# Physics
# Review Booklet

# Spring 2012

Instructions to the Students: This booklet contains Regents questions taken from past examinations. They cover the material that you have been working on in your Regents Physics classes. There are 50 multiple choice questions in the booklet. It is suggested that you complete ten (10) questions per day. Please make sure to select the choice that you feel best answers the question or completes the statement.

The reference tables that you will need to complete the questions are located at the back of the booklet. Please make sure to complete all questions and if there are any questions that you do not fully understand, make a notation on the question and be sure to ask you teacher for the explanation when you return to school.

*The questions and tables in this packet are from the New York State Education Department at* http://www.nysedregents.org/Physics/. *You can visit this link for additional Regents exams and practice.*

**1** A force of 25 newtons east and a force of 25 newtons west act concurrently on a 5.0-kilogram cart. What is the acceleration of the cart?

(1) 1.0 m/s$^2$ west
(2) 0.20 m/s$^2$ east
(3) 5.0 m/s$^2$ east
(4) 0 m/s$^2$

**2** An unstretched spring has a length of 10. centimeters. When the spring is stretched by a force of 16 newtons, its length is increased to 18 centimeters. What is the spring constant of this spring?

(1) 0.89 N/cm
(2) 2.0 N/cm
(3) 1.6 N/cm
(4) 1.8 N/cm

**3** What is the acceleration due to gravity at a location where a 15.0-kilogram mass weighs 45.0 newtons?

(1) 675 m/s$^2$
(2) 9.81 m/s$^2$
(3) 3.00 m/s$^2$
(4) 0.333 m/s$^2$

**4** As a car is driven south in a straight line with *decreasing* speed, the acceleration of the car must be

(1) directed northward
(2) directed southward
(3) zero
(4) constant, but not zero

**5** A baseball dropped from the roof of a tall building takes 3.1 seconds to hit the ground. How tall is the building? [Neglect friction.]

(1) 15 m
(2) 30. m
(3) 47 m
(4) 94 m

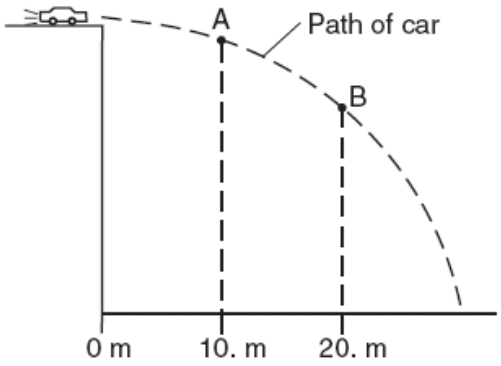
**6** Which object has the greatest inertia?

(1) a falling leaf
(2) a softball in flight
(3) a seated high school student
(4) a rising helium-filled toy balloon

**7** Centripetal force $F_c$ acts on a car going around a curve. If the speed of the car were twice as great, the magnitude of the centripetal force necessary to keep the car moving in the same path would be

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

**8** The diagram below represents the path of a stunt car that is driven off a cliff, neglecting friction.




Compared to the horizontal component of the car's velocity at point *A*, the horizontal component of the car's velocity at point *B* is

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

**9** What is the average power required to raise a $1.81 \times 10^4$-newton elevator 12.0 meters in 22.5 seconds?

(1) $8.04 \times 10^2$ W
(2) $9.65 \times 10^3$ W
(3) $2.17 \times 10^5$ W
(4) $4.89 \times 10^6$ W

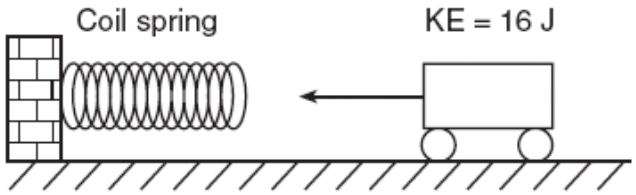
**10** If the speed of a moving object is doubled, the kinetic energy of the object is

(1) halved
(2) doubled
(3) unchanged
(4) quadrupled

**11** Which statement best explains why a "wet saw" used to cut through fine optical crystals is constantly lubricated with oil?

(1) Lubrication decreases friction and minimizes the increase of internal energy.
(2) Lubrication decreases friction and maximizes the increase of internal energy.
(3) Lubrication increases friction and minimizes the increase of internal energy.
(4) Lubrication increases friction and maximizes the increase of internal energy.

**12** The diagram below shows a toy cart possessing 16 joules of kinetic energy traveling on a frictionless, horizontal surface toward a horizontal spring.




If the cart comes to rest after compressing the spring a distance of 1.0 meter, what is the spring constant of the spring?

(1) 32 N/m
(2) 16 N/m
(3) 8.0 N/m
(4) 4.0 N/m

**13** How much work is required to lift a 10.-newton weight from 4.0 meters to 40. meters above the surface of Earth?

(1) 2.5 J
(2) 3.6 J
(3) $3.6 \times 10^2$ J
(4) $4.0 \times 10^2$ J

**14** Which situation describes a system with *decreasing* gravitational potential energy?

(1) a girl stretching a horizontal spring
(2) a bicyclist riding up a steep hill
(3) a rocket rising vertically from Earth
(4) a boy jumping down from a tree limb

**15** If 20 joules of work is used to transfer 20 coulombs of charge through a 20-ohm resistor, the potential difference across the resistor is

(1) 1 V
(2) 20 V
(3) 0.05 V
(4) 400 V

**16** At 20°C, four conducting wires made of different materials have the same length and the same diameter. Which wire has the *least* resistance?

(1) aluminum
(2) gold
(3) nichrome
(4) tungsten

**17** Three identical lamps are connected in parallel with each other. If the resistance of each lamp is $X$ ohms, what is the equivalent resistance of this parallel combination?

(1) $X\ \Omega$
(2) $\frac{X}{3}\Omega$
(3) $3X\ \Omega$
(4) $\frac{3}{X}\Omega$

**18** A 2.0-ohm resistor and a 4.0-ohm resistor are connected in series with a 12-volt battery. If the current through the 2.0-ohm resistor is 2.0 amperes, the current through the 4.0-ohm resistor is

(1) 1.0 A
(2) 2.0 A
(3) 3.0 A
(4) 4.0 A

**19** A dampened fingertip rubbed around the rim of a crystal stemware glass causes the glass to vibrate and produce a musical note. This effect is due to

(1) resonance
(2) refraction
(3) reflection
(4) rarefaction

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

(1) radio wave
(2) microwave
(3) light wave
(4) mechanical wave

**21** Compared to the speed of a sound wave in air, the speed of a radio wave in air is

(1) less
(2) greater
(3) the same

**22** If the amplitude of a wave is increased, the frequency of the wave will

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

**23** Which unit is equivalent to meters per second?

(1) Hz•s
(2) Hz•m
(3) s/Hz
(4) m/Hz

**24** Which characteristic is the same for every color of light in a vacuum?

(1) energy
(2) frequency
(3) speed
(4) period

**25** What is the speed of light ($f = 5.09 \times 10^{14}$ Hz) in flint glass?

(1) $1.81 \times 10^8$ m/s
(2) $1.97 \times 10^8$ m/s
(3) $3.00 \times 10^8$ m/s
(4) $4.98 \times 10^8$ m/s

**26** The speedometer in a car does *not* measure the car's velocity because velocity is a

(1) vector quantity and has a direction associated with it
(2) vector quantity and does not have a direction associated with it
(3) scalar quantity and has a direction associated with it
(4) scalar quantity and does not have a direction associated with it

**27** A projectile launched at an angle of 45° above the horizontal travels through the air. Compared to the projectile's theoretical path with no air friction, the actual trajectory of the projectile with air friction is

(1) lower and shorter
(2) lower and longer
(3) higher and shorter
(4) higher and longer

**28** Cart *A* has a mass of 2 kilograms and a speed of 3 meters per second. Cart *B* has a mass of 3 kilograms and a speed of 2 meters per second. Compared to the inertia and magnitude of momentum of cart *A*, cart *B* has

(1) the same inertia and a smaller magnitude of momentum
(2) the same inertia and the same magnitude of momentum
(3) greater inertia and a smaller magnitude of momentum
(4) greater inertia and the same magnitude of momentum

**29** Approximately how much time does it take light to travel from the Sun to Earth?

(1) $2.00 \times 10^{-3}$ s
(2) $1.28 \times 10^0$ s
(3) $5.00 \times 10^2$ s
(4) $4.50 \times 10^{19}$ s

**30** A rock falls from rest a vertical distance of 0.72 meter to the surface of a planet in 0.63 second. The magnitude of the acceleration due to gravity on the planet is

(1) 1.1 m/s$^2$
(2) 2.3 m/s$^2$
(3) 3.6 m/s$^2$
(4) 9.8 m/s$^2$

**31** Two stones, *A* and *B*, are thrown horizontally from the top of a cliff. Stone *A* has an initial speed of 15 meters per second and stone *B* has an initial speed of 30. meters per second. Compared to the time it takes stone *A* to reach the ground, the time it takes stone *B* to reach the ground is

(1) the same
(2) twice as great
(3) half as great
(4) four times as great

**32** The speed of an object undergoing constant acceleration increases from 8.0 meters per second to 16.0 meters per second in 10. seconds. How far does the object travel during the 10. seconds?

(1) $3.6 \times 10^2$ m
(2) $1.6 \times 10^2$ m
(3) $1.2 \times 10^2$ m
(4) $8.0 \times 10^1$ m

**33** A 1200-kilogram space vehicle travels at 4.8 meters per second along the level surface of Mars. If the magnitude of the gravitational field strength on the surface of Mars is 3.7 newtons per kilogram, the magnitude of the normal force acting on the vehicle is

(1) 320 N
(2) 930 N
(3) 4400 N
(4) 5800 N

**34** An airplane flies with a velocity of 750. kilometers per hour, 30.0° south of east. What is the magnitude of the eastward component of the plane's velocity?

(1) 866 km/h
(2) 650. km/h
(3) 433 km/h
(4) 375 km/h

**35** An 80-kilogram skier slides on waxed skis along a horizontal surface of snow at constant velocity while pushing with his poles. What is the horizontal component of the force pushing him forward?

(1) 0.05 N
(2) 0.4 N
(3) 40 N
(4) 4 N

**36** A 0.45-kilogram football traveling at a speed of 22 meters per second is caught by an 84-kilogram stationary receiver. If the football comes to rest in the receiver's arms, the magnitude of the impulse imparted to the receiver by the ball is

(1) 1800 N•s
(2) 9.9 N•s
(3) 4.4 N•s
(4) 3.8 N•s

**37** A carpenter hits a nail with a hammer. Compared to the magnitude of the force the hammer exerts on the nail, the magnitude of the force the nail exerts on the hammer during contact is

(1) less
(2) greater
(3) the same

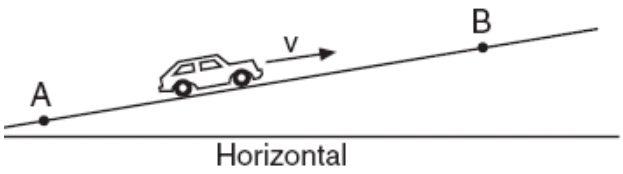
**38** As a meteor moves from a distance of 16 Earth radii to a distance of 2 Earth radii from the center of Earth, the magnitude of the gravitational force between the meteor and Earth becomes

(1) $\frac{1}{8}$ as great
(2) 8 times as great
(3) 64 times as great
(4) 4 times as great

**39** A 60.-kilogram student climbs a ladder a vertical distance of 4.0 meters in 8.0 seconds. Approximately how much total work is done against gravity by the student during the climb?

(1) $2.4 \times 10^3$ J
(2) $2.9 \times 10^2$ J
(3) $2.4 \times 10^2$ J
(4) $3.0 \times 10^1$ J

**40** A car travels at constant speed $v$ up a hill from point $A$ to point $B$, as shown in the diagram below.




As the car travels from $A$ to $B$, its gravitational potential energy

(1) increases and its kinetic energy decreases
(2) increases and its kinetic energy remains the same
(3) remains the same and its kinetic energy decreases
(4) remains the same and its kinetic energy remains the same

**41** What is the maximum amount of work that a 6000.-watt motor can do in 10. seconds?

(1) $6.0 \times 10^1$ J
(2) $6.0 \times 10^2$ J
(3) $6.0 \times 10^3$ J
(4) $6.0 \times 10^4$ J

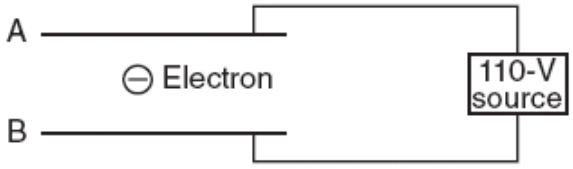
**42** Three resistors, 4 ohms, 6 ohms, and 8 ohms, are connected in parallel in an electric circuit. The equivalent resistance of the circuit is

(1) less than 4 Ω
(2) between 4 Ω and 8 Ω
(3) between 10. Ω and 18 Ω
(4) 18 Ω

**43** An electric circuit contains a variable resistor connected to a source of constant voltage. As the resistance of the variable resistor is increased, the power dissipated in the circuit

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

**44** An electron is located in the electric field between two parallel metal plates as shown in the diagram below.




If the electron is attracted to plate *A*, then plate *A* is charged

(1) positively, and the electric field is directed from plate *A* toward plate *B*
(2) positively, and the electric field is directed from plate *B* toward plate *A*
(3) negatively, and the electric field is directed from plate *A* toward plate *B*
(4) negatively, and the electric field is directed from plate *B* toward plate *A*

**45** A potential difference of 10.0 volts exists between two points, *A* and *B*, within an electric field. What is the magnitude of charge that requires $2.0 \times 10^{-2}$ joule of work to move it from *A* to *B*?

(1) $5.0 \times 10^{2}$ C
(2) $2.0 \times 10^{-1}$ C
(3) $5.0 \times 10^{-2}$ C
(4) $2.0 \times 10^{-3}$ C

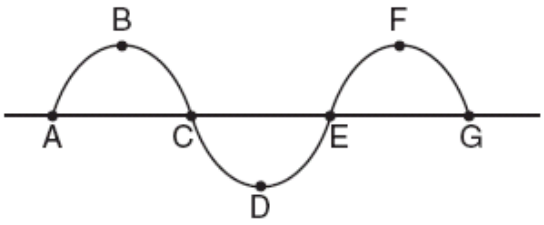
**46** A circuit consists of a resistor and a battery. Increasing the voltage of the battery while keeping the temperature of the circuit constant would result in an increase in

(1) current, only
(2) resistance, only
(3) both current and resistance
(4) neither current nor resistance

**47** An electromagnetic AM-band radio wave could have a wavelength of

(1) 0.005 m
(2) 5 m
(3) 500 m
(4) 5 000 000 m

**48** The diagram below represents a transverse wave.




The wavelength of the wave is equal to the distance between points

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

**49** When a light wave enters a new medium and is refracted, there must be a change in the light wave's

(1) color
(2) frequency
(3) period
(4) speed

**50** The speed of light in a piece of plastic is $2.00 \times 10^{8}$ meters per second. What is the absolute index of refraction of this plastic?

(1) 1.00
(2) 0.670
(3) 1.33
(4) 1.50

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# Reference Tables for Physical Setting/PHYSICS

## 2006 Edition

## List of Physical Constants

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

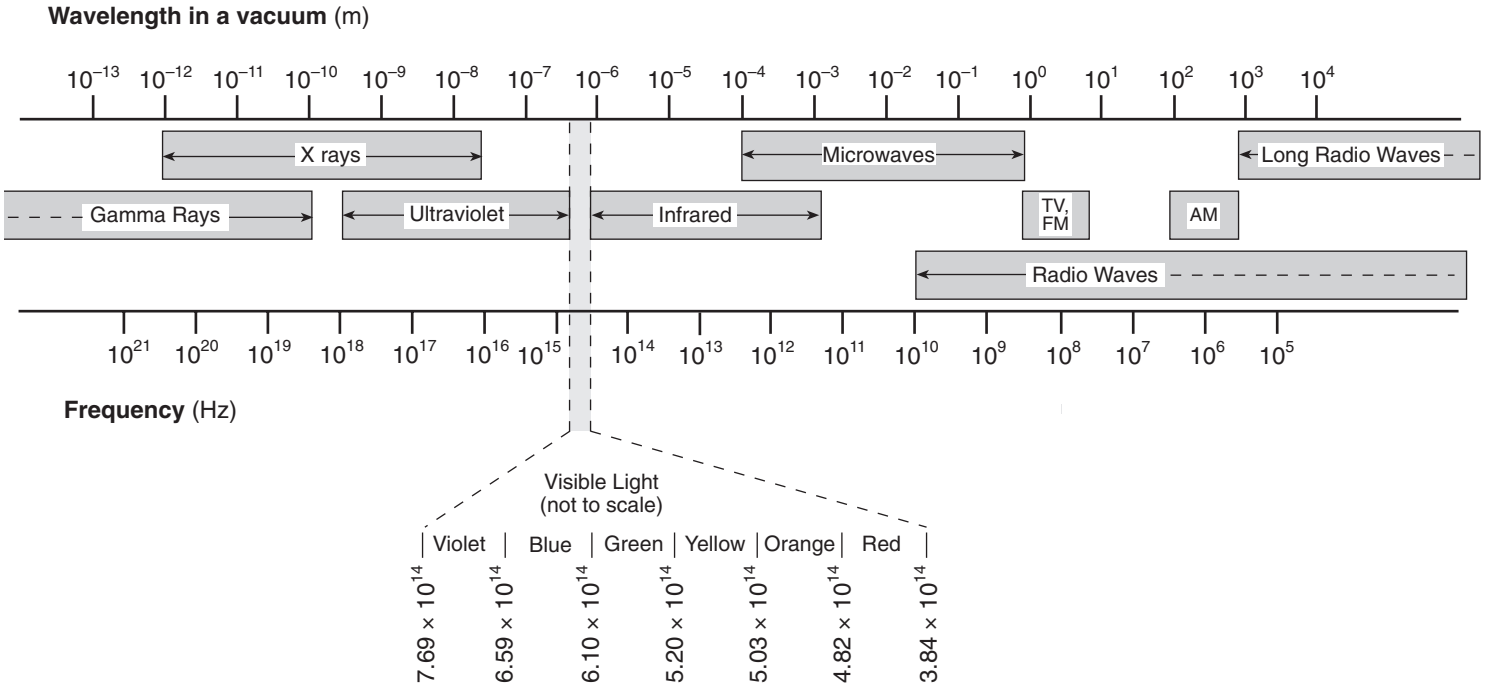
## Prefixes for Powers of 10

| 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



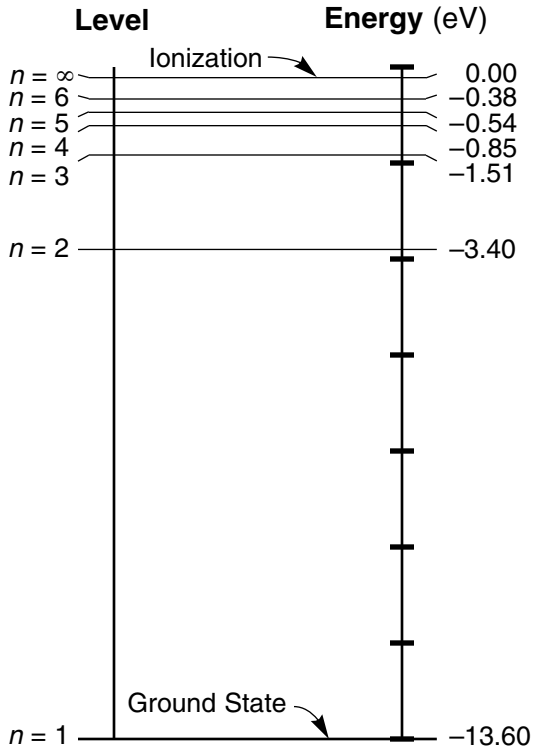

## Absolute Indices of Refraction

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

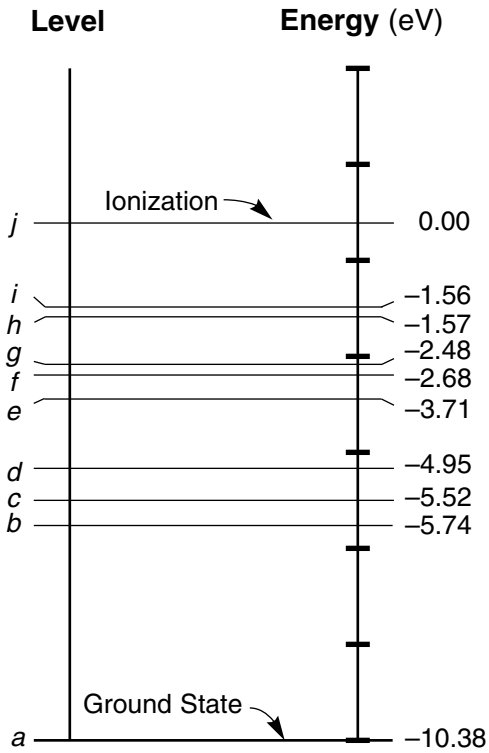
# Energy Level Diagrams

## Hydrogen




**Energy Levels for the Hydrogen Atom**

## Mercury




**A Few Energy Levels for the Mercury Atom**

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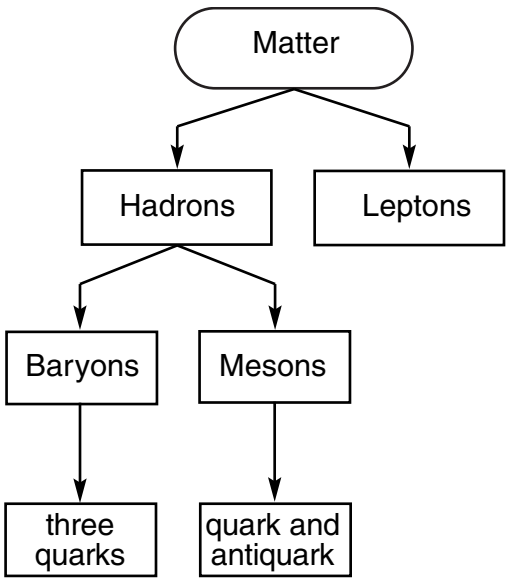
## Classification of Matter




## 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 |
| | down | strange | bottom |
| | $d$ | $s$ | $b$ |
| | $-\frac{1}{3}$ e | $-\frac{1}{3}$ e | $-\frac{1}{3}$ e |

### Leptons

| | | |
|---|---|---|
| electron | muon | tau |
| e | $\mu$ | $\tau$ |
| –1e | –1e | –1e |
| electron neutrino | muon neutrino | tau neutrino |
| $\nu_e$ | $\nu_\mu$ | $\nu_\tau$ |
| 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)
$\Delta$ = change
$\rho$ = resistivity

### Series Circuits

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

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

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

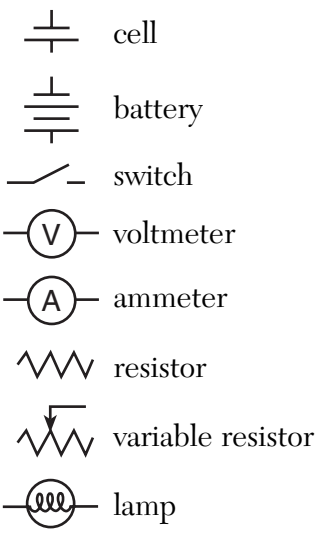
### Parallel Circuits

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

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

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

## Circuit Symbols




cell
battery
switch
voltmeter
ammeter
resistor
variable resistor
lamp

**Resistivities at 20°C**

| Material | Resistivity ($\Omega \cdot m$) |
|---|---|
| Aluminum | $2.82 \times 10^{-8}$ |
| Copper | $1.72 \times 10^{-8}$ |
| Gold | $2.44 \times 10^{-8}$ |
| Nichrome | $150. \times 10^{-8}$ |
| Silver | $1.59 \times 10^{-8}$ |
| Tungsten | $5.60 \times 10^{-8}$ |

## 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
$\lambda$ = wavelength
$\theta$ = angle
$\theta_i$ = angle of incidence
$\theta_r$ = 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
$\lambda$ = wavelength

## Geometry and Trigonometry

**Rectangle**

$A = bh$

**Triangle**

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

**Circle**

$A = \pi r^2$
$C = 2\pi r$

**Right Triangle**

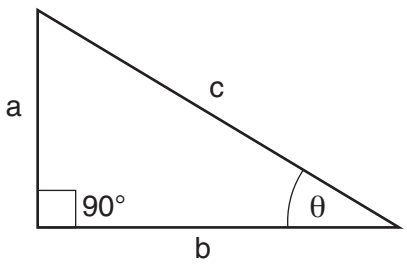
$c^2 = a^2 + b^2$

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

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

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

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



## Mechanics

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

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

$$v_f = v_i + at$$

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

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

$$A_y = A \sin \theta$$

$$A_x = A \cos \theta$$

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

$$F_f = \mu F_N$$

$$F_g = \frac{G m_1 m_2}{r^2}$$

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

$$p = mv$$

$$p_{before} = p_{after}$$

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

$$F_s = kx$$

$$PE_s = \frac{1}{2} k x^2$$

$$F_c = m a_c$$

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

$$\Delta PE = mg\Delta h$$

$$KE = \frac{1}{2} m v^2$$

$$W = Fd = \Delta E_T$$

$$E_T = PE + KE + Q$$

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

$a$ = 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

$\bar{v}$ = average velocity or average speed

$W$ = work

$x$ = change in spring length from the equilibrium position

$\Delta$ = change

$\theta$ = angle

$\mu$ = coefficient of friction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# Physics
# Review Booklet (2012)
# Answers

| | |
|---|---|
| [1] 4 | [26] 1 |
| [2] 2 | [27] 1 |
| [3] 3 | [28] 4 |
| [4] 1 | [29] 3 |
| [5] 3 | [30] 3 |
| [6] 3 | [31] 1 |
| [7] 4 | [32] 3 |
| [8] 3 | [33] 3 |
| [9] 2 | [34] 2 |
| [10] 4 | [35] 3 |
| [11] 1 | [36] 2 |
| [12] 1 | [37] 3 |
| [13] 3 | [38] 3 |
| [14] 4 | [39] 1 |
| [15] 1 | [40] 2 |
| [16] 2 | [41] 4 |
| [17] 2 | [42] 1 |
| [18] 2 | [43] 1 |
| [19] 1 | [44] 1 |
| [20] 4 | [45] 4 |
| [21] 2 | [46] 1 |
| [22] 3 | [47] 3 |
| [23] 2 | [48] 2 |
| [24] 3 | [49] 4 |
| [25] 1 | [50] 4 |