

Name: Key

Physics 200

Notes - 5.2 Drag

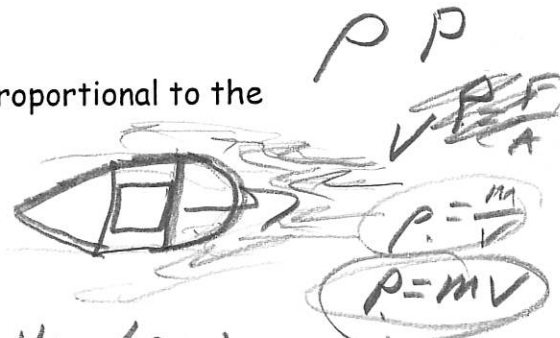
1. What other force is experienced when moving in a fluid (either a gas or a liquid)?

Drag

2. Like friction, the drag force always opposes the motion of an object.

3. For objects not moving too slowly, the drag force is proportional to the square of the velocity.

4. $F_D = \frac{1}{2} A C_d \rho v^2$



where
rho

C_d Drag coefficient
 ρ = density
 A = Cross-sectional Area

Tells how aerodynamic a shape is

5. Why is aerodynamic shaping of automobiles important?

Reduces drag coefficient, increasing mileage

6. How is the drag coefficient C determined?

Experimentally, using wind tunnels

7. List the drag coefficient of a

Sphere

0.45

Honda Civic

0.36

Sky Diver (horizontal)

1.00

spread eagled

higher = more drag

8. List how drag is minimized in the following sports.

Golf:

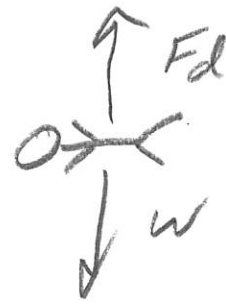
Dimples

Swimming:

Caps, shaving, special suits,

9. Sky Diver Falling Through The Air

A. At terminal velocity, $F_{Net} = 0$



B. At terminal velocity, $F_D = w$

$$w = F_D \Rightarrow mg = \frac{1}{2} A C_d \rho v^2$$

C. At terminal velocity, $v =$

$$v_T = \sqrt{\frac{2mg}{A C_d \rho}}$$

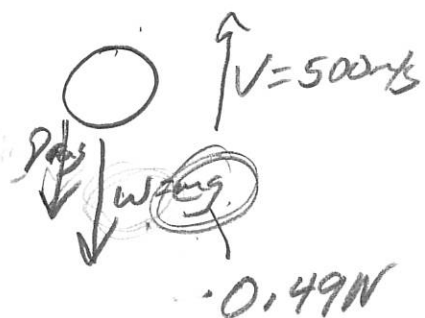
10. Find the terminal velocity of an 85-kg skydiver falling in a spread-eagle (i.e. horizontal) position. $A = 0.7 \text{ m}^2$

$$v_T = \sqrt{\frac{2(85 \text{ kg})(9.8 \text{ m/s}^2)}{0.7 \text{ m}^2 (1.0) (1.2 \text{ kg/m}^3)}} = 44 \text{ m/s}$$

11. Find the force of drag acting on a 0.05 kg sphere traveling upward at 500 m/s. The radius of the sphere is 0.01 m. The air density is 1.2 kg/m³, and the sphere's drag coefficient is 0.45.

$$F_d = -\frac{1}{2} A C_d \rho v^2$$

$$-21.1 \text{ N} = -\frac{1}{2} (\pi (0.01 \text{ m})^2 (0.45) (1.2 \text{ kg/m}^3) (500 \text{ m/s})^2)$$



12. What is the net force acting on that sphere?

$$\Sigma F = -21.1 \text{ N} - 0.49 \text{ N} = -21.6 \text{ N}$$

13. What is the sphere's acceleration?

$$\Sigma F = ma = -21.6 \text{ N}$$

$$0.05 a = -21.6 \text{ N}$$

$$a = -432 \text{ m/s}^2$$