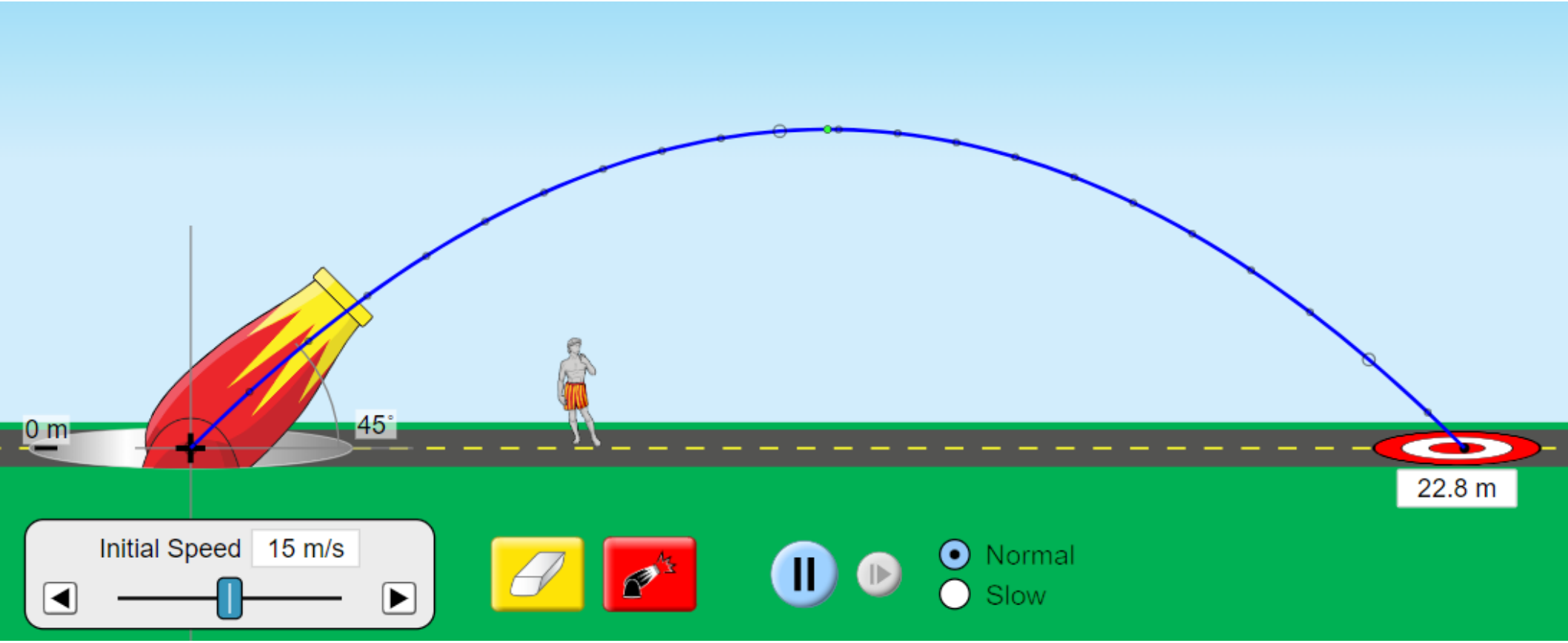
How much distance do you lose due to the drag force acting on a bowling ball in projectile motion?

$m \sim 10\,kg$ $r \sim 15\,cm$? air $\rightarrow \rho \sim 1.2\,kg/m^3$



$$\vec{F}_{\text{drag}} = \left(\tfrac{1}{2} C \mathrm{d}\, \rho A v^2, \text{direction opposite the motion}\right)$$

Chapter 6 – Dynamics: Motion Along a Line

- Mass/Weight/Gravity
- Friction forces
- Drag forces

$$Re = \frac{\text{inertial forces}}{\text{viscous forces}} = \frac{\rho v L}{\eta}$$

$$\vec{F}_{\text{drag}} = \left(\tfrac{1}{2} C_d \rho A v^2, \text{ direction opposite the motion}\right)$$

fluid

TABLE 6.3 Drag coefficients

Object	C_d
Commercial airliner	0.024
Swimming fish	0.15
Toyota Prius	0.24
Pitched baseball	0.35
Racing cyclist	0.88
Running person	1.2

TABLE 6.2 Density and viscosity

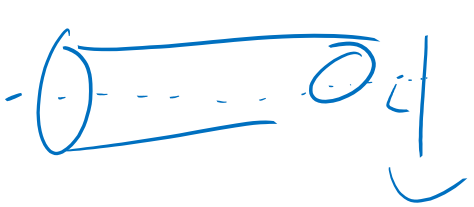
Fluid	ρ (kg/m^3)	η (Pa s)
Air (20°C at sea level)	1.2	1.8×10^{-5}
Water (20°C)	1000	1.0×10^{-3}
Water (40°C)	1000	6.5×10^{-4}
Ethyl alcohol (20°C)	790	1.3×10^{-3}
Olive oil (20°C)	910	8.4×10^{-2}
Honey (20°C)	1400	10
Honey (40°C)	1400	1.7

Team Up Questions

(assume C_d is either 0.5 or 1.0, you should know which)

$$\vec{F}_{\text{drag}} = \left(\tfrac{1}{2} C d \rho A v^2, \text{direction opposite the motion}\right)$$

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



$C_d = 1$

$A = l \times 2r$

$C_d = 0.5$

$A = \pi r^2$

How much distance do you lose due to the drag force acting on a bowling ball in projectile motion? Assume it's launched at 15 m/s at 45 degrees.

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

$\frac{1}{2}\ 1.2\ \pi r^2\ (10)^2$

$r \sim 15\ cm$

$m \sim 10\ kg$

$a_x = \frac{1}{m} \frac{1}{2} C_d \rho A v^2$

$a_x = \frac{1}{10} \frac{1}{2} \frac{1}{2} 1.2\ \pi (0.15)^2 (10)^2$

$a_x \simeq 0.21\ m/s^2$

$t \sim 2\ s$

$\Delta x \sim \frac{1}{2}(0.21)(2)^2 \sim 0.4\ m$

https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html