

# Advanced Placement Physics

# Force

## Force

### Newton's 1<sup>st</sup> Law

### Newton's 2<sup>nd</sup> Law

### Newton's 3<sup>rd</sup> Law

Any push or pull

Law of inertia (Restatement of Galileo's principle of inertia)

$$\sum F = ma$$

Equal and opposite forces. For every action force there is an equal & opposite reaction force. Forces come in action - reaction pairs.

$\sum F$  Key to all problems.  $\sum F_x$   $\sum F$  in  $x$  direction on traditional coordinate axis.  $\sum F_y$   $\sum F$  in  $y$  direction.

$\sum F_{\parallel}$   $\sum F$  parallel to a slope (direction of motion).  $\sum F_{\perp}$   $\sum F$  perpendicular to slope.

$\sum F = ma$  Sum of force is **Net Force**. You may need to solve for  $a$  using the kinematic equations, then solve for force, or given force you solve for  $a$  and then use it in the kinematic equations to find  $v$ ,  $x$ , or  $t$ .

## Strategy on force Problems:

1. Draw FBD.
  2. Set direction of motion. *What would the object do if it could?* Considered this the positive direction.
  3. Using the forces listed below write the  $\sum F$  equations relevant to the problem. *In what direction is the problem moving?* What matters, the  $x$  or the  $y$  direction? The *parallel* or the *perpendicular* direction? Any force vectors in the FBD pointing in the direction of motion are positive while any vectors the other way are negative.
  4. Substitute known equation, (forces like  $F_g$  become  $mg$ ).
  5. Substitute for  $\sum F$ . Ask yourself what the sum of force should be based on the chart below. Is the object standing still, moving at constant velocity, or accelerating. Substitute zero or  $ma$  for  $\sum F$ .
- |   |                              |                                   |                            |               |
|---|------------------------------|-----------------------------------|----------------------------|---------------|
| 1 | $v = 0$                      | $\Delta v = 0$                    | $a = 0$                    | $\sum F = 0$  |
| 2 | $v = +/-$ a constant value   | $\Delta v = 0$                    | $a = 0$                    | $\sum F = 0$  |
| 3 | $v$ increasing or decreasing | $\Delta v = +/-$ a constant value | $a = +/-$ a constant value | $\sum F = ma$ |
6. Plug in and solve. (All values including 9.8 are entered as positives. The negative signs were decided when setting up the sum of force equation. Plugging in  $-9.8$  will just turn a vector assigned as  $-F_g$  into a positive. You decided its sign based on the way it was pointing relative to the problems direction of motion. Don't reverse it now!)

$F_P$  Push or Pull.

$F_g$  Force of gravity.  $F_g = mg$

$F_T$  Tension is a rope, string, etc. This force has no equation. You either solve for it, or it cancels, or it's given.

$F_N$  Force Normal. A contact force, always perpendicular to the surface. (On a tilted surface use  $\sum F_{\parallel}$  &  $\sum F_{\perp}$ )

$F_f$  Friction force.  $F_f = \mu F_N$  Always opposes motion. Static friction: not moving. Kinetic friction: object moving.

$F_{ar}$  Force of air resistance. This force has no equation. You either solve for it, or it cancels, or it's given.

$F_c$  Force Centripetal. It is the  $\sum F$  in circular motion problems. So  $F_c$  can be any force that keeps an object in circular motion.

$$F_c = F_g \quad F_c = F_N \quad F_c = F_T \quad F_c = F_f \quad F_c = F_{ar} \quad \text{etc.}$$

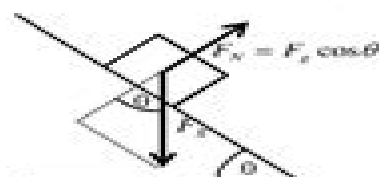
It can also be two or more of these added together. The direction of motion is toward the center. So any force directed toward the center is positive and any force directed outward is negative.

The key in using any of these equations is to ask yourself: 1. What is causing the circular motion? 2. Then set up the equality. 3. Substitute known equations. 4. Solve.

$F_B$  Force due to a magnetic field. This force is perpendicular to the field and perpendicular to the velocity of the particle. So any charged particle will move in a circle. Use the right hand rule for positive charges or positive current, and use the left hand for negative charges or electron current.

$F_{any}$  subscript that make sense to solve the problem

**Normal force:** Gravity pulls the object **down** the slope **and into the slope**. If we only consider the motion into the slope (perpendicular), the object has no perpendicular velocity. So the  $\sum F_{\perp} = 0$ . Then the surface must push upward, equal and opposite to the perpendicular gravity component. Named the normal force, it is a contact force and operates perpendicular to any surface. It must counter only the component of gravity perpendicular to the surface.



$F_N = F_g \cos \theta$  Where  $\theta$  is the angle between  $F_g$  and  $F_{g\perp}$ . It is also the tilt angle of the surface measured from the ground. Substituting  $mg$  for  $F_g$

$F_N = mg \cos \theta$  Flat surfaces  $\theta = 0^\circ$ .  $F_N = F_g$  or  $F_N = mg$

# Student Study Guide For Advanced Placement Physics

**Greg Jacobs**



## **Student Study Guide For Advanced Placement Physics:**

**AP Physics B** Connie Wells, Hugh Henderson, 2002 For students who wish to prepare for the Advanced Placement AP Physics exam on their own this guide includes a full content review two full length practice tests hundreds of practice questions with thorough answer explanations and proven test taking strategies 352 pp *AP® Physics 1 Crash Course, 2nd Ed., For the 2021 Exam, Book + Online* Amy Johnson, 2020-12-01 AP Physics 1 Crash Course updated for today's exam A Higher Score in Less Time REA's Crash Course is the top choice for AP students who want to make the most of their study time and earn a high score Here's why more AP teachers and students turn to REA's AP Physics 1 Crash Course Targeted Focused Review Study Only What You Need to Know REA's new 2nd edition addresses all the latest test revisions We cover only the information tested on the exam so you can make the most of your valuable study time Expert Test taking Strategies and Advice Written by Amy Johnson a seasoned AP Physics teacher the book gives you the tips and topics that matter most on exam day Crash Course relies on the author's extensive analysis of the test's structure and content By following her advice you can boost your score in every section of the test Practice questions a mini test in the book a full length exam online Are you ready for your exam Try our focused practice questions inside the book Then take our full length online practice exam to ensure you're ready for test day If you're cramming for the exam or looking for a concise course review Crash Course is the study guide every AP student needs **AP® Physics B and C** David Jones, 2009-02-11 Are You Serious About Scoring a 5 on Your Advanced Placement Exam Then You Need REA's Test Prep for the AP Physics B mechanics electricity and magnetism waves and optics heat kinetic theory and thermodynamics modern physics Physics C classical mechanics electricity and magnetism The book includes four full length practice exams two exams for Physics B and two exams for Physics C with easy to follow detailed explanations of all answers Our in depth answer explanations help you study smarter and score higher on test day The TestWare CD contains two practice exams for AP Physics B with automatic scoring and instant feedback Each practice test is composed of every type of question that can be expected on the actual AP Physics exam so you can target your strengths and weaknesses before the exam If you're serious about getting a 5 on your exam you need REA's test prep for the AP Physics B C exams REA has helped more than a million students succeed on their AP exams Teachers across the country consider our AP titles to be invaluable resources and consistently recommend our books to their students **5 Steps to a 5: AP Physics 1: Algebra-Based 2017** Greg Jacobs, 2016-08-05 Get ready for your AP Physics 1 exam with this straightforward easy to follow study guide AP Physics 1 and AP Physics 2 together replaced the course formerly titled AP Physics B The new courses debuted in 2014 with the first Physics 1 and Physics 2 exams given in 2015 The wildly popular test prep guide updated and enhanced for smartphone users 5 Steps to a 5 AP Physics 1 2017 provides a proven strategy to achieving high scores on this demanding Advanced Placement exam This logical and easy to follow instructional guide introduces an effective 5 step study plan to help students build the skills knowledge and test taking

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