**Dynamics & Space**

**Motion**

**Summary**

**Speed** is a measure of the distance travelled by an object in a unit of time.

Speed is measured in metres per second (ms-1).

**Average speed**, *v̅*, is a measure of the average of the speed for an entire journey.

**Speed, Distance and Time**

m

ms-1

s

*v*

*d*

*t*

* measure distance travelled with a ruler
* measure time taken to travel with a stop clock

**Instantaneous speed** is the speed at one point during the journey.

* measure length of card attached to vehicle with a ruler
* measure time taken for card to pass through a light gate with an electronic timer

**Scalar** quantities only have a magnitude (size)

Distance and speed are scalar quantities; as are time, frequency, energy and mass.

**Vector** quantities have both magnitude (size) and direction

**Velocity, Displacement and Time**

m

ms-1

s

*v*

*s*

*t*

Velocity and displacement are vector quantities; as are acceleration and force.

When adding vector quantities they must be added “nose-to-tail”. This can be done by scale diagram or using trigonometry

e.g. A displacement of 300 m North then 500 m East

500 m

300 m

 resultant = 583 m @ 059

**Acceleration** is a measure of the rate of change of velocity of an object.

**Acceleration, Velocity and Time**

*a*

*v-u*

*t*

ms-2

s

ms-1

Acceleration is measured in metres per second per second (ms-2).

Acceleration can be calculated by dividing the change in velocity by the time taken for the change.

The two velocities can be determined experimentally by using either:

* a single card and two light gates connected to an electronic timer

or

* a double card and a single light gate connected to an electronic timer

A **velocity-time graph** shows how the velocity of a moving object varies with time.

A

B

C

D

E

F

O

*velocity*

*time*

OA – constant acceleration

AB – constant velocity

BC – constant deceleration

CD – at rest (zero velocity)

DE – constant acceleration in the opposite direction

EF – constant deceleration in the opposite direction

The acceleration of the object is equal to the gradient of the graph.

e.g.

A

B

C

O

*velocity*

*time*

=

Note: negative gradients represent negative accelerations

The displacement of the object is equal to the area under the graph.

e.g.

A

B

C

O

*velocity*

*time*

1

2

3

Note: areas under the velocity-time graphs represent negative displacements (displacements in the opposite direction)