A.1

# Horizontal Projectiles

IB PHYSICS | PROJECTILES

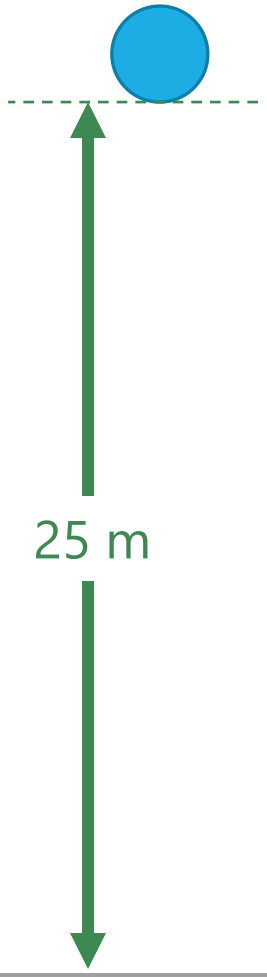
# Data Booklet Equations

A.1

| | |
|---|---|
| A.1 Kinematics | $s = \frac{u+v}{2}t$<br><br>$v = u + at$<br><br>$s = ut + \frac{1}{2}at^2$<br><br>$v^2 = u^2 + 2as$ |

# Dropping the Ball

A.1




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

$$s = \cancel{ut} + \frac{1}{2}at^2$$

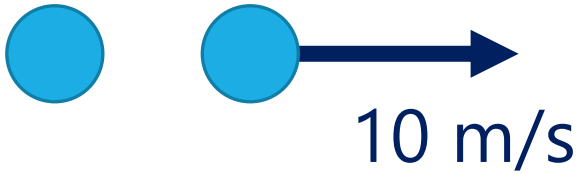
$$-25 = \frac{1}{2}(-9.8)t^2$$

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

| | |
|---|---|
| $s$ | -25 m |
| $u$ | 0 m $s^{-1}$ |
| $v$ | ---- |
| $a$ | -9.8 m $s^{-2}$ |
| $t$ | ? |

# Air Time - Comparison

A.1



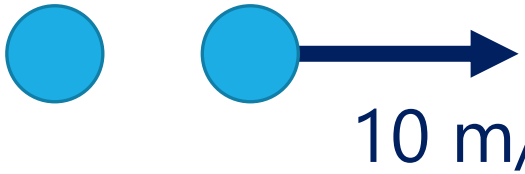

Which ball will have more air time?

# Air Time - Comparison

A.1

# Air Time - Comparison

A.1

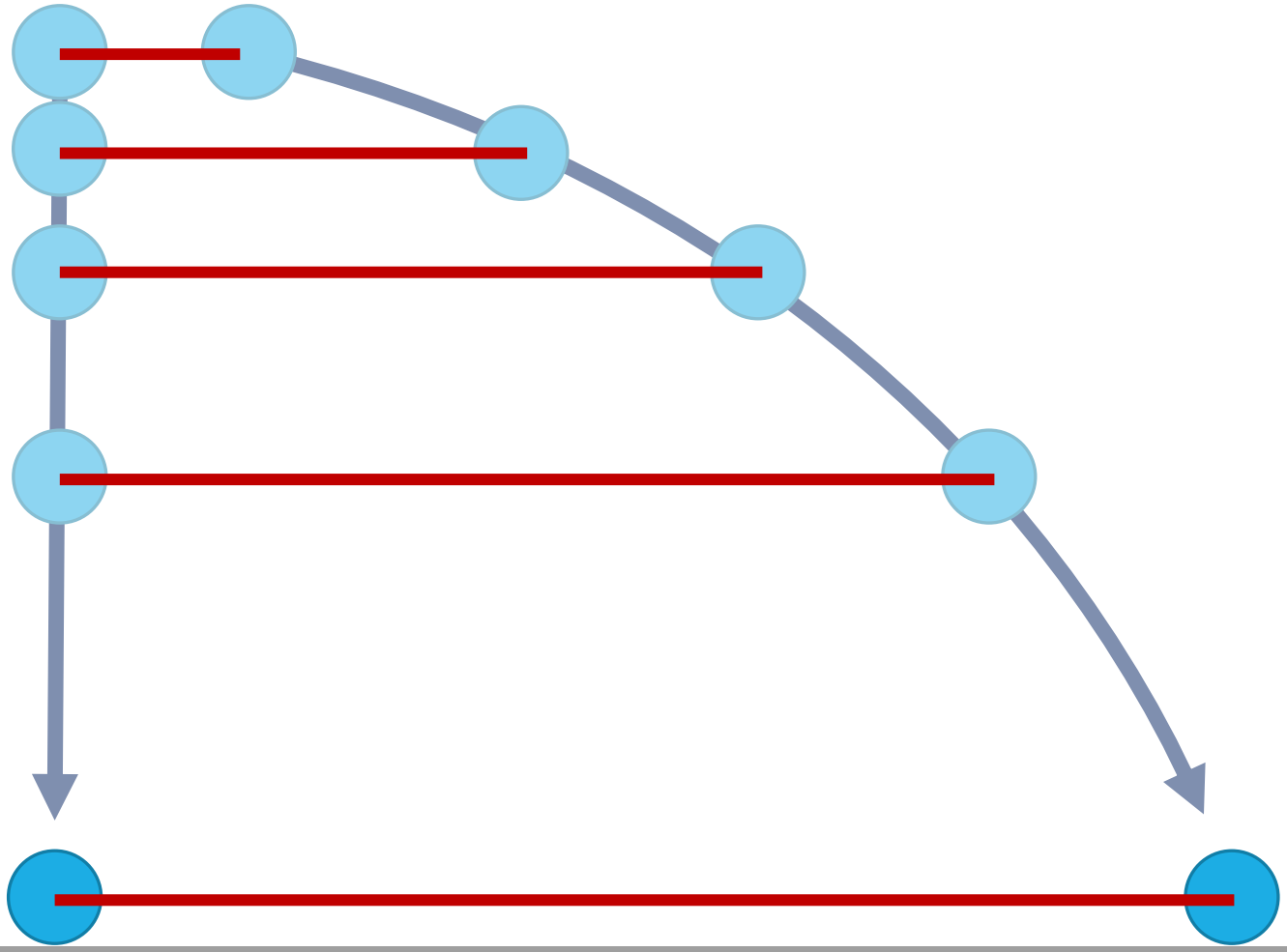



Which ball will have more air time?

The balls hit the ground at EXACTLY the same time

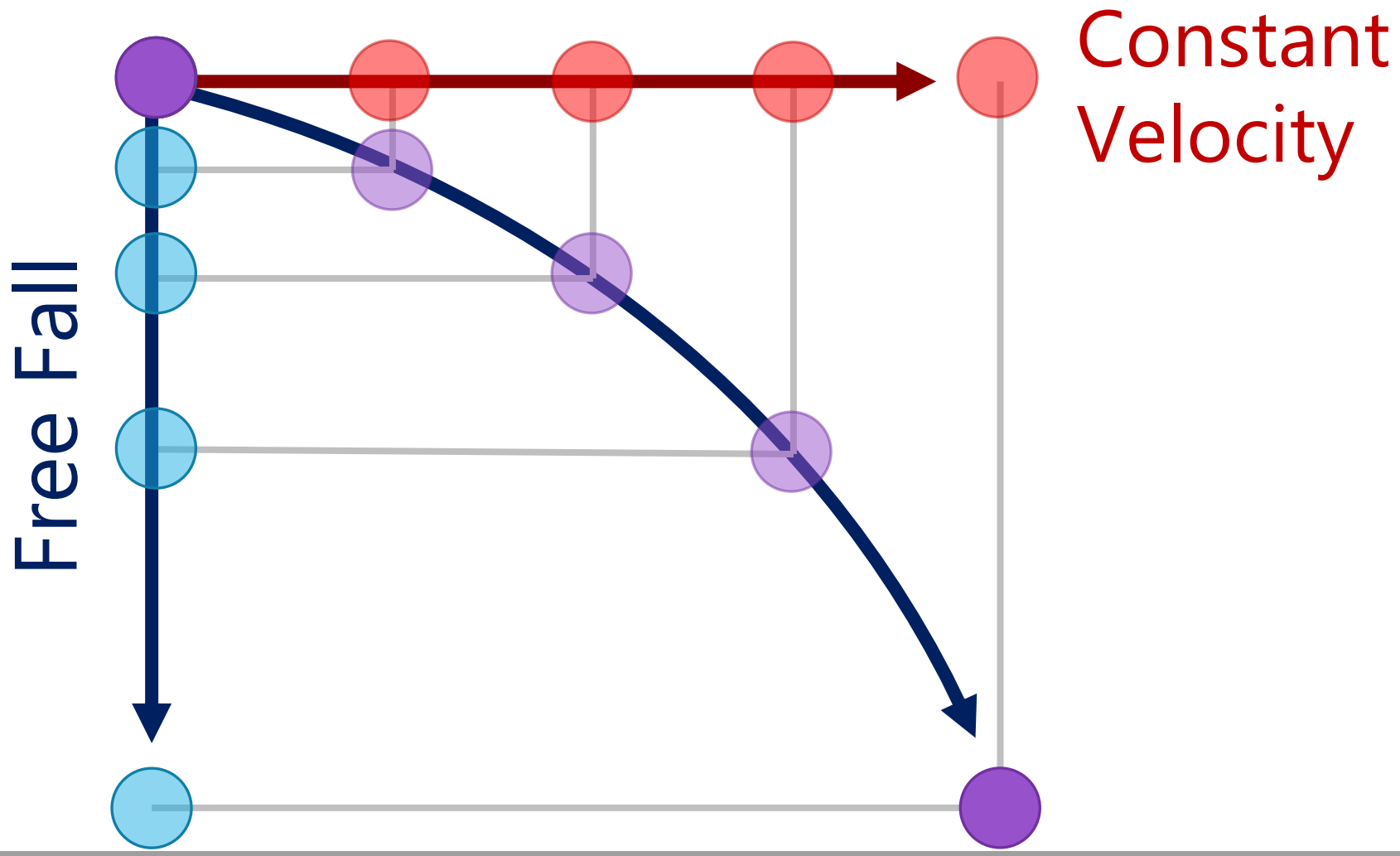
# Air Time - Comparison

A.1



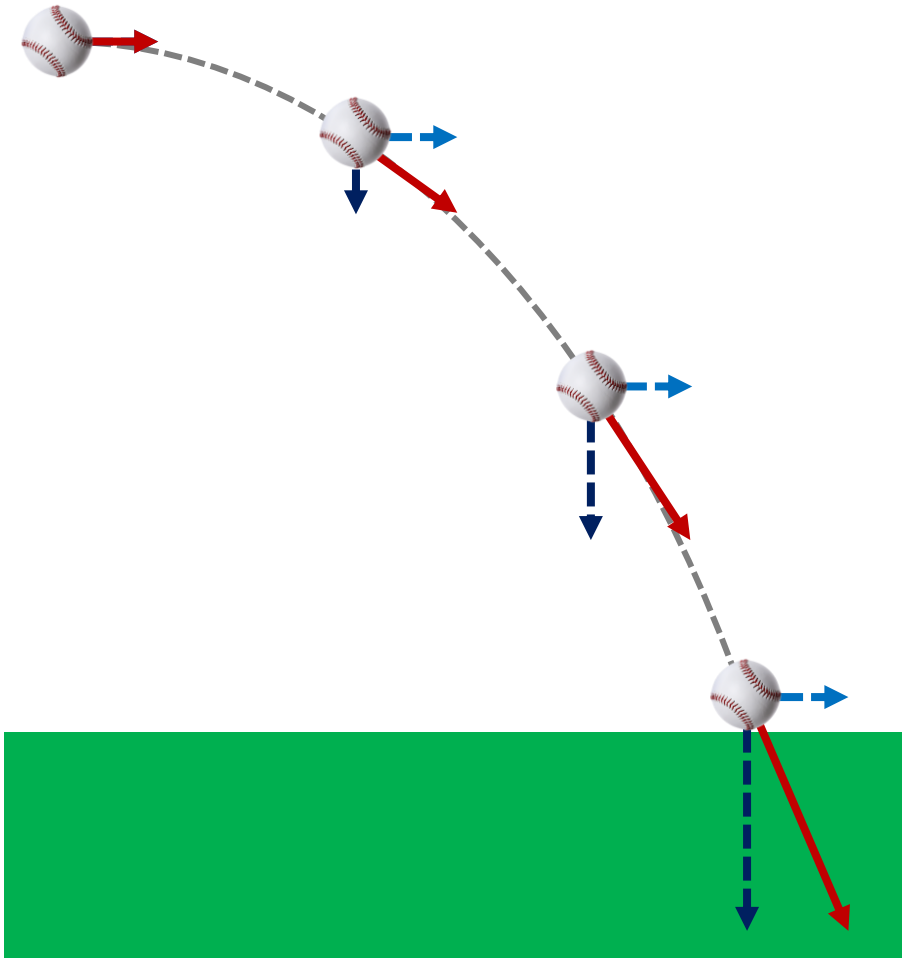
# Air Time - Comparison

A.1



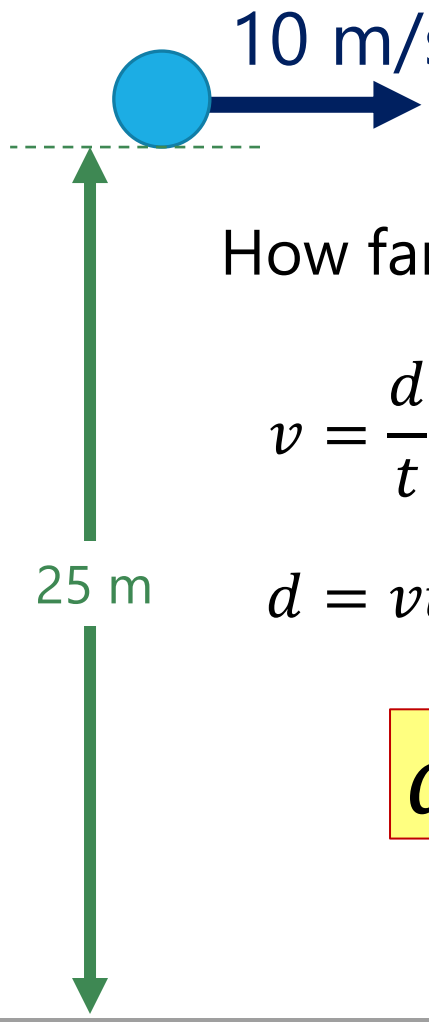
# Horizontal Projectile

A.1



# Horizontal Projectile

A.1




From Previous Problem →

| Vertical Only | |
|---|---|
| $s$ | -25 m |
| $u$ | 0 m s$^{-1}$ |
| $v$ | ---- |
| $a$ | -9.8 m s$^{-2}$ |
| $t$ | 2.26 s |

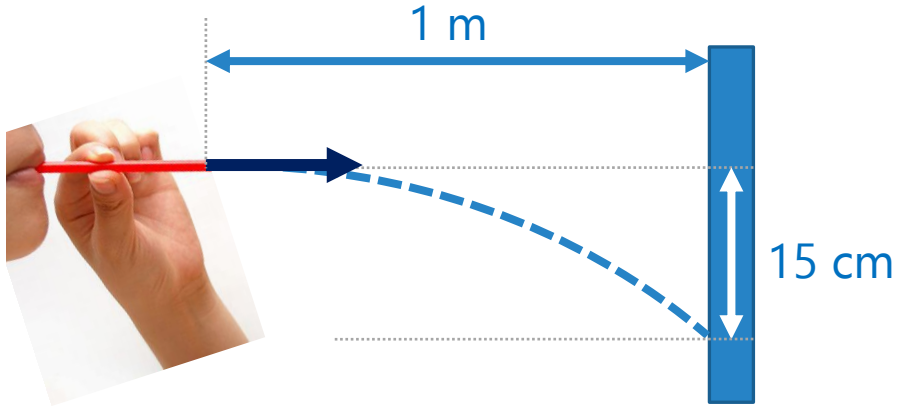
How far does the ball travel?

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

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

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

# How fast was the spitball?




$$s = \cancel{ut} + \tfrac{1}{2}at^2$$

$$-0.15 = \tfrac{1}{2}(-9.8)t^2$$

$$t = 0.175\ \text{s}$$

$$v = \frac{d}{t} = \frac{1\ \text{m}}{0.175\ \text{s}}$$

Horizontal Motion

$$v = 5.71\ \text{m s}^{-1}$$

| Vertical Only | |
|---|---|
| $s$ | -0.15 m |
| $u$ | 0 m s$^{-1}$ |
| $v$ | ---- |
| $a$ | -9.8 m s$^{-2}$ |
| $t$ | 0.175 s |

A.1

# One Dimensional Motion

A.1

**Vertical**
Accelerating

**Horizontal**
Constant Velocity

**[v = d/t]**

# Horizontal Projectile

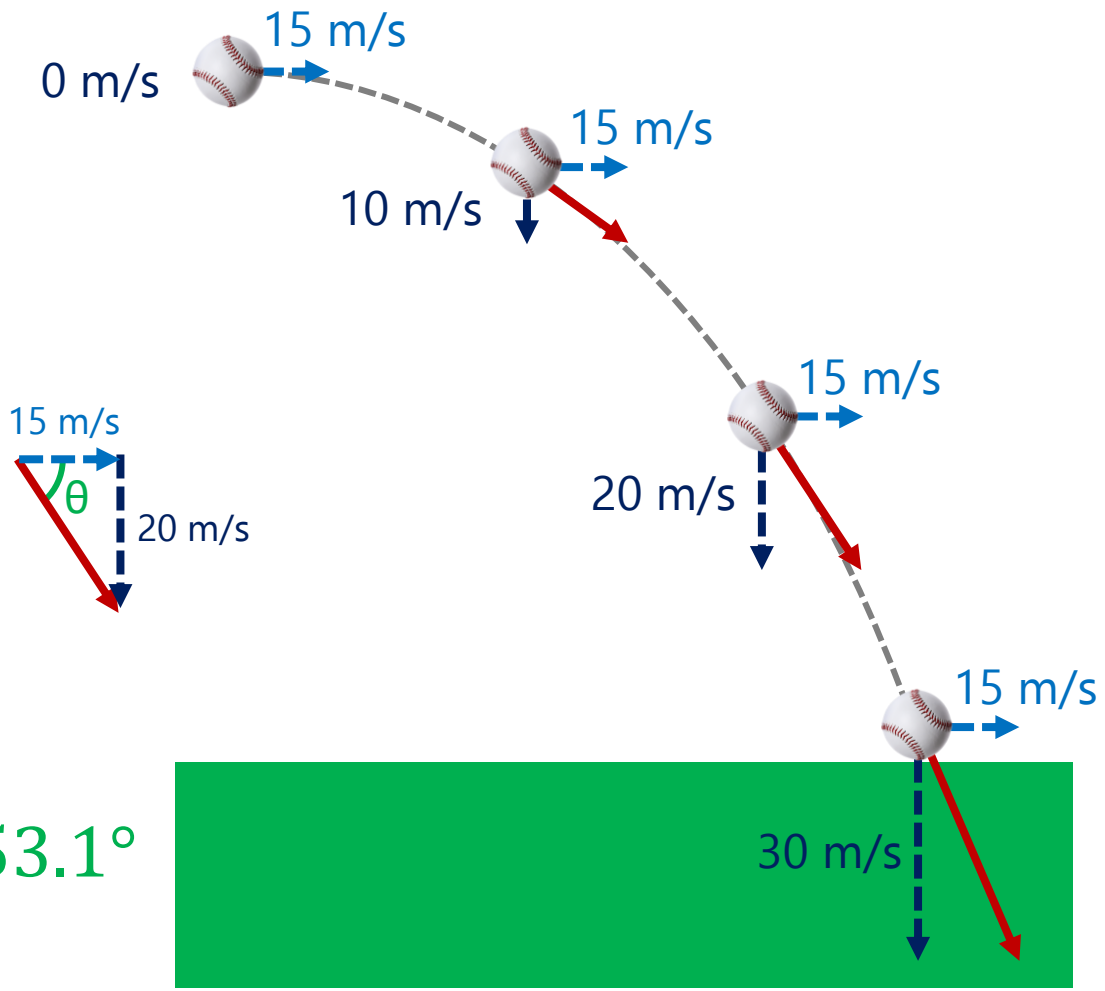
A.1

$v^2 = 20^2 + 15^2$

$v = 25$ m/s

$$\tan\theta = \frac{20}{15}$$

$$\theta = \tan^{-1}\left(\frac{20}{15}\right) = 53.1°$$



# Lesson Takeaways

A.3

- ❑ I can compare the air-time for a horizontal projectile and an object dropped from the same height
- ❑ I can use information about a horizontal projectile's motion to calculate the initial velocity
- ❑ I can calculate the horizontal distance traveled by a horizontal projectile when given a velocity and height
- ❑ I can calculate the resultant velocity and angle by combining horizontal and vertical velocity vectors