The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 21, 2007 — 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 in the answer booklet.

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

Notice. . .

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

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

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

Part A

Answer all questions in this part.

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

1 Which is *not* a vector quantity?

(1) electric charge
(2) magnetic field strength
(3) velocity
(4) displacement

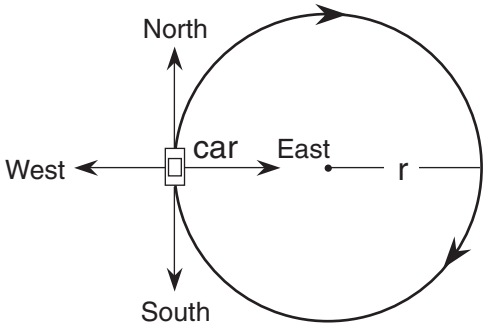
2 An astronaut standing on a platform on the Moon drops a hammer. If the hammer falls 6.0 meters vertically in 2.7 seconds, what is its acceleration?

(1) 1.6 m/s^2
(2) 2.2 m/s^2
(3) 4.4 m/s^2
(4) 9.8 m/s^2

3 A 2.00-kilogram object weighs 19.6 newtons on Earth. If the acceleration due to gravity on Mars is 3.71 meters per second^2, what is the object's mass on Mars?

(1) 2.64 kg
(2) 2.00 kg
(3) 19.6 N
(4) 7.42 N

4 A car moves with a constant speed in a clockwise direction around a circular path of radius *r*, as represented in the diagram below.



When the car is in the position shown, its acceleration is directed toward the

(1) north
(2) west
(3) south
(4) east

Note that question 5 has only three choices.

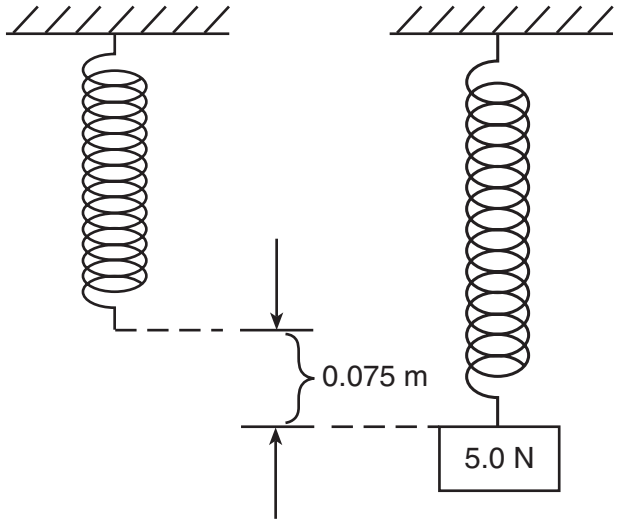
5 As the angle between two concurrent forces decreases, the magnitude of the force required to produce equilibrium

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

6 A child walks 5.0 meters north, then 4.0 meters east, and finally 2.0 meters south. What is the magnitude of the resultant displacement of the child after the entire walk?

(1) 1.0 m
(2) 5.0 m
(3) 3.0 m
(4) 11.0 m

7 The diagram below represents a spring hanging vertically that stretches 0.075 meter when a 5.0-newton block is attached. The spring-block system is at rest in the position shown.



The value of the spring constant is

(1) 38 N/m
(2) 67 N/m
(3) 130 N/m
(4) 650 N/m

8 A 0.50-kilogram object moves in a horizontal circular path with a radius of 0.25 meter at a constant speed of 4.0 meters per second. What is the magnitude of the object's acceleration?

(1) 8.0 m/s^2
(2) 16 m/s^2
(3) 32 m/s^2
(4) 64 m/s^2

9 Which situation will produce the greatest change of momentum for a 1.0-kilogram cart?

(1) accelerating it from rest to 3.0 m/s
(2) accelerating it from 2.0 m/s to 4.0 m/s
(3) applying a net force of 5.0 N for 2.0 s
(4) applying a net force of 10.0 N for 0.5 s

10 Earth's mass is approximately 81 times the mass of the Moon. If Earth exerts a gravitational force of magnitude F on the Moon, the magnitude of the gravitational force of the Moon on Earth is

(1) F
(2) $\frac{F}{81}$
(3) $9F$
(4) $81F$

11 The table below lists the mass and speed of each of four objects.

Data Table

Objects	Mass (kg)	Speed (m/s)
A	1.0	4.0
B	2.0	2.0
C	0.5	4.0
D	4.0	1.0

Which two objects have the same kinetic energy?

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

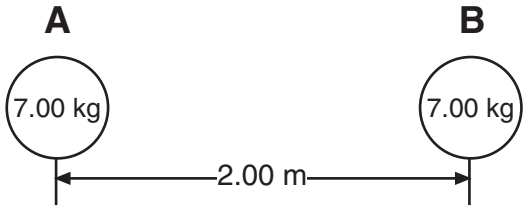
12 A horizontal force of 5.0 newtons acts on a 3.0-kilogram mass over a distance of 6.0 meters along a horizontal, frictionless surface. What is the change in kinetic energy of the mass during its movement over the 6.0-meter distance?

(1) 6.0 J
(2) 15 J
(3) 30. J
(4) 90. J

13 Which quantity is a measure of the rate at which work is done?

(1) energy
(2) power
(3) momentum
(4) velocity

14 The diagram shows two bowling balls, A and B, each having a mass of 7.00 kilograms, placed 2.00 meters apart.



What is the magnitude of the gravitational force exerted by ball A on ball B?

(1) 8.17×10^{-9} N
(2) 1.63×10^{-9} N
(3) 8.17×10^{-10} N
(4) 1.17×10^{-10} N

15 If 1.0 joule of work is required to move 1.0 coulomb of charge between two points in an electric field, the potential difference between the two points is

(1) 1.0×10^{0} V
(2) 9.0×10^{9} V
(3) 6.3×10^{18} V
(4) 1.6×10^{-19} V

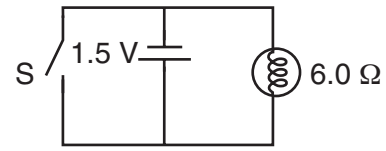
16 The current through a 10.-ohm resistor is 1.2 amperes. What is the potential difference across the resistor?

(1) 8.3 V
(2) 12 V
(3) 14 V
(4) 120 V

17 A copper wire of length L and cross-sectional area A has resistance R. A second copper wire at the same temperature has a length of $2L$ and a cross-sectional area of $\frac{1}{2}A$. What is the resistance of the second copper wire?

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

18 A 6.0-ohm lamp requires 0.25 ampere of current to operate. In which circuit below would the lamp operate correctly when switch S is closed?

(1)


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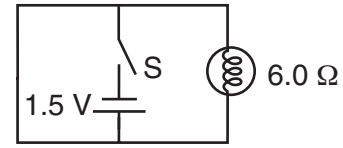

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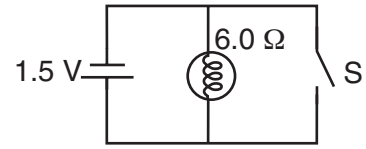

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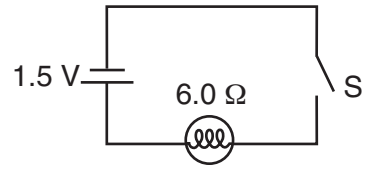


19 What is the total current in a circuit consisting of six operating 100-watt lamps connected in parallel to a 120-volt source?

(1) 5 A
(2) 20 A
(3) 600 A
(4) 12 000 A

20 A 4.50-volt personal stereo uses 1950 joules of electrical energy in one hour. What is the electrical resistance of the personal stereo?

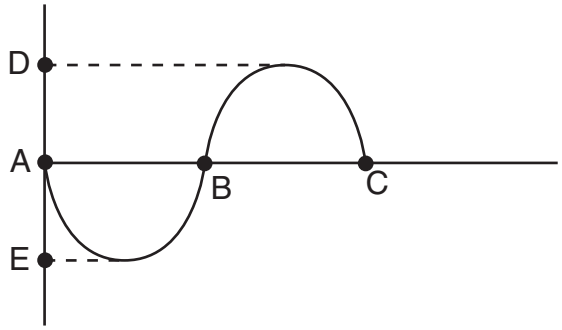
(1) 433 Ω
(2) 96.3 Ω
(3) 37.4 Ω
(4) 0.623 Ω

Note that question 21 has only three choices.

21 As yellow light ($f = 5.09 \times 10^{14}$ Hz) travels from zircon into diamond, the speed of the light

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

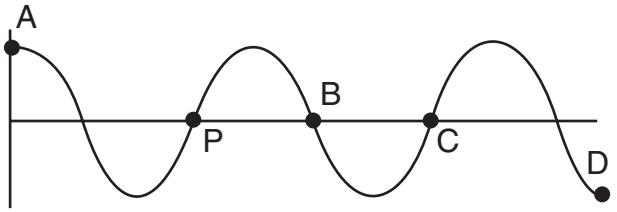
22 The diagram below represents a transverse wave.



The distance between which two points identifies the amplitude of the wave?

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

23 The diagram below represents a periodic wave.



Which point on the wave is in phase with point P?

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

24 What is the period of a 60.-hertz electromagnetic wave traveling at 3.0×10^8 meters per second?

(1) 1.7×10^{-2} s
(2) 2.0×10^{-7} s
(3) 6.0×10^{1} s
(4) 5.0×10^{6} s

25 At an outdoor physics demonstration, a delay of 0.50 second was observed between the time sound waves left a loudspeaker and the time these sound waves reached a student through the air. If the air is at STP, how far was the student from the speaker?

(1) 1.5×10^{-3} m
(2) 1.7×10^{2} m
(3) 6.6×10^{2} m
(4) 1.5×10^{8} m

26 A microwave and an x ray are traveling in a vacuum. Compared to the wavelength and period of the microwave, the x ray has a wavelength that is

(1) longer and a period that is shorter
(2) longer and a period that is longer
(3) shorter and a period that is longer
(4) shorter and a period that is shorter

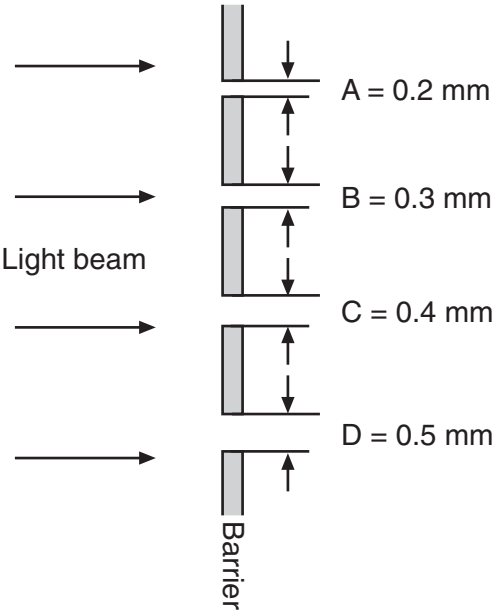
27 Which type of wave requires a material medium through which to travel?

(1) electromagnetic
(2) infrared
(3) sound
(4) radio

28 A car traveling at 70 kilometers per hour accelerates to pass a truck. When the car reaches a speed of 90 kilometers per hour the driver hears the glove compartment door start to vibrate. By the time the speed of the car is 100 kilometers per hour, the glove compartment door has stopped vibrating. This vibrating phenomenon is an example of

(1) the Doppler effect
(2) diffraction
(3) resonance
(4) destructive interference

29 A beam of monochromatic light approaches a barrier having four openings, *A*, *B*, *C*, and *D*, of different sizes as shown below.



Which opening will cause the greatest diffraction?

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

30 Two waves having the same frequency and amplitude are traveling in the same medium. Maximum constructive interference occurs at points where the phase difference between the two superposed waves is

(1) 0°
(2) 90°
(3) 180°
(4) 270°

31 A student sees a train that is moving away from her and sounding its whistle at a constant frequency. Compared to the sound produced by the whistle, the sound observed by the student is

(1) greater in amplitude
(2) a transverse wave rather than a longitudinal wave
(3) higher in pitch
(4) lower in pitch

32 Which quantity of excess electric charge could be found on an object?

(1) 6.25×10^{-19} C
(2) 4.80×10^{-19} C
(3) 6.25 elementary charges
(4) 1.60 elementary charges

33 The diagram below represents two electrically charged identical-sized metal spheres, *A* and *B*.

If the spheres are brought into contact, which sphere will have a net gain of electrons?

(1) *A*, only
(2) *B*, only
(3) both *A* and *B*
(4) neither *A* nor *B*

34 Light demonstrates the characteristics of

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

35 The energy produced by the complete conversion of 2.0×10^{-5} kilogram of mass into energy is

(1) 1.8 TJ
(2) 6.0 GJ
(3) 1.8 MJ
(4) 6.0 kJ

Part B–1

Answer all questions in this part.

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

36 What is the approximate length of a baseball bat?

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

37 A force of 1 newton is equivalent to 1

(1) $\frac{\text{kg} \bullet \text{m}}{\text{s}^2}$
(2) $\frac{\text{kg} \bullet \text{m}}{\text{s}}$
(3) $\frac{\text{kg} \bullet \text{m}^2}{\text{s}^2}$
(4) $\frac{\text{kg}^2 \bullet \text{m}^2}{\text{s}^2}$

Base your answers to questions 38 and 39 on the information below.

A stream is 30. meters wide and its current flows southward at 1.5 meters per second. A toy boat is launched with a velocity of 2.0 meters per second eastward from the west bank of the stream.

38 What is the magnitude of the boat's resultant velocity as it crosses the stream?

(1) 0.5 m/s
(2) 2.5 m/s
(3) 3.0 m/s
(4) 3.5 m/s

39 How much time is required for the boat to reach the opposite bank of the stream?

(1) 8.6 s
(2) 12 s
(3) 15 s
(4) 60. s

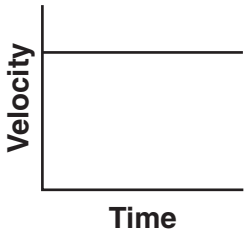
40 An observer recorded the following data for the motion of a car undergoing constant acceleration.

Time (s)	**Speed** (m/s)
3.0	4.0
5.0	7.0
6.0	8.5

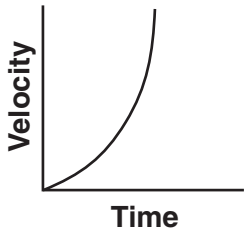
What was the magnitude of the acceleration of the car?

(1) 1.3 m/s^2
(2) 2.0 m/s^2
(3) 1.5 m/s^2
(4) 4.5 m/s^2

41 Which graph best represents the relationship between the velocity of an object thrown straight upward from Earth's surface and the time that elapses while it is in the air? [Neglect friction.]



(1)



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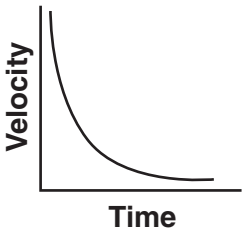

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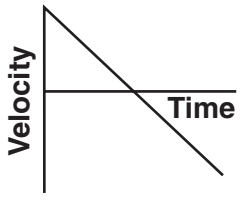
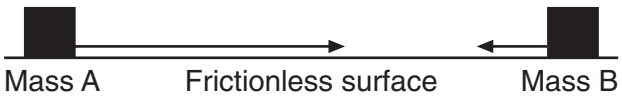
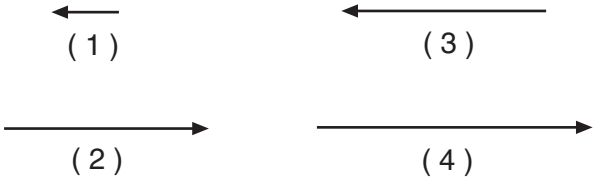


(4)

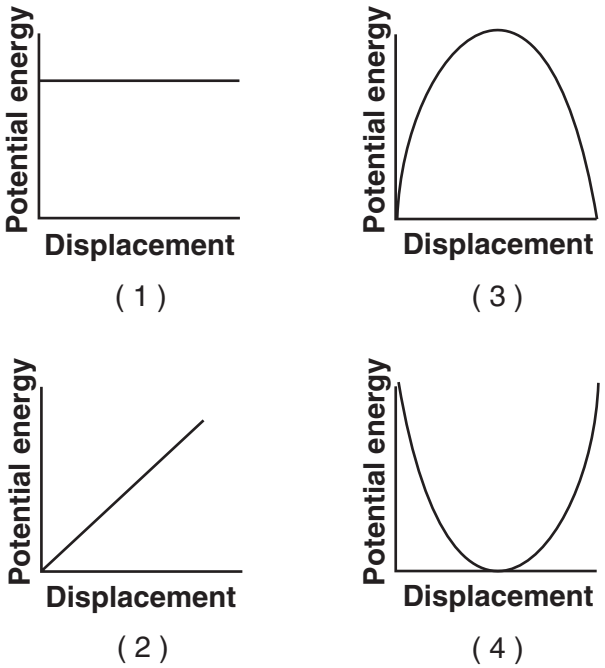
42 In the diagram below, scaled vectors represent the momentum of each of two masses, *A* and *B*, sliding toward each other on a frictionless, horizontal surface.



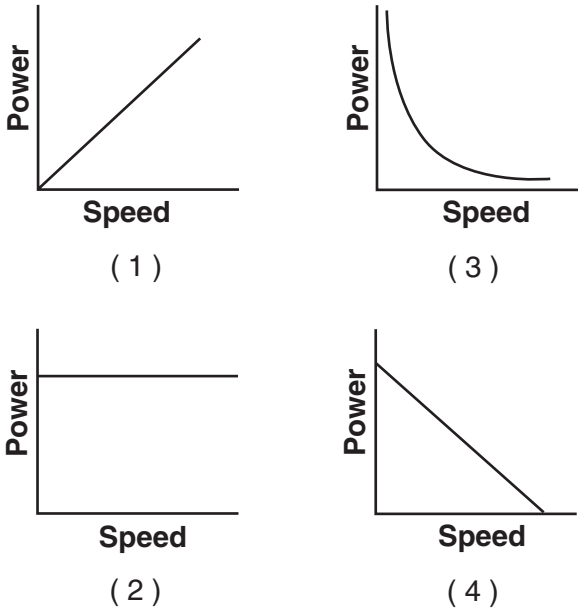
Which scaled vector best represents the momentum of the system after the masses collide?



43 A pendulum is pulled to the side and released from rest. Which graph best represents the relationship between the gravitational potential energy of the pendulum and its displacement from its point of release?



44 Which graph best represents the relationship between the power required to raise an elevator and the speed at which the elevator rises?



45 Baryons may have charges of

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

46 The slope of a graph of photon energy versus photon frequency represents

(1) Planck's constant
(2) the mass of a photon
(3) the speed of light
(4) the speed of light squared

Part B–2

Answer all questions in this part.

Directions (47–60): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 47 and 48 on the information below.

The magnitude of the electric field strength between two oppositely charged parallel metal plates is 2.0×10^3 newtons per coulomb. Point *P* is located midway between the plates.

47 On the diagram *in your answer booklet*, sketch *at least five* electric field lines to represent the field between the two oppositely charged plates. [Draw an arrowhead on each field line to show the proper direction.] [1]

48 An electron is located at point *P* between the plates. Calculate the magnitude of the force exerted on the electron by the electric field. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 49 through 51 on the information below.

A student generates a series of transverse waves of varying frequency by shaking one end of a loose spring. All the waves move along the spring at a speed of 6.0 meters per second.

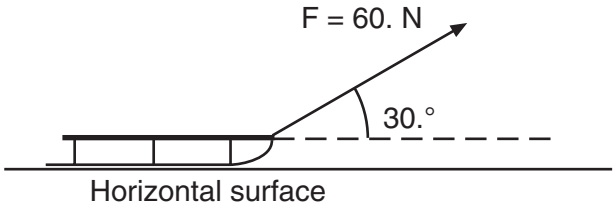
49 Complete the data table *in your answer booklet*, by determining the wavelengths for the frequencies given. [1]

50 On the grid *in your answer booklet*, plot the data points for wavelength versus frequency. [1]

51 Draw the best-fit line or curve. [1]

Base your answers to questions 52 and 53 on the information and diagram below.

A force of 60. newtons is applied to a rope to pull a sled across a horizontal surface at a constant velocity. The rope is at an angle of 30. degrees above the horizontal.



52 Calculate the magnitude of the component of the 60.-newton force that is parallel to the horizontal surface. [Show all work, including the equation and substitution with units.] [2]

53 Determine the magnitude of the frictional force acting on the sled. [1]

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54 A book sliding across a horizontal tabletop slows until it comes to rest. Describe what change, if any, occurs in the book's kinetic energy and internal energy as it slows. [2]

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

A projectile is launched into the air with an initial speed of v_i at a launch angle of 30.° above the horizontal. The projectile lands on the ground 2.0 seconds later.

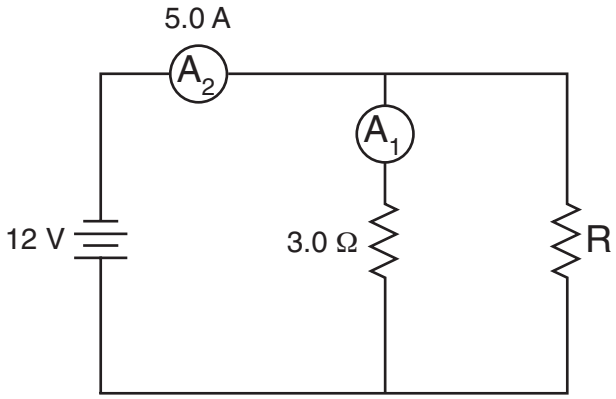
55 On the diagram *in your answer booklet*, sketch the ideal path of the projectile. [1]

56 How does the maximum altitude of the projectile change as the launch angle is increased from 30.° to 45° above the horizontal? [Assume the same initial speed, v_i.] [1]

57 How does the total horizontal distance traveled by the projectile change as the launch angle is increased from 30.° to 45° above the horizontal? [Assume the same initial speed, v_i.] [1]

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

A 3.0-ohm resistor, an unknown resistor, R, and two ammeters, A_1 and A_2, are connected as shown with a 12-volt source. Ammeter A_2 reads a current of 5.0 amperes.



58 Determine the equivalent resistance of the circuit. [1]

59 Calculate the current measured by ammeter A_1. [Show all work, including the equation and substitution with units.] [2]

60 Calculate the resistance of the unknown resistor, R. [Show all work, including the equation and substitution with units.] [2]

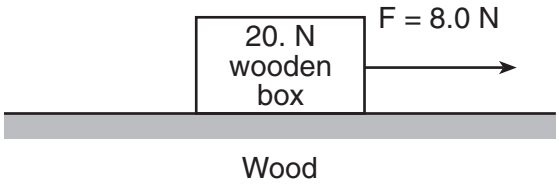
Part C

Answer all questions in this part.

Directions (61–74): Record your answers in the spaces provided in your answer booklet.

Base your answers to question 61 through 65 on the information and diagram below.

A horizontal force of 8.0 newtons is used to pull a 20.-newton wooden box moving toward the right along a horizontal, wood surface, as shown.



61 Starting at point *P* on the diagram *in your answer booklet*, use a metric ruler and a scale of 1.0 cm = 4.0 N to draw a vector representing the normal force acting on the box. Label the vector F_N. [1]

62 Calculate the magnitude of the frictional force acting on the box. [Show all work, including the equation and substitution with units.] [2]

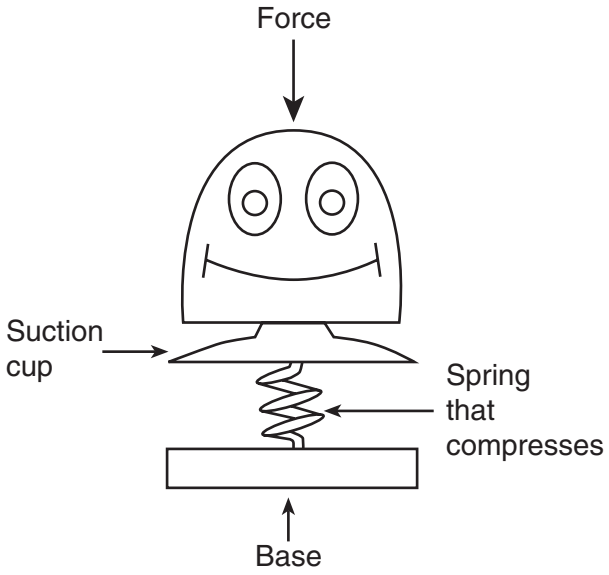
63 Determine the magnitude of the net force acting on the box. [1]

64 Determine the mass of the box. [1]

65 Calculate the magnitude of the acceleration of the box. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 66 and 67 on the information and diagram below.

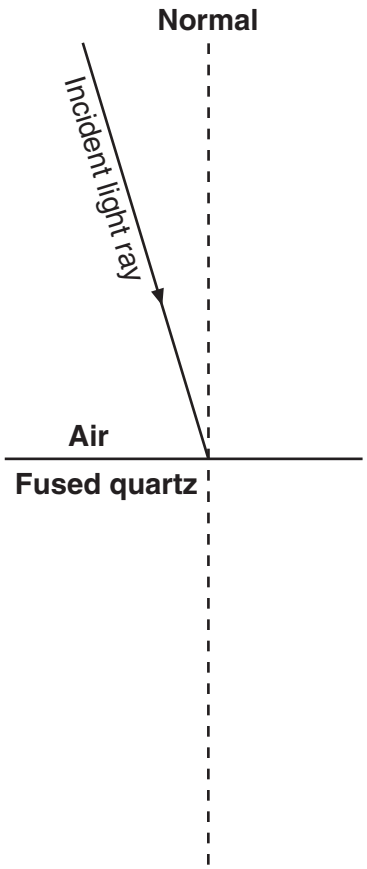
A pop-up toy has a mass of 0.020 kilogram and a spring constant of 150 newtons per meter. A force is applied to the toy to compress the spring 0.050 meter.



66 Calculate the potential energy stored in the compressed spring. [Show all work, including the equation and substitution with units.] [2]

67 The toy is activated and all the compressed spring's potential energy is converted to gravitational potential energy. Calculate the maximum vertical height to which the toy is propelled. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 68 through 71 on the diagram below, which shows a light ray (f = 5.09 × 10^{14} Hz) in air, incident on a boundary with fused quartz. At the boundary, part of the light is refracted and part of the light is reflected.



68 Using a protractor, measure the angle of incidence of the light ray at the air-fused quartz boundary. [1]

69 Calculate the angle of refraction of the incident light ray. [Show all work, including the equation and substitution with units.] [2]

70 Using a protractor and straightedge, construct the refracted light ray in the fused quartz on the diagram *in your answer booklet*. [1]

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

Base your answers to questions 72 through 74 on the information below.

A photon with a frequency of 5.02 × 10^{14} hertz is absorbed by an excited hydrogen atom. This causes the electron to be ejected from the atom, forming an ion.

72 Calculate the energy of this photon in joules. [Show all work, including the equation and substitution with units.] [2]

73 Determine the energy of this photon in electronvolts. [1]

74 What is the number of the *lowest* energy level (closest to the ground state) of a hydrogen atom that contains an electron that would be ejected by the absorption of this photon? [1]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 21, 2007 — 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	42 .....
37	43 .....
38	44 .....
39	45 .....
40	46 .....
41	

Part B–1 Score

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

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

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

Signature

Tear Here

Tear Here

PS/PHYSICS

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Thursday, June 21, 2007 — 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	11	
B–2	19	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

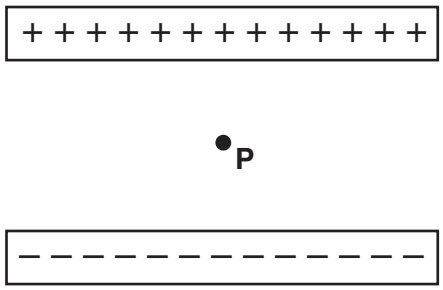
Final Score (From Conversion Chart)

Raters' Initials:

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

Part B–2

47

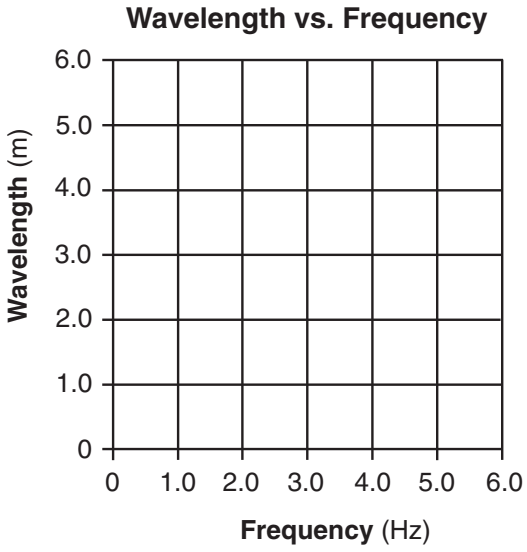


48

49

Data Table	
Frequency (Hz)	Wavelength (m)
1.0	
2.0	
3.0	
6.0	

50–51



52

53 _____ **N**

54 _____

_____

55

56 _____

_____

57 _____

_____

58 _____ Ω

59

60

Part C

61

62

63 _____ **N**

64 _____ **kg**

65

66

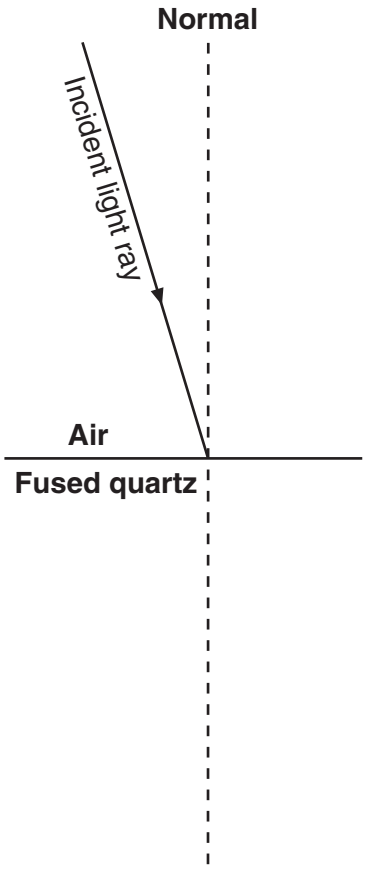
67

°

68 _____

69

70–71



72

73 _____ **eV**

74 n = _____