Cambridge Ordinary Level Notes
Physics 5054

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Contents

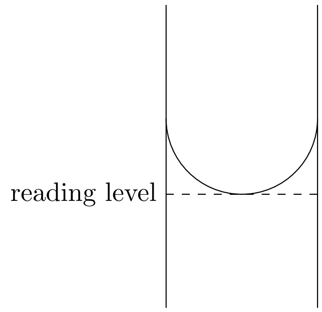

Figure 1: For colourless liquids.

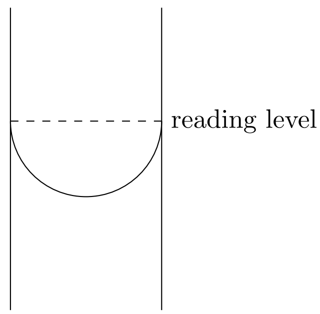

Figure 2: For coloured liquids.

1 Motion, forces and energy

1.1 Physical quantities and measurement techniques

Describe how to measure a variety of lengths with appropriate precision using tapes, rulers and micrometers (including reading the scale on an analogue micrometer)

Every ruler has a minimum length it can measure. Readings must be written rounded to that nearest reading. For a ruler calibrated to the nearest 0.1 mm, all readings should be written to the nearest 0.1 mm. To read micrometers, watch: `https://youtu.be/StBc56ZifMs`.

Understand that, given a set of equipment and something to measure, we must choose the equipment with maximum readings closest to the thing to measure.

Describe how to use a measuring cylinder to measure the volume of a liquid and to determine the volume of a solid by displacement

For colourless liquids, readings in a measuring cylinder must be taken from the lower meniscus, and for coloured liquids the upper meniscus should be used, see Figures 1 and 2.

Describe how to measure a variety of time intervals using clocks and digital timers

Determine an average value for a small distance and for a short interval of time by measuring multiples (including the period of oscillation of a pendulum)

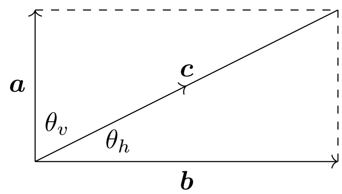

Figure 3: Vectors pointing outward.

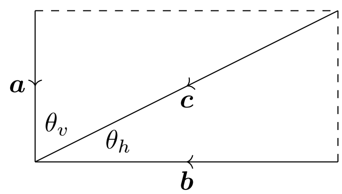

Figure 4: Vectors pointing inward.

For experiments involving oscillation, oscillations are counted, and total time for those oscillations is taken. The total time is divided by the number of oscillations, giving an average value for each oscillation, removing influence of inaccurate and anomalous experiment.

Understand that a scalar quantity has magnitude (size) only and that a vector quantity has magnitude and direction

Know that the following quantities are scalars: distance, speed, time, mass, energy and temperature

Know that the following quantities are vectors: displacement, force, weight, velocity, acceleration, momentum, electric field strength and gravitational field strength

Determine, by calculation or graphically, the resultant of two vectors at right angles

Mathematically, the resultant, $\boldsymbol{c}$, of two vectors, $\boldsymbol{a}$ and $\boldsymbol{b}$ has is given by:

$$\boldsymbol{c} = \sqrt{\boldsymbol{a}^2 + \boldsymbol{b}^2}$$

The angle with the horizontal, θ_h and that with the vertical θ_v can be found:

$$\tan\theta_v = \boldsymbol{b}/\boldsymbol{a}$$

$$\tan\theta_h = \boldsymbol{a}/\boldsymbol{b}$$

refer to Figure 3 and 4 for directionality.

1.2 Motion

Define speed as distance travelled per unit time and define velocity as change in displacement per unit time

Figure 5: Distance-time or speed-time graph.

Displacement is the distance of an object with respect to a certain point, called the origin. Essentially, displacement is the vector form of distance. Speed and velocity, $\boldsymbol{v}$ are the rates of change of distance and displacement, $\boldsymbol{s}$ with respect to time, t.

Mathematically,

$$\boldsymbol{v} = \boldsymbol{s}/t$$

Recall and use the equation

$$(\text{average speed}) = (\text{total distance})/(\text{time taken})$$

Define acceleration as change in velocity per unit time; recall and use the equation

$$(\text{acceleration}) = (\text{change in velocity})/(\text{time taken})$$

Symbolically,

$$\boldsymbol{a} = \frac{\Delta \boldsymbol{v}}{\Delta t} = \frac{\boldsymbol{v} - \boldsymbol{u}}{t}$$

where $\boldsymbol{v}$ is final and $\boldsymbol{u}$ is initial velocity.

State what is meant by, and describe examples of, uniform acceleration and non-uniform acceleration

When over a period of time, acceleration does not change, i.e., $\Delta \boldsymbol{a} = 0$, acceleration is said to be *uniform* or *constant*. When $\Delta \boldsymbol{a} \neq 0$, acceleration has changed, causing a *non-uniform* or *non-constant* acceleration.

Know that a deceleration is a negative acceleration and use this in calculations

A negative acceleration causes a decrease in velocity, and is called deceleration. A deceleration of x is the same as an acceleration of $-x$, and the opposite also applies.

Sketch, plot and interpret distance–time and speed–time graphs

The motion of objects can be investigated by their data, which is made more convenient by the use of graphical representations of the data. The distance covered by the object and the velocity or speed of the object can be plotted against time.

Determine from the shape of a distance–time graph when an object is:

(a) at rest *(b) moving with constant speed* *(c) accelerating* *(d) decelerating*

2 Overall

A change in a quantity x is represented Δx. The change in x is always its final value minus the initial.

$$\Delta x = x_f - x_i$$

where x_f is the final value and x_i is the initial.