GenPhysics q1 module Cheat Sheet

by Jerstellar via cheatography.com/204102/cs/43564/

Module 1 - Measurement

Fundamental/Base Quantities - group of physical quantities that can be measured **without relying on other quantities**; *(mass, length, molar mass, luminous intensity)*

Derived Quantitites - use any **combination of fundamental quantities**; *(velocity, acceleration, rate, force)*

Convertion of Units - convertion between different units for the same quantity

Unit prefixes - placed before the symbol of a unit to specify the order of magnitude of the quantity; used for very large or very small numbers

Prefixes

Table 1: Commonly Used Prefixes

Prefix	Symbol	Multiple of Unit
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ, mc	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
deca	da	10^{1}
hecto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Notations

Regular Notation	standard way of writing numbers	seven hundred sixty = 760
Scientific Notation	convenient and shorthand way of writing really large or really small numbers	280,000,000 = 2.8×10^{8}
		0.000817 = 8.17×10^{-4}

Module 2 - Accuracy and Precision

Significant Figures - digits that carry meaningful contributions to its measurement resolutions

1. Non-zero digits are always significant
2. Any zeroes between two significant digits are significant
3. A final zero or trailing zeroes in the decimal portion only are significant

13000 = 2 sig. figs.

0.00410 = 5 sig. figs.

9.6010 × 10^{8} = 5 sig. figs.

Module 2 - Accuracy and Precision (cont)

Accuracy - describes how close a measured value is to the true value, it is expressed using relative error:

Relative error = |(measured value - expected value)/(expected value)| × 100

Precision - degree of exactness with which a measurement is made and stated; for example, 1.324 is more precise than 1.3; it is expressed as a relative or fractional uncertainty

Relative Uncertainty = (uncertainty / measured quantity) × 100

Module 3 - Vector and Scalar Quantities

Table 1: Examples of Scalar and Vector quantities

Scalar Quantities	Vector Quantities
Distance	Displacement
Speed	Velocity
Mass	Weight
Energy	Acceleration
Density	Force
Power	Impulse
Length, Area, Volume	Pressure
Time	Momentum
Temperature	Gravity
Work	Drag

-Scalar quantities are described by a magnitude (size or numerical value) only; *(Mass - amount of matter in your body = **g** or **kg**)*

-Vector quantities give both the magnitude and direction; *(Weight - amount of gravitational force exerted on the matter = **kg·m/s^2** or **N**)*

Vectors and Addition of Vectors

Vectors - can be represented by a ray line →; the length of the arrow represents the *magnitude* while the direction of the arrow represents the *direction* of the vector; the tail is called the *initial point or the origin*

Vector Direction - North, South, East, West; however, some vectors are projected to a certain degree: **30° North**

Magnitude of a Vector - shown by the length of the arrow with a **chosen scale**

Resultant Vector - vector sum or difference of all individual vectors

Methods of Adding Vectors

Graphical	Analytical

Methods of Adding Vectors (cont)

choose appropriate scale and frame of reference	Vectors in the same or opposite direction must be added with sign convention; North and East (↑→) are **positive** and South and West (←↓) are **negative**
use tools of measurement (basta may minemeasure ka bes)	Vectors perpendicular or in right-angle, use **pythgorean theorem for magnitude** and **trigonometric functions for direction**
	Vectors not perpendicular, use **law of cosine for magnitude** and **law of sine for direction**

-Another way is the component method were the x and y components of the vectors are determined to find the resultant

Module 4 - Displacement and Velocity

Motion - can also be described through visual representations like graphs
Acceleration - rate of change in velocity
Constant Accelaration - when an object is moving with the same rate of change of velocity
Displacement - shortest distance from an object to the reference point; **areas of velocity vs. time curve**
Velocity - rate of change of position; **areas of displacement vs. time curve**
Average Velocity - total displacement of a body over a time interval
Instantaneous Velocity - velocity at a specific instant in time

For more examples:

Physics Calculation Worksheet

Module 5 - Acceleration

Acceleration - slope in velocity vs. time; if velocity is constant then there is no acceleration
Instantaneous Acceleration - acceleration at any instant time (only one point in time) **(▵v)/(▵t)**
Average Acceleration - **(total velocity)/(total elapsed time)**

Slope of acceleration

$$\text{slope} = \frac{\text{change in Y}}{\text{change in X}} \quad \text{or} \quad m= \frac{\Delta Y}{\Delta x} = \frac{Y_2 - y_1}{x_2 - x_1}$$

-Velocity (Y) is divided by Time (X) in a velocity-time graph and position-time graph
-To get the total acceleration (only in velocity-time graph), get the summation of all calculated acceleration and divide it by the points in the graph (time periods); the unit will be **m/s^2**

Module 6 - Uniformly Acc. Motion & Free-Fall

Uniformly Accelerated Motion (UAM) - motion with constant acceleration; velocity changes by equal amounts in equal intervals
Free-Fall/Vertical Motion - a uniformly accelerated motion; objects in motion under gravity only **(g = 9.8 m/s^2)**

UAM equations in one dimension

Eq. #	Equations
1	$d =(\frac{V_i + V_f}{2})t$
2	$V_f= V_i + at$
3	$d = V_i t +1/2\, at^2$
4	$V_f^2= V_i + 2ad$

Table 2. Equations for Uniformly Accelerated Motion

The variables were represented by the following:

d= position *V_i= initial velocity* *V_f =final velocity* *t=time* *a=acceleration*

UAM equations in one dimension (free-fall)

Eq. #	Equations
1	$y =(\frac{V_i + V_f}{2})t$
2	$V_f= V_i - gt$
3	$y = V_i t -1/2\, gt^2$
4	$V_f^2= V_i - 2gy$

Table 3. Equations for Free-Fall (a=g=-9.8 m/)s^2

The variables were represented by the following:

y= vertical position *V_i= initial velocity* *V_f =final velocity*
t=time *g=acceleration due to gravity*

-the **a** is replaced by **g**, -9.8 m/s^2 for downward acceleration and vice versa

Module 7 - Components of Projectile

Projectile - any object that is thrown or otherwise projected into the air
Trajectory - characteristic path of a projectile; a parabola
Projectile Motion - describes the movement of a projectile along its trajectory

Module 8 - Time at Max Height of Trajectory

Half Time of Flight - time it takes for a projectile to reach the maximum height; **$t = \sqrt{(2d_Y/g)}$**
(where $d_Y = (V_{iY}t)/(½gt^2)$, t = time of flight, g = acceleration due to gravity)
Total time of flight - double the half time of flight; **$t = (V^f_Y - V_{iY})/g$**
(where V^f_Y = final vertical velocity, V_{iY} = initial vertical velocity, g = acceleration due to gravity, t = time of travel)
Maximum Height - highest point the projectile can reach in the trajectory; the **displacement formula** is used: **$d_Y = (V_{iY}t)/(½gt^2)$**
(where d_Y = vertical displacement, V_{iY} = initial vertical velocity, t = time of flight, g = acceleration due to gravity)
Range of the Projectile - distance from the initial point on the ground to the final point it reaches; **$d_x = V_{ix}t$**
(where d_x = range, V_{ix} = initial horizontal velocity, t = time of flight)
X and Y Component of the Velocity - used to determine the graph of trajectory; **$V_{ix} = V_i \cos θ$** and **$V_{iY} = V_i \sin θ$**
(where V_{ix} = initial horizontal velocity, V_{iY} = initial vertical velocity, V_i = inital velocity, θ = angle of trajectory)

Module 9 - Circular Motion

Circular Motion - motion along a circular path in which the direction of the velocity is always changing; the speed is tangent to the path and the force towards the center is constant
Tangential Speed **(v_r)** - speed of an object in circular motion; depends on the distance from the object to the center. If the **tangential speed is constant**, the motion is said to be **uniform circular motion**
Centripetal Acceleration - acceleration directed toward the center of the circular path; **centripetal acceleration = (tangential speed)²/(radius of circular path)** or **a□ = v_t^2/r**
Tangential Acceleration **(a_r)** - acceleration of a certain object in a circular motion **due to change in speed**
Non-uniform Circular Motion - an object moving in a circular path with changing velocity

Module 9 - Circular Motion (cont)

Centripetal Force - "center-seeking force," net force directed toward the center of the circle; $F_{net} = F_{centripetal}$
*(where F_{net} = m×a; **F_{net} = F□entripetal = mass × centripetal acceleration**)*
F□entripetal = mass × (tangential speed² / radius of circular) OR **F□ = mv_t^2/r**

Module 10 - First Law Motion: Law of Inertia

Contact Forces - two objects having physical contact with each other (pushing or pulling)
+ Tension Force **(t)** - force transmitted through a string, rope, cable, or wire, when it is pulled tight by forces avting on its opposite ends
+ Air Resistance - special type of frictional force that acts upon objects as they travel through the air
Normal Force **(N)** - support force exerted upon an object that is in contact upon another stable object
+ Friction **(Ff)** - force exerted by a surface as an object moves across it or makes an effort to move it across
+ Applied Force **(Fa)** - force applied to an object by a person or another object
Non-Contact Forces - objects are subjected to a force but do not need to be in contact with each other
+ Gravitional Force - "**Weight (W)**"; the force with which the earth, moon, or other massively large object attracts another towards itself
Newton's First Law of Motion: Law of Inertia
*-an object at rest stays at rest and an object in motion stays in motion with the same velocity unless acted upon by **an unbalanced force***
-valid for an inertial reference frame
Inertia - tendency of an object to resist changes in its motion; the heavier the mass, the greater is the inertia
Inertial Frame of Reference - frame of reference with constant velocity and non-accelerating;
For example, you are standing, and your speed relative to the ground is zero, but your speed relative to the sun is 2.97x104 m/s
Free Body Diagram - shows relative magnitude and direction of all forces acting upon an object; direction of arrow shows direction of force and the size of arrow shows the magnitude of force

Free Body Diagram

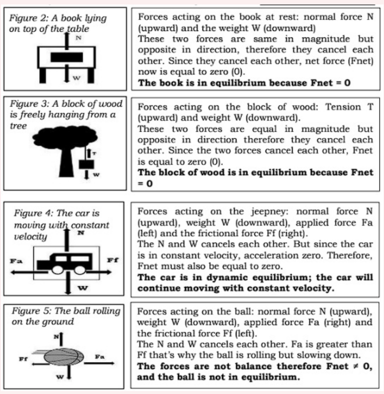

Figure 2: A book lying on top of the table	Forces acting on the book at rest: normal force N (upward) and the weight W (downward) These two forces are same in magnitude but opposite in direction, therefore they cancel each other. Since they cancel each other, net force (Fnet) now is equal to zero (0). **The book is in equilibrium because Fnet = 0**
Figure 3: A block of wood is freely hanging from a tree	Forces acting on the block of wood: Tension T (upward) and weight W (downward). These two forces are equal in magnitude but opposite in direction therefore they cancel each other. Since the two forces cancel each other, Fnet is equal to zero (0). **The block of wood is in equilibrium because Fnet = 0**
Figure 4: The car is moving with constant velocity	Forces acting on the jeepney: normal force N (upward), weight W (downward), applied force Fa (left) and the frictional force Ff (right). The N and W cancels each other. But since the car is in constant velocity, acceleration zero. Therefore, Fnet must also be equal to zero. **The car is in dynamic equilibrium; the car will continue moving with constant velocity.**
Figure 5: The ball rolling on the ground	Forces acting on the ball: normal force N (upward), weight W (downward), applied force Fa (right) and the frictional force Ff (left). The N and W cancels each other. Fa is greater than Ff that's why the ball is rolling but slowing down. **The forces are not balance therefore Fnet ≠ 0, and the ball is not in equilibrium.**

Module 11 - 2nd Law of Motion: Law of Acceleration

-*The acceleration produced by a net force on an object is directly proportional to the magnitude of the net force, is in the same direction as the net force, and is inversely proportional to the mass of the object*

-a is directly proportional to F where m is constant

-a is inversely proportional to 1/m where F is constant

acceleration = (net force)/(mass); a = F/m; F = ma

Weight - gravitational force exerted by a large body, measured in Newton (N); **W = mg**

Module 12 - 3rd Law of Motion: Law of Interaction

-*when one object exerts a force (action) on a second object, the second object exerts a force (reaction) on the first object that is equal in magnitude but opposite in direction*

$F_1 = F_2$ or force of action = force of reaction

Friction - force that opposes the motion between two surfaces that are in contact

Coefficient of Friction - level of friction that different material exhibit; **μ = Ff/N**

(where μ = coefficient of friction, Ff = friction, N = normal force)

Static Friction **(f_s)** - acts on objects when they are resting on a surface

Sliding Friction or Kinetic Friction **(f_k)** - force that acts between moving surfaces

Module 13 - Work

Work - amount of force applied on an object over a displacement; **W = F×d**

SI unit of Joules (J)

If the force is at an angle to the displacement using dot product: **W = F x d x cos θ**

Module 14 - Power

Power - measures rate at which work is done or energy is transformed; **P = (Work)/(Time)**

SI Unit: Joule per second **(J/s)**

if Force and Displacement were given: **P = (Force)(Displacement)/(Time)**

if it's in an angle: **P = (Force)(Displacement)(cosine Ø)/(Time)**

if Velocity is given: **P = (Force)(Velocity)**

if it's in an angle: **P = (Force)(Velocity)(cosine Ø)**

Module 15 - Energy and Energy Conservation

Energy - property of an object or system that enables it to do work; measured in **Joules**

Mechanical Energy - energy due to the position of something or the movement of something; **sum of kinetic and potential energy** and therefore always **stay the same**

+ Potential Energy - **stored energy**; form of energy due to the position of an object to the other objects or a reference point.

Gravitational Potential Energy - energy due to the object's position **relative to the gravitational source**; depends on the height from a zero level

GPE = (mass)(acceleration due to gravity)(height) or **GPE = mgh**

Elastic Potential Energy - energy stored in a compressed or stretched spring or object

EPE = (½) (spring constant)(distance compressed or stretched)^2 or **EPE = ½kx^2**

+ Kinetic Energy - Work done to change the speed of an object; depends on mass and speed

KE = (½)(mass)(speed)^2 or **KE = ½mv^2**

Work-Energy Theorem - whenever work is done, energy changes; if work is done on an object, the net work is equal to its change in kinetic energy

$Work_{net}$ = change in kinetic energy or $Work_{net}$ = △KE or

$Work_{net}$ = ½mv^2(final) - ½mv^2(initial)

Module 16 - Center of Mass

Eq.1 $$x_{CM} = \frac{x_1m_1 + x_2m_2 + x_3m_3 + \ldots\ldots}{m_1 + m_2 + m_3 + \ldots\ldots} = \frac{\Sigma x_im_i}{\Sigma m_i}$$

Eq.2 $$y_{CM} = \frac{y_1m_1 + y_2m_2 + y_3m_3 \ldots\ldots}{m_1 + m_2 + m_3 \ldots\ldots} = \frac{\Sigma y_im_i}{\Sigma m_i}$$

Eq.3 $$z_{CM} = \frac{z_1m_1 + z_2m_2 + z_3m_3 \ldots\ldots}{m_1 + m_2 + m_3 \ldots\ldots} = \frac{\Sigma z_im_i}{\Sigma m_i}$$

where:

x_{CM}, y_{CM} *and* z_{CM} = coordinates of the center of mass of the system

x_{1+}, y_{1+} *and* z_{1+} = coordinates of each elements making up the system

m_1, m_2 *and* m_3 = represent the mass of each element making up the system

-The formula for computing the velocity of the center of mass of a system in three dimensions may be obtained by replacing x, y, and z by **vx, vy and vz**, respectively.

Module 17 - Momentum and Impulse

Momentum - describes the difficulty in changing the state of motion of a moving object; **p = mass×velocity**

Impulse (I) - product of the force and the time it takes for the force to be applied; SI unit of **kg.m/s**

I = Force×time or **I = m(vf - vi)**

Impulse-Momentum Theorem - since p = mv, **I = ᐞp**

Module 18 - Conservation of Momentum

Law of Conservation of Momentum - the total momentum before the collision is equal to the momentum of the system after the collision; **pf = pi**

Coefficient of Restitution **(e)** - negative ratio of the relative velocity of two colliding bodies after a collision to the relative velocity before the collision; **e = (v_{X2} - v_{Y2})/(v_{X1} - v_{Y1})**

(where v_{X2} and v_{Y2} =velocities of bodies X and Y after collision, v_{X1} and v_{Y1} = velocities of bodies X and Y before collision)

The coefficient of restitution can have a value from **0 to 1**, depending on the type of collision

Elastic Collision - both momentum and kinetic energy are conserved; the coefficient of restitution is **equal to 1**

Inelastic Collision - total momentum is conserved but the total kinetic energy is not conserved, some of the kinetic energy goes into other forms like **heat, sound, and permanent deformation**; the coefficient of restitution for inelastic collision is between **0 to1**

Perfectly Inelastic Collision - interacting bodies **stick together and move as one** after a collision; the coefficient of restitution for inelastic is **0**

YEY! you finished q1, I am so proud of you :)