York County School Division

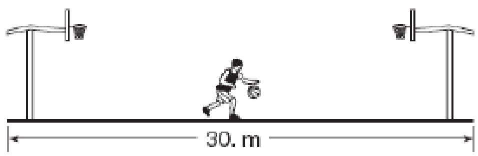
AP Summer Assignment

Course: AP Physics I	
Assignment title	AP Physics Summer Assignment
Date due	1st Day of Class
Estimated time for completion	~ 15 Hours
Resources needed to complete assignment	☒ Textbook assigned by school ☐ Book(s) supplied by student ☒ Other supplies: NYS Regents Reference Tables
How the assignment will be assessed	Will count as a test grade. Multiple Choice will be graded for accuracy. Free-Response will be graded for accuracy and correct process. Show equations used, proper substitution with units, and final answer with units. All work must be shown. Use a separate piece of paper if required.
Purpose of assignment	☒ Review foundational material/concepts/skills. ☐ Expose students to required material/concepts/skills/texts that cannot entirely be covered during the academic year. ☒ Have students read material that will be discussed or used in class at the beginning of the year.

AP Physics I Summer Assignment
Part I: Multiple Choice

Refer to the diagram below for questions 1 and 2:

A basketball player runs a drill in which he runs the length of the 30.0 meter court and back. He does this three times in 50.0 seconds.



(Not drawn to scale)

1. The magnitude of the player's total displacement after running the drill is

(1) 0.0 m (3) 60.0 m
(2) 30.0 m (4) 180 m

2. The average speed of the player during the drill is

(1) 0.0 m/s (3) .60 m/s
(2) 3.6 m/s (4) 1.7 m/s

3. The length of a football field is closest to

(1) 1000 cm (3) 1000 km
(2) 1000 dm (4) 1000 mm

4. Which scenario describes an object that has no unbalanced force acting on it?
(1) an apple falling from a tree
(2) a satellite orbiting Earth
(3) a hockey puck traveling across the ice with a constant velocity
(4) a lab cart accelerating down a frictionless incline

5. A child riding a bicycle at 15 m/s brakes with an acceleration of -3.0 m/s^2 for 4.0 seconds. What is the child's speed at the end of this 4.0 second interval?
(1) 12 m/s (3) 3.0 m/s
(2) 27 m/s (4) 7.0 m/s

6. An unbalanced for of 50.0 Newtons keeps a 4.0 kg object traveling in a circle of radius 2.0 m. What is the speed of the object?

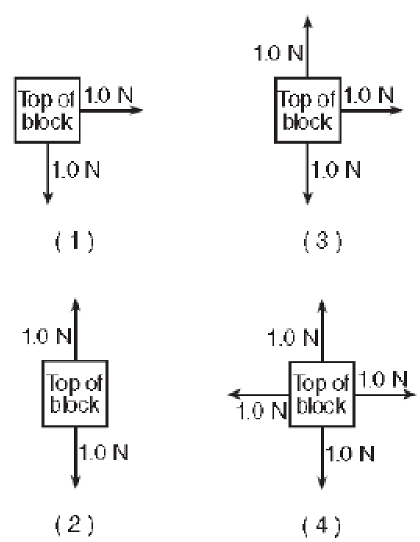
(1) 5.0 m/s (3) 25 m/s
(2) 2.0 m/s (4) 4.0 m/s

7. A 60 kg hockey player is skating across the ice at a speed of 5.0 meters per second. What is the magnitude of the average force required to stop the player in .60 second?

(1) 180 N (3) 690 N
(2) 900 N (4) 500 N

8. A student is standing in an elevator that is accelerating upward. The force that the student exerts on the floor of the elevator must be
(1) less than the weight of the student when at rest
(2) greater than the weight of the student when at rest
(3) less than the force of the floor on the student
(4) greater than the force of the floor on the student

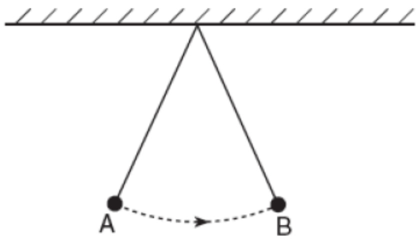
9. A number of 1.0 Newton horizontal forces are exerted on a block on a frictionless, horizontal surface. Which top-view diagram shows the forces producing the greatest magnitude of acceleration of the block?



10. How much work is done by the force lifting a .1 kilogram cheeseburger vertically upward at a constant velocity to an elevation .30 meter above a plate?

(1) .03 J (3) 0.3 J
(2) 0.1 J (4) 0.4 J

11. In the diagram below, an ideal pendulum (not affected by friction) released from position A swings freely to position B.



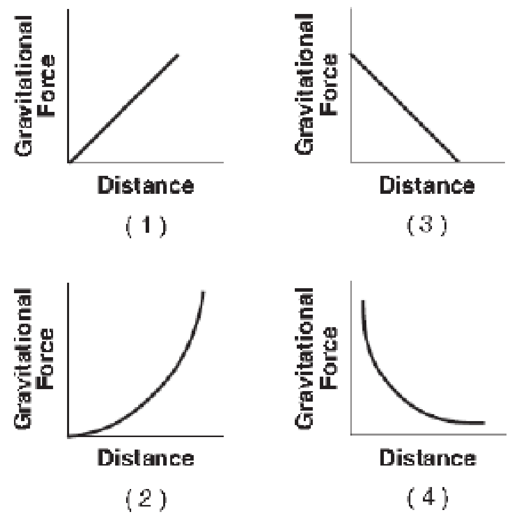
As the pendulum swings from A to B, its kinetic energy
(1) decreases, then increases
(2) increases, only
(3) increases, then decreases
(4) remains the same

12. The magnitude of a centripetal force acting on an object traveling in a horizontal, circular path will increase if the

(1) mass of the object is increased
(2) radius of the path is increased
(3) direction of motion of the object is reversed
(4) speed of the object is decreased

13. The centripetal force acting on the international space station as it orbits Earth is equal to the station's
(1) mass (3) velocity
(2) momentum (4) weight

14. Which graphs represents the relationship between the magnitude of gravitational force exerted by Earth on a launched rocket and the distance between the center of the rocket and the center of the Earth? (Assume the mass of the rocket is not changing.)



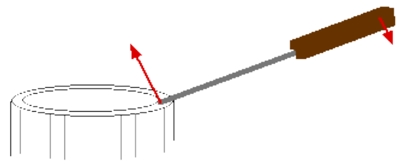
15. When a 2.0 kg cart moving with a speed of .50 m/s on a horizontal surface collides with a second 2.0 kg cart initially at rest, the carts lock together. What is the speed of the combined carts after the collision? (neglect friction)

(1) 1.0 m/s (3) .25 m/s
(2) .50 m/s (4) 0 m/s

16. A wheel, initially rotating at 25 rad/s undergoes an angular acceleration of 5 rad/s^2 for 4 seconds. How many revolutions will it make in 1 second at this new angular velocity?

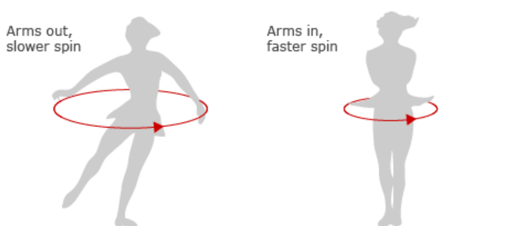
(1) 45 rad/s (3) 7.2 rad/s
(2) 45 revolutions (4) 7.2 revolutions

17. A screwdriver is used to raise the lid on a can of paint. The edge of the can serves as a resting point (pivot) for the screwdriver, which is 2.0 cm from tip and 20 cm from the end of the handle. If a downward force of 15 N is applied to the end of the handle, how much force is exerted on the lid?

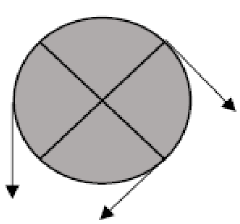


(1) 300 N
(2) 150 N
(3) 15. N
(4) 1.5 N

18. What is the reason an ice skater in a tight spin slows down when she quickly extends her arms?
(1) Her moment of inertia increases
(2) Her moment of inertia decreases
(3) Her angular momentum increases
(4) Her angular momentum decreases



19. Three children are pulling on a 2.0 m rotating platform on the nearby playground. Jack and Jill each pull with 30 N of force in a clockwise direction, while their friend Jen pulls with 50 N of force in the counter-clockwise direction. What is the net torque on the platform?



(1) 20 Nm clockwise
(2) 20 Nm counter-clockwise
(3) 220 Nm clockwise
(4) 0 Nm

20. Two electrons are separated by a distance of 2.00×10^{-6} meter. What are the magnitude and direction of the electrostatic force each exerts on the other?

(1) 1.152×10^{-22} N away from each other
(2) 1.152×10^{-22} N toward each other
(3) 5.76×10^{-17} N away from each other
(4) 5.76×10^{-17} N toward each other

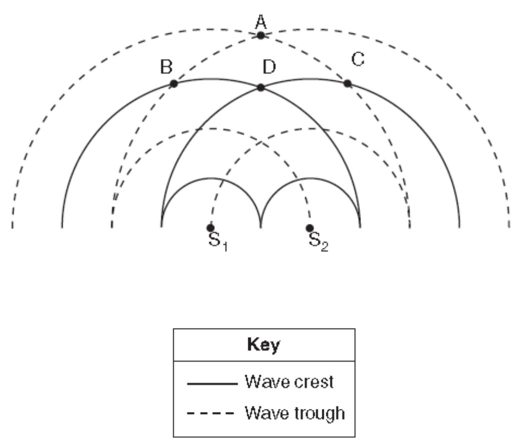
21. A tuning fork is struck and vibrates at a frequency of 264 Hz. The sound produced by the tuning fork will travel through the air as a

(1) transverse wave with air molecules vibrating perpendicular to the direction of travel
(2) longitudinal wave with air molecules vibrating perpendicular to the direction of travel
(3) transverse wave with air molecules vibrating parallel to the direction of travel
(4) longitudinal wave with air molecules vibrating parallel to the direction of travel

22. While sitting on a boat, a fisherman observes that two complete waves pass by his position every 5 seconds. What is the period of these waves?

(1) 2.5 s
(2) .40 s
(3) 10 s
(4) .50 s

23. Two speakers, S_1 and S_2, operating in phase in the same medium produce the circular wave patterns in the diagram below.



At which two points is constructive interference occurring?
(1) A and B
(2) A and D
(3) B and C
(4) B and D

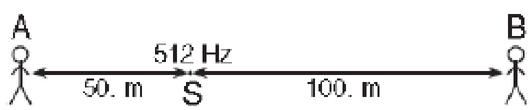
24. What is the wavelength of a 2.50 kilohertz sound wave traveling at 326 m/s through air?

(1) .130 m
(2) 1.30 m
(3) 7.67 m
(4) 130 m

25. What is characteristic of both sound waves and light (electromagnetic) waves?

(1) They are transverse waves
(2) Neither require a medium
(3) Both transfer energy
(4) Both are mechanical waves

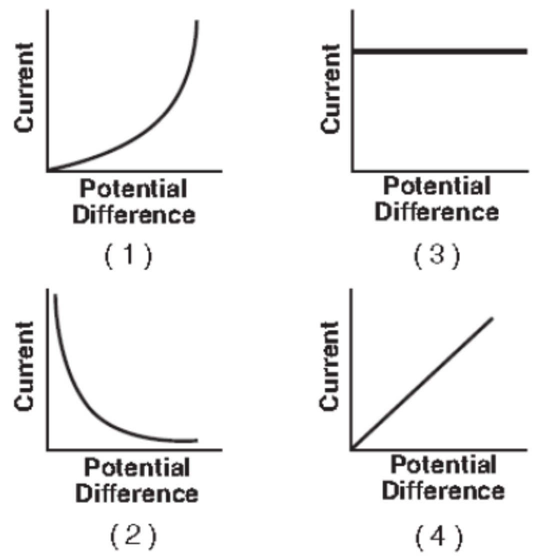
26. In the diagram below, a stationary source located at point S produces sound having a constant frequency of 512 hertz. Observer A, 50 meters to the left of S, hears a frequency of 512 hertz. Observer B, 100 meters to the right of S hears a frequency lower than 512 hertz.



Which statement best describes the motion of the observer?
(1) Observer B is moving toward point S, and observer A is stationary
(2) Observer A is moving toward point S, and observer B is stationary
(3) Observer B is moving away from point S, while observer A is stationary
(4) Both observers are moving away from S

27. Which change increases the electrical resistance of a piece of copper wire?
(1) increasing the wire's diameter
(2) decreasing the wire's temperature
(3) increasing the wire's length
(4) decreasing the wire's resistivity coefficient

28. The resistance of a circuit remains constant. Which graph best represents the relationship between the current in the circuit and the potential difference provided by the battery?



29. A 3 ohm resistor and a 6 ohm resistor are connected in parallel across a 9 volt battery. Which statement best compares the potential difference across each resistor?
(1) The potential difference across the 6 ohm resistor is half as great as the potential difference across the 3 ohm resistor.
(2) The potential difference across the 6 ohm resistor is four times as great as the potential difference across the 3 ohm resistor.
(3) The potential difference across the 6 ohm resistor is the same as the potential difference across the 3 ohm resistor.
(4) The potential difference across the 6 ohm resistor is twice as great as the potential difference across the 3 ohm resistor.

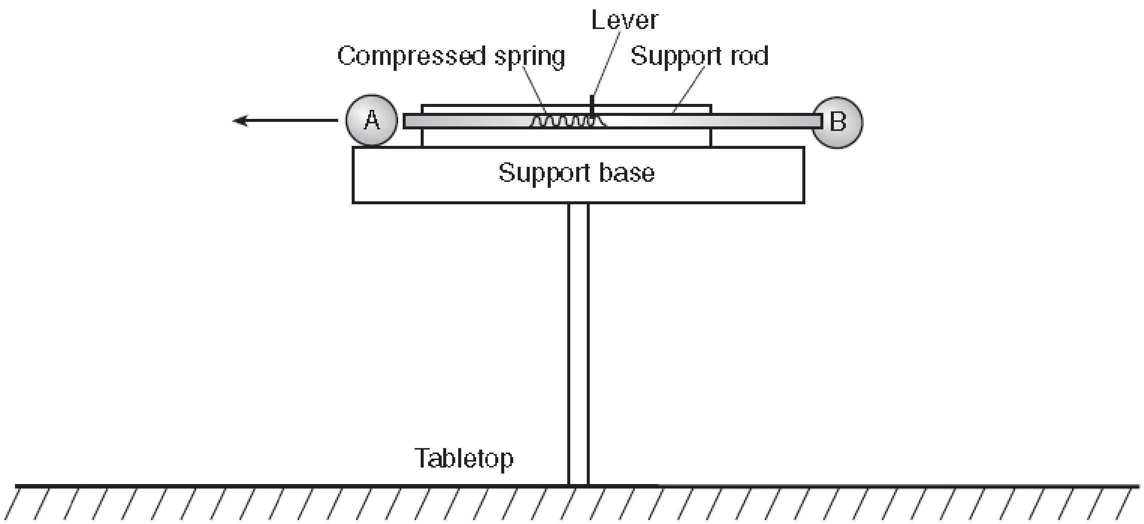
30. A 7.2 V volt battery is used to operate a cell phone for 10.0 minutes. If the cell phone dissipates .128 Watt of power during its operation, the current that passes through the phone is

(1) 56.25 A
(2) .922 A
(3) 9.22 A
(4) .018 A

Part II: Multiple Choice
(More than one answer/explain your answer)

Problem 31:

The diagram below represents a setup for demonstrating motion.



When the lever is released, the support rod withdraws from ball B, allowing it to fall. At the same instant, the rod contacts ball A, propelling it horizontally to the left.

Circle **TWO** statements that accurately describe the motion observed after the lever is released and the balls fall to the tabletop. Neglect friction.

(1) Ball A travels at constant velocity.

(2) Ball A hits the tabletop at the same time as Ball B.

(3) Ball B hits the tabletop before ball A.

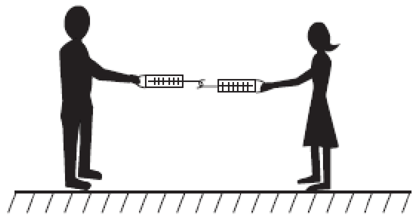
(4) Ball B travels with an increasing acceleration.

(5) Ball B travels with an constant acceleration.

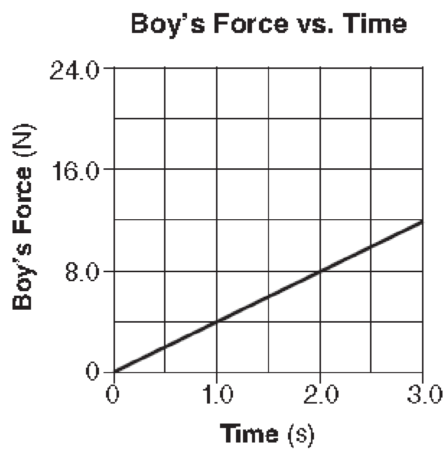
(6) Ball B will hit the tabletop with the same speed as Ball B.

Problem 32:

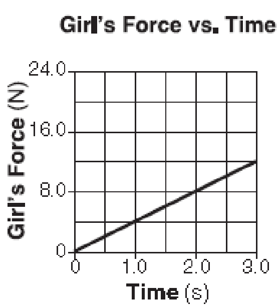
A 100.0-kilogram boy and a 50.0-kilogram girl, each holding a spring scale, pull against each other as shown in the diagram below.



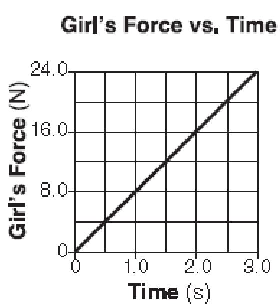
The graph below shows the relationship between the magnitude of the force that the boy applies on his spring scale and time.



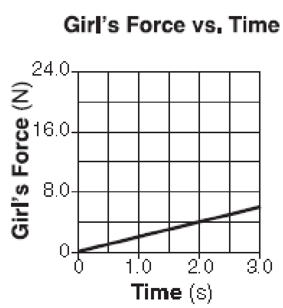
Which graph best represents the relationship between the magnitude of the force that the girl applies on her spring scale and time?



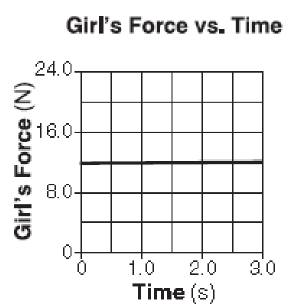
(1)



(2)



(3)



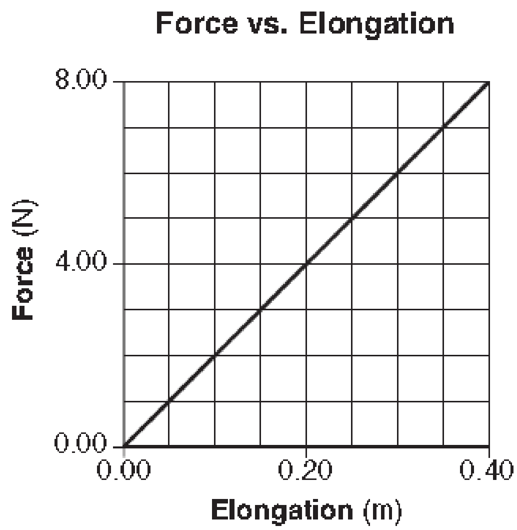
(4)

Explain the reason for your choice.

Part III: Short Answer Problem Solving

Show all work, including equations, substitutions, calculations and units.

Problem 33:



A student produced various elongations of a spring by applying a series for forces to the spring. The graph represents the relationship between the applied force and the elongation of the spring.

a. Determine the spring constant of the spring.

b. Calculate the energy stored in the spring when it is stretched .30 m from its rest position.

Problem 34:

A runner accelerates uniformly from rest to a speed of 8.00 meters per second. The kinetic energy of the runner was determined at 2.00 meter-per-second intervals and recorded in the data table.

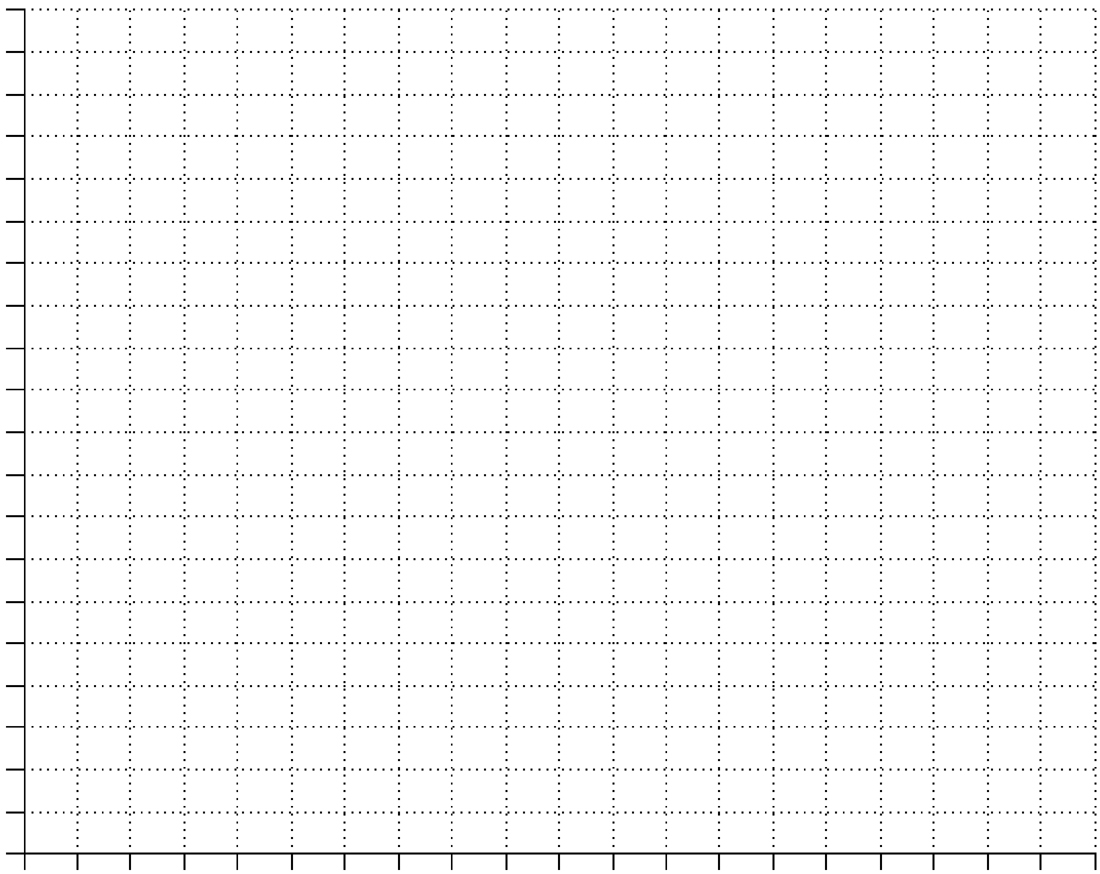
Using the information in the data table, construct a graph following the directions below.

Data Table

Speed (m/s)	**Kinetic Energy** (J)
0.00	0.00
2.00	140.
4.00	560.
6.00	1260
8.00	2240

a. On the next page, plot the data points for kinetic energy of the runner vs. his speed.

b. Draw the line or curve of best fit.



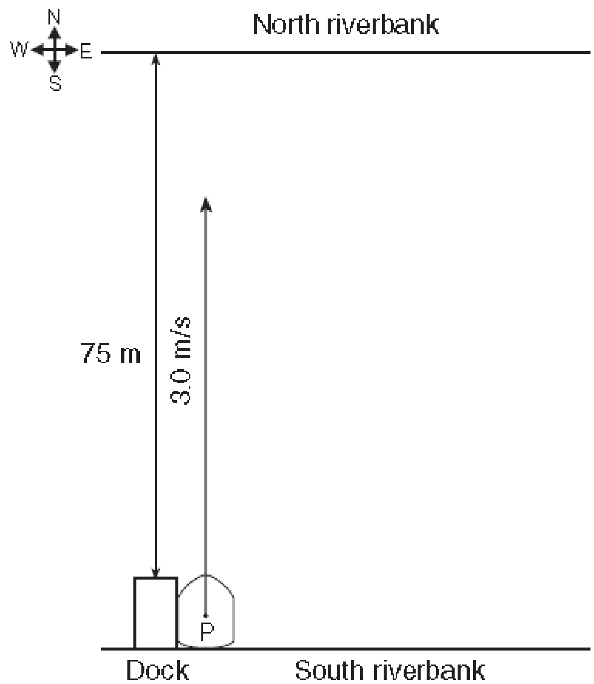
c. What formula demonstrate the relationship between Kinetic Energy and speed as illustrated by the graph?

d. Use the data to calculate the mass of the runner. Show all work, including equations, substitutions, calculations and units.

e. What is the ratio of the kinetic energy of the runner when she is running at 6.00 m/s to her kinetic energy when running at 3.00 m/s.

Problem 35:

A river has a current flowing with a velocity of 2.0 meters per second due east. A boat is 75 meters from the north riverbank. It travels at 3.0 meters per second relative to the river and is headed due north. In the diagram below, the vector starting at point P represents the velocity of the boat relative to the river water.



a. Calculate the time required for the boat to cross the river. Show all work, including equations, substitutions, calculations and units.

b. On the diagram above, add a vector which represents the velocity of the river current and another vector which represents the resultant (net) velocity of the boat.

c. Calculate the magnitude of the resultant velocity of the boat. Show all work, including equations, substitutions, calculations and units.

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Reference Tables for Physical Setting/PHYSICS

2006 Edition

List of Physical Constants

Name	Symbol	Value
Universal gravitational constant	G	6.67×10^{-11} N•m²/kg²
Acceleration due to gravity	g	9.81 m/s^2
Speed of light in a vacuum	c	3.00×10^{8} m/s
Speed of sound in air at STP		3.31×10^{2} m/s
Mass of Earth		5.98×10^{24} kg
Mass of the Moon		7.35×10^{22} kg
Mean radius of Earth		6.37×10^{6} m
Mean radius of the Moon		1.74×10^{6} m
Mean distance—Earth to the Moon		3.84×10^{8} m
Mean distance—Earth to the Sun		1.50×10^{11} m
Electrostatic constant	k	8.99×10^{9} N•m^2/C^2
1 elementary charge	e	1.60×10^{-19} C
1 coulomb (C)		6.25×10^{18} elementary charges
1 electronvolt (eV)		1.60×10^{-19} J
Planck's constant	h	6.63×10^{-34} J•s
1 universal mass unit (u)		9.31×10^{2} MeV
Rest mass of the electron	m_e	9.11×10^{-31} kg
Rest mass of the proton	m_p	1.67×10^{-27} kg
Rest mass of the neutron	m_n	1.67×10^{-27} kg

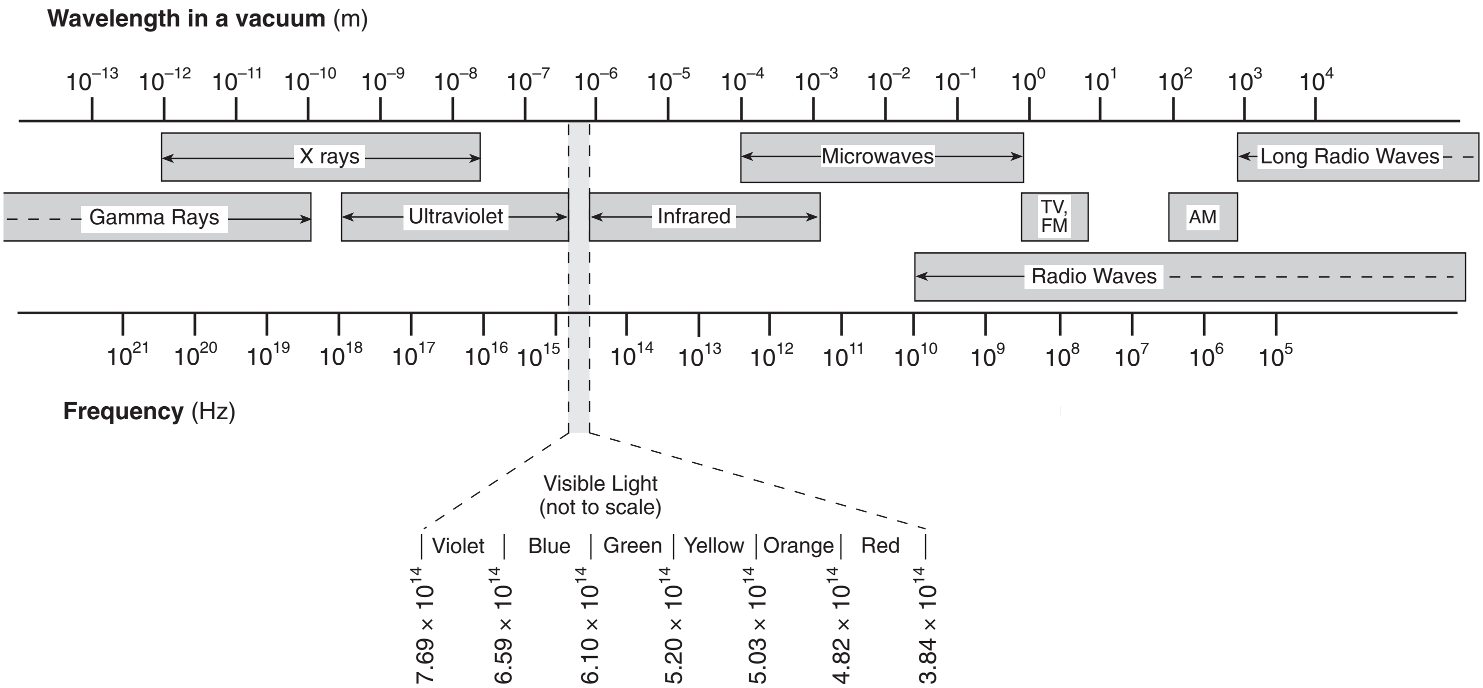
Prefixes for Powers of 10

Prefix	Symbol	Notation
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

Approximate Coefficients of Friction

	Kinetic	Static
Rubber on concrete (dry)	0.68	0.90
Rubber on concrete (wet)	0.58	
Rubber on asphalt (dry)	0.67	0.85
Rubber on asphalt (wet)	0.53	
Rubber on ice	0.15	
Waxed ski on snow	0.05	0.14
Wood on wood	0.30	0.42
Steel on steel	0.57	0.74
Copper on steel	0.36	0.53
Teflon on Teflon	0.04	

The Electromagnetic Spectrum



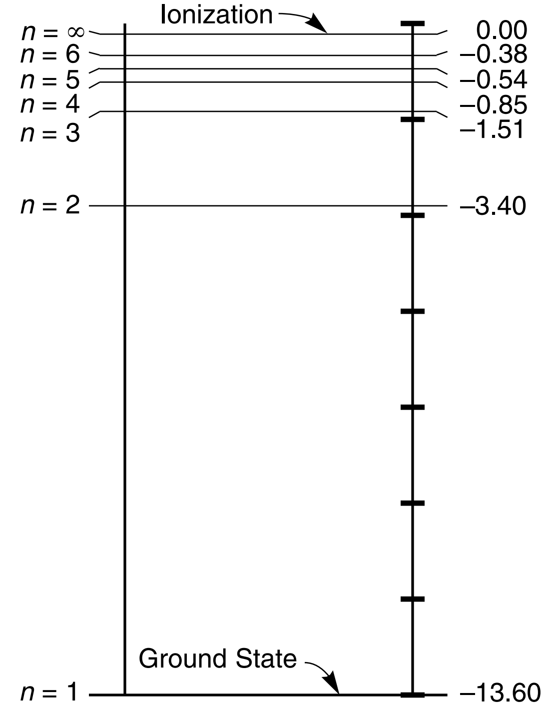
Absolute Indices of Refraction

($f = 5.09 \times 10^{14}$ Hz)

Air	1.00
Corn oil	1.47
Diamond	2.42
Ethyl alcohol	1.36
Glass, crown	1.52
Glass, flint	1.66
Glycerol	1.47
Lucite	1.50
Quartz, fused	1.46
Sodium chloride	1.54
Water	1.33
Zircon	1.92

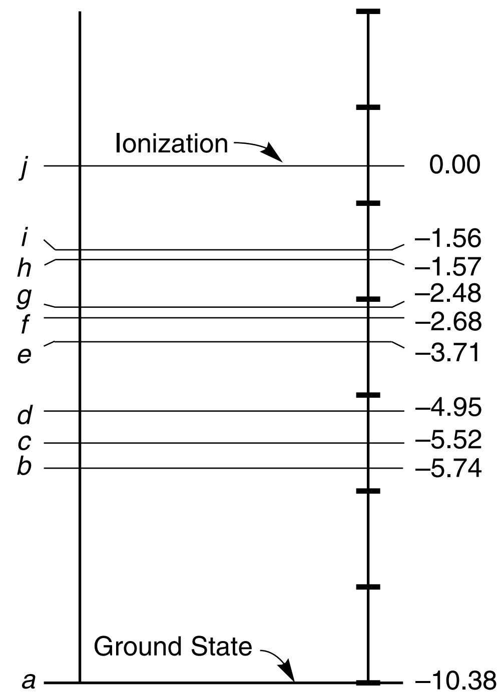
Energy Level Diagrams

Hydrogen



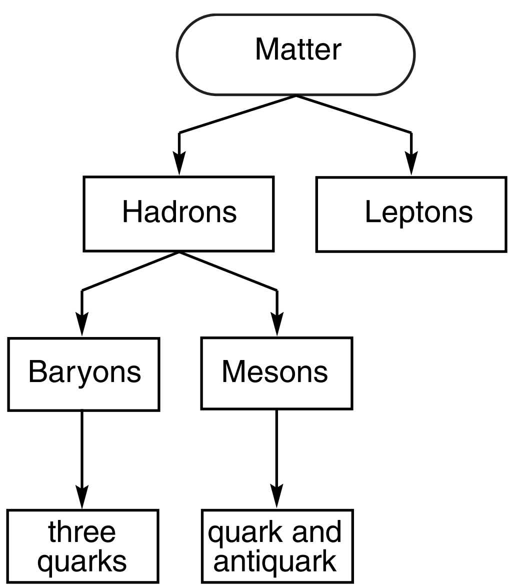
Energy Levels for the Hydrogen Atom

Mercury



A Few Energy Levels for the Mercury Atom

Classification of Matter



Particles of the Standard Model

Quarks

Name	up	charm	top
Symbol	*u*	*c*	*t*
Charge	$+\frac{2}{3}$ e	$+\frac{2}{3}$ e	$+\frac{2}{3}$ e
Name	down	strange	bottom
Symbol	*d*	*s*	*b*
Charge	$-\frac{1}{3}$ e	$-\frac{1}{3}$ e	$-\frac{1}{3}$ e

Leptons

electron	muon	tau
e	μ	τ
–1e	–1e	–1e
electron neutrino	muon neutrino	tau neutrino
ν_e	ν_μ	ν_τ
0	0	0

Note: For each particle, there is a corresponding antiparticle with a charge opposite that of its associated particle.

Electricity

$$F_e = \frac{kq_1q_2}{r^2}$$

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

$$V = \frac{W}{q}$$

$$I = \frac{\Delta q}{t}$$

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

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

$$P = VI = I^2R = \frac{V^2}{R}$$

$$W = Pt = VIt = I^2Rt = \frac{V^2t}{R}$$

A = cross-sectional area
E = electric field strength
F_e = electrostatic force
I = current
k = electrostatic constant
L = length of conductor
P = electrical power
q = charge
R = resistance
R_{eq} = equivalent resistance
r = distance between centers
t = time
V = potential difference
W = work (electrical energy)
Δ = change
ρ = resistivity

Series Circuits

$$I = I_1 = I_2 = I_3 = \ldots$$

$$V = V_1 + V_2 + V_3 + \ldots$$

$$R_{eq} = R_1 + R_2 + R_3 + \ldots$$

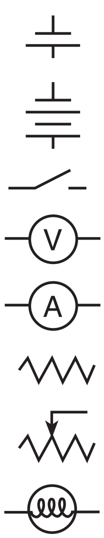
Parallel Circuits

$$I = I_1 + I_2 + I_3 + \ldots$$

$$V = V_1 = V_2 = V_3 = \ldots$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

Circuit Symbols



cell
battery
switch
voltmeter
ammeter
resistor
variable resistor
lamp

Resistivities at 20°C	
Material	**Resistivity** (Ω•m)
Aluminum	2.82×10^{-8}
Copper	1.72×10^{-8}
Gold	2.44×10^{-8}
Nichrome	$150. \times 10^{-8}$
Silver	1.59×10^{-8}
Tungsten	5.60×10^{-8}

Waves

$v = f\lambda$

$T = \frac{1}{f}$

$\theta_i = \theta_r$

$n = \frac{c}{v}$

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

$\frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$

c = speed of light in a vacuum
f = frequency
n = absolute index of refraction
T = period
v = velocity or speed
λ = wavelength
θ = angle
θ_i = angle of incidence
θ_r = angle of reflection

Modern Physics

$E_{photon} = hf = \frac{hc}{\lambda}$

$E_{photon} = E_i - E_f$

$E = mc^2$

c = speed of light in a vacuum
E = energy
f = frequency
h = Planck's constant
m = mass
λ = wavelength

Geometry and Trigonometry

Rectangle

$A = bh$

Triangle

$A = \frac{1}{2}bh$

Circle

$A = \pi r^2$

$C = 2\pi r$

Right Triangle

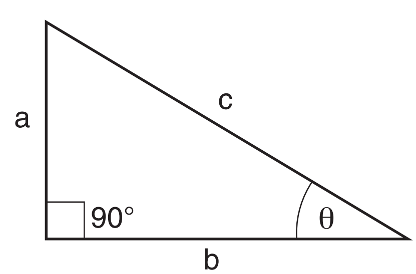
$c^2 = a^2 + b^2$

$\sin \theta = \frac{a}{c}$

$\cos \theta = \frac{b}{c}$

$\tan \theta = \frac{a}{b}$

A = area
b = base
C = circumference
h = height
r = radius



Mechanics

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

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

$v_f = v_i + at$

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

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

$A_y = A \sin \theta$

$A_x = A \cos \theta$

$a = \frac{F_{net}}{m}$

$F_f = \mu F_N$

$F_g = \frac{Gm_1m_2}{r^2}$

$g = \frac{F_g}{m}$

$p = mv$

$p_{before} = p_{after}$

$J = F_{net}t = \Delta p$

$F_s = kx$

$PE_s = \frac{1}{2}kx^2$

$F_c = ma_c$

$a_c = \frac{v^2}{r}$

$\Delta PE = mg\Delta h$

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

$W = Fd = \Delta E_T$

$E_T = PE + KE + Q$

$P = \frac{W}{t} = \frac{Fd}{t} = F\overline{v}$

a = acceleration
a_c = centripetal acceleration
A = any vector quantity
d = displacement or distance
E_T = total energy
F = force
F_c = centripetal force
F_f = force of friction
F_g = weight or force due to gravity
F_N = normal force
F_{net} = net force
F_s = force on a spring
g = acceleration due to gravity or gravitational field strength
G = universal gravitational constant
h = height
J = impulse
k = spring constant
KE = kinetic energy
m = mass
p = momentum
P = power
PE = potential energy
PE_s = potential energy stored in a spring
Q = internal energy
r = radius or distance between centers
t = time interval
v = velocity or speed
$\overline{v}$ = average velocity or average speed
W = work
x = change in spring length from the equilibrium position
Δ = change
θ = angle
μ = coefficient of friction

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