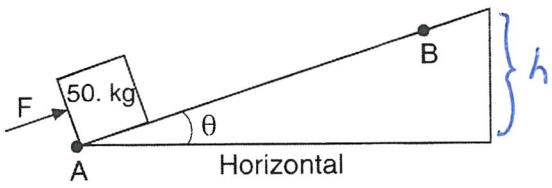
Part A

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 50.-kilogram crate on a frictionless plane at angle θ to the horizontal. The crate is pushed at constant speed up the incline from point *A* to point *B* by force *F*.



If angle θ were increased, what would be the effect on the magnitude of force *F* and the total work *W* done on the crate as it is moved from *A* to *B*?

(1) *W* would remain the same and the magnitude of *F* would decrease.
(2) *W* would remain the same and the magnitude of *F* would increase.
(3) *W* would increase and the magnitude of *F* would decrease.
(4) *W* would increase and the magnitude of *F* would increase.

2 A vector makes an angle, θ, with the horizontal. The horizontal and vertical components of the vector will be equal in magnitude if angle θ is

(1) 30°
(2) 45°
(3) 60°
(4) 90°

3 A car initially traveling at a speed of 16 meters per second accelerates uniformly to a speed of 20. meters per second over a distance of 36 meters. What is the magnitude of the car's acceleration?

(1) 0.11 m/s²
(2) 2.0 m/s²
(3) 0.22 m/s²
(4) 9.0 m/s²

4 A ball is thrown at an angle of 38° to the horizontal. What happens to the magnitude of the ball's vertical acceleration during the total time interval that the ball is in the air?

(1) It decreases, then increases.
(2) It decreases, then remains the same.
(3) It increases, then decreases.
(4) It remains the same.

5 A man standing on a scale in an elevator notices that the scale reads 30 newtons greater than his normal weight. Which type of movement of the elevator could cause this greater-than-normal reading?

(1) accelerating upward
(2) accelerating downward
(3) moving upward at constant speed
(4) moving downward at constant speed

Base your answers to questions 6 and 7 on the information below.

Projectile *A* is launched horizontally at a speed of 20. meters per second from the top of a cliff and strikes a level surface below, 3.0 seconds later. Projectile *B* is launched horizontally from the same location at a speed of 30. meters per second.

6 The time it takes projectile *B* to reach the level surface is

(1) 4.5 s
(2) 2.0 s
(3) 3.0 s
(4) 10. s

7 Approximately how high is the cliff?

(1) 29 m
(2) 44 m
(3) 60. m
(4) 104 m

8 A 60-kilogram skydiver is falling at a constant speed near the surface of Earth. The magnitude of the force of air friction acting on the skydiver is approximately

(1) 0 N
(2) 6 N
(3) 60 N
(4) 600 N

9 An astronaut weighs 8.00×10^2 newtons on the surface of Earth. What is the weight of the astronaut 6.37×10^6 meters above the surface of Earth?

(1) 0.00 N
(2) 2.00×10^2 N
(3) 1.60×10^3 N
(4) 3.20×10^3 N

10 A 10.-newton force is required to hold a stretched spring 0.20 meter from its rest position. What is the potential energy stored in the stretched spring?

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

11 When a 12-newton horizontal force is applied to a box on a horizontal tabletop, the box remains at rest. The force of static friction acting on the box is

(1) 0 N
(2) between 0 N and 12 N
(3) 12 N
(4) greater than 12 N

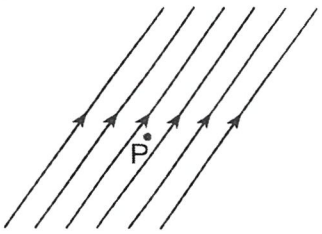
12 Ball *A* of mass 5.0 kilograms moving at 20. meters per second collides with ball *B* of unknown mass moving at 10. meters per second in the same direction. After the collision, ball *A* moves at 10. meters per second and ball *B* at 15 meters per second, both still in the same direction. What is the mass of ball *B*?

(1) 6.0 kg
(2) 2.0 kg
(3) 10. kg
(4) 12 kg

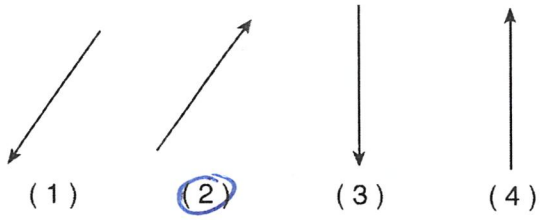
13 A 1.5-kilogram lab cart is accelerated uniformly from rest to a speed of 2.0 meters per second in 0.50 second. What is the magnitude of the force producing this acceleration?

(1) 0.70 N
(2) 1.5 N
(3) 3.0 N
(4) 6.0 N

14 The diagram below represents the magnetic field near point *P*.



If a compass is placed at point *P* in the same plane as the magnetic field, which arrow represents the direction the north end of the compass needle will point?



15 Which person has the greatest inertia?

(1) a 110-kg wrestler resting on a mat
(2) a 90-kg man walking at 2 m/s
(3) a 70-kg long-distance runner traveling at 5 m/s
(4) a 50-kg girl sprinting at 10 m/s

16 A child is riding on a merry-go-round. As the speed of the merry-go-round is doubled, the magnitude of the centripetal force acting on the child

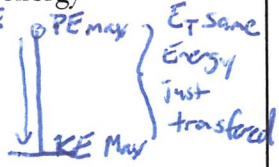
(1) remains the same
(2) is doubled
(3) is halved
(4) is quadrupled

17 The magnitude of the electrostatic force between two point charges is *F*. If the distance between the charges is doubled, the electrostatic force between the charges will become

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

Note that question 18 has only three choices.

18 As a ball falls freely (without friction) toward the ground, its total mechanical energy
(1) decreases
(2) increases
(3) remains the same



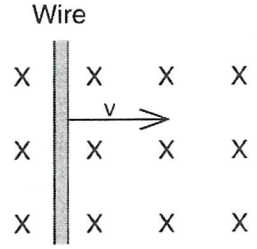
19 A 0.50-kilogram ball is thrown vertically upward with an initial kinetic energy of 25 joules. Approximately how high will the ball rise? [Neglect air resistance.]
(1) 2.6 m
(2) 5.1 m
(3) 13 m
(4) 25 m

20 What is the average power developed by a motor as it lifts a 400.-kilogram mass at constant speed through a vertical distance of 10.0 meters in 8.0 seconds?
(1) 320 W
(2) 500 W
(3) 4,900 W
(4) 32,000 W

21 If 4.8×10^{-17} joule of work is required to move an electron between two points in an electric field, what is the electric potential difference between these points?
(1) 1.6×10^{-19} V
(2) 4.8×10^{-17} V
(3) 3.0×10^{2} V
(4) 4.8×10^{2} V

Note that question 22 has only three choices.

22 The diagram below shows a wire moving to the right at speed v through a uniform magnetic field that is directed into the page.



Magnetic field directed into page

As the speed of the wire is increased, the induced potential difference will
(1) decrease
(2) increase
(3) remain the same

23 A change in the speed of a wave as it enters a new medium produces a change in
(1) frequency
(2) period
(3) wavelength
(4) phase

24 Two identical resistors connected in parallel have an equivalent resistance of 40. ohms. What is the resistance of each resistor?
(1) 20. Ω
(2) 40. Ω
(3) 80. Ω
(4) 160 Ω

25 A tuning fork oscillates with a frequency of 256 hertz after being struck by a rubber hammer. Which phrase best describes the sound waves produced by this oscillating tuning fork?
(1) electromagnetic waves that require no medium for transmission
(2) electromagnetic waves that require a medium for transmission
(3) mechanical waves that require no medium for transmission
(4) mechanical waves that require a medium for transmission

26 In a vacuum, all electromagnetic waves have the same
(1) wavelength
(2) frequency
(3) speed
(4) amplitude

27 The speed of light ($f = 5.09 \times 10^{14}$ Hz) in a transparent material is 0.75 times its speed in air. The absolute index of refraction of the material is approximately
(1) 0.75
(2) 1.3
(3) 2.3
(4) 4.0

28 Waves pass through a 10.-centimeter opening in a barrier without being diffracted. This observation provides evidence that the wavelength of the waves is
(1) much shorter than 10. cm
(2) equal to 10. cm
(3) longer than 10. cm, but shorter than 20. cm
(4) longer than 20. cm

29 Standing waves in water are produced most often by periodic water waves

(1) being absorbed at the boundary with a new medium
(2) refracting at a boundary with a new medium
(3) diffracting around a barrier
(4) reflecting from a barrier

Note that question 30 has only three choices.

30 A sound of constant frequency is produced by the siren on top of a firehouse. Compared to the frequency produced by the siren, the frequency observed by a firefighter approaching the firehouse is

(1) lower
(2) higher
(3) the same

Siren Fire-Fighter (Running to Siren)

Dopple Effect

31 White light is passed through a cloud of cool hydrogen gas and then examined with a spectroscope. The dark lines observed on a bright background are caused by

(1) the hydrogen emitting all frequencies in white light
(2) the hydrogen absorbing certain frequencies of the white light
(3) diffraction of the white light
(4) constructive interference

32 Compared to a photon of red light, a photon of blue light has a

Blue $6.1-6.59\times10^{14}$ Hz Red $3.84-4.82\times10^{14}$ Hz

(1) greater energy
(2) longer wavelength
(3) smaller momentum
(4) lower frequency

↑ Freq → ↑ Energy

33 Protons and neutrons are examples of

(1) positrons Anti Electrons
(2) baryons
(3) mesons - Positive Charge net add up to +1 or 0
(4) quarks

34 The strong force is the force of

Like Charges repel

(1) repulsion between protons
(2) attraction between protons and electrons
(3) repulsion between nucleons
(4) attraction between nucleons

Nucleons seek to repel from each other
Strong Force causes them to stay togeth

35 If a deuterium nucleus has a mass of 1.53×10^{-3} universal mass units less than its components, this mass represents an energy of

(1) 1.38 MeV
(2) 1.42 MeV
(3) 1.53 MeV
(4) 3.16 MeV

Given
$m = 1.53\times10^{-3}$ u
$E = ?$ MeV??

Find Energy

$1\ u = 931$ MeV

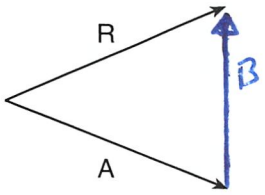
$1.53\times10^{-3}\ u \times \frac{931\ \text{MeV}}{1\ u} = 1.42$ MeV

Part B–1

Answer all questions in this part.

Directions (36–47): 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.

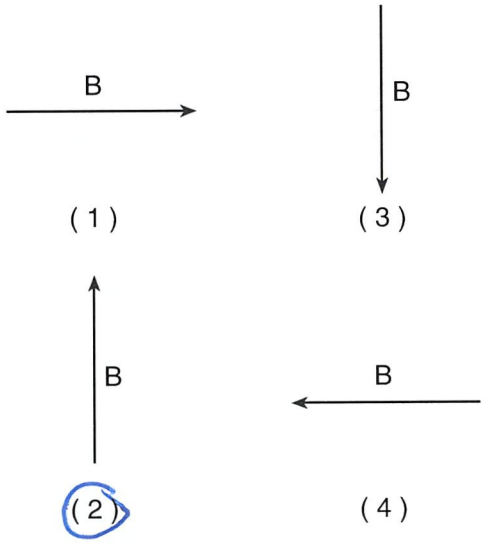
36 Forces *A* and *B* have a resultant *R*. Force *A* and resultant *R* are represented in the diagram below.



Vectors added tip to tail to get resultant

Vector A + Vector B = Vector (R)

Which vector best represents force *B*?



37 An object with a net charge of 4.80×10^{-6} coulomb experiences an electrostatic force having a magnitude of 6.00×10^{-2} newton when placed near a negatively charged metal sphere. What is the electric field strength at this location?

(1) 1.25×10^{4} N/C directed away from the sphere
(2) 1.25×10^{4} N/C directed toward the sphere
(3) 2.88×10^{-8} N/C directed away from the sphere
(4) 2.88×10^{-8} N/C directed toward the sphere

Given
$q = 4.80 \times 10^{-6}$ C
$F_e = 6.00 \times 10^{-2}$ N
$E = ??$

$E = \frac{F_e}{q}$

$E = \frac{6.00 \times 10^{-2}\ N}{4.80 \times 10^{-6}\ C}$

$E = 12{,}500\ \frac{N}{C}$

Positive Net Charge will be attracted to negative Sphere

38 What is the approximate width of a person's little finger?

(1) 1 m
(2) 0.1 m
(3) 0.01 m
(4) 0.001 m

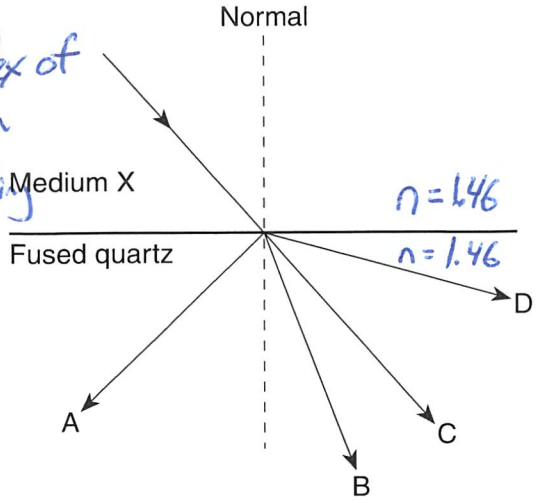
Width = 1cm

1m = 100 cm

so 1cm = .01m

[6]

39 The diagram below represents a ray of monochromatic light ($f = 5.09 \times 10^{14}$ Hz) passing from medium X ($n = 1.46$) into fused quartz.



Same index of Refraction → No Bending

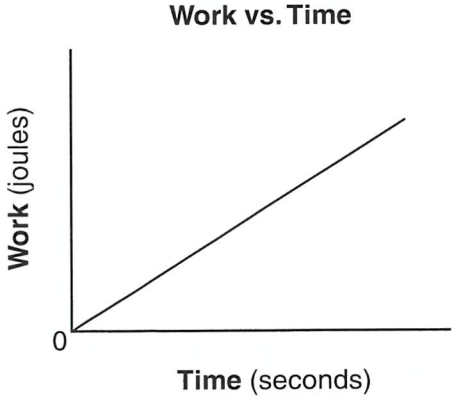
n = 1.46

n = 1.46

Which path will the ray follow in the quartz?

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

40 The graph below shows the relationship between the work done by a student and the time of ascent as the student runs up a flight of stairs.

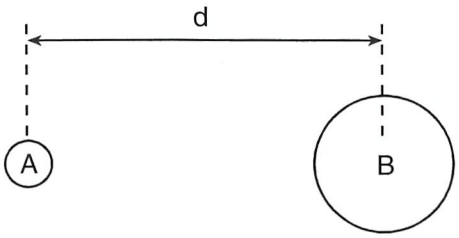


The slope of the graph would have units of

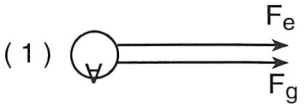
(1) joules
(2) seconds
(3) watts
(4) newtons

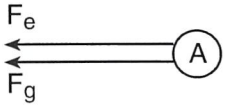
Slope = $\frac{\Delta y}{\Delta x}$ $P = \frac{work}{time}$

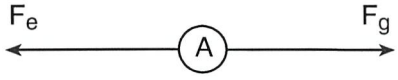
41 In the diagram below, two positively charged spheres, A and B, of masses m_A and m_B are located a distance d apart.

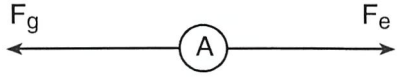


Which diagram best represents the directions of the gravitational force, F_g, and the electrostatic force, F_e, acting on sphere A due to the mass and charge of sphere B? [Vectors are not drawn to scale.]

(1) 

(2) 

(3) 

(4) 

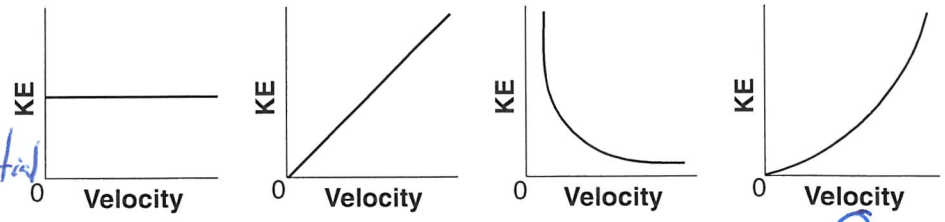
$F_g = \frac{G m_1 m_2}{r^2}$ All objects attract all other objects

$F_e = \frac{k q_1 q_2}{r^2}$ Like Charges will want to repel

42 Which graph best represents the relationship between the kinetic energy, KE, and the velocity of an object accelerating in a straight line?

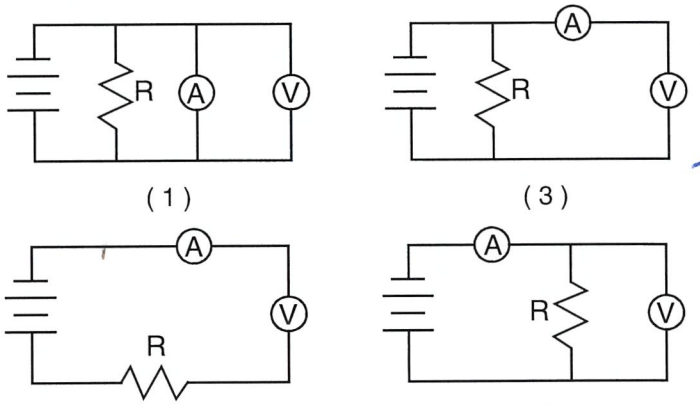
$KE = \frac{1}{2}mv^2$

Exponential



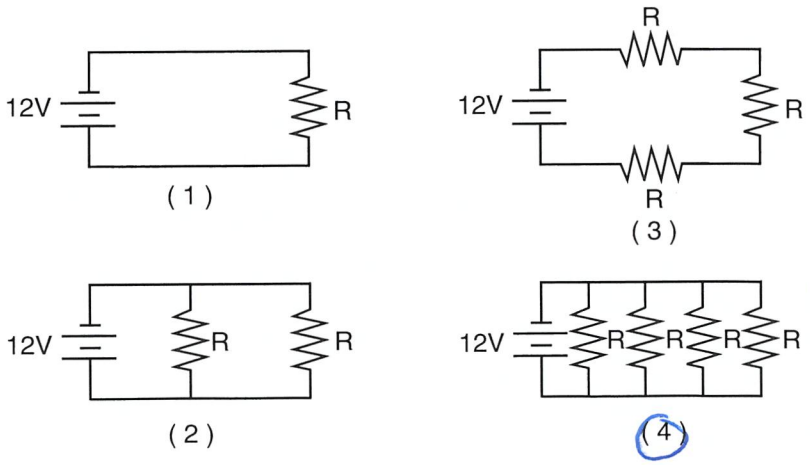
(1) (2) (3) (4)

43 Which circuit diagram below correctly shows the connection of ammeter A and voltmeter V to measure the current through and potential difference across resistor R?



- Ammeter is wired into the circuit
- Voltmeter wraps around an object (light, resistor, ...)

44 Identical resistors (R) are connected across the same 12-volt battery. Which circuit uses the greatest power?



$P = VI$

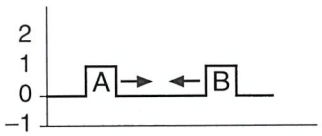
Increase Current → Increase Power

Parallel circuits produce most current

$I_T = I_1 + I_2 + I_3 + I_4$

Choice 4 most parallel

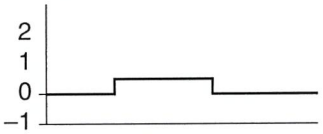
45 The diagram below shows two pulses, *A* and *B*, approaching each other in a uniform medium.



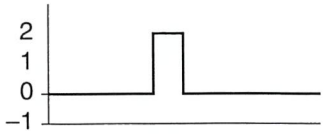
height of A +1 height of B +1

Which diagram best represents the superposition of the two pulses?

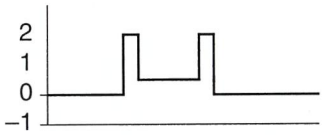
A + B
1 + 1 = 2



(1)



(3)

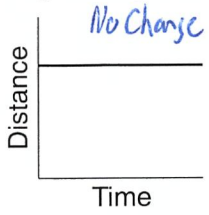


(2)

(4)

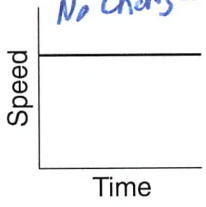
46 Which graph best represents the motion of an object that is *not* in equilibrium as it travels along a straight line?

No Change

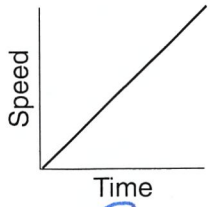


(1)

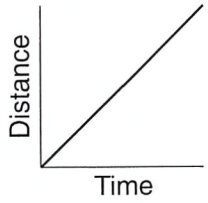
No change



(3)



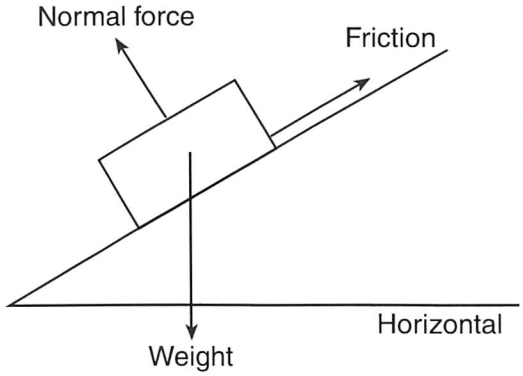
(2)



(4)

As time increases an objects speed increases

47 Three forces act on a box on an inclined plane as shown in the diagram below. [Vectors are not drawn to scale.]



If the box is at rest, the net force acting on it is equal to

(1) the weight
(2) the normal force
(3) friction
(4) zero

$F_{net} = ma$, $a = 0$

$F_{net} = 0$

At rest, no accel

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
PHYSICS

Tuesday, June 17, 2003 — 1:15 to 4:15 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	12	
B–2	18	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

Final Score (From Conversion Chart)

Raters' Initials:

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

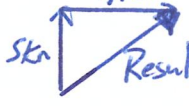
Part B–2

48 Horizontal or Perpendicular to the Magnetic field [1]

49 Resonance [1]

50 Energy level transitions can not occur in-between energy levels [1]

51 8.6 km [1]



$5^2+7^2=c^2$

$25+49=c^2$

$c=$

52 12 km [1]

53 4.8×10^{-19} C [1]

$+3\not{e} \times \frac{1.6\times10^{-19}\text{C}}{1\not{e}} =$

54 Given

$V=120V$

$I=1.25A$

$t=35s$

$W=$ Electrical Energy

$W=VIt$

$120V(1.25A)(35s)$

$W=5250J$ [2]

55 Radio Wave is an Electro Magnetic Wave

$V=3\times10^8 m/s$

$f=2.2\times10^6 Hz$

$\lambda=??$

$V=f\lambda$

$3\times10^8\frac{m}{s}=(2.2\times10^6 Hz)(\lambda)$

$\lambda=136m$ [2]

+10

56 interference / destructive Interference / superposition [1]

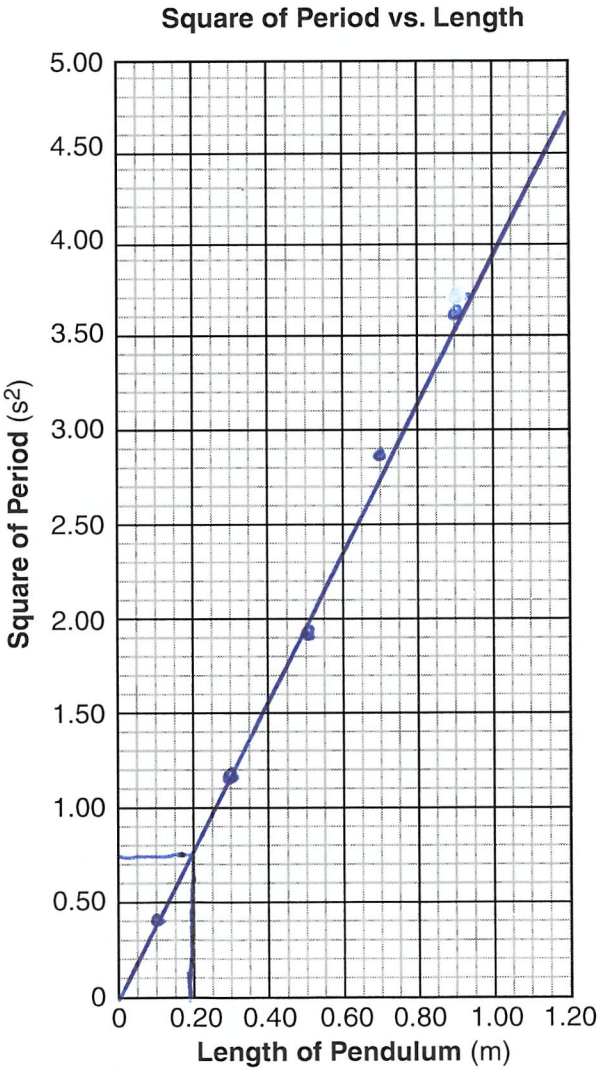
[1] 57 visible less mass less energy / lower freq / larger wavelength

UV More Engy ↑ freq ↓ λ

58–59

[1] Plot Pts

[1] Line of Best Fit



60 $\sqrt{.8 \pm .1}$ s [1]

$.89 \pm 1$

[b]

+5

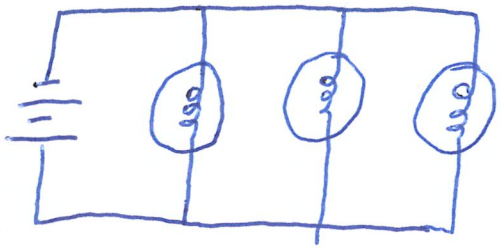
61 - Find The Slope and divide it by $4\pi^2$ -or-
- Find coordinates from the line of best fit and substitute it into $T^2 = \frac{4\pi l}{g}$ and solve for g
[1]

62 One is a magnet [1]

63 West [1]

Part C

64 [2] 1 pt Parallel 1 pt Correct Symbols



65 40.1 v [1] In Parallel $V_T = V_1 = V_2 = V_3$

66 $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ [2]

$\frac{1}{R_T} = \frac{1}{89\Omega} + \frac{1}{365\Omega} + \frac{1}{143\Omega}$

$\frac{1}{R_T} = .0210$

$R_T = 48\Omega$

[c]

+8

67 40.1 v [1]

68 .11 A [1]

69 angle of incidence = $45° \pm 2°$ [1]

angle of refraction = $26° \pm 2°$ [1]

70 $n_1 \sin\theta_1 = n_2 \sin\theta_2$ [2]

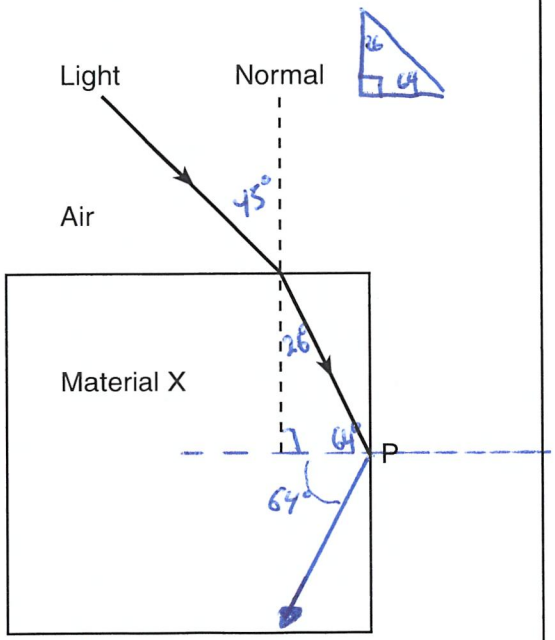
$1(\sin 45) = n_2(\sin 26)$

$.7071 = n_2$

$.4384$

$n = 1.61$

71 [1]



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

$1.61(\sin 64) = 1(\sin\theta_2)$

$\frac{1.44}{1} = \sin\theta_2$

Error (Total Internal Reflection)

72 [2] $P_{Before} = P_{After}$

$mv + mv = (50kg + 10kg)v$

Person sled Combined

$50kg(6\frac{m}{s}) + 10kg(0\frac{m}{s}) = 60v$

$300 = 60v$

$v = 5.0\frac{m}{s}$

73 [2] $KE = \frac{1}{2}mv^2$

$KE = \frac{1}{2}(60kg)(5\frac{m}{s})^2$

$KE = 750J$

74 750 J [1] Work = KE

75 [2] $\lambda = \frac{h}{mv}$

Given

$m = 6.7\times10^{-27}kg$

$v = 2.0\times10^6 m/s$

$h = 6.63\times10^{-34}Js$ (Planks constant)

$\lambda = \frac{(6.63\times10^{-34}Js)}{(6.7\times10^{-27}kg)(2.0\times10^6 m/s)}$

$\lambda = \frac{6.63\times10^{-34}Js}{1.34\times10^{-20}}$

$\lambda = 4.9\times10^{-14}m$

76 Gamma Rays [1]

+15