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

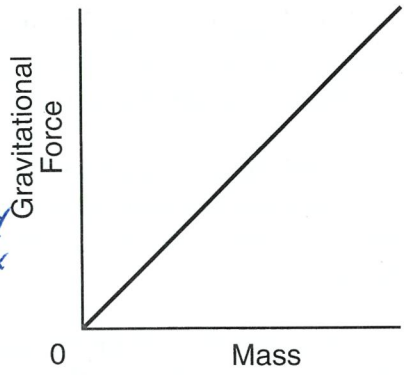
4 If the sum of all the forces acting on a moving object is zero, the object will

(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

9) $a_c = \frac{v^2}{r}$ $a_c = (12\,m/s)^2/(30\,m)$ $= 4.8\,m/s^2$

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.

Given $m = 2000\,kg$, $v = 12\,m/s$, $r = 30\,m$

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

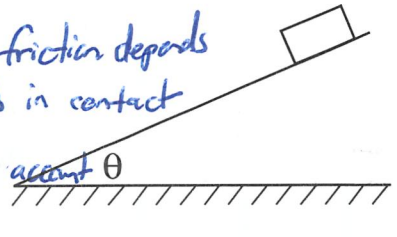
(1) 0.40 m/s^2
(2) 4.8 m/s^2
(3) 800 m/s^2
(4) 9,600 m/s^2

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.



Coefficient of friction depends on the materials in contact

F_f take into account the angle

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

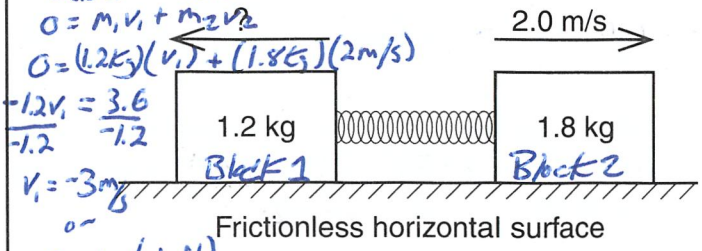
12 The amount of work done against friction to slide a box in a straight line across a uniform, horizontal floor depends most on the

(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

$W = F \cdot d$

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.

$P_{Before} = P_{After}$
$0 = m_1 v_1 + m_2 v_2$
$0 = (1.2\,kg)(v_1) + (1.8\,kg)(2\,m/s)$
$-1.2v_1 = 3.6$
$\frac{-1.2}{-1.2} = \frac{3.6}{-1.2}$
$v_1 = -3\,m/s$
$3\,m/s$ (left)



Frictionless horizontal surface

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

Given $F_w = 100\,N$

$F_G = \frac{G m_1 m_2}{r}$

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

$F_G = \frac{(6)(1)(1)}{2^2} = \frac{1}{4}$

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

$F_w = 15\,N$, $d = .22\,m$

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

$W = Fd = \Delta E_T$
$W = 15N(.22m) \approx 3.3\,J$

Note that question 16 has only three choices.

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

As it falls the KE ↑ PE ↓

(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

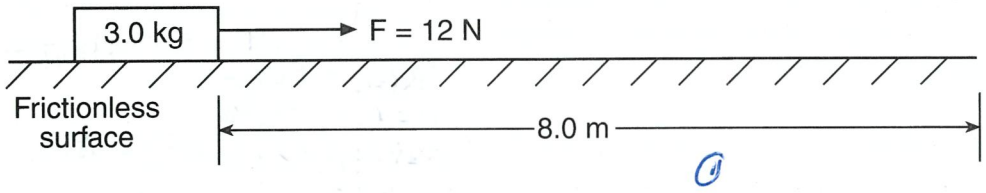
Given $q = 2.5 \times 10^{-6}\,C$, $W = 6.3 \times 10^{-4}\,J$, $V = ?$

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

$V = \frac{W}{q} = \frac{6.3 \times 10^{-4}\,J}{2.5 \times 10^{-6}\,C} = 252\,V$

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.

Given
$m = 3kg$
$d = 8m$
$t = 2s$
$F = 12N$
$P = ?$

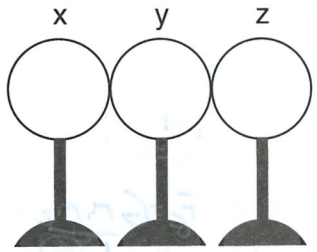


What is the average power developed while moving the block?

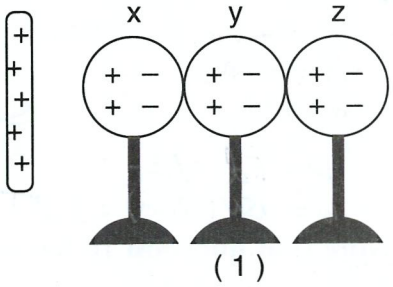
(1) 24 W
(2) 32 W
(3) 48 W
(4) 96 W

$P = \frac{Fd}{t} = \frac{12N(8m)}{2s} = 48W$

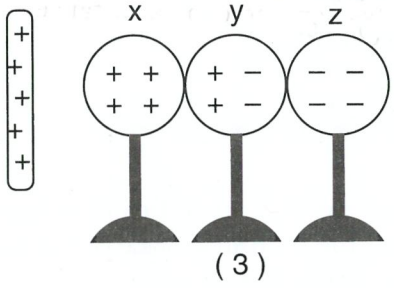
19 The diagram below shows three neutral metal spheres, x, y, and z, in contact and on insulating stands.



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)



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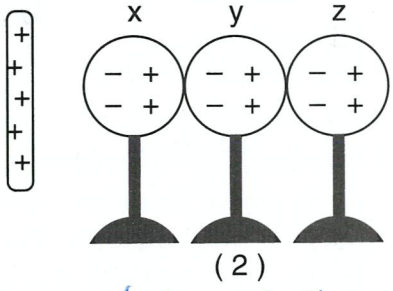

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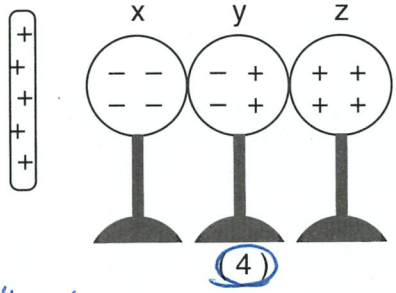
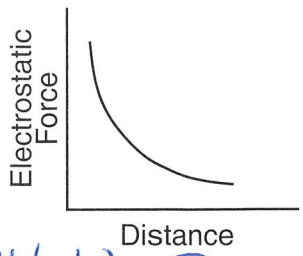


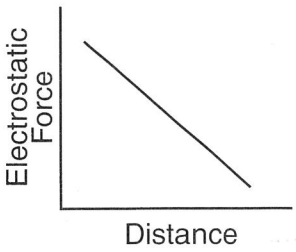
(4)

* You are looking at the net overall charge

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?



(1)



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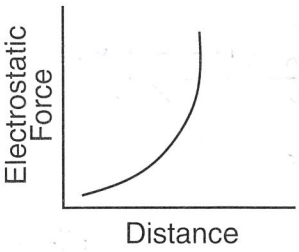

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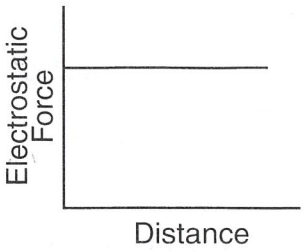


(4)

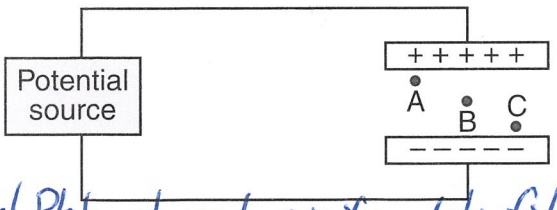
21 When a neutral metal sphere is charged by contact with a positively charged glass rod, the sphere

(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

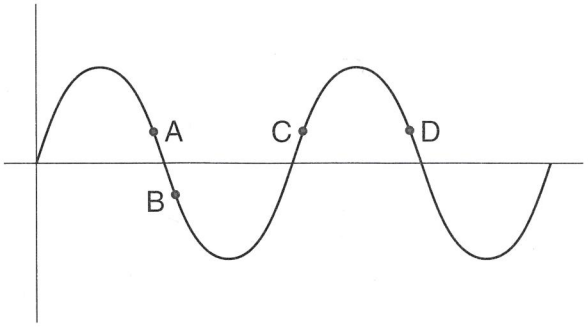
26 An electric iron operating at 120 volts draws 10. amperes of current. How much heat energy is delivered by the iron in 30. seconds?

(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?

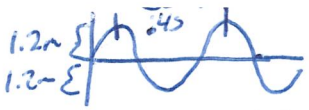
(1) 0.25 Hz
(2) 15 Hz
(3) 25 Hz
(4) 4.0 Hz

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*



time for 1 wave is .4 sec

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 $v = 4.5\frac{m}{s}$ $.45 = 1.8m$

(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

Given $v = 2.25 \times 10^8 \frac{m}{s}$, $f = 5.09 \times 10^{14}$ Hz

(1) crown glass
(2) flint glass $n = \frac{c}{v} = \frac{3 \times 10^8 \frac{m}{s}}{2.25 \times 10^8 \frac{m}{s}}$ $n = 1.33$
(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?

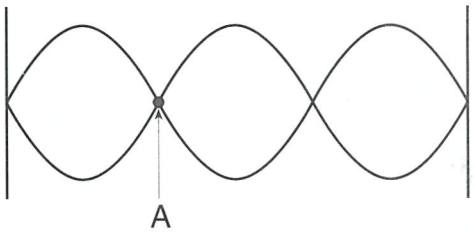
Given $f = 5 \times 10^{14}$ Hz, $v = 3 \times 10^8$ m/s, $w = ?$ $v = f\lambda$ $3 \times 10^8 \text{ m/s} = (5 \times 10^{14} \text{ Hz})(w)$

(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

1 electron $= 1.6 \times 10^{-19}$ C
$6.0 \times 10^6 (1.6 \times 10^{-19} \text{C}) = 9.6 \times 10^{-13}$ C

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

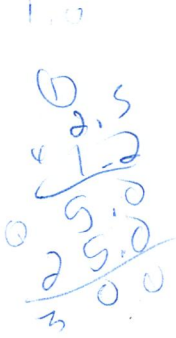
(1) 2.7×10^{-26} C
(2) 5.5×10^{-24} C
(3) 3.8×10^{-13} C
(4) 9.6×10^{-13} C

35 One watt is equivalent to one

(1) N•m
(2) N/m
(3) J•s
(4) J/s

Watt is Unit for Power

$P = \frac{W}{t}$ Unit $\frac{J}{s}$

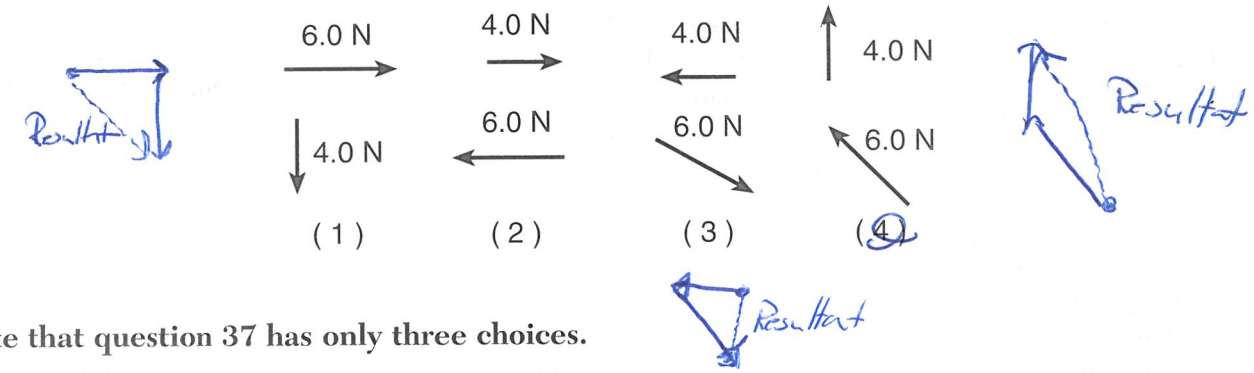


Part B–1

Answer all questions in this part.

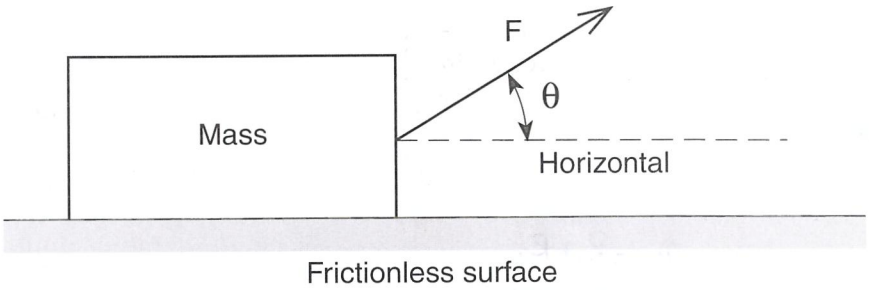
Directions (36–50): For *each* statement or question, write on the separate answer sheet, the *number* of the word or expression that, of those given, best completes the statement or answers the question.

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

Larger Y Component, Smaller X Component

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

2.2 lb = 1 kg
Avg person
65 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

$E_{photon} = hf$
Biggest freq
↑ ↑

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

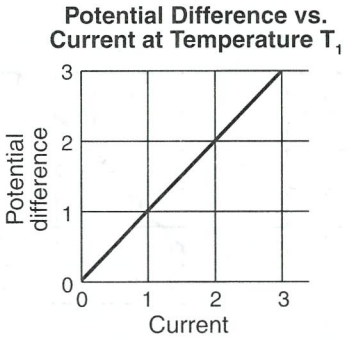
Given: $x = .5m$, $F = 15N$, $K = ?$
① Find K: $F = Kx$, $15N = K \cdot .5m$, $K = 30$
② Find PE_s: $PE_s = \frac{1}{2}Kx^2$, $PE_s = \frac{1}{2}(30)(.5)^2$

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.

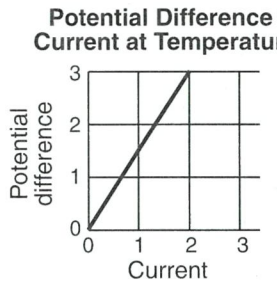
↑T ⇒ ↑Resistance

V = IR

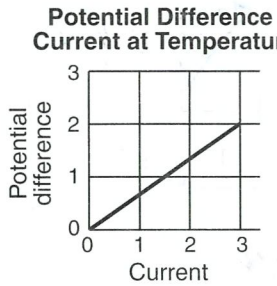
R = V/I



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



(1)



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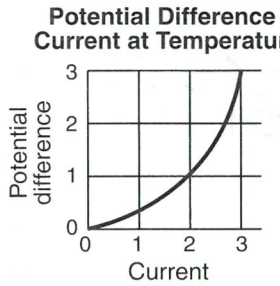

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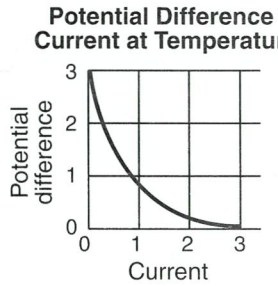
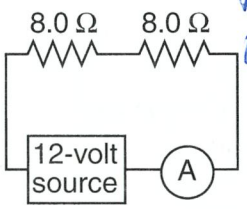


(4)

43 The diagram below shows a circuit with two resistors.

Given
$V_T = 12V$
$I_T = ?$
$R_T = 16\Omega$



$R_T = R_1 + R_2$
$R_T = 8\Omega + 8\Omega$
$R_T = 16\Omega$

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

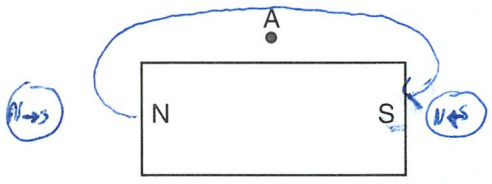
What is the reading on ammeter A?

$I = \frac{V}{R} = \frac{12V}{16V}$

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

$I = .75A$

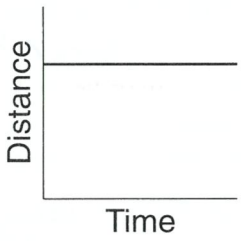
44 The diagram below shows a bar magnet.



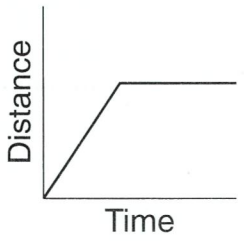
Which arrow best represents the direction of the needle of a compass placed at point A?

(1) ↑
(2) ↓
(3) →
(4) ←

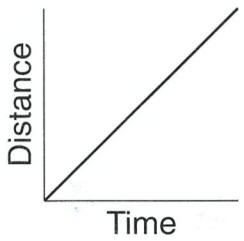
45 Which graph best represents the motion of a block accelerating uniformly down an inclined plane?



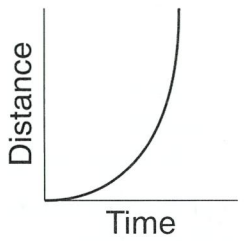
(1)



(3)



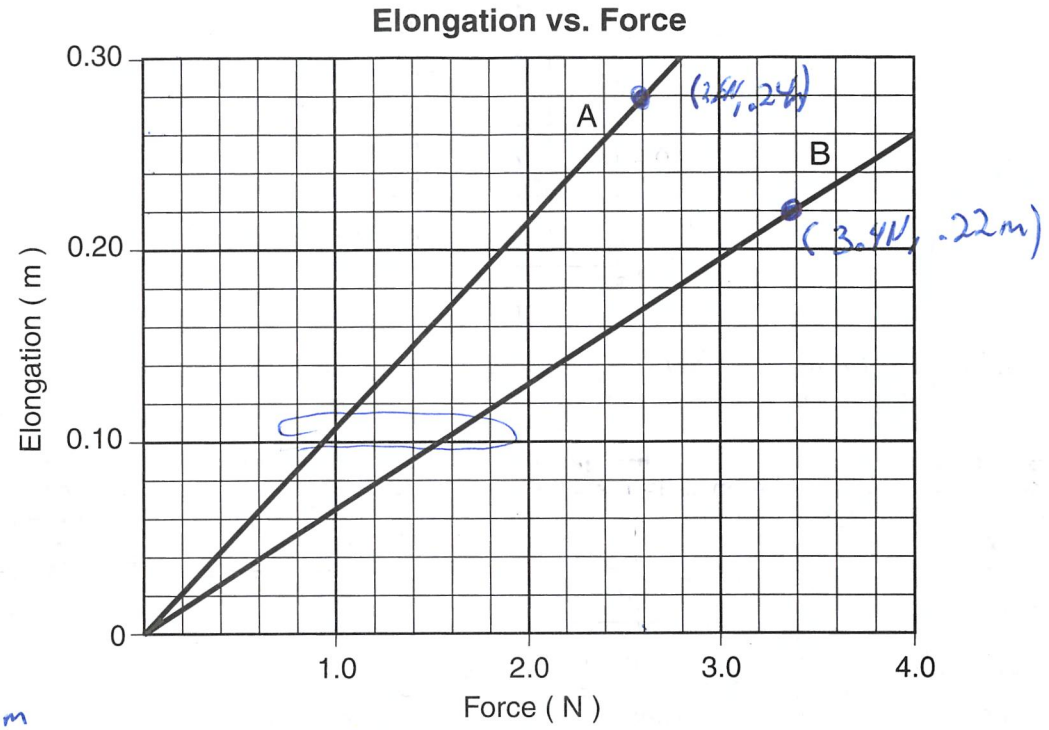
(2)



(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*.



(A)
F=kx
2.6N=K.24m
K=10.8

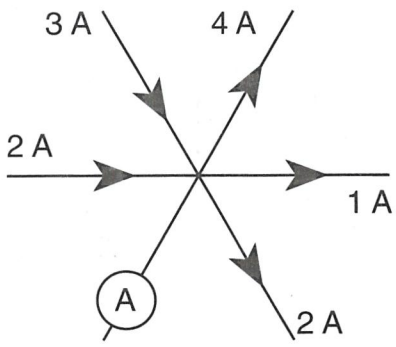
(B)
F=Kx
3.4N=K .22m
K=15.5

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.

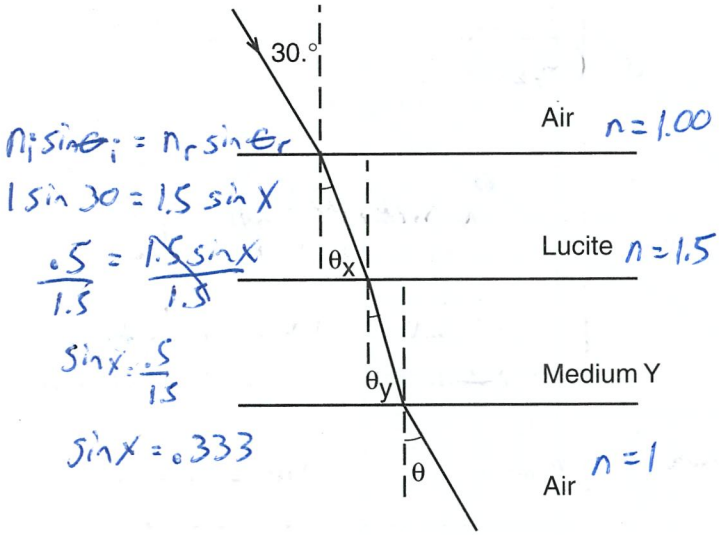


Current In = Current Out
2A+3A+X = 4A+1A+2A
5A+X = 7A
-5A -5A
X= 2A (In)

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.



$n_i \sin\theta_i = n_r \sin\theta_r$

$1 \sin 30 = 1.5 \sin X$

$\frac{.5}{1.5} = \frac{1.5 \sin X}{1.5}$

$\sin X = \frac{.5}{1.5}$

$\sin X = .333$

Air $n = 1$

48 The sine of angle θ_x is

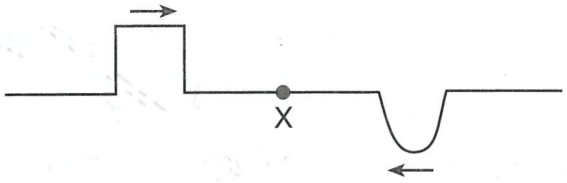
(1) 0.333
(2) 0.500
(3) 0.707
(4) 0.886

49 Light travels *slowest* in

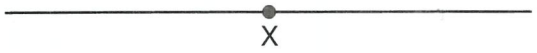
(1) air, only
(2) Lucite, only
(3) medium Y, only
(4) air, Lucite, and medium Y

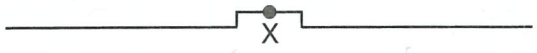
θ_y bends closest to the normal, most dense Result: slowest

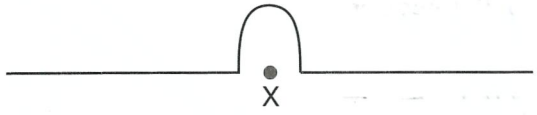
50 The diagram below shows two pulses traveling toward each other in a uniform medium.

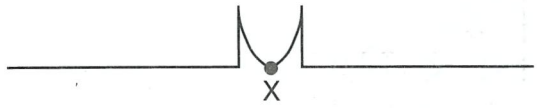


Which diagram best represents the medium when the pulses meet at point *X*?

(1)


(2)


(3)


(4)


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

☐ Male

Student ..... Sex: ☐ Female

Teacher .....

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

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

Part	Maximum Score	Student's Score
A	35	
B–1	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 (1) [1]

v_y, $v = 19.6$ m/s, 30°, v_x

$v_x = v\cos\theta$
$= 19.6\text{m/s}\cos 30$
$= 16.97 \approx 17.0$ m/s

$v_y = v\sin\theta$
$= 19.6\frac{m}{s}\sin 30$
$= 9.8$ m/s

52 [2]

Component	X-Direction	Y-Direction
Initial Velocity	17 m/s	9.8 m/s
Acceleration	0 m/s² Constant Speed	−9.8 m/s²

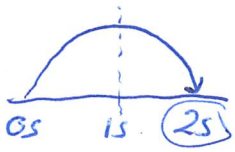
① Solve for t in Y-Direction

$v_f = v_i + at$

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

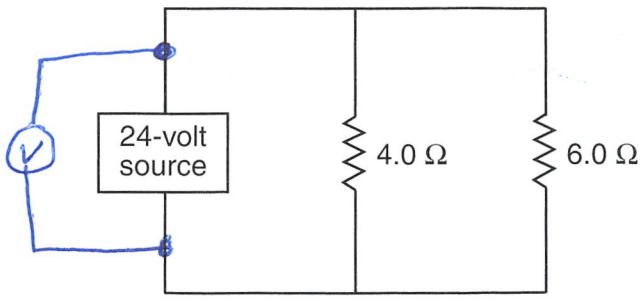
$\frac{-9.8}{-9.8} = \frac{-9.8t}{-9.8}$ $t = 1$ sec time to reach max height

② Solve for time in X-Direction



2 seconds

53 [1]



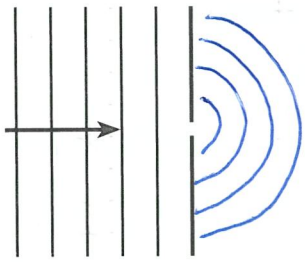
[1]

54 $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_{eq}} = \frac{1}{4\Omega} + \frac{1}{6\Omega}$ $\frac{1}{R_{eq}} = .416$ $R_{eq} = 2.4\Omega$ (2)

5

[1]

55



56 strong nuclear force / Strong Force [1]

57 Given:
$L = 1m$
$A = 7.85 \times 10^{-7} m^2$
$V = 1.5V$
nichrome Wire
$\rho = 150 \times 10^{-8} \Omega \cdot m$

$R = \frac{\rho L}{A}$

$\frac{150 \times 10^{-8} \Omega \cdot m \ (1m)}{7.85 \times 10^{-7} m^2} = 1.91 \Omega$ [2]

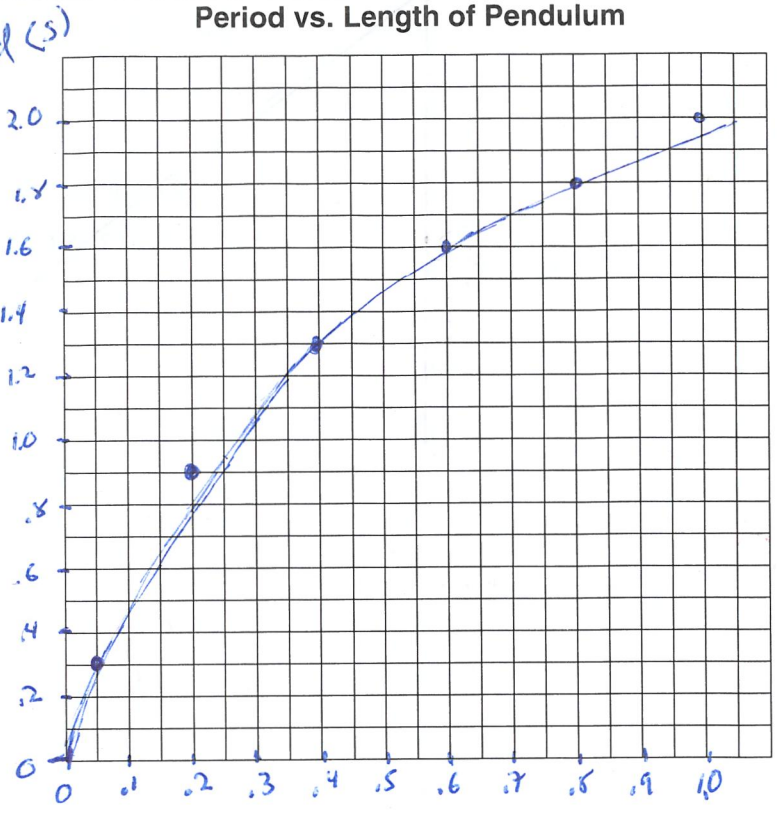
58 0.785 A [1]

$V = IR$
$1.5V = I\ (1.91\Omega)$
$I = .785A$

[b]

5

59–61



- Scales must be linear & labeled
- Line of Best Fit is not linear.

59. [2] Label/set-up
60. [1] Plot Pts
61 [1] Line of Best fit

62 1.0s ± .03s s [1]

+5

Part C

63 B, because the mass has the greatest speed [1]

64 A, because it is the highest point of travel [1]

(Question asked about Gravitational PE, not PEs)

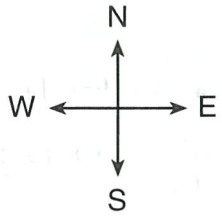
+3

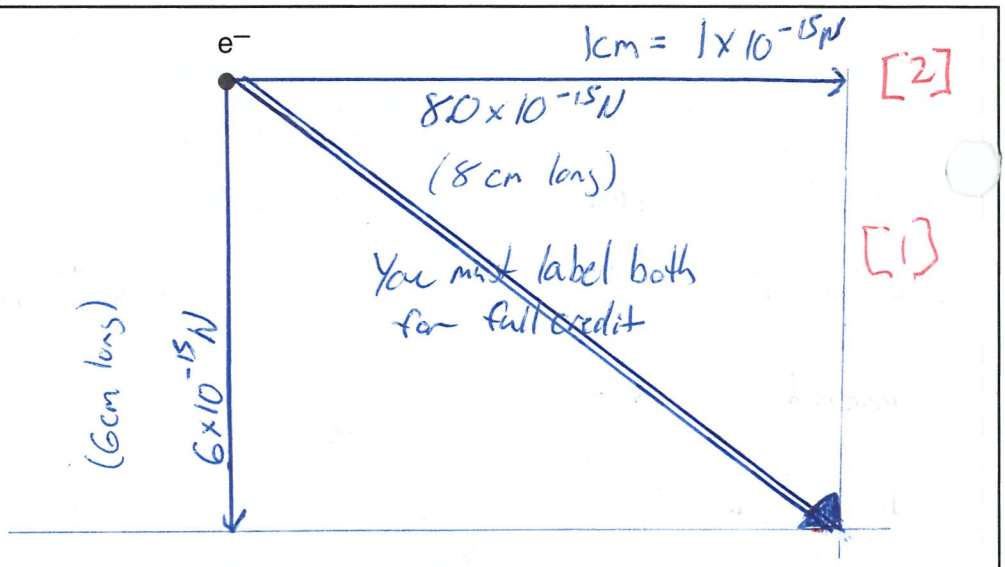
65 C, because the spring is stretched to the maximum amount [1]

B

A/C

66–67





[2]

[1]

68 10×10^{-15} N / 1×10^{-14} N ($\pm .2 \times 10^{-15}$ N) [1]

69 53° (±2°) [1]

70 [2]

$F_f = \mu F_N$

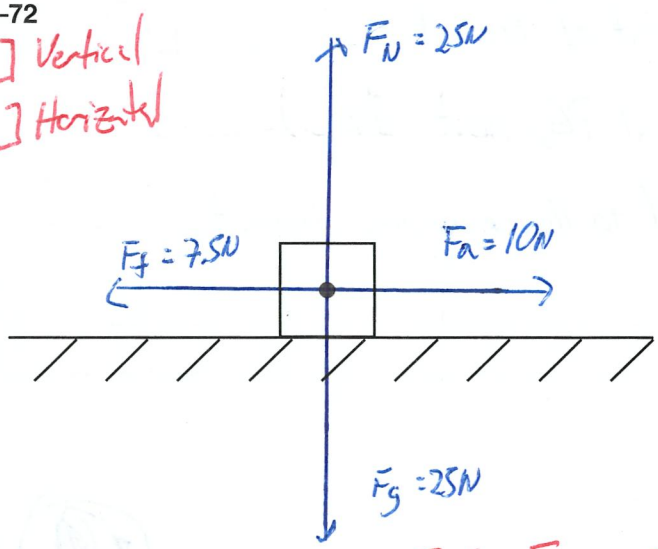
$F_f = (.30)(25N)$

$= 7.5N$

71–72

[1] Vertical

[1] Horizontal



73 2.5 N

$F_{net} = F_{Applied} - F_f$

$F_{net} = 10N - 7.5N$

$= 2.5N$

74 Yes, unbalanced force acting on the object [1]

75 1.89 eV [1]

76 3.02×10^{-19} J [1]

$E_{photon} = E_f - E_i$

$= -1.51ev - (-3.40ev)$

$= 1.89ev$

77

$1.89ev \cdot \frac{1.6 \times 10^{-19} J}{1ev} = 3.02 \times 10^{-19} J$

$E = hf$ [2]

$\frac{3.02 \times 10^{-19} J}{6.63 \times 10^{-34} Js} = \frac{6.63 \times 10^{-34} Js \cdot f}{6.63 \times 10^{-34} Js}$

$f = 4.56 \times 10^{14}$ Hz

78 [2]

$E = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E}$

$\lambda = \frac{(6.63 \times 10^{-34} Js)(3 \times 10^{8} m/s)}{3.02 \times 10^{-19} J}$

$\lambda = 6.59 \times 10^{-7} m$