Formulas and Constants (PHYS 215)

(for 1st, 2nd, and final exams)

Celestial Objects	Radius (km)	Mass (kg)	Ave. Distance From the Sun	Orbital Period	Rotational Period	Eccentricity (e)
Mercury	02439	33×10^{22}	0057909000 km	00088 days	1408 hrs.	0.206
Venus	06052	49×10^{23}	0108209000 km	00225 days	5832 hrs.	0.007
Earth	06378	60×10^{23}	0150000000 km	365.25 days	0024 hrs.	0.017
Mars	03397	64×10^{22}	0227939000 km	00687 days	0025 hrs.	0.093
Jupiter	71492	19×10^{26}	0778298000 km	04337 days	0010 hrs.	0.048
Saturn	60268	57×10^{25}	1429394000 km	10760 days	0011 hrs.	0.056
Uranus	25559	87×10^{24}	2875039000 km	30700 days	0017 hrs.	0.046
Neptune	24764	10×10^{25}	4504450000 km	60200 days	0016 hrs.	0.010
Pluto	0 1151	11×10^{21}	5915799000 km	90780 days	0153 hrs.	0.248

1 hr	=	60 min	=	3600 sec	
1 day	=	24 hrs			
1 year	=	365.25 days			
1 deg	=	60 arc-min	=	3600 arc-sec	
1 deg	=	$(180/\pi)$ rad		(radians to degrees)	
1 km	=	1000 m			
1 m	=	100 cm	=	1000 mm	
1 m	=	1×10^{9} nm	=	1×10^{10} Å	
c	=	3.0×10^{8} m/s		(speed of light)	
G	=	6.67×10^{-11} $m^3/kg\text{-}s^2$			

1 ly	=	9.46×10^{15} m
1 pc	=	3.09×10^{16} m
1 a.u.	=	1.5×10^{11} m
$r_{moon\text{-}earth}$	=	384403 km
R_{moon}	=	1738 km
M_{moon}	=	7.4×10^{22} kg
M_{sun}	=	2.0×10^{30} kg
R_{sun}	=	7.0×10^{5} km
M_{earth}	=	6.0×10^{24} kg
R_{earth}	=	6378 km

If the value of a wavelength (λ) is not mentioned in the question then use the following:

λ (violet) = 400 nm , λ (indigo) = 450 nm , λ (blue) = 500 nm , λ (green) = 550 nm

λ (yellow) = 600 nm , λ (orange) = 650 nm , λ (red) = 700 nm

$\Delta\lambda / \lambda_o = v / c$ (Doppler effect [shift]) , $c = \lambda \times f$,

C.P. $\propto D^2$

Mag $= f_o / f_e$

$\theta = \lambda / (500\times D)$

$E = h \times f$

$\lambda_{peak}\, T$ = constant = 2.9 (mm/K) Wein's Law

$I = \sigma T^4 = L/A$ Stefan-Boltzmann Law

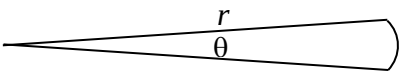
$h = 6.626\times10^{-34}$ J.s Planck's constant

$\sigma = 5.67\times10^{-8}$ $W/(m^2.T^4)$ Stefan-Boltzmann constant

$$P^2 = (4\pi^2 / GM)\, a^3$$
$$(P_1 / P_2)^2 = (a_1 / a_2)^3$$

(Kepler's **3**rd Law)

$s = r \times \theta$



s = length of an arc of a circle of radius ***r***

$V = (4/3)\,\pi R^3$ (volume of a sphere)

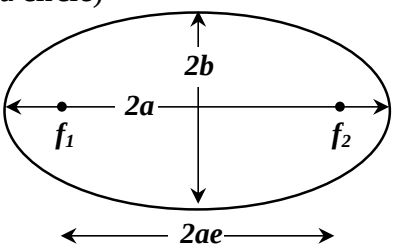
$A = 4\,\pi R^2$ (surface area of a sphere)

$C = 2\,\pi R$ (Circumference of a circle)

$A = \pi R^2$ (Area of a circle)

Equation of an ellipse: $\boldsymbol{r = a\,(1 - e^2) / \{1 + e\cos(\theta)\}}$

or $\boldsymbol{x^2/a^2 + y^2/b^2 = 1}$



where: ***e*** is the eccentricity

$\boldsymbol{f_1}$ & $\boldsymbol{f_2}$ are the locations of the two foci

a & ***b*** are the semi-major axis and semi-minor axis, respectively