Welcome to Physics 100!

Basic Concepts of Physics

Based on the book by **Paul G. Hewitt:**

Prof. Steve Greenbaum
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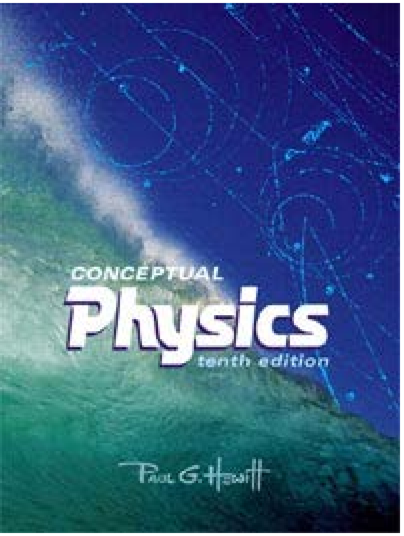
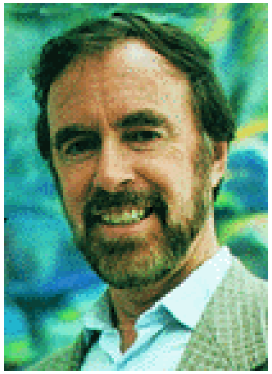
Office hours: Tu, 4:00 – 5:00 pm
F, 12:00 – 1:00 pm
or by appointment





Conceptual Physics, 12 ed.
Pearson
ISBN 13:978-0-321-90910-7
(older eds. OK)

- **Please pick up handouts for today**

Course information (on your handout)

Location: Room 511 HW
Lecture Times: Tu and Fr: 2:10pm – 3:25pm

Text: ***Conceptual Physics, 12th Edition***, by Paul G. Hewitt (Pearson 2015).
Lectures posted on-line:
www.hunter.cuny.edu/physics/courses/physics100/physics-100

Grading:

2 in-class Exams	50%	No homework assigned, but I strongly suggest
Final Exam	50%	that you try some HW questions after lectures

Laboratory: Make sure you are registered for the lab course, Physics 101 LB, if you need the lab credit (see later).

Dates: Friday March 4 and Friday April 1. One make-up, by permission only, Friday, May 20.
Final Exam: Tuesday May 24, room and time to be determined.
Exam format: multiple-choice
Note: for review purposes, exam questions minus choices will be distributed and posted one week or one class before the exam dates to help you focus your studies.

Participation in classroom discussions is strongly encouraged.

- Important Note! This is a *one-semester terminal* physics course, and it does *not* fulfill the pre-med, pre-dental, pre PT physics requirement.
- Another note: PHYS 100 fulfills the Scientific World category of the Flexible Core of Pathways. It is a pre/co-requisite of the lab-including course PHYS 101, of the Life and Physical Sciences category (but you may take 100 without taking 101).

Note from the Office of Student Services:

- All students must make sure they are registered for this class and have not been dropped.
- Students who are not registered and have not paid may not continue attending the class.
- Check your registration status on E-SIMS. You should also read your Hunter email to learn of any changes in your registration status.

If you have any questions you can receive assistance at the OASIS, Room 217 North Building

Syllabus:
(on your handout)

Topic	Book chapter
Introduction/Newton's First Law	2
Linear Motion	3
Newton's Second Law	4
Newton's Third Law	5
Momentum	6
Energy	7
Rotation	8
Gravity	9
The Atomic Nature of Matter	11
Liquids	13
Gases and Plasmas	14
Heat	15
Vibrations and Waves	19
Sound	20
Electrostatics	22
Electric current	23
Magnetism	24
Electromagnetic Induction	25
Properties of Light	26
Color	27
Introduction to Quantum Theory	(31)

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The college is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

Info about you, for me:

On a piece of paper, please write down the following information and turn it at the end of class today.

1. Your name
2. Your email address
3. Your year in school (i.e. sophomore etc)
4. Your major
5. Any previous exposure (eg high school) to physics
6. Reasons for taking this course

A little about your instructor

www.hunter.cuny.edu/physics/faculty/greenbaum

for background, training, research interests, etc

Area of research: Experimental solid state physics, materials science, magnetic resonance, renewable energy materials (photovoltaics, lithium batteries, fuel cells)

Lab 1217N

Guest lecturer during my absence: Mr. Kartik Pilar

CUNY doctoral student in physics

Notes on Chapter 1: About Science

- *We will barely cover this in class, and it will **not** be examined, but I encourage you to read it on your own.*

- Main points I want to stress:

Observable physical evidence is at the basis of science. Scientific theories must be **testable**.

Measurement plays a crucial role (eg. read about measurements in 200's BC of size of earth, moon, sun – and try some at home!)

Mathematics provides unambiguous, compact language for science.

Terminology:

Hypothesis = educated guess

Law = **principle** = rule

Theory = synthesis of body of info that encompasses well-tested and verifiable hypotheses about certain aspects of the natural world. Theories may change in time!

Beware of pseudoscience! Lacks evidence and wrong-ness test.
(relevant to debate on intelligent design; other recent examples?)
cold fusion; magnetic shoe inserts; leukemia from power lines;
positions of planets and stars affects our daily lives. Any more?

Chapter 2: Newton's First Law of Motion - Inertia

Before getting into this, note early ideas on motion *(I won't examine this)*

– **Aristotle** (c. 320 BC), all motions are due to "nature" of the object, or to "violent" influences (push or pull) .

"Normal state" = at rest, except for celestial bodies.

Heavier objects fall faster, striving harder to achieve their "proper place".

-- **Copernicus** (c. 1500's) doubted that everything revolved around earth. Formulated sun-centered system.

-- **Galileo** (c. 1600's) agreed with Copernicus, and disagreed also with Aristotle's "natural state" idea, using observation and experiment. Dropped objects from Leaning Tower of Pisa and found they fell at the same rate (apart from small effect of air resistance). Inclined planes experiments. Concept of Inertia

Read more in your book.

-- **Newton** (c. 1665) formulated Newton's Laws of Motion…

Newton's 1st Law of Motion: Inertia

- Every object **continues** in its state of rest, or of uniform motion in a straight line, unless acted on by a force.

Eg1: Table here, at rest. If it started moving, we'd look for what caused the motion (force)

Eg2: "Tablecloth trick" (or, here, "keys-on-paper-on-table trick"). If I whip out the paper from under the keys, the keys stay fixed – continuing in state of rest.

Eg3: Ball at rest. Give a push (force) – it starts to roll (changes state of motion). When you let go, it continues to roll, even with no force on it – continuing in its state of motion.

Eg4: Riding on the subway, you have to hang on to the pole to stop continuing forward after the subway stops…

- **Inertia** = property of objects to resist changes in motion

Heavier (more massive) objects tend to have more inertia (more later)

02_InertiaOfAnvil_VID.mov

- **Force** = something that produces a change in motion, a push or a pull. Source can be muscle effort, or gravitational, or electric, or magnetic…Often we denote force by **F**

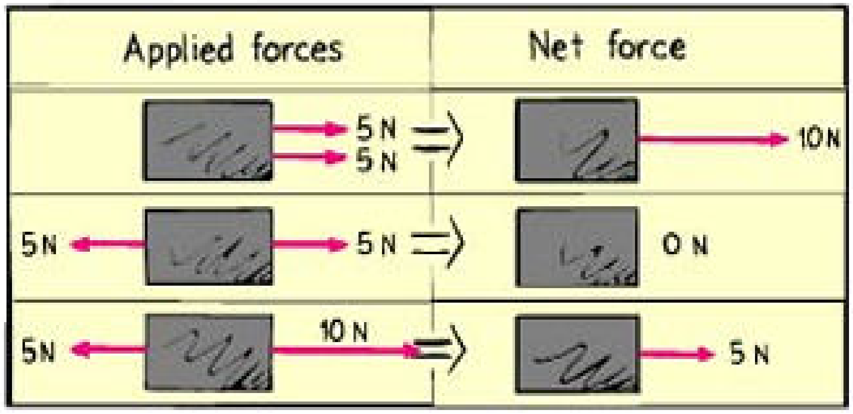
Newton, N = standard unit of force. Physicists equivalent of “pounds”, but not the same numerically i.e. 1-lb = 4.448-N.

Eg. 1-kg weighs 9.8-N and 2.2-lb (on Earth).

Net force = resultant force when several forces are acting

Eg. Tug of War – both teams pull on opposite ends. If they each pull with the same magnitude of force, there is zero net force on the rope.

Eg:



Note that any force has a direction!

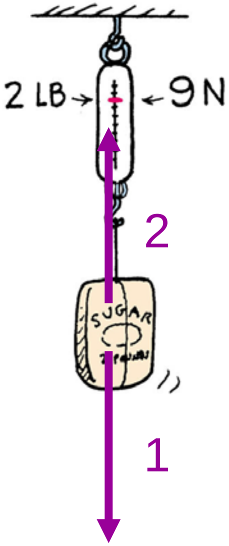
Equilibrium

- Equilibrium is when the net force on something is zero

Mathematically, **$\Sigma F = 0$**

An object in equilibrium remains at rest or remains in uniform straight-line motion (Newton's law)

Eg. 2-lb bag of sugar hanging on a weighing scale



There are 2 forces on the bag:

(1) gravitational force downwards towards earth (= 2-lb, or 9-N down)

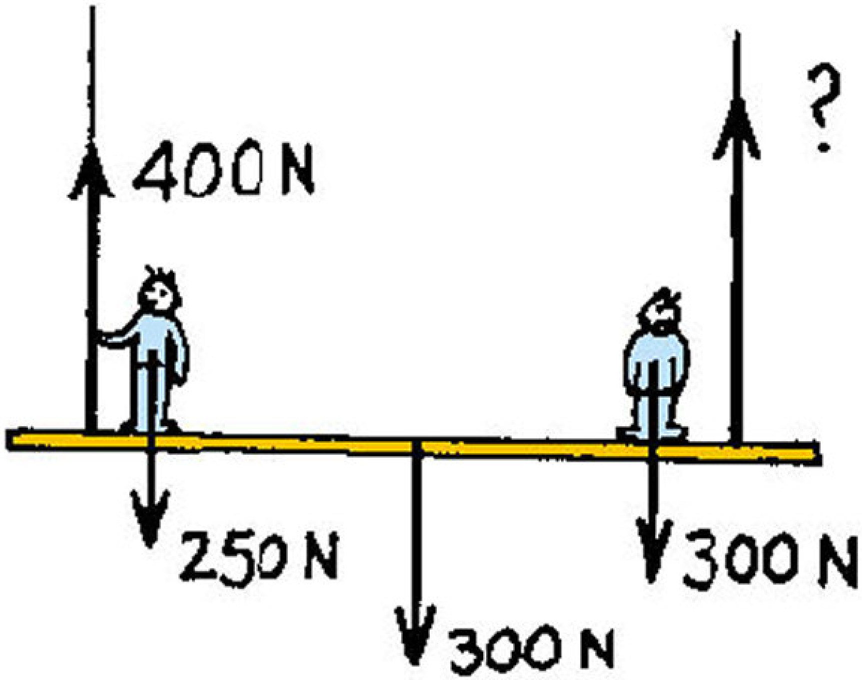
(2) tension force upwards from stretched spring (= 2-lb, or 9-N up)

-- equal and opposite, so no net force, and bag remains at rest.

Question

The staging shown weighs 300 N and supports two painters, one 250 N and the other 300 N.

The reading on the left scale is 400 N. what is the reading on the right-hand scale?



Answer: 450 N.

The upward forces are (400 N + RH tension). By the equilibrium rule $\Sigma F = 0$, this upward total must equal the downward forces are (250 N + 300 N + 300 N) = 850 N. Hence, RH tension must be 450 N.

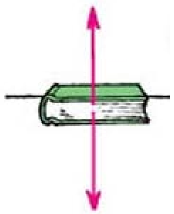
Note that although the two tensions must add to the total weight, the tension is larger in the rope nearer the heavier person.

Support Force (a.k.a. Normal Force)

What forces are acting on the book lying on the table?

Gravity (weight of book) acts downward. But since book is at rest, there must be an equal upward force.

This upward force is called the **support** force, or **normal** force, and equals the weight of the book.



Σ F = 0, since at rest

What creates the normal force? The atoms in the table behave like tiny springs, so push back on anything (eg book) trying to compress them.

Question

Say a 120-lb person steps on some bathroom scales.

(i) How much is gravity pulling on her ?

120-lb (=weight)

(ii) What is the net force on her?

0 (since she's at rest)

(iii) What is the net force on the bathroom scales?

0 (since scales are at rest)

(iv) Now suppose she stands on two bathroom scales, with weight evenly divided between them. What will each scale read?

60 –lb each, since the sum of the scale readings must balance the weight.

Equilibrium of Moving Things

- An object moving at constant speed in a straight line is also in equilibrium, Σ F = 0.

Question: Can any object on which only **one** force is acting, be in equilibrium? *No!*

Consider pushing a box across a floor.

(1) What forces are acting on the box?

Weight downward, support force upward, your push across, and friction between the floor and the box opposing your push.

(2) What can you say about the relative magnitudes of the forces if is moving with unchanging speed across the floor ?

Magnitude of weight = support force.

Your push = friction, if speed unchanging.

(If it is speeding up, then your push > friction.)

The moving Earth

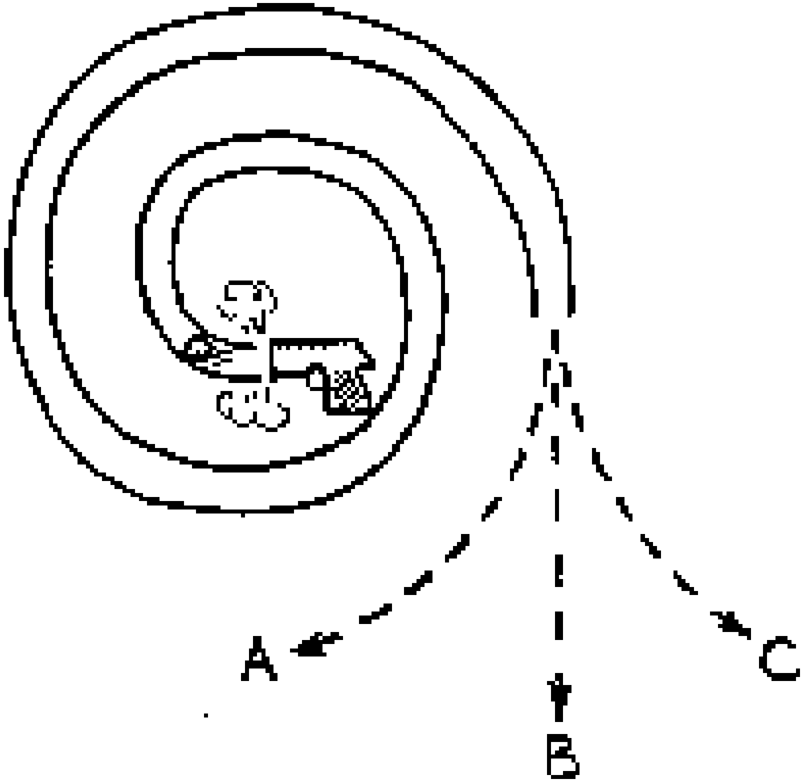
- Earth is moving around the sun at 30 km/sec.

- So, if I stand near a wall, and jump up in the air for a few seconds, why doesn’t the wall slam into me??

  Because of inertia. While standing on the ground, I am moving along with the earth at 30 km/s, and when I jump, I (and the air) continue moving (sideways) at 30 km/s.

Question

When the pellet fired into the spiral tube emerges, which path will it follow? (Neglect gravity).



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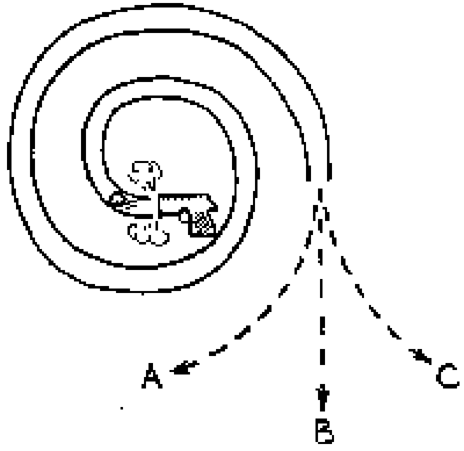


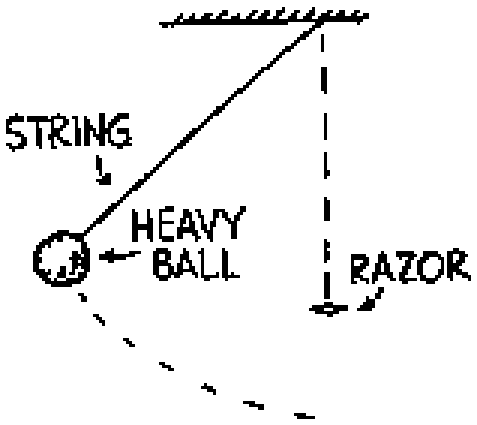
Answer

B:

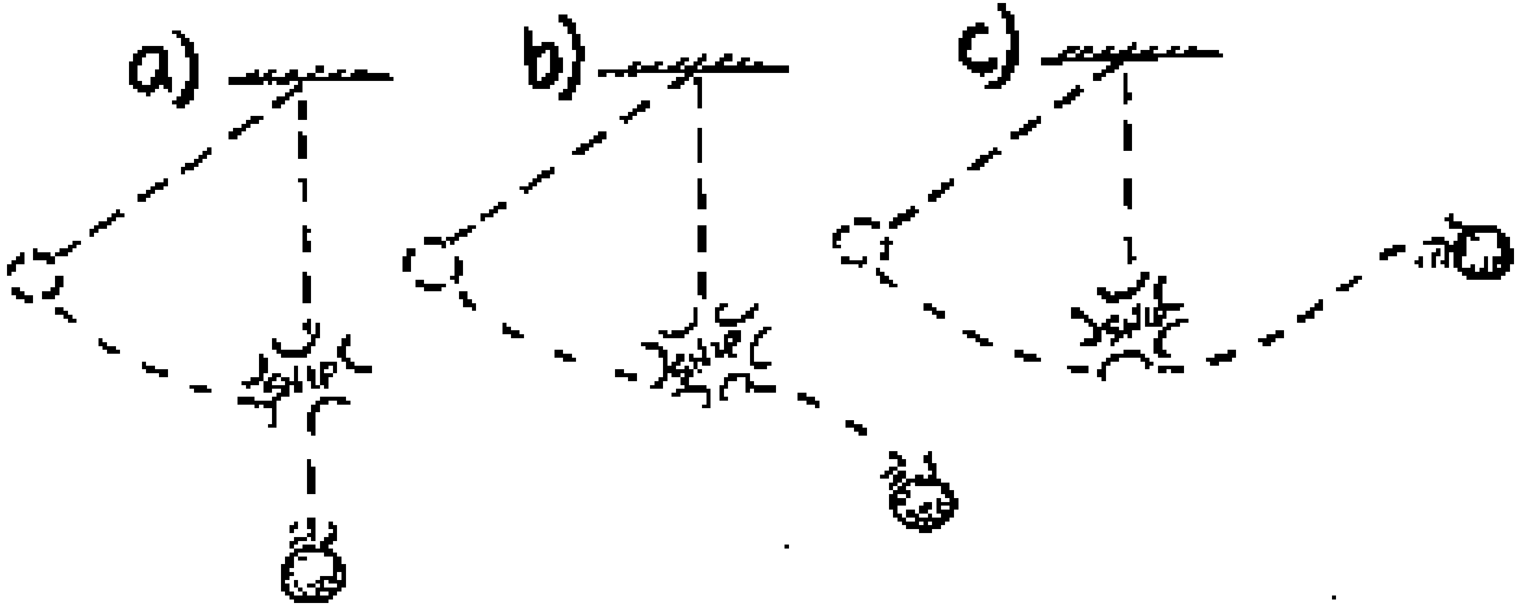
While in the tube, the pellet is forced to curve, but when it gets outside, no force is exerted on the pellet and (law of inertia) it follows a straight-line path – hence, B.

Question

When the ball at the end of the string swings to its lowest point, the string is cut by a sharp razor.



What path will the ball then follow?



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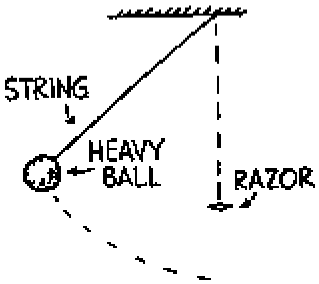

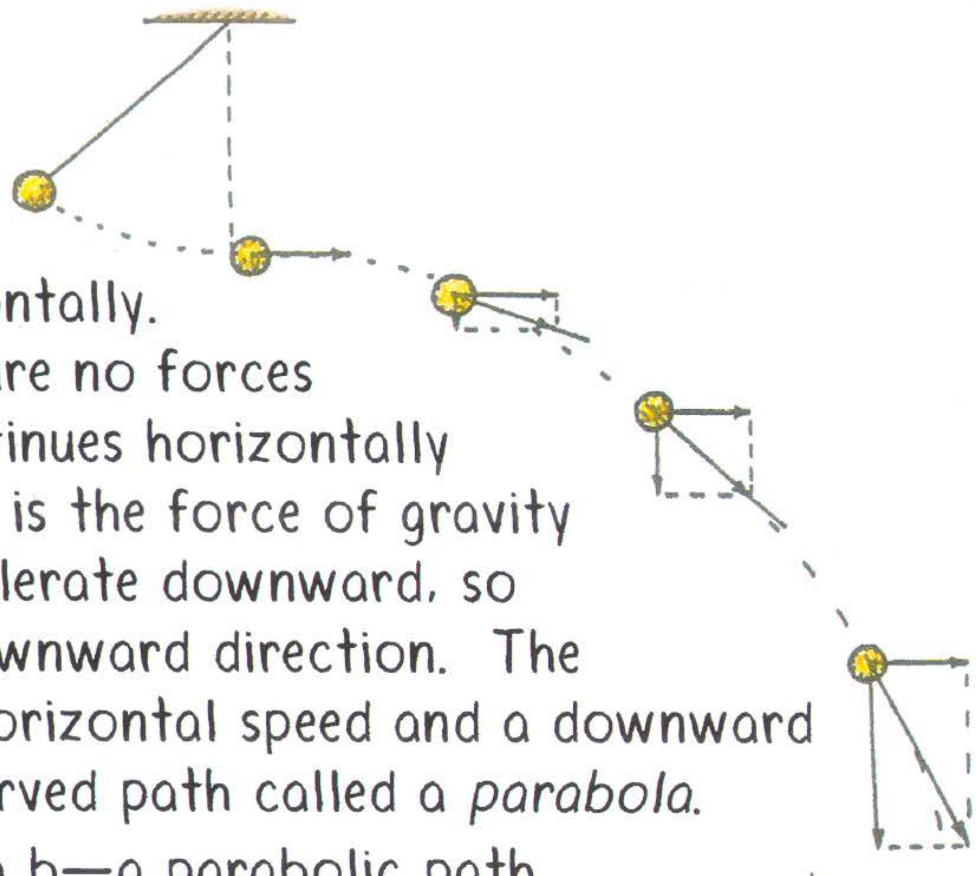

Answer: b

At the moment the string is cut, the ball is moving horizontally. After the string is cut there are no forces horizontally, so the ball continues horizontally at constant speed. But there is the force of gravity which causes the ball to accelerate downward, so the ball gains speed in the downward direction. The combination of a constant horizontal speed and a downward gain in speed produces the curved path called a *parabola*. The ball continues along path b—a parabolic path.

NEXT-TIME QUESTION

Suppose you and a pair of life preservers are floating down a swift river, as shown. You wish to get to either of the life preservers for safety. One is 3 meters downstream from you and the other is 3 meters upstream from you.

Which can you swim to in the shortest time?

a) The preserver upstream.

b) The preserver downstream.

c) Both require the same amount of time.

thanx to John Clement and Charlie Camp

Hewitt Drew it!