

Grade 12 Physical Sciences: Mechanics Study Guide

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Free Study Resources for South African Matric Learners

1. Newtons Laws of Motion

Newton's First Law (Inertia)

An object remains at rest or in uniform motion in a straight line unless acted on by a net external force.

Newton's Second Law

Net force:	$F_{\text{net}} = ma$
Weight:	$W = mg$ ($g = 9.8 \text{ m/s}^2$ on Earth)

Newton's Third Law

For every action there is an equal and opposite reaction. Forces always act in pairs on DIFFERENT objects.

2. Kinematics (Motion in 1D)

$v = u + at$	(final velocity)
$s = ut + (1/2)at^2$	(displacement)
$v^2 = u^2 + 2as$	(velocity-displacement)
$s = (u+v)/2 \cdot t$	(average velocity)

TIP Take a clear positive direction at the start of every problem. Down is often positive for free-fall. Deceleration = negative acceleration in your chosen direction.

3. Momentum & Impulse

Momentum p :	$p = mv$ (kg.m/s)
Impulse:	$J = F \cdot \Delta t = \Delta p$
Conservation:	$p_{\text{before}} = p_{\text{after}}$ (isolated system)
Elastic collision:	KE is conserved
Inelastic:	Objects stick together; KE not conserved

4. Work, Energy & Power

Work W :	$W = F \cdot d \cdot \cos(\theta)$ (J)
KE:	$KE = (1/2)mv^2$ (J)
PE (gravitational):	$PE = mgh$ (J)
Work-energy theorem:	$W_{\text{net}} = \Delta KE$
Power P :	$P = W/t = Fv$ (W)
Efficiency:	$\text{eff} = (\text{useful output} / \text{input}) \times 100\%$

5. Vertical Projectile Motion

Objects thrown vertically or in free fall:

- Acceleration = $g = 9.8 \text{ m/s}^2$ downward (take down as positive for simplicity)

- At maximum height: $v = 0$
- Time up = time down (symmetric if same start/end height)

TIP Always define positive direction first. At the top of its path, velocity = 0 but acceleration = g still acts downward.