

Contents

Section 1 — General Physics: Forces and Motion

Speed and Velocity	1
Acceleration	2
Distance-Time Graphs	3
Speed-Time Graphs	4
Mass, Weight and Gravity	5
Density	6
<i>Warm-Up & Exam Questions</i>	7
<i>Exam Questions</i>	8
Resultant Forces	9
Calculating Resultant Forces	10
Forces and Motion	11
Friction and Terminal Velocity	12
<i>Warm-Up & Exam Questions</i>	13
<i>Exam Questions</i>	14
Forces and Elasticity	15
Investigating Springs	16
Turning Effects	17
Principle of Moments	18
Forces in Equilibrium	19
Centre of Mass	20
Momentum	21
Impulse	22
<i>Warm-Up & Exam Questions</i>	23
<i>Exam Questions</i>	24
Revision Summary	25

Section 2 — General Physics: Energy and Pressure

Types of Energy	26
Kinetic and Gravitational Potential Energy	27
Conservation of Energy and Energy Transfers	28
<i>Warm-Up & Exam Questions</i>	29
Energy Resources	30
Generating Electricity from Fuels	31
Non-Renewable Resources	32
Solar Power	33
Biomass and Wind Power	34
Geothermal and Hydroelectric Power	35
Wave Power and Tidal Barrages	36
<i>Warm-Up & Exam Questions</i>	37
<i>Exam Questions</i>	38
Work	39
Power	40
Efficiency	41
<i>Warm-Up & Exam Questions</i>	42
Pressure	43
Atmospheric Pressure	44
Measuring Pressure	45
<i>Warm-Up & Exam Questions</i>	46
Revision Summary	47

Section 3 — Thermal Physics

The Kinetic Molecular Model	48
Brownian Motion	49
Gas Pressure	50
Internal Energy and Changes of State	51
Evaporation	52
Specific Latent Heat	53
<i>Warm-Up & Exam Questions</i>	54
Thermal Capacity	55
Measuring Specific Heat Capacity	56
Thermal Expansion	57
Measuring Temperature	58
More on Measuring Temperature	59
<i>Warm-Up & Exam Questions</i>	60
<i>Exam Questions</i>	61
Thermal Energy Transfers by Radiation	62
Investigating Energy Transfer by Radiation	63
Conduction	64
Convection	65
Managing Thermal Energy Transfers	66
<i>Warm-Up & Exam Questions</i>	67
<i>Exam Questions</i>	68
Revision Summary	69

Section 4 — Properties of Waves

General Wave Properties	70
Transverse and Longitudinal Waves	71
<i>Warm-Up & Exam Questions</i>	72
Reflection	73
Mirror Images	74
Refraction	75
Investigating Refraction of Light	76
Refractive Index	77
Internal Reflection	78
More on Internal Reflection	79
Diffraction	80
<i>Warm-Up & Exam Questions</i>	81
<i>Exam Questions</i>	82
Converging Lenses	83
Images and Magnifying Glasses	84
Dispersion	85
<i>Warm-Up & Exam Questions</i>	86
Electromagnetic Waves and Their Uses	87
More Uses of Electromagnetic Waves	88
Sound Waves	90
Sound Waves — Loudness and Pitch	91
Hearing and Echoes	92
<i>Warm-Up & Exam Questions</i>	93
Revision Summary	94

Section 5 — Electricity

Static Electricity	95
Charging by Induction	96
Electric Fields	97
<i>Warm-Up & Exam Questions</i>	98
Circuits and Current	99
E.m.f., Potential Difference and Current.....	100
Resistance	101
Determining Resistance.....	102
Energy and Power in Circuits.....	103
<i>Warm-Up & Exam Questions</i>	104
Series Circuits.....	105
Parallel Circuits	106
Electrical Safety	107
<i>Warm-Up & Exam Questions</i>	108
<i>Exam Questions</i>	109
Potential Dividers	110
Rectifiers and Relays.....	111
Input Transducers	112
<i>Warm-Up & Exam Questions</i>	113
Logic Gates	114
More Logic Gates.....	115
<i>Warm-Up & Exam Questions</i>	116
Revision Summary.....	117

Section 6 — Magnetism and Electromagnetism

Magnetism	118
Magnetising Magnetic Materials	119
Electromagnetism	120
Electromagnets	121
<i>Warm-Up & Exam Questions</i>	122
Force on a Current-Carrying Conductor.....	123
Electric Motors	125
Electromagnetic Induction	126
Generators	127
Transformers.....	128
Transformers and Distributing Electricity.....	129
<i>Warm-Up & Exam Questions</i>	130
<i>Exam Questions</i>	131
Revision Summary.....	132

Section 7 — Atomic Physics

The Atomic Model.....	133
Isotopes	134
Radioactive Emissions	135
Radioactive Emissions, Fission and Fusion.....	136
Detecting and Deflecting Radioactive Emissions	137
<i>Warm-Up & Exam Questions</i>	138
Half-Life	139
Half-Life Calculations	140
Background Radiation	141
Safety and Radiation.....	142
<i>Warm-Up & Exam Questions</i>	143
<i>Exam Questions</i>	144
Revision Summary.....	145

Practical Skills

Planning Experiments	146
Making Measurements	147
Safety and Experiments.....	151
Processing Data.....	152
Anomalous Results and Uncertainty	153
Presenting Data	154
More on Graphs	155
Drawing Conclusions	156
Evaluations	157

Practice Exams

Paper 1: Multiple Choice (Core).....	158
Paper 2: Multiple Choice (Extended).....	169
Paper 3: Theory (Core)	181
Paper 4: Theory (Extended)	194
Paper 5: Alternative to Practical	211
Answers	221
Glossary	236
Index.....	242

Speed and Velocity

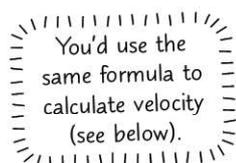
Speed and velocity are similar, but in physics they're not quite the same...

Speed is Calculated from Distance and Time

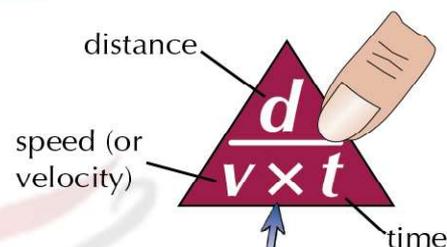


Speed is just how fast you're going (e.g. 30 km/h or 20 m/s) with no regard to the direction.

For any object, the distance moved, (average) speed, and time taken are related by this formula:



$$\text{average speed} = \frac{\text{total distance}}{\text{time taken}}$$



Speed is measured in m/s (metres per second). To calculate speed in m/s make sure the distance you use in the formula is in metres and the time is in seconds. Other common units of speed are km/h and mph.

EXAMPLE:

A cat walks 20 m in 40 s.

a) Calculate its average speed.

b) How long will it take the cat to walk 75 m at this speed?

a) Use the formula for average speed.

$$v = d \div t \\ = 20 \div 40 = 0.5 \text{ m/s}$$

b) Rearrange $v = d \div t$ using the formula triangle to get $t = d \div v$.

$$t = d \div v \\ = 75 \div 0.5 = 150 \text{ s}$$

Velocity is Speed in a Given Direction

Velocity is very similar to speed, but it has a direction too. It has the same units as speed, and the formula for average speed can also be used to calculate average velocity.



Velocity is how fast you're going with the direction specified, e.g. 30 km/h north or 20 m/s at 60° above the horizontal.

This means you can have objects travelling at a constant speed with a changing velocity. This happens when the object is changing direction whilst staying at the same speed.

Speed is how much distance you cover in a unit of time...

Learn the formula for speed but watch out for the units. If you're given the time in minutes, multiply by 60 to convert it to seconds. And make sure you're happy converting between km, cm and m.

Acceleration

Things rarely travel at the same speed — this is where **acceleration** and **deceleration** come in.

Changing Speed Means Acceleration

- 1) **Acceleration** is related to changing **speed**.
- 2) The **faster** the speed is changing, the **greater** the acceleration.
- 3) **Deceleration** means the speed is decreasing — the object is **slowing down**.
- 4) The **unit** of acceleration is m/s^2 . **Not** m/s , which is speed (or velocity), but m/s^2 .
- 5) The force of gravity makes objects accelerate towards the Earth. Acceleration **due to gravity** (g) is **constant** near the Earth. So an object in **free fall** will accelerate towards the Earth at a **constant rate**.

Changing Direction Means Acceleration Too

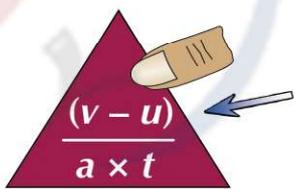
- 1) Acceleration is actually how quickly **velocity** is **changing**. The definition is:



Acceleration is the change in velocity per unit time.

- 2) This change in velocity can be a **change in speed** or a **change in direction**, or both. You only have to worry about the change in **speed** bit for calculations. The **formula** for it is:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$



Here 'v' is the final velocity and 'u' is the initial velocity, so $v - u$ is the change in velocity.

EXAMPLE:

A cat accelerates from 2 m/s to 6 m/s in 5.6 s. Find its acceleration.

Substitute the values into the **formula**.

$$a = (v - u) \div t = (6 - 2) \div 5.6$$

$$= 4 \div 5.6 = 0.714... = 0.71 \text{ m/s}^2 \text{ (to 2 s.f.)}$$

This formula for acceleration only works when the acceleration is constant.

- 3) A **negative value** for acceleration means something is **slowing down** (decelerating).



Make sure you're comfortable with using this equation...

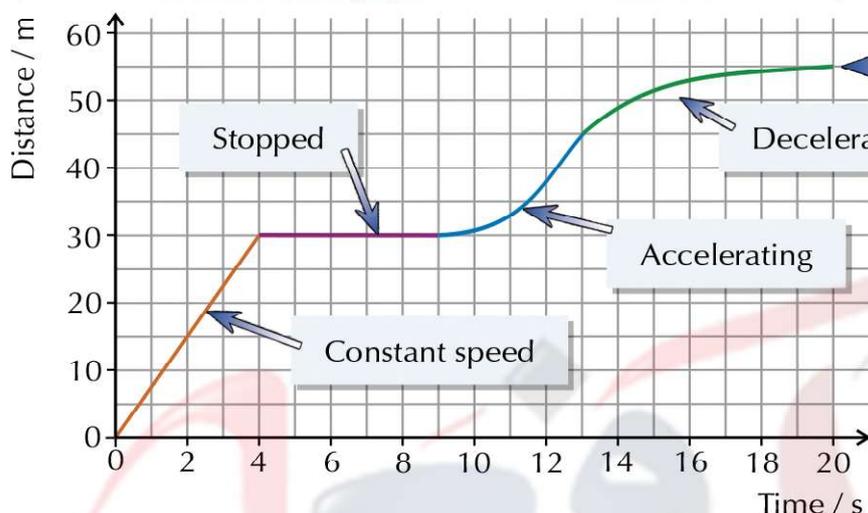
Don't get confused if a question says an object starts 'at rest' or 'is initially stationary'. This just means that the initial velocity, u , is 0. And if the object finishes at rest, the final velocity, v , is 0.

Distance-Time Graphs

Distance-time (D-T) graphs tell you **how fast** an object is moving and **how far** it's travelled. Simple as that really. Make sure you get them straight in your head before turning over...

Distance-Time Graphs Tell You How Far Something has Travelled

The different parts of a **distance-time graph** describe the **motion** of an object:



After 20 seconds, the object has travelled 55 m from its starting point.

- 1) The **gradient** (slope) at any point gives the **speed** of the object.
- 2) **Flat** sections are where it's **stopped**.
- 3) A **steeper** graph means it's going **faster**.
- 4) **Curves** represent **acceleration**.
- 5) A **curve getting steeper** means it's **speeding up** (increasing gradient). This is **acceleration**.
- 6) A **levelling off curve** means it's **slowing down** (decreasing gradient). This is **deceleration**.

Calculating Speed from a Distance-Time Graph

To calculate the **speed** from a distance-time graph, just work out the **gradient**:

EXAMPLE:

Calculate the speed of the object from the graph above, between 0 and 4 s.

The vertical change between 0 and 4 s is 30 m.

$$\text{speed} = \text{gradient} = \frac{\text{change in vertical}}{\text{change in horizontal}} = \frac{30}{4} = 7.5 \text{ m/s}$$

You can also calculate the **average speed** of an object over a period of time by **dividing** the **total distance** travelled by the **time** it takes to travel that distance.

For example, the **average speed** over the whole journey is $55 \div 20 = 2.8 \text{ m/s}$ (to 2 s.f.).

Don't forget to use the scales of the axes to work out the gradient. Don't measure in cm!



Read the axes of any graph you get given carefully...

Make sure you don't get confused between distance-time graphs and speed-time graphs (which are coming up next). They do look quite similar, but they tell you different things...