

# Physics 1303, Formula sheet

## Introductory Physics Formulas

### **motion**

distance  $x$

velocity  $v = \frac{\Delta x}{\Delta t}$

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

### **forces**

Force  $F = ma$

Weight  $W = mg$

centripetal force:  $F_c = mv^2/r$

### **energy**

gravitational potential energy:  $PE = mgy$

elastic potential energy stored in a spring:  $PE_s = \frac{1}{2}kx^2$

kinetic energy:  $KE = \frac{1}{2}mv^2$

energy conservation:  $KE_i + PE_i = KE_f + PE_f$

power:  $P = E/t$

### **momentum**

momentum:  $p = mv$

Impulse:  $F \Delta t = \Delta p$  (that means:  $F = \Delta p / \Delta t = m \Delta v / \Delta t = ma$ )

conservation of momentum:  $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

### **rotational motion**

torque:  $\tau = Fr$

angular momentum:  $L = pr$

### **gravity**

Newton's Law of Gravitation:  $F = G \frac{m_1 m_2}{r^2}$

gravitational acceleration on Earth:  $g = \frac{GM_E}{R_E^2}$

## Exam 1 formulas

### Doppler Effect

Doppler Effect:  $f' = f (1 \pm \frac{v}{c})$

Speed of light:  $c = f\lambda = 3 \times 10^8 \text{ m/s}$

### Star properties

Star Classification: Oh Boy, An F Grade Kills Me

Absolute Magnitude of a Star: measured for a star at 10 Parsec

Wien's law (emission wavelength based on surface temperature):  $\lambda_{max} = k/T$

Keplers 3rd law:  $(M_1 + M_2)p^2 = a^3$  (p = period, a = distance)

density = mass/volume =  $m/V$  (volume  $V = \frac{4}{3}\pi r^3$ )

### Conservation laws

Total energy, momentum and angular momentum are conserved in the universe

### Resolution

minimum resolution angle  $\theta = \lambda/d$  (d=diameter,  $\lambda$  = wavelength)

### Factors and Constants

AU = Astronomical Unit = distance between earth and sun

one degree = 3600 arcsec =  $4.85 \times 10^{-6} \text{ rad}$

visible light: 400 nm (blue) to 700 nm (red)

## Exam 2 formulas

### Sun's Structure

Core, Radiative Zone, Convective Zone, Sunspots

Atmosphere: Photosphere, Chromosphere, Corona

### Basic Building Blocks

Fermions/Bosons, Quarks/Leptons, Baryons/Mesons, Neutrinos

Sun's energy chain: H to He to Be to C to O to.....

### H-R Diagram

Main Sequence, RGB, AGB, T-tauri Stars

### Final State of Stellar Evolution

Brown Dwarfs, Neutron Stars, Black Holes, Supernovae

### Special and General Relativity

Space Time Diagrams

## **Exam 3 formulas**

### **Milky Way**

Nucleus, Bulge, Spiral Arms, Halo

Interstellar Matter, Nebulae, Dust

### **Galaxies**

Spirals, Irregulars, Ellipticals

AGN, Quasars, Seyfert Galaxies, Galactic Evolution

### **Dark Matter / Dark Energy**

Dark Matter evidence: galactic rotation, large scale structure

### **The Big Bang Evolution**

Epochs: GUT, Quark, nucleosynthesis, atoms, light, CMB

### **Life in the Universe**

Drake factors, Rare Earth Theory, Complex Life, SETI