Physics Notes 2013

Kinematics, Scalars and Vectors

Kinematics - Introduction

Defining Key Terms:

Displacement – Distance moved in a specified direction
Speed – Rate of change of distance with respect to time
Velocity – Rate of change of displacement with respect to time

Velocity

Instantaneous velocity

Definition – Rate of change of displacement at a particular instant of time.
Instantaneous velocity is given by the gradient of the tangent at a particular point of a displacement-time graph.

Formula: v = $\frac{\Delta s}{\Delta t}$

Average velocity

Definition – Total displacement divided by total time taken.

Formula: $\langle v \rangle = \frac{S}{T}$ OR $\langle v \rangle = \frac{u+v}{2}$

Acceleration

Instantaneous Acceleration

Definition – Rate of change in velocity at a particular instant of time.

Average Acceleration

Definition –Total change in velocity divided by total time taken.

Acceleration of gravity

It is always 9.81 m s^{-2} (if downwards is taken to be positive)

Air resistance

Key idea – Faster the object moves, the greater the air resistance.

Air resistance increases with:

1. Surface area (size)
2. Speed of object
3. Density of object

Terminal velocity

As an object continues to fall, the air resistance acting on the object will become non-negligible. Hence, terminal velocity is achieved when the force of air resistance is the same as the weight of the object. The object will cease to accelerate and move with a constant velocity.

Formulas to remember

1. $s = \frac{1}{2}(u + v)t$
2. $v = u + at$
3. $s = ut + \frac{1}{2}at^2$
4. $v^2 = u^2 + 2as$

*Note:
s – displacement
v – final velocity
u – initial velocity
a – acceleration
t – time taken

Scalars and Vectors

Definitions

Scalars – Quantities that are fully described by magnitude alone.

Vectors – Quantities that are fully described by both a magnitude and a direction.

Addition of Vectors

Parallel vectors

If the direction of the 2 vectors is the same, then we must add one to the other.
If the vectors are in different directions, then we must subtract one from the other.

Using vector diagrams

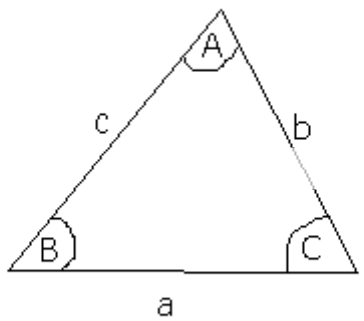
2 different methods can be used to find the resultant vector of 2 vectors at an angle to one another.

They are:

1. Vector triangle method/Head-to-tail method
2. Parallelogram method

*Refer to Physics notes and worksheets on how to address this.

Using Cosine Rule and Sine Rule



Cosine rule: $c^2 = a^2 + b^2 - 2abcosC$

Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Subtraction of vectors

Subtracting a vector can be seen as adding a negative vector.

E.g.: A – B = A + (-B)

Use the vector triangle method again to work this out.

Vector Resolution

Any vector can be resolved into its 2 components: a horizontal one and a vertical one. We can use the tangent function to find these 2 components.