IDX G9 Physics H
Study Guide S1 Finals
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Note: the full chapter 4 and 1 will also be tested; however, they are already covered in the previous study guides.

1.6 **Converting Units**

- Conversion factors are equal to 1
  - Ex: $\frac{1\ kg}{1000\ g} = 1$
  - $72\frac{km}{h} = \frac{72\ km}{1\ h} \times \frac{1000\ m}{1\ km} \times \frac{1\ h}{3600\ s} = 20\frac{m}{s}$

1.7 **Order of Magnitude**

- A (very) rough estimate through rounding off numbers to the **nearest power of 10**
  - Ex: $114514 \approx 10^5$
  - If it helps, you can first round the number to 1 sf, then determine the power of 10
- Helpful for double checking results of a calculation
- Sample question: Estimate the total number of heartbeats a typical human makes in a lifetime, assumkng a human lives 70 years.

- $80\frac{beats}{min} \times 70years \times \frac{365\ days}{1\ yr} \times \frac{24\ hrs}{1\ day} \times \frac{60\ min}{1\ hr}$

  $\approx 80\frac{beats}{min} \times 70years \times \frac{400\ days}{1\ yr} \times \frac{20\ hrs}{1\ day} \times \frac{60\ min}{1\ hr}$

  $\approx 80\frac{beats}{min} \times 3 \times 10^7$

  $\approx 2 \times 10^9$

  Order of magnitude $= 10^9$

- Some orders of magnitude that appeared on the packet (you might need to remember):

Table 1-3 The Universe by Orders of Magnitude

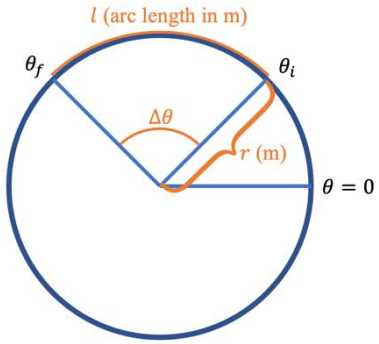
Size or Distance	(m)	Mass	(kg)	Time Interval	(s)
Proton	10^{-15}	Electron	10^{-30}	Time for light to cross nucleus	10^{-23}
Atom	10^{-10}	Proton	10^{-27}	Period of visible light radiation	10^{-15}
Virus	10^{-7}	Amino acid	10^{-25}	Period of microwaves	10^{-10}
Giant amoeba	10^{-4}	Hemoglobin	10^{-22}	Half-life of muon	10^{-6}
Walnut	10^{-2}	Flu virus	10^{-19}	Period of highest audible sound	10^{-4}
Human being	10^{0}	Giant amoeba	10^{-8}	Period of human heartbeat	10^{0}
Highest mountain	10^{4}	Raindrop	10^{-6}	Half-life of free neutron	10^{3}
Earth	10^{7}	Ant	10^{-4}	Period of Earth's rotation	10^{3}
Sun	10^{9}	Human being	10^{2}	Period of Earth's revolution around the Sun	10^{7}
Distance from Earth to the Sun	10^{11}	Saturn V rocket	10^{6}		
		Pyramid	10^{10}	Lifetime of human being	10^{9}
Solar system	10^{13}	Earth	10^{24}	Half-life of plutonium-239	10^{12}
Distance to nearest star	10^{16}	Sun	10^{30}	Lifetime of mountain range	10^{15}
Milky Way galaxy	10^{21}	Milky Way galaxy	10^{41}	Age of Earth	10^{17}
Visible universe	10^{26}	Universe	10^{52}	Age of universe	10^{18}

8.1 Angular Quantities

Radian:

- 1 radian = angle whose arc length equals to radius

- circumference of a circle is $2\pi r$, so there are $2\pi r/r = 2\pi$ radians in a full circle
  - $1\,rad = \frac{1\,rad}{1} \times \frac{360°}{2\pi\,rad} = 57.3°$
- Radian is the standard unit

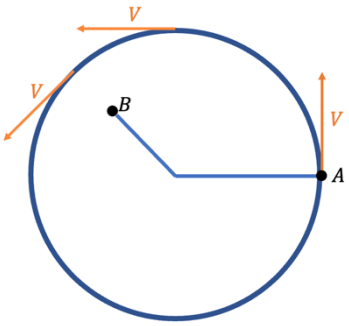


Angular position & displacement:

- Angular position: θ
- Angular position: $\Delta\theta = \theta_f - \theta_i$
- $\boldsymbol{l = \theta r}$
- Counterclockwise is +; clockwise is –

Angular & Linear Velocity

- Angular velocity: angular displacement divided by time taken
  - Formula: $\bar{\omega} = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T}(rad/s)$
  - $\omega_A = \omega_B$ when A and B are one the same rigid body
  - $1\,rpm = \frac{1\,rev}{1\,min} = \frac{2\pi\,rad}{60\,s}$
- Linear velocity
  - Formula: $V = \frac{d}{t} = \frac{\Delta\theta r}{t} = \left(\frac{\Delta\theta}{t}\right) r = \omega r\,(rad/s)$
  - $\vec{V}$ tangent to circle
    - Gears have the same linear V
  - $r_A > r_B \rightarrow V_A > V_B;\ \omega_A = \omega_B$



Graphs

- Slope of $\theta - t = \omega$