

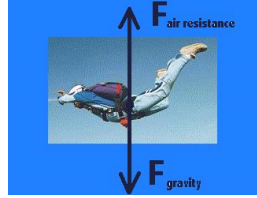
Air Resistance

Air Resistance & Force

Objective:

Use force to analyze the air resistance acting on a falling object.

Define terminal velocity.



Ruler	Feather
$AR = .5 N$ $W = 10 N$ $F_{net} = 9.5 N$ $F = ma \quad 9.5 N = 1 kg \cdot a$ $a = 9.5 m/s^2$	$AR = .5 N$ $W = 1 N$ $F_{net} = .5 N$ $F = ma$ $.5 N = .1 kg \cdot a$ $a = 5 m/s^2$

Air Resistance

diminishes the F_{net} acting on an object

$$F_{net} = W - AR$$

depends on surface area

increases when velocity increases

Ruler	Feather
$AR = 1 N$ $W = 10 N$ $F_{net} = 9 N$ $a = \frac{F_{net}}{m}$ $a = 9 m/s^2$	$AR = 1 N$ $W = 1 N$ $F_{net} = 0 N$ $a = 0$ terminal velocity!

Terminal Velocity

air resistance = weight

Forces balanced $F_{net} = 0$



No acceleration falls at constant rate

fastest possible velocity - for that object

Ruler	Feather
$AR = 12 N$ $W = 10 N$ $F_{net} = -2 N$ $a = -2 m/s^2$ slowing down	 $.1 kg$

Air Resistance

Typical Terminal Velocities:

- Feather = 1/2 m/s
- Raindrop = 7 m/s
- Baseball = 40 m/s
- Bullet = 100 m/s
- Skydiver with parachute open = 5 - 9 m/s
- Skydiver in spread eagle = 50 - 60 m/s
- Skydiver in dive = 100 m/s
- Penny falling flat (not on edge) = 11 m/s

Falling and Air Resistance

Brenco skydives and parachutes from a stationary helicopter. Various stages of fall are shown in positions a through f. Using Newton's 2nd law,

$$\vec{a} = \frac{F_{\text{net}}}{m} = \frac{W - R}{m}$$

Find Brenco's acceleration at each position (answer in the blanks to the right). You need to know that Brenco's mass is 100 kg and his weight is a constant 1000 N. Air resistance R varies with speed and cross-sectional area as shown.

Circle the correct answers.

1. When Brenco's speed is least, his acceleration is
(a) 0 (b) 10 (c) 20 (d) 30

2. In which position(s) does Brenco experience a downward acceleration?
(a) a (b) b (c) c (d) d

3. In which position(s) does Brenco experience an upward acceleration?
(a) a (b) b (c) c (d) d

4. When Brenco experiences an upward acceleration, his velocity is
(a) 0 (b) positive (c) negative (d) upward also.

5. In which position(s) is Brenco's velocity constant?
(a) a (b) b (c) c (d) d

6. In which position(s) does Brenco experience terminal velocity?
(a) a (b) b (c) c (d) d

7. In which position(s) is terminal velocity greatest?
(a) a (b) b (c) c (d) d (e) f

8. If Brenco were heavier, his terminal velocity would be
(a) greater (b) less (c) the same.

CONCEPTS IN PHYSICS

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Assignments . . .



- Finish Lab 4.1
- Chapter 4 HW #11 - 16

