FREE FALL: THE CALCULATIONS

How fast does one fall in free fall?

Ignoring air resistance, an object accelerates downward at 9.8 m/s^2.

An object falls 9.8 m/s each second it falls.

g=9.8 m/s^2

FREE FALL: What is terminal velocity?

It is the maximum speed that a person or object can achieve while falling toward the earth.

FREE FALL: TERMINAL VELOCITY

•<u>Terminal velocity</u>

– Constant speed an object falling through air approaches

– Force of gravity pulling down is balanced by the force of air resistance pushing up.

FREE FALL

When the two forces are =, the person stops accelerating and falls to the earth at a constant velocity .

This speed is between 93 and 125 mph.

Dependent on weight and the aero -dynamics of the diver.

FREE FALL EQUATIONS
THESE GO WELL IN A FLIP CHART

How fast is the object falling?

$$v_f = v_i + at$$

For a falling object, a (acceleration) is gravity

a can be replaced by g, giving us : $v_f = v_i + gt$

v_f = final velocity (m/s)

v_i = initial velocity (m/s)

t = time (s)

FREE FALL EQUATIONS
THESE GO WELL IN A FLIP CHART

How fast is the object falling?

$$v_f = v_i + at$$

Is V_i ever zero?

FREE FALL EQUATIONS
THESE GO WELL IN A FLIP CHART

How far has the object fallen?

$$d = v_i t + \frac{1}{2}at^2$$

Can v_i be zero?

FREE FALL EQUATIONS
THESE GO WELL IN A FLIP CHART

How far has the object fallen?

What is the acceleration for a falling object?

$$d = v_i t + \frac{1}{2} g t^2$$

FREE FALL EQUATIONS
THESE GO WELL IN A FLIP CHART

How long is the object falling?

$$t = \sqrt{\frac{2d}{g}} \text{ if } v_i = 0$$

$$or$$

$$t = \frac{v_f - v_i}{g}, \text{ if } v_i \neq 0$$

FREE FALL EQUATIONS
THESE GO WELL IN A FLIP CHART

Landing Speed

$$v_f^2 = v_i^2 + 2ad$$

$v_i = 0$ start at rest

$a = g$

$$v_f = \sqrt{2gd}$$ unit m/s

REAL WORLD PRACTICE

A diver jumps from a height of 10,000 feet.

How far down will the diver be after 5 seconds?

What is the speed of the diver at this time?

How far down will the diver be after 5 seconds?

knowns

$d = 1000\,ft$

$t = 5s$

$g = 9.8\,{}^{m}\!/\!_{s^2}$

$v_i = 0$

unknowns

$\Delta d = ?\,m$

equations

$d = v_i t + {}^{1}\!/\!_{2}\,g t^2$

What is the speed of the diver at this time?

Watch as we work it out on the board!

BUNGEE JUMPING

REAL WORLD PRACTICE-ON YOUR OWN...

Michael drops a pencil down the stairs from the 3rd floor. Where is the pencil 1.5s later? How fast is the pencil falling at 1.5 s?

Elevator Key anyone?

The single cable supporting the school elevator breaks when the elevator is at rest on the 3rd floor (120m). There are no kittens in the elevator.

With what speed does the elevator strike the ground?

How long did it fall?

TERMINAL VELOCITY

Terminal Velocity (in Wisconsin) is the only ride in the world, that allows you **unattached, controlled free fall** .
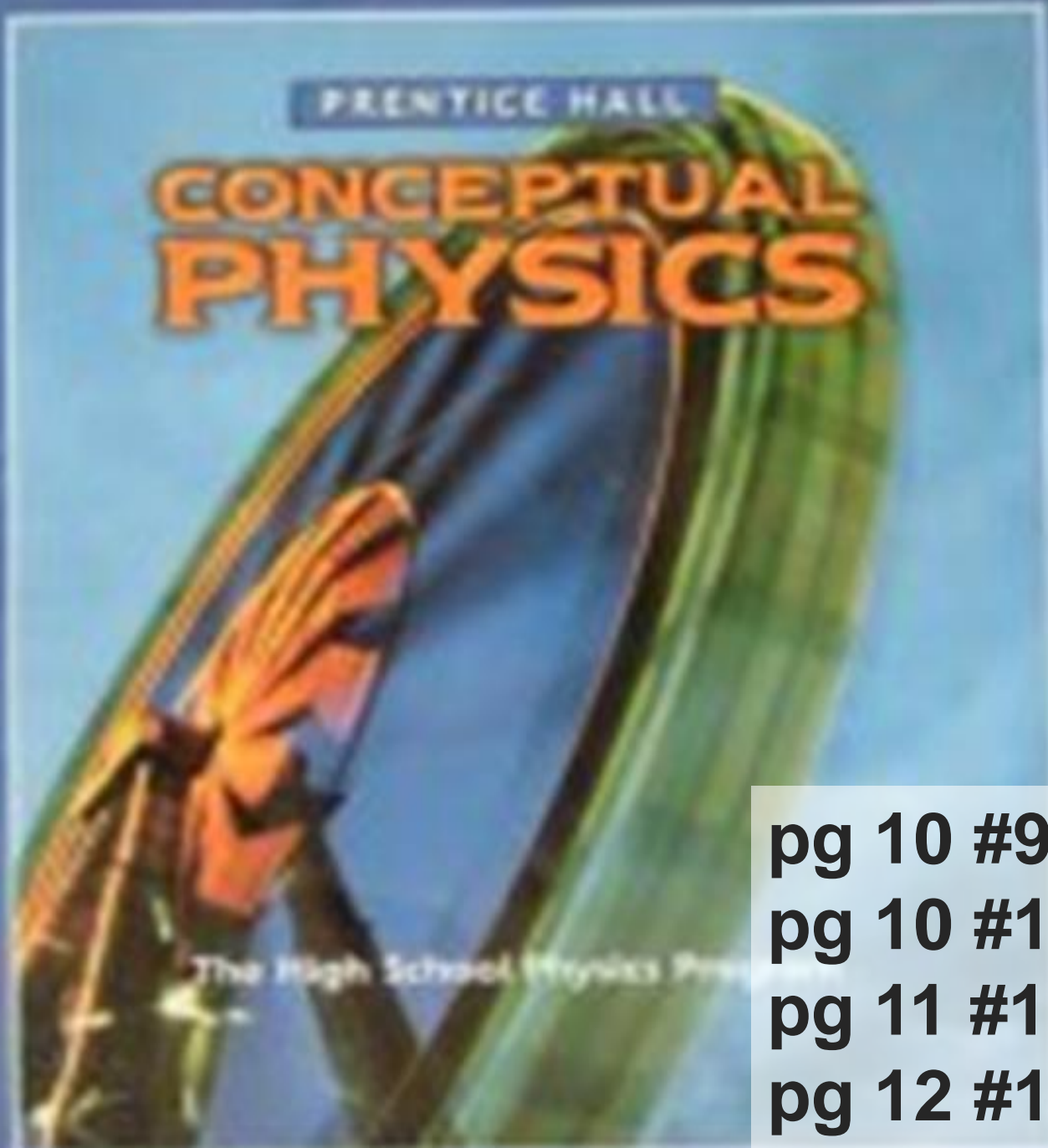
How long does the 100 foot last?

What is the top speed?

Your turn to practice

We are standing on top of the building for a great experiment. Dewey and Baker decided to jump off (or perhaps they were pushed) at exactly the same moment as we drop a stone. There is no air resistance. All three are propelled vertically downward at 12.0 m/s. The roof is 30m off the ground.

Who/what reaches the ground first? How long does it take for the stone to reach the ground? What is the speed of the stone at impact?

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Resources

http://www.onlinephys.com/kinematics1Dc.html

http://openlearn.open.ac.uk/mod/resource/view.php?id=171667&direct=1