetic radiation has the most energy?

(1) ultraviolet
(2) x ray
(3) infrared
(4) microwave

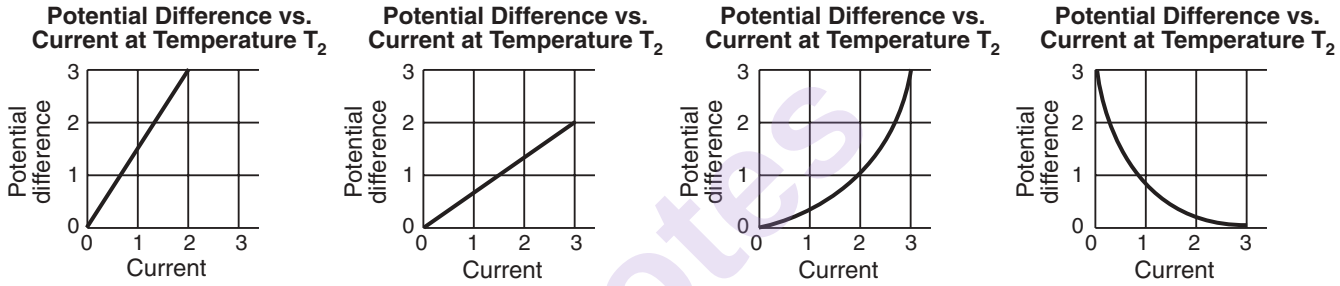
41 The spring of a toy car is wound by pushing the car backward with an average force of 15 newtons through a distance of 0.50 meter. How much elastic potential energy is stored in the car's spring during this process?

(1) 1.9 J
(2) 7.5 J
(3) 30. J
(4) 56 J

42 The graph below shows the relationship between the potential difference across a metallic conductor and the electric current through the conductor at constant temperature T_1.

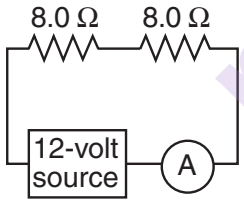


Which graph best represents the relationship between potential difference and current for the same conductor maintained at a higher constant temperature, T_2?



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

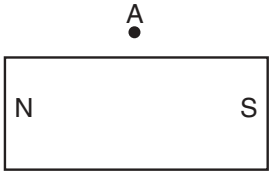
43 The diagram below shows a circuit with two resistors.



What is the reading on ammeter A?

(1) 1.3 A (3) 3.0 A
(2) 1.5 A (4) 0.75 A

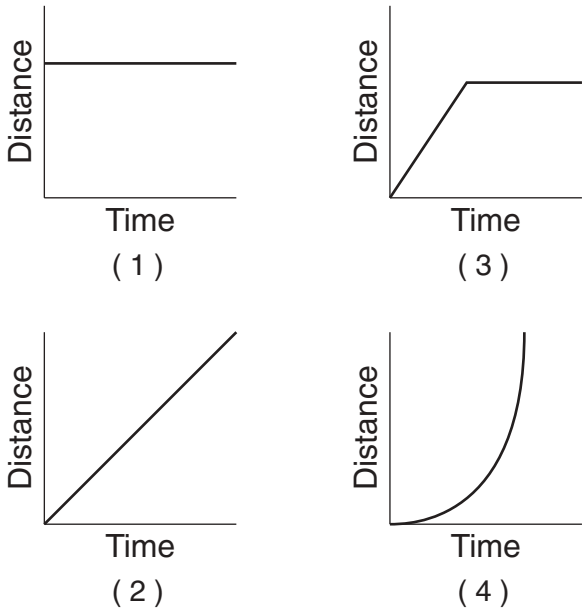
44 The diagram below shows a bar magnet.



Which arrow best represents the direction of the needle of a compass placed at point A?

(1) ↑ (3) →
(2) ↓ (4) ←

45 Which graph best represents the motion of a block accelerating uniformly down an inclined plane?

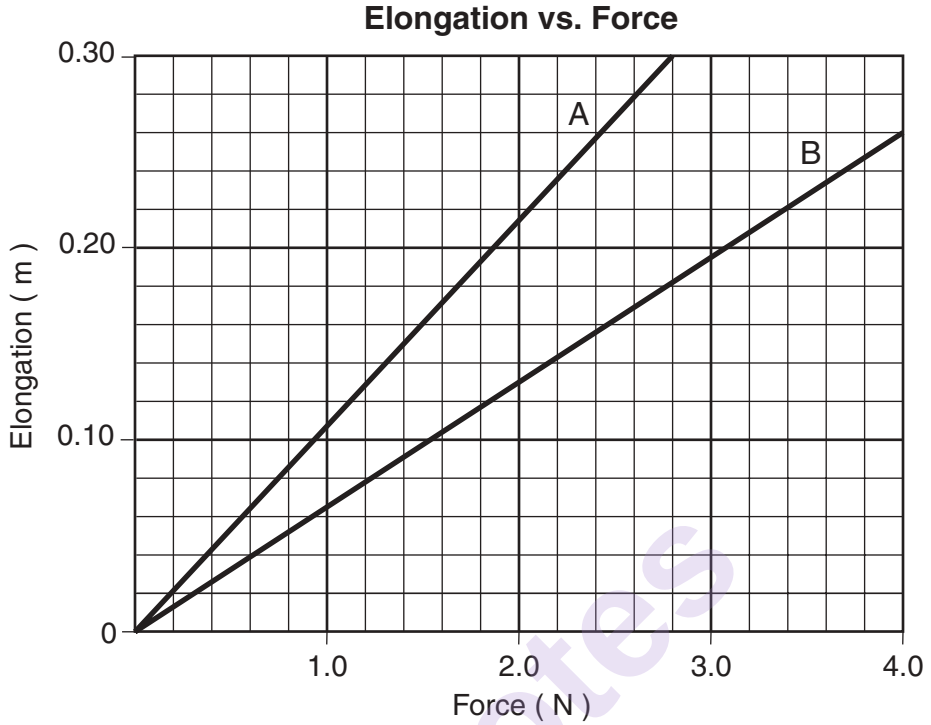


(1) (3)

(2) (4)

Note that question 46 has only three choices.

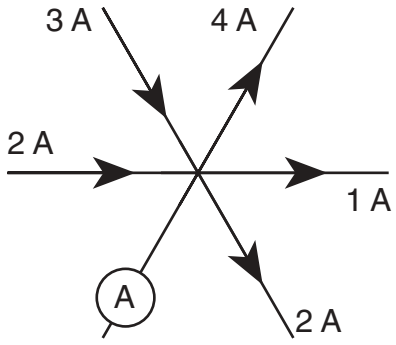
46 The graph below shows elongation as a function of the applied force for two springs, *A* and *B*.



Compared to the spring constant for spring *A*, the spring constant for spring *B* is

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

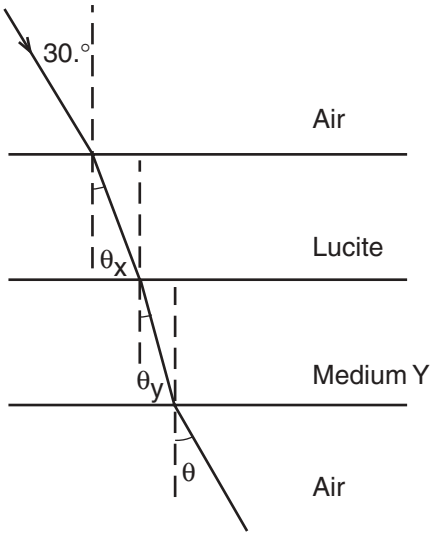
47 The diagram below represents currents in a segment of an electric circuit.



What is the reading of ammeter *A*?

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

Base your answers to questions 48 and 49 on the diagram below, which represents a light ray traveling from air to Lucite to medium *Y* and back into air.



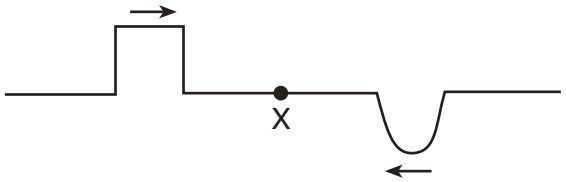
48 The sine of angle θ_x is

(1) 0.333
(2) 0.500
(3) 0.707
(4) 0.886

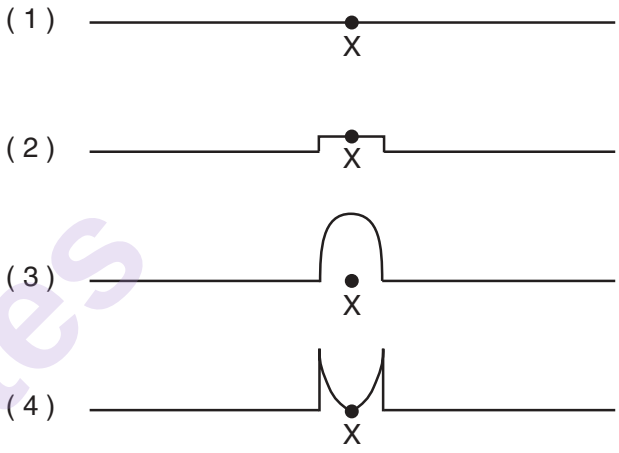
49 Light travels *slowest* in

(1) air, only
(2) Lucite, only
(3) medium *Y*, only
(4) air, Lucite, and medium *Y*

50 The diagram below shows two pulses traveling toward each other in a uniform medium.



Which diagram best represents the medium when the pulses meet at point *X*?



Part B–2

Answer all questions in this part.

Directions (51–62): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 51 and 52 on the information below.

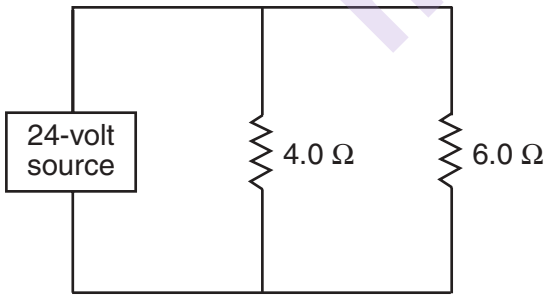
An outfielder throws a baseball to the first baseman at a speed of 19.6 meters per second and an angle of 30.° above the horizontal.

51 Which pair represents the initial horizontal velocity (v_x) and initial vertical velocity (v_y) of the baseball?

(1) v_x = 17.0 m/s, v_y = 9.80 m/s
(2) v_x = 9.80 m/s, v_y = 17.0 m/s
(3) v_x = 19.4 m/s, v_y = 5.90 m/s
(4) v_x = 19.6 m/s, v_y = 19.6 m/s

52 If the ball is caught at the same height from which it was thrown, calculate the amount of time the ball was in the air. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 53 and 54 on the circuit diagram below, which shows two resistors connected to a 24-volt source of potential difference.

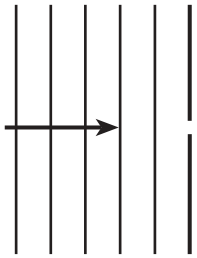


53 On the diagram *in your answer booklet,* use the appropriate circuit symbol to indicate a correct placement of a voltmeter to determine the potential difference across the circuit. [1]

54 What is the total resistance of the circuit?

(1) 0.42 Ω
(2) 2.4 Ω
(3) 5.0 Ω
(4) 10. Ω

55 The diagram below shows a plane wave passing through a small opening in a barrier.



On the diagram *in your answer booklet,* sketch four wave fronts after they have passed through the barrier. [1]

56 What prevents the nucleus of a helium atom from flying apart? [1]

Base your answers to questions 57 and 58 on the information below.

A 1.00-meter length of nichrome wire with a cross-sectional area of 7.85×10^{-7} meter^2 is connected to a 1.50-volt battery.

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

58 Determine the current in the wire. [1]

Base your answers to questions 59 through 62 on the information and table below.

In a laboratory exercise, a student kept the mass and amplitude of swing of a simple pendulum constant. The length of the pendulum was increased and the period of the pendulum was measured. The student recorded the data in the table below.

Length (meters)	**Period** (seconds)
0.05	0.30
0.20	0.90
0.40	1.30
0.60	1.60
0.80	1.80
1.00	2.00

Directions (59–61): Using the information in the table, construct a graph on the grid provided *in your answer booklet*, following the directions below.

59 Label each axis with the appropriate physical quantity and unit. Mark an appropriate scale on each axis. [2]

60 Plot the data points for period versus pendulum length. [1]

61 Draw the best-fit line or curve for the data graphed. [1]

62 Using your graph, determine the period of a pendulum whose length is 0.25 meter. [1]

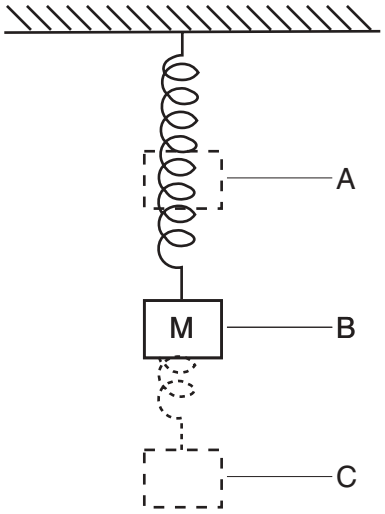
Part C

Answer all questions in this part.

Directions (63–78): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 63 through 65 on the information and diagram below.

A mass, M, is hung from a spring and reaches equilibrium at position B. The mass is then raised to position A and released. The mass oscillates between positions A and C. [Neglect friction.]



63 At which position, A, B, or C, is mass M located when the kinetic energy of the system is at a maximum? Explain your choice. [1]

64 At which position, A, B, or C, is mass M located when the gravitational potential energy of the system is at a maximum? Explain your choice. [1]

65 At which position, A, B, or C, is mass M located when the elastic potential energy of the system is at a maximum? Explain your choice. [1]

Base your answers to questions 66 through 69 on the information below.

A force of 6.0×10^{-15} newton due south and a force of 8.0×10^{-15} newton due east act concurrently on an electron, e^-.

66 On the diagram *in your answer booklet*, draw a force diagram to represent the *two* forces acting on the electron. (The electron is represented by a dot.) Use a metric ruler and the scale of 1.0 centimeter = 1.0×10^{-15} newton. Begin each vector at the dot representing the electron and label its magnitude in newtons. [2]

67 *In your answer booklet*, determine the resultant force on the electron, *graphically*. Label the resultant vector R. [1]

68 Determine the magnitude of the resultant vector R. [1]

69 Determine the angle between the resultant and the 6.0×10^{-15}-newton vector. [1]

Base your answers to questions 70 through 74 on the information below.

A force of 10. newtons toward the right is exerted on a wooden crate initially moving to the right on a horizontal wooden floor. The crate weighs 25 newtons.

70 Calculate the magnitude of the force of friction between the crate and the floor. [Show all work, including the equation and substitution with units.] [2]

71 On the diagram *in your answer booklet*, draw and label all vertical forces acting on the crate. [1]

72 On the diagram *in your answer booklet*, draw and label all horizontal forces acting on the crate. [1]

73 What is the magnitude of the net force acting on the crate? [1]

74 Is the crate accelerating? Explain your answer. [1]

Base your answers to questions 75 through 78 on the information below.

An electron in a hydrogen atom drops from the $n = 3$ energy level to the $n = 2$ energy level.

75 What is the energy, in electronvolts, of the emitted photon? [1]

76 What is the energy, in joules, of the emitted photon? [1]

77 Calculate the frequency of the emitted radiation. [Show all work, including the equation and substitution with units.] [2]

78 Calculate the wavelength of the emitted radiation. [Show all work, including the equation and substitution with units.] [2]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, January 29, 2003 — 9:15 a.m. to 12:15 p.m., only

ANSWER SHEET

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

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

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

Part A

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

Part A Score

Part B–1

36	44 . . . . .
37	45 . . . . .
38	46 . . . . .
39	47 . . . . .
40	48 . . . . .
41	49 . . . . .
42	50 . . . . .
43	

Part B–1 Score

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

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

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

Signature

Tear Here

Tear Here

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Wednesday, January 29, 2003 — 9:15 a.m. to 12:15 p.m., only

ANSWER BOOKLET

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

Teacher . . . . . .

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

Answer all questions in Part B–2 and Part C. Record your answers in this booklet.

Part	Maximum Score	Student's Score
A	35	
B–1	15	
B–2	15	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

Final Score (From Conversion Chart)

Raters' Initials:

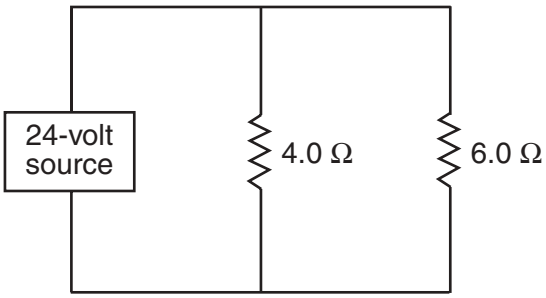
Rater 1 . . . . . **Rater 2** . . . . . .

Part B–2

51 _____

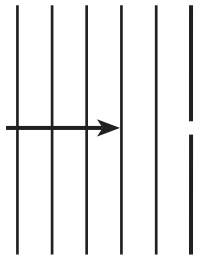
52

53



54

55



56 _____

_____

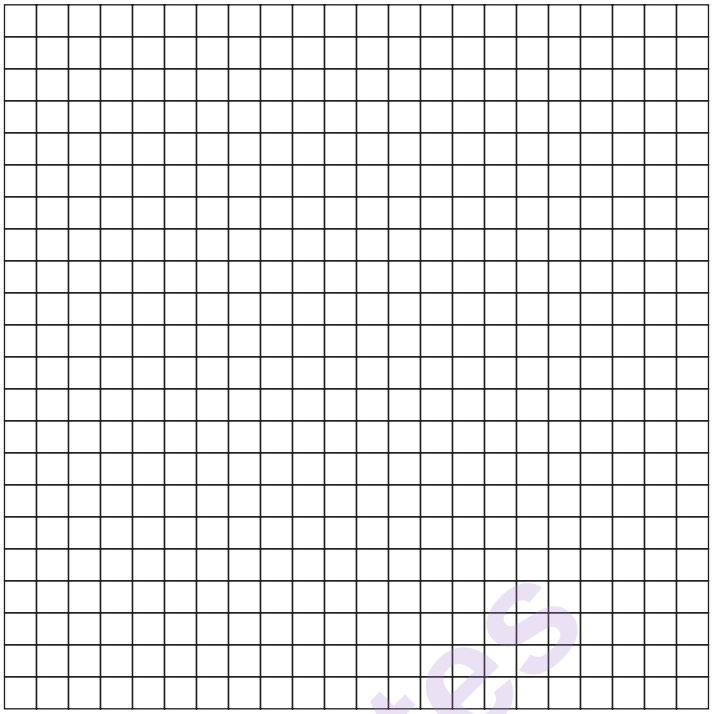
57

58 _____ **A**

[b]

59–61

Period vs. Length of Pendulum



62 _____ s

Part C

63 _____

_____

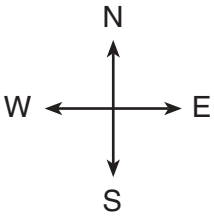
64 _____

_____

65 _____

_____

66–67



e^-

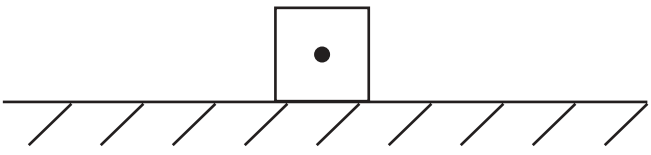
●

68 _____ **N**

69 _____ °

70

71–72



73 _____ **N**

74 _____

_____

_____

_____

75 _____**eV**

76 _____**J**

77

78