Useful Data

M_e	Mass of the earth	5.98×10^{24} kg	
R_e	Radius of the earth	6.37×10^{6} m	
g	Free-fall acceleration on earth	9.80 m/s^2	
G	Gravitational constant	6.67×10^{-11} N m^2/kg^2	
k_B	Boltzmann's constant	1.38×10^{-23} J/K	
R	Gas constant	8.31 J/mol K	
N_A	Avogadro's number	6.02×10^{23} particles/mol	
T_0	Absolute zero	−273°C	
σ	Stefan-Boltzmann constant	5.67×10^{-8} W/m^2 K^4	
p_{atm}	Standard atmosphere	101,300 Pa	
v_{sound}	Speed of sound in air at 20°C	343 m/s	
m_p	Mass of the proton (and the neutron)	1.67×10^{-27} kg	
m_e	Mass of the electron	9.11×10^{-31} kg	
K	Coulomb's law constant ($1/4\pi\epsilon_0$)	8.99×10^{9} N m^2/C^2	
ϵ_0	Permittivity constant	8.85×10^{-12} C^2/N m^2	
μ_0	Permeability constant	1.26×10^{-6} Tm/A	
e	Fundamental unit of charge	1.60×10^{-19} C	
c	Speed of light in vacuum	3.00×10^{8} m/s	
h	Planck's constant	6.63×10^{-34} J s	4.14×10^{-15} eV s
$\hbar$	Planck's constant	1.05×10^{-34} J s	6.58×10^{-16} eV s
a_B	Bohr radius	5.29×10^{-11} m	

Common Prefixes

Prefix	Meaning
femto-	10^{-15}
pico-	10^{-12}
nano-	10^{-9}
micro-	10^{-6}
milli-	10^{-3}
centi-	10^{-2}
kilo-	10^{3}
mega-	10^{6}
giga-	10^{9}
terra-	10^{12}

Conversion Factors

Length
1 in = 2.54 cm
1 mi = 1.609 km
1 m = 39.37 in
1 km = 0.621 mi

Velocity
1 mph = 0.447 m/s
1 m/s = 2.24 mph = 3.28 ft/s

Mass and energy
1 u = 1.661×10^{-27} kg
1 cal = 4.19 J
1 eV = 1.60×10^{-19} J

Time
1 day = 86,400 s
1 year = 3.16×10^{7} s

Pressure
1 atm = 101.3 kPa = 760 mm of Hg
1 atm = 14.7 lb/in^2

Rotation
1 rad = $180°/\pi = 57.3°$
1 rev = $360° = 2\pi$ rad
1 rev/s = 60 rpm

Cos(60°) = 1/2 Sin(60°) = $\sqrt{3}/2$ Tan(60°)= $\sqrt{3}$	Cos(30°) = $\sqrt{3}/2$ Sin(30°) =1/2 Tan(30°)=1/$\sqrt{3}$	Cos(45°) = $\sqrt{2}/2$ Sin(45°) = $\sqrt{2}/2$ Tan(45°)=1

NAME: _____	Quiz #9a: Phys270

1. [10 pts] A 20.0-cm-diameter blackbody radiating sphere is glowing red, but a spectrum shows that its emission spectrum peaks at an infrared wavelength of 1.0 mm. How much power does the sphere radiate?

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NAME: _____	Quiz #9b: Phys270

1. [10 pts] To initiate a nuclear reaction, an experimental nuclear physicist wants to shoot a proton into a ^{12}C nucleus. The proton must impact the nucleus with a kinetic energy of 3.00 MeV. The nuclear radius is 3.00 fm. You can assume the nucleus remains at rest and the proton's velocity is non-relativistic. [Note: 1 eV = 1.6×10^{-19} J]

a. [5 pts] With what speed must the proton be fired toward the target?

b. [5 pts] Through what potential difference must the proton be accelerated from rest to acquire this speed?

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NAME: _____	Quiz #9c: Phys270

1. [10 pts] A neutral lithium atom has three electrons. Two of these electrons form an "inner core" but the third – the valence electron – orbits at a much larger radius. From the valence electron's perspective, it is orbiting a spherical ball of charge having a net charge of +e (that is, the three protons in the nucleus and the two inner-core electrons). The energy required to ionize a lithium atom in the ground state is 5.0 eV. According to Rutherford's nuclear model of the atom, what are the orbital radius and speed of the valence electron?

   [Note: 1 eV = 1.6×10^{-19} J]

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NAME: _____	Quiz #9d: Phys270

1. [10 pts] An unknown charged particle passes without deflection throug h crossed electric and magnetic fields of strengths 200,000 V/m and 0.10 T, respectively. The velocity of the particle is perpendicular to both fields. The particle then passes out of this region and into a region of uniform magnetic field of 0.2 T in which the particle makes a semicircle of diameter 20 cm. What is the particle's charge-to-mass ratio?