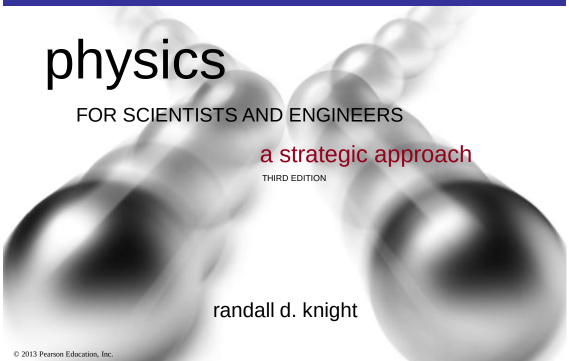
Class 5 – Sections 2.5-2.7, Preclass Notes



ALWAYS LEARNING PEARSON

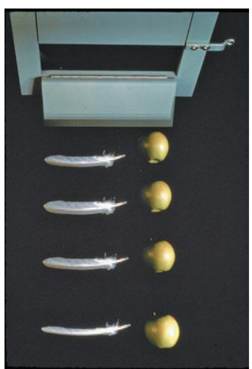
Chapter 2 Goal: To learn how to solve problems about motion in a straight line.

Slide 2-2

2.5 Free Fall

- The motion of an object moving under the influence of gravity only, and no other forces, is called **free fall**
- Two objects dropped from the same height will, if air resistance can be neglected, hit the ground at the same time and with the same speed
- Consequently, any two objects in free fall, regardless of their mass, have the same acceleration:

$$\vec{a}_{\text{free fall}} = (9.80\ \text{m/s}^2\text{, vertically downward})$$



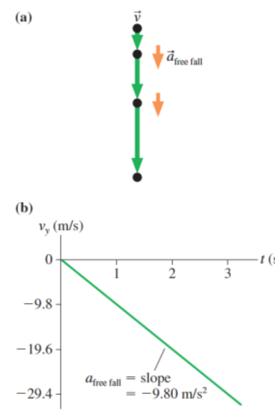
The apple and feather seen here are falling in a vacuum.

Free Fall

- The velocity graph is a straight line with a slope:

$$a_y = a_{\text{free fall}} = -g$$

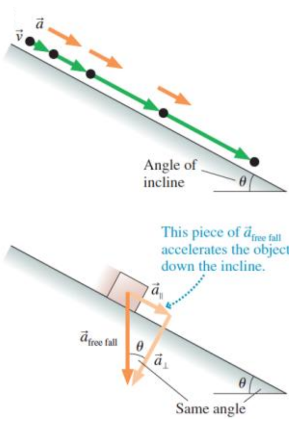
- where g is a positive number which is equal to 9.80 m/s^2 on the surface of the earth
- Other planets have different values of g



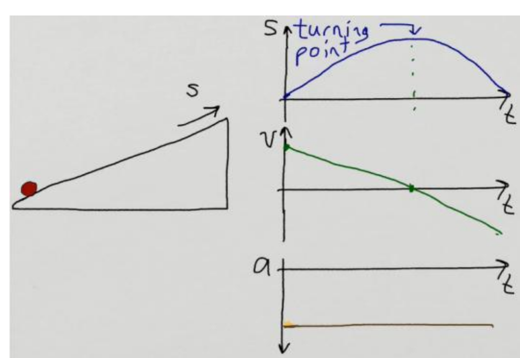
2.6 Motion on an Inclined Plane

- Consider an object sliding down a straight, frictionless inclined plane
- $\vec{a}_{\text{free fall}}$ is the acceleration the object would have if the incline suddenly vanished.
- This vector can be broken into two pieces: $\vec{a}_{\parallel}$ and $\vec{a}_{\perp}$
- The surface somehow "blocks" $\vec{a}_{\perp}$, so the one-dimensional acceleration along the incline is:

$$a_s = \pm g \sin\theta$$

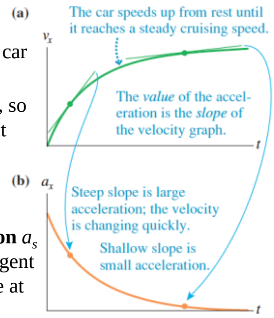


Tactics: Interpreting graphical representations of motion



2.7 Non-Constant Acceleration

- Figure (a) shows a realistic velocity-versus-time graph for a car leaving a stop sign
- The graph is not a straight line, so this is *not* motion with a constant acceleration
- Figure (b) shows the car's acceleration graph
- The **instantaneous acceleration** a_s is the slope of the line that is tangent to the velocity-versus-time curve at time t



$$a_s = \frac{dv_s}{dt} = \text{slope of the velocity-versus-time graph at time } t$$

Finding Velocity from Acceleration

- Suppose we know an object's velocity to be v_{is} at an initial time t_i
- We also know the acceleration as a function of time between t_i and some later time t_f
- Even if the acceleration is not constant, we can divide the motion into N steps of length Δt in which it is approximately constant
- In the limit $\Delta t \rightarrow 0$ we can compute the final velocity as

$$v_{fs} = v_{is} + \lim_{\Delta t \to 0} \sum_{k=1}^{N} (a_s)_k \Delta t = v_{is} + \int_{t_i}^{t_f} a_s \, dt$$

- The integral may be interpreted graphically a_s the area under the acceleration curve as between t_i and t_f