

Projectile Motion

IB PHYSICS | MOTION

Reminder of our Equations

<i>Units</i>	<i>m</i>	<i>m s⁻¹</i>	<i>m s⁻¹</i>	<i>m s⁻²</i>	<i>s</i>
$v = u + at$		<i>u</i>	<i>v</i>	<i>a</i>	<i>t</i>
$s = ut + \frac{1}{2}at^2$	<i>s</i>	<i>u</i>		<i>a</i>	<i>t</i>
$v^2 = u^2 + 2as$	<i>s</i>	<i>u</i>	<i>v</i>	<i>a</i>	
$s = \frac{(v+u)t}{2}$	<i>s</i>	<i>u</i>	<i>v</i>		<i>t</i>

Dropping the Ball



How much time will it take this ball to hit the ground when dropped? The impact velocity?

$$s = \cancel{ut} + \frac{1}{2}at^2$$
$$-25 = \frac{1}{2}(-9.81)t^2$$

$$t = 2.26 \text{ s}$$

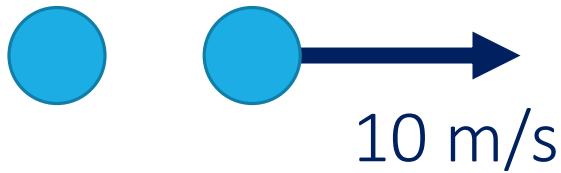
$$v^2 = \cancel{u^2} + 2as$$

$$v = \sqrt{2as} = \sqrt{2(-9.81)(-25)}$$

$$v = -22.2 \text{ m s}^{-1}$$

s	-25 m
u	0 m s ⁻¹
v	?
a	-9.81 m s ⁻²
t	?

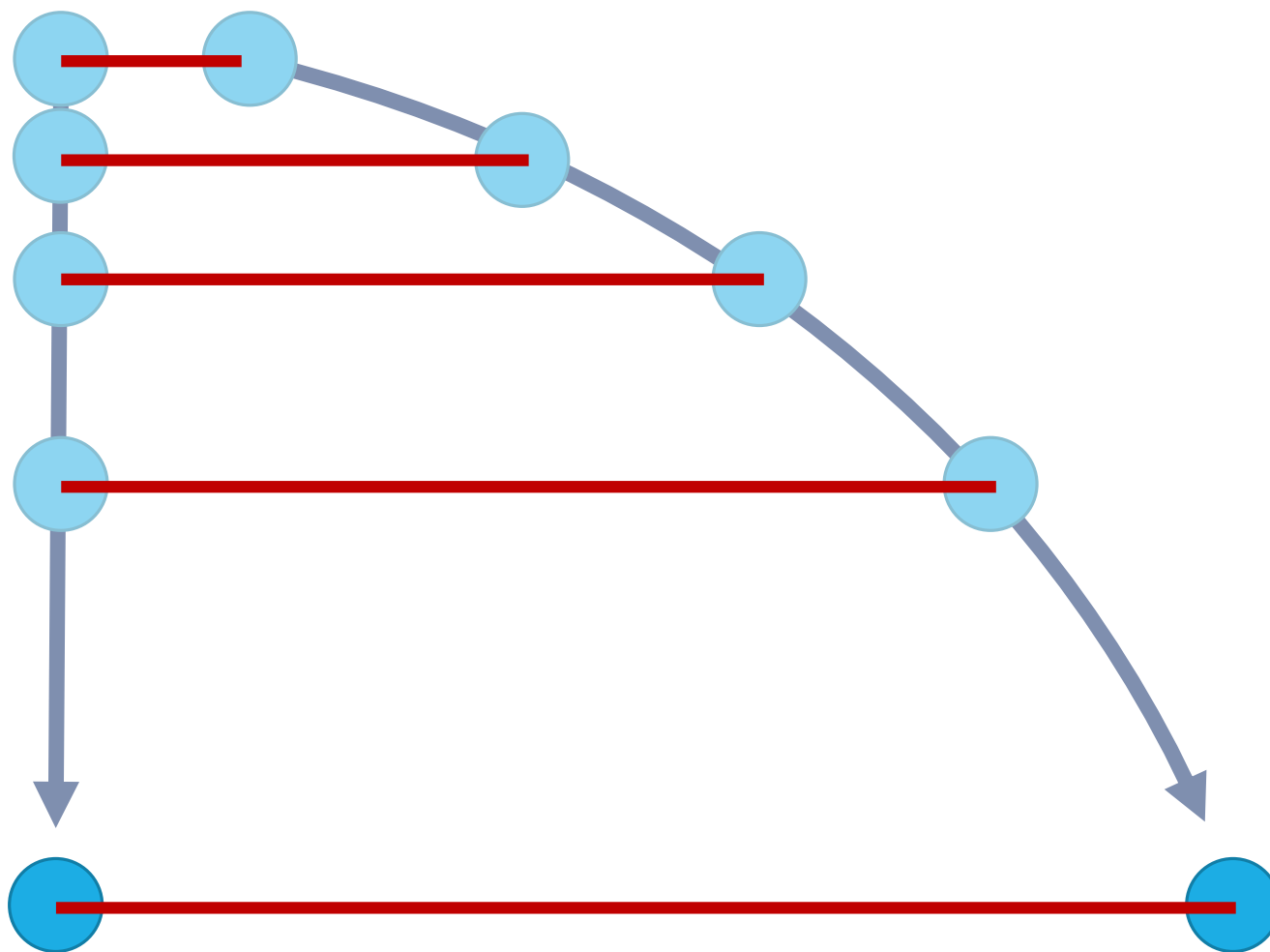
Air Time - Comparison

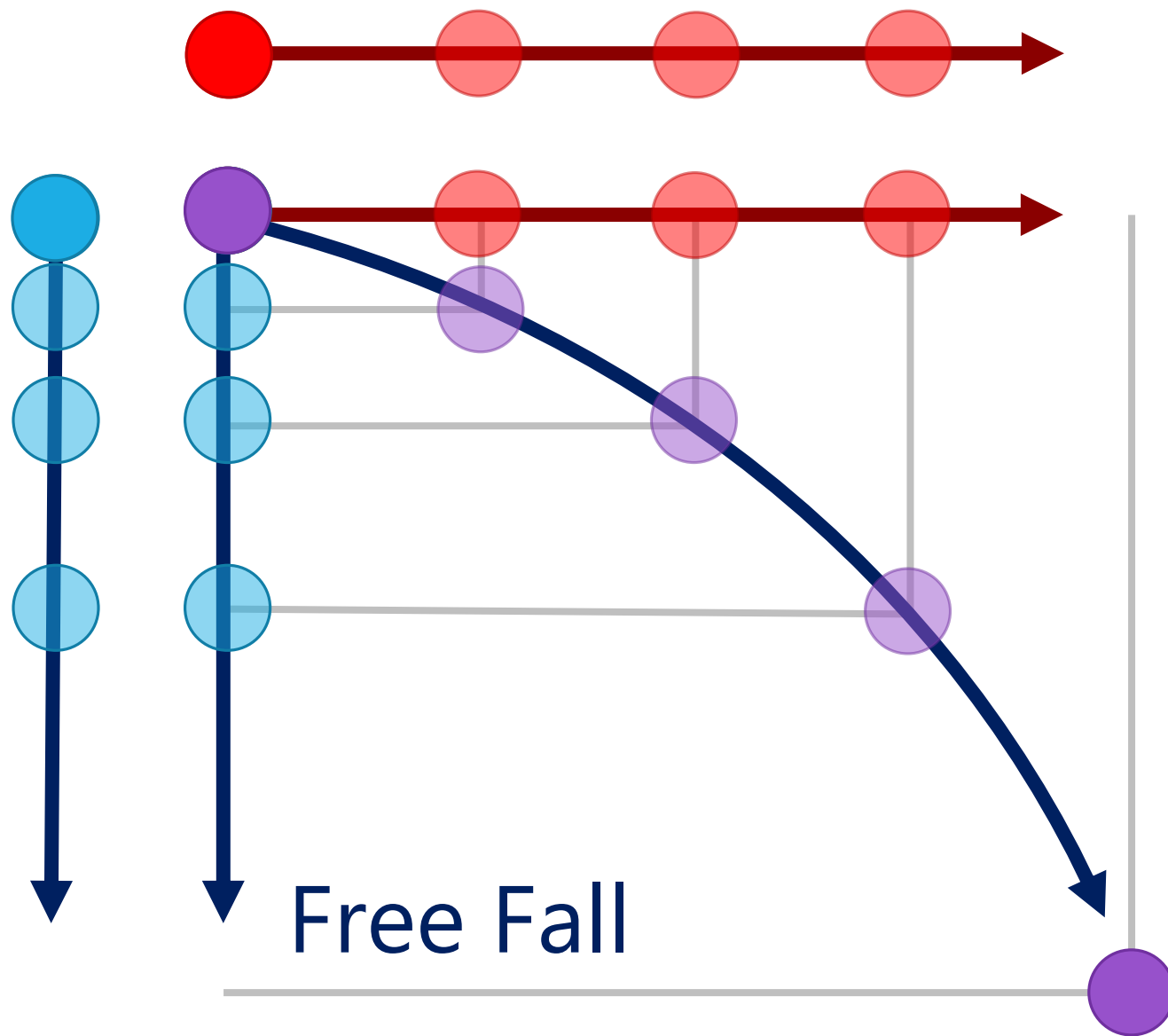


Which ball will have
more air time?

The balls hit the ground at
EXACTLY the same time

Air Time - Comparison

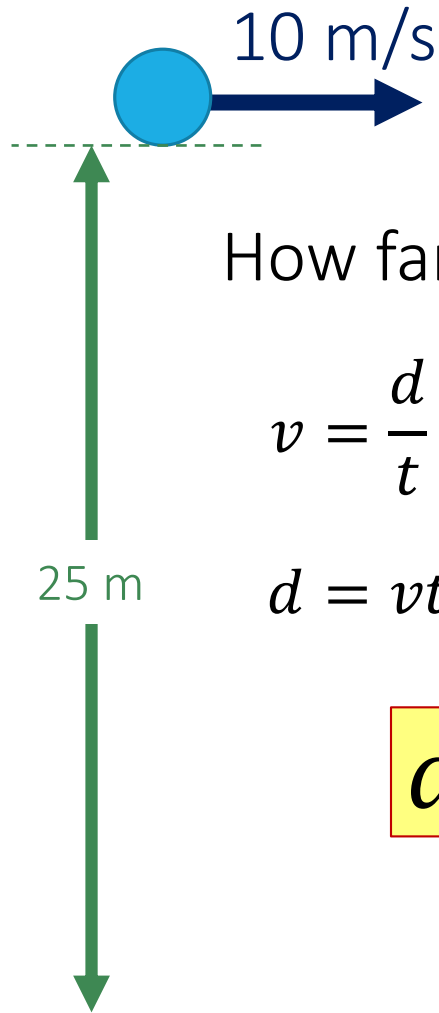




Constant
Velocity

Free Fall

Horizontal Projectile



From Previous Problem →

Vertical Only

How far does the ball travel?

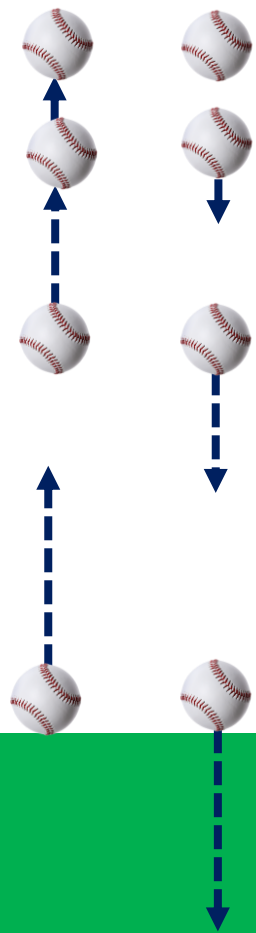
$$v = \frac{d}{t}$$

$$d = vt = (10 \text{ m s}^{-1})(2.26 \text{ s})$$

$$d = 22.6 \text{ m}$$

s	-25 m
u	0 m s ⁻¹
v	-22.2 m s ⁻¹
a	-9.81 m s ⁻²
t	2.26 s

One Dimensional Motion



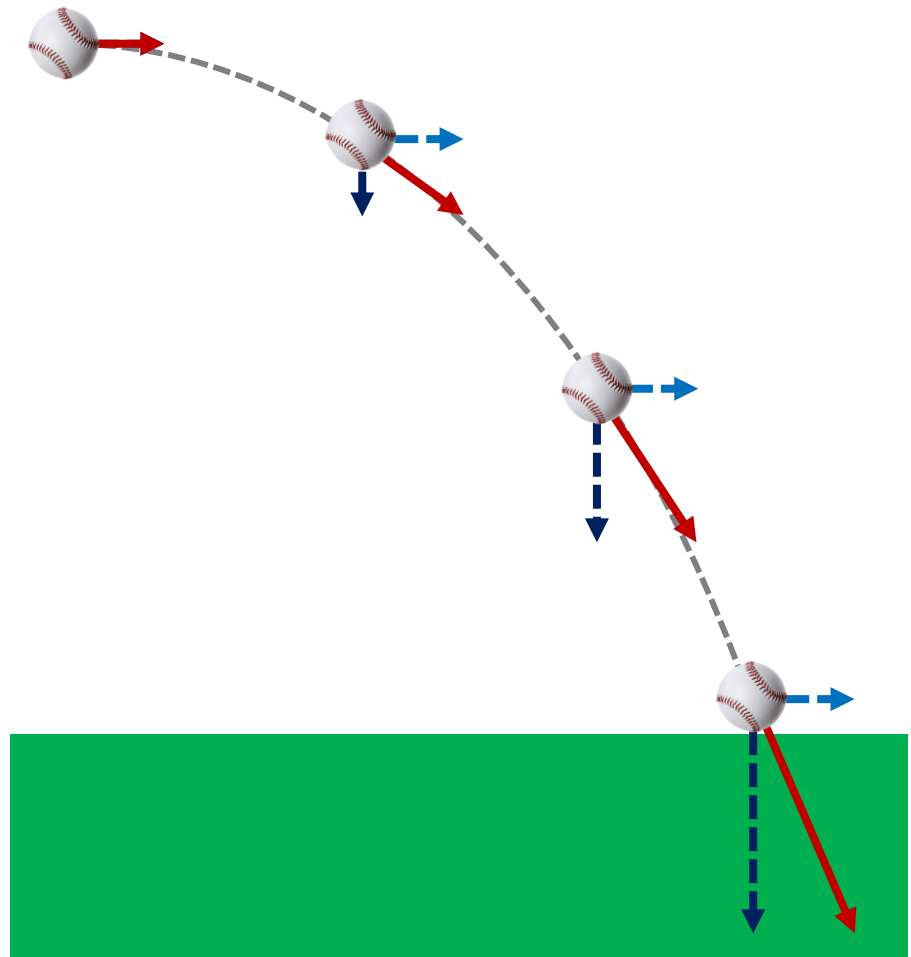
Vertical
Accelerating

Horizontal
Constant Velocity

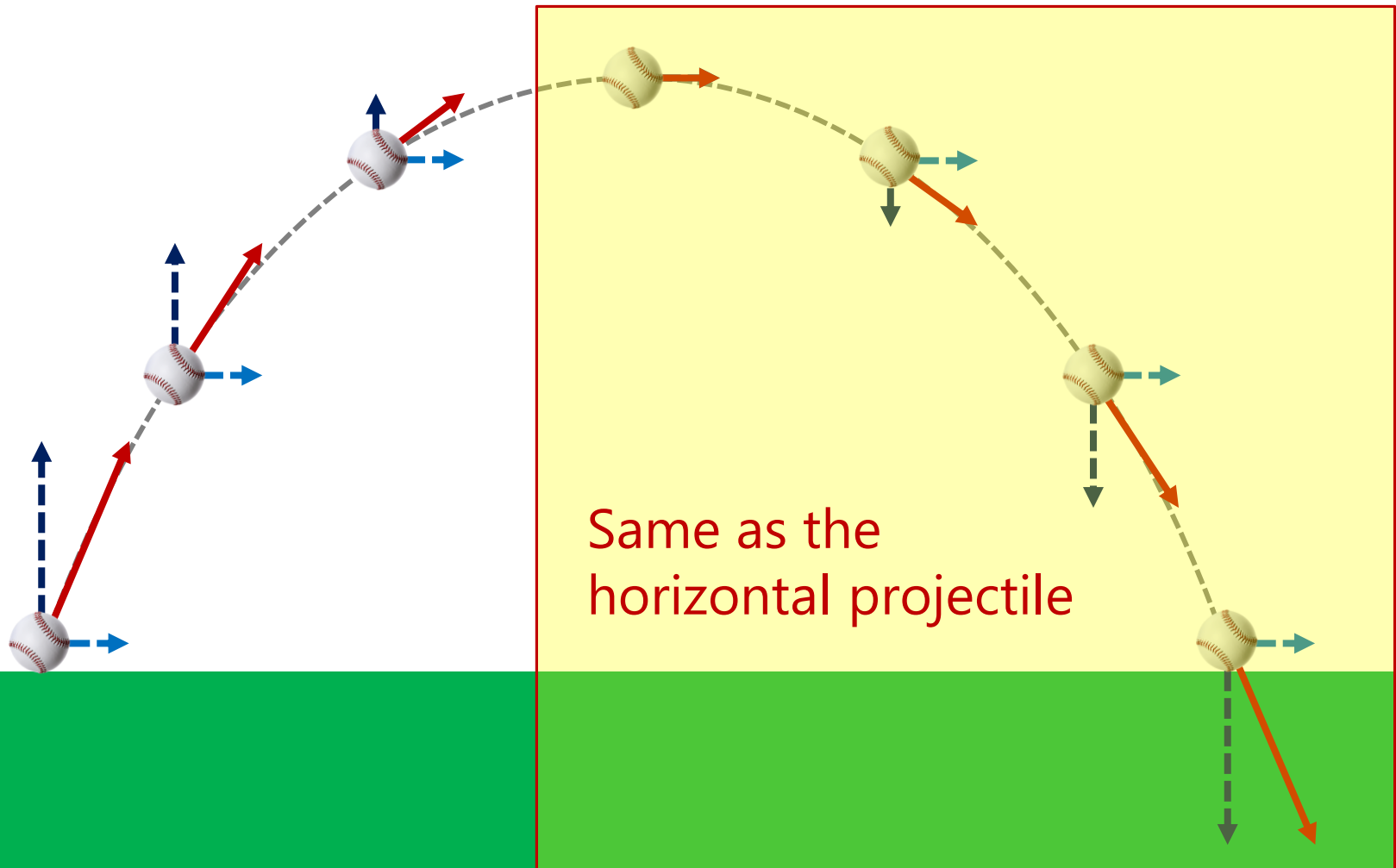


$$[v = d/t]$$

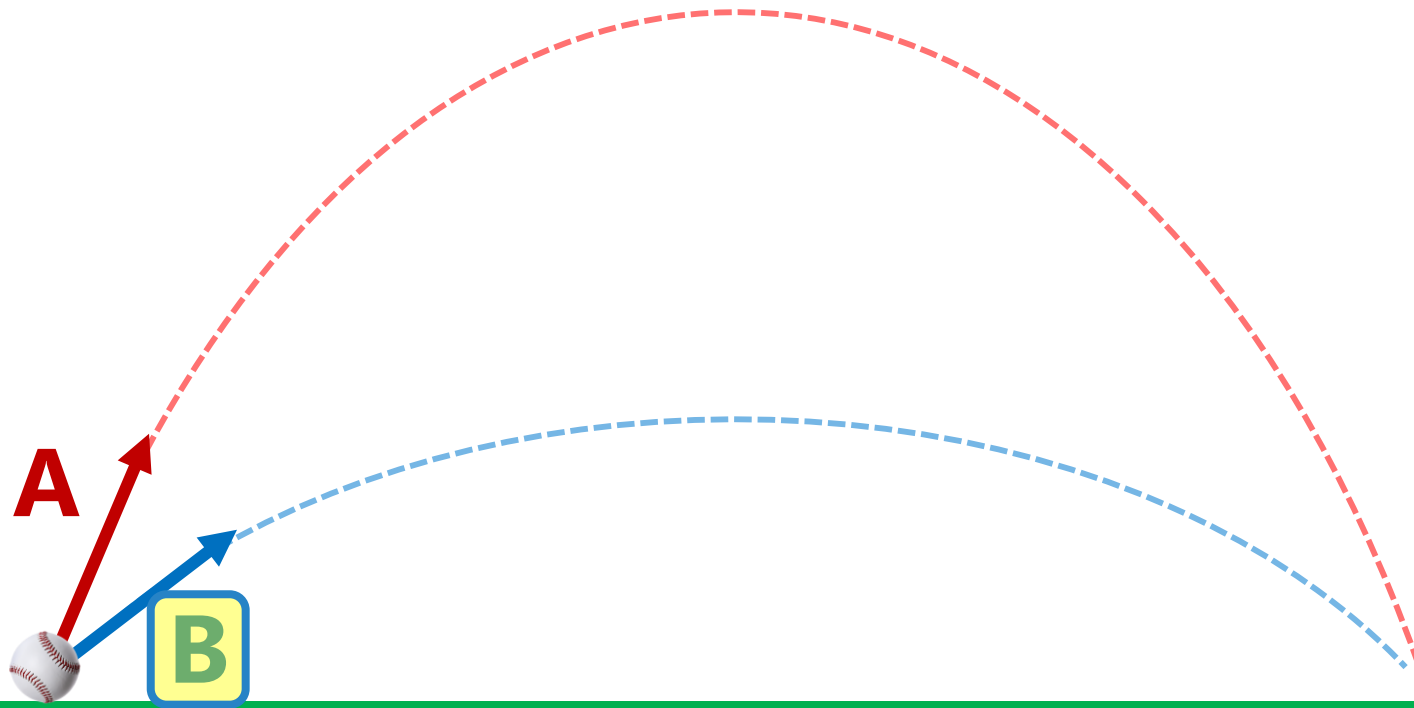
Horizontal Projectile



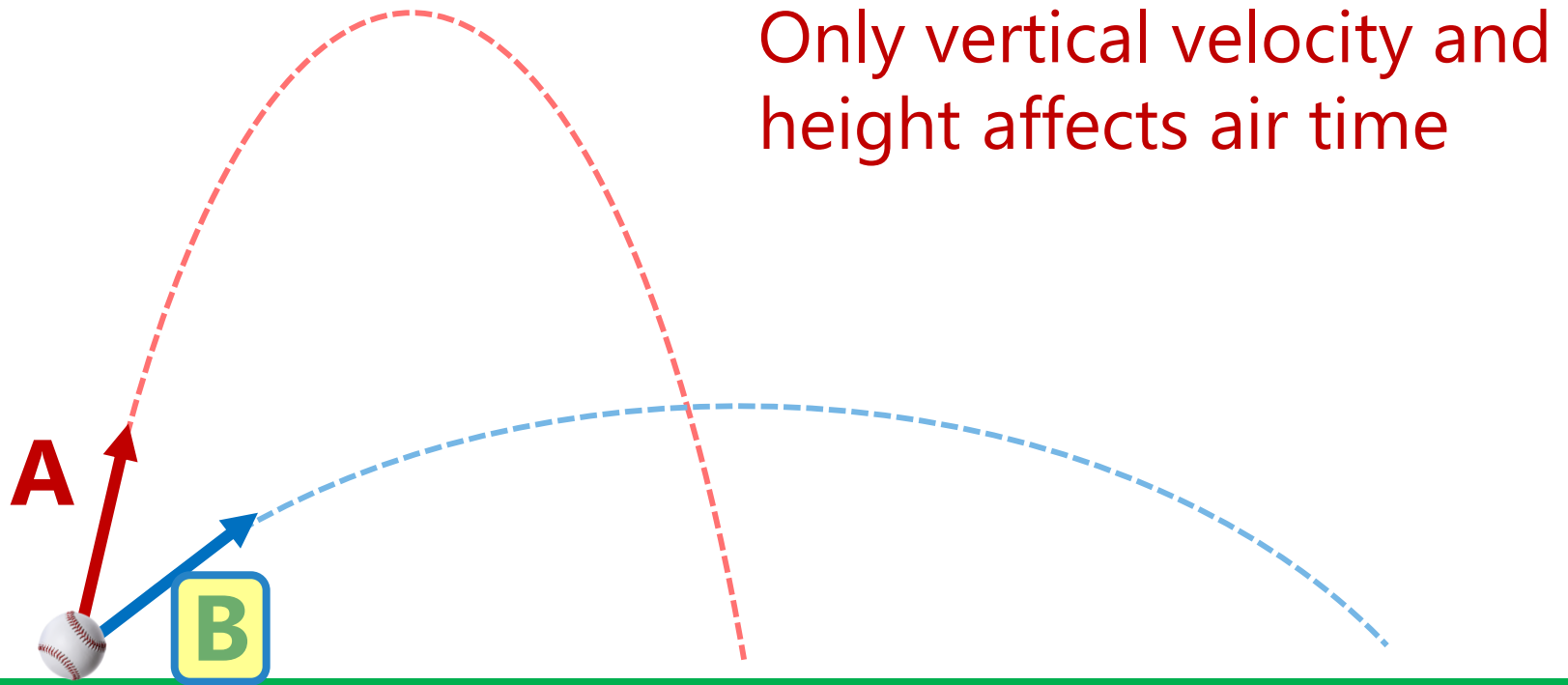
Two-Dimensional Projectile



Which one lands first??



Which one lands first??



Lesson Takeaways

- ☐ I can compare the motion of an object dropped from rest and an object with an initial horizontal velocity
- ☐ I can calculate the air time and speed for a horizontal projectile
- ☐ I can describe how the vertical and horizontal components are independent from each other for a projectile's motion
- ☐ I can compare the air time for two projectiles given their trajectories.