Physics 140 – Fall 2007

Lecture 3 : 11 Sep

Ch 3 topics:

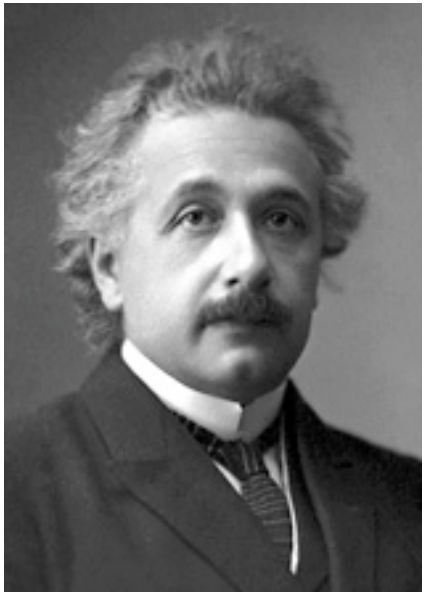
- motion in two dimensions
- projectile motion

Notices:

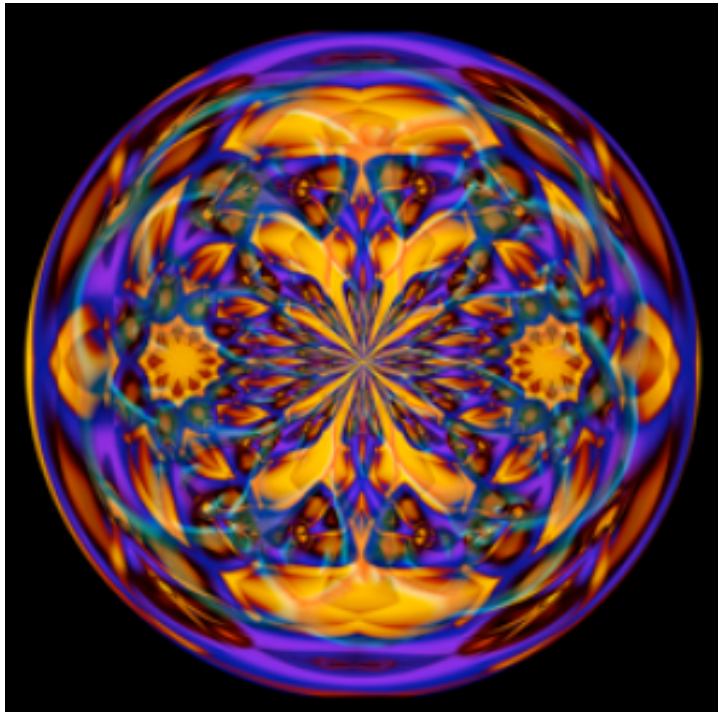
- Science Learning Center STUDY GROUP sign-up starts this Thursday (see Physics Help on CTools course site)

I believe in intuitions and inspirations. … I sometimes *feel* that I am right. I do not *know* that I am.

The New Quotable Einstein, A. Calaprice, ed., Princeton Univ. Press, 2005, pp. 235,6



Source: Nobel Foundation (1921)



Science, according to the articulate writer and Nobel Laureate in medicine, Peter Medawar, is the 'art of the soluble,' and as there is virtually no system in nature that is *exactly* soluble, the application to the real world of physics – the quintessential science- is to a great extent the art of modeling. To recount the great successes of physics is in large measure to unfold an historical record of aptly chosen, albeit hypothetical, models of reality such as frictionless free-fall, point electrical charges, and ideal gases.

M. P. Silverman, *More than One Mystery: Explorations in Quantum Interference*, (Springer-Verlag: Berlin) 1995, p. 129.

common idealizations

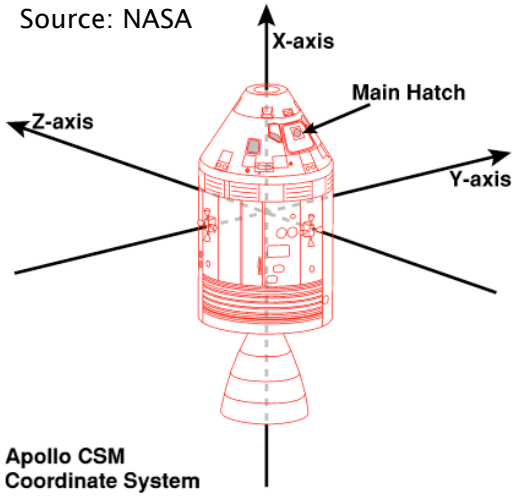
Some idealizations, or approximations of reality, that we'll use include:

- Objects with genuine size and extent are treated as if they can be shrunk to a point, becoming effectively **a single particle**. This approximation is valid when describing purely *translational motion*, but it doesn't work for *rotational motion* or *rolling motion*.

- We'll mostly ignore the effects of air on the motion of objects. This is true for the case of **projectile motion**, in which the vertical* component of motion is assumed to be under constant acceleration g (acting downward), whereas the horizontal component is assumed to have zero acceleration. In reality, there is nearly always some amount of horizontal and vertical acceleration due to air resistance.

* for standard reference frames, in which vertical is perpendicular to the Earth's surface.

motion in 2 or 3 dimensions



- Motion in space can be described as a combination of movement in *orthogonal* (perpendicular) directions.

  Position, velocity and acceleration are vector quantities with components that function *independently of* (separately from) one another. Time links their behavior.
  Choosing an orthogonal set of basis/unit vectors and defining zeros of position specifies the *frame of reference* used to measure motion.

- *Projectile motion* is planar (2D) motion composed of horizontal (x-direction) and vertical (*y*-direction) components.
  Ignoring air resistance (or any effects other than gravity)

  vertical component : motion at constant acceleration
  horizontal component : motion at constant velocity

Danny Way: human projectile across China's Great Wall

http://www.dannyway.com/_videos/dc_great_wall_med.mov

A cyclist thinking about physics while riding down a slope constructs the `tilted' coordinate system shown in the figure. Which of the following statements about projectile motion is/are **true** in this `tilted' frame of reference?

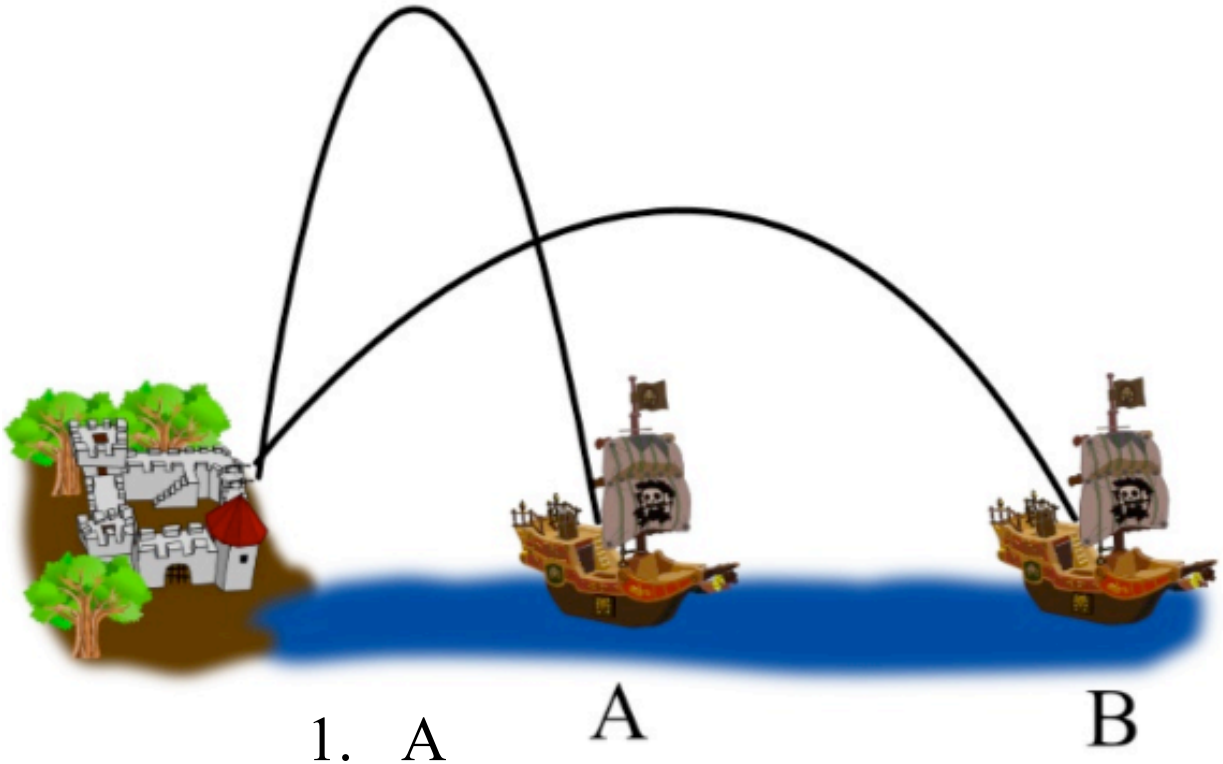
1. Motion in the i-direction occurs at constant velocity.
2. The magnitude of the component of acceleration in the j-direction is less than g.
3. There is non-zero acceleration due to gravity in both the i-direction and the j-direction.
4. Both 1) and 3).
5. Both 2) and 3).
6. All of the above.

lessons from demos

1. *Billiard ball launcher*. The fact the ball launched horizontally strikes the ground at the same time as the ball dropped at rest implies that the vertical motions of the two balls are the indistinguishable. More generally, this demo supports the assertion that ***the horizontal and vertical components of any motion are independent of each other***.

2. *Shoot the Monkey*. Over a given time interval, the vertical displacement of the monkey caused by gravity matches the vertical displacement of the bullet caused by gravity.

A fortress simultaneously fires two cannon balls at pirate ships. If the shots fire the parabolic trajectories shown, which ship gets hit first?



1. A
2. Both at the same time
3. B
4. Need more information