A.1

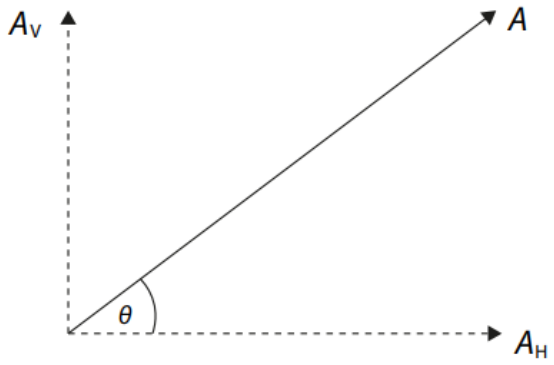
Angled Projectiles

IB PHYSICS | PROJECTILES

Data Booklet Equations

A.1

Vectors



$A_H = A\cos\theta$

$A_V = A\sin\theta$

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

A.1

Warm Up

You launch a ball up in the air at 19.7 m/s

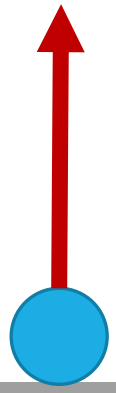
How high will it go?

$$v^2 = u^2 + 2as$$
$$0^2 = 19.7^2 + 2(-9.8)s$$
$$s = 19.8 \text{ m}$$

How long will it be in the air?

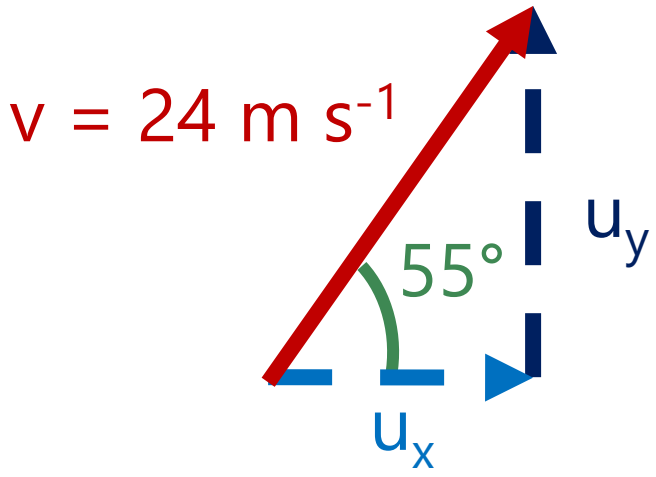
$$v = u + at$$
$$0 = 19.7 + (-9.8)t$$
$$t = 2.01 \text{ s}$$

$$Air\ Time = 2.01 \times 2 = 4.02\ s$$



s	19.8 m
u	19.7 m s^{-1}
v	0 m s^{-1}
a	-9.8 m s^{-2}
t	2.01 s

Remember Vectors?



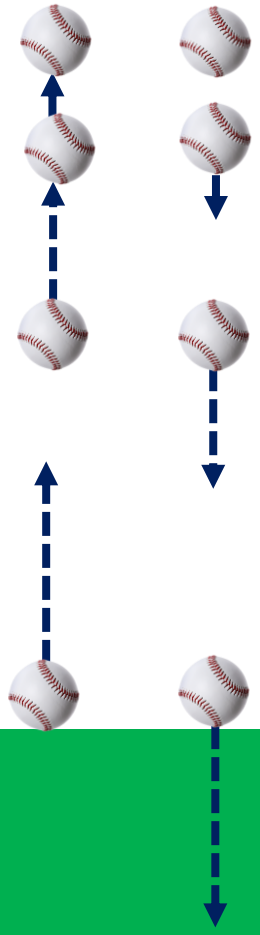
u_x	13.8 m s^{-1}
u_y	19.7 m s^{-1}

$u_x = 24 \cos(55) = 13.8$

$u_y = 24 \sin(55) = 19.7$

One Dimensional Motion

A.1



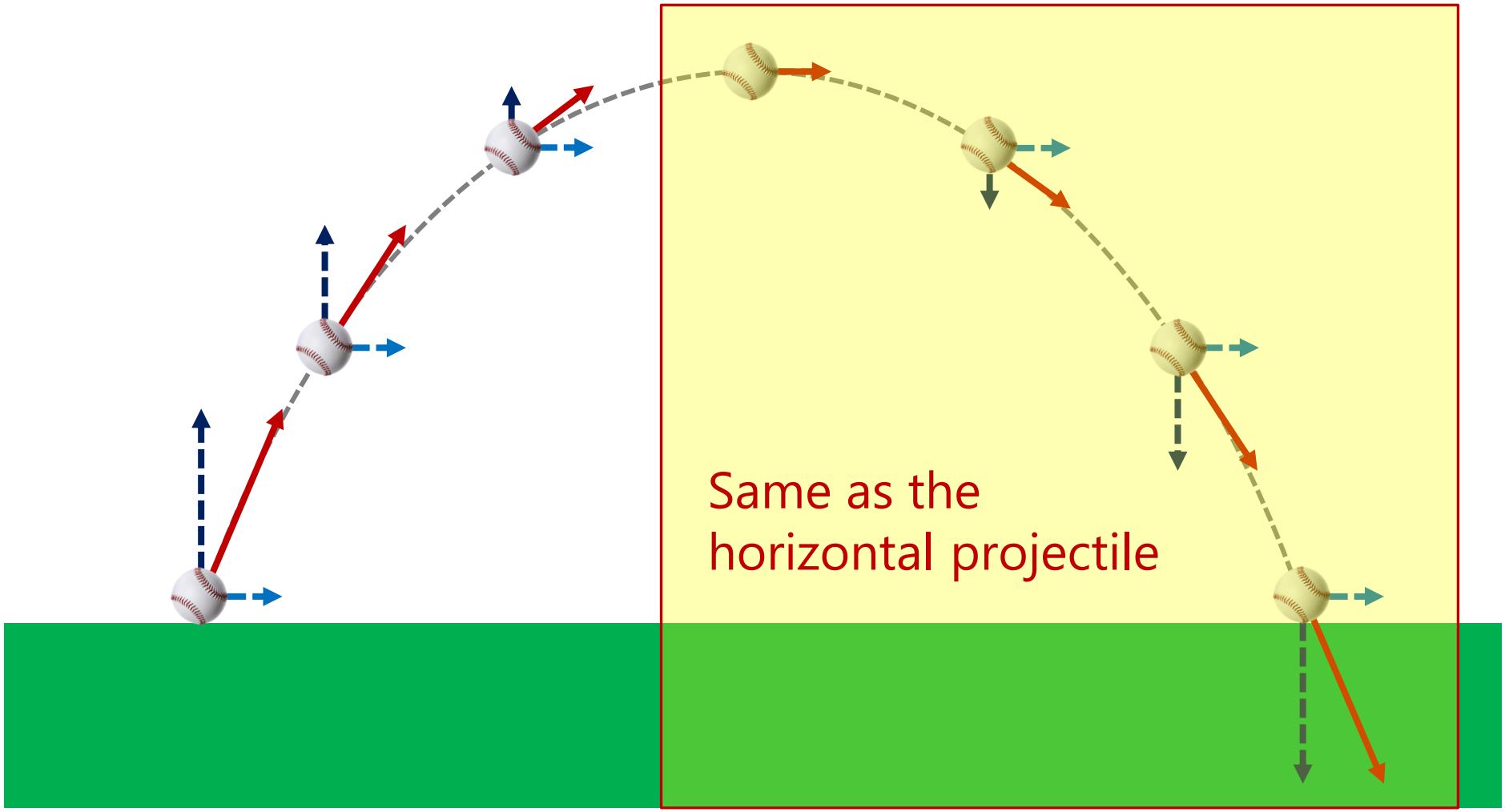
Vertical
Accelerating

Horizontal
Constant Velocity

[v = d/t]

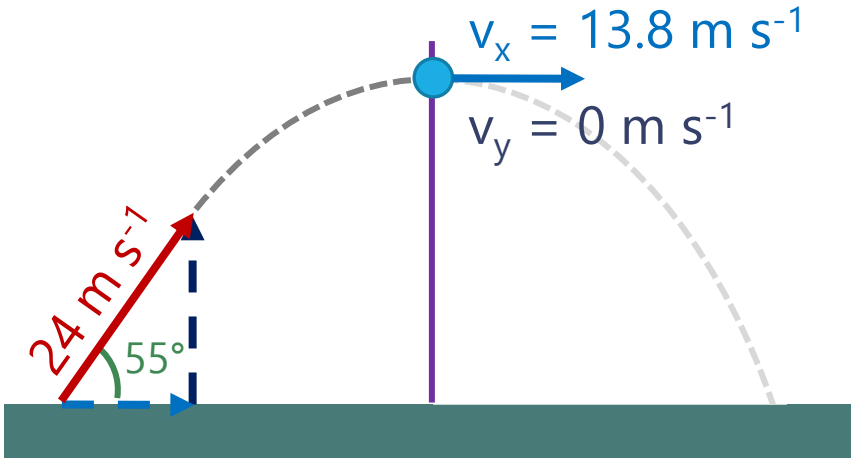
Two-Dimensional Projectile

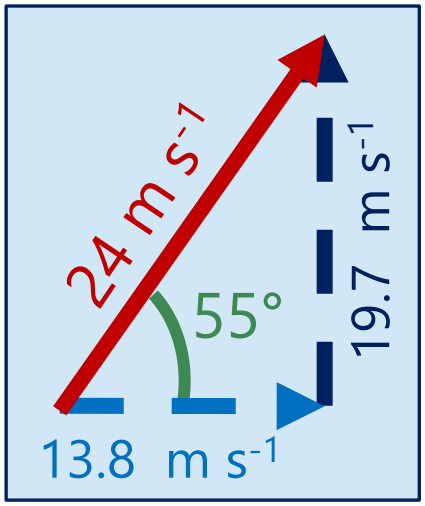
A.1



Projectile – First Half

A.1





$v = u + at$

$0 = 19.7 + (-9.8)t$

$t = 2.01$ s

$v^2 = u^2 + 2as$

$0^2 = 19.7^2 + 2(-9.8)s$

$s = 19.8$ m

1st Half Vertical	
s	19.8 m
u	19.7 m s^{-1}
v	0 m s^{-1}
a	-9.8 m s^{-2}
t	2.01 s

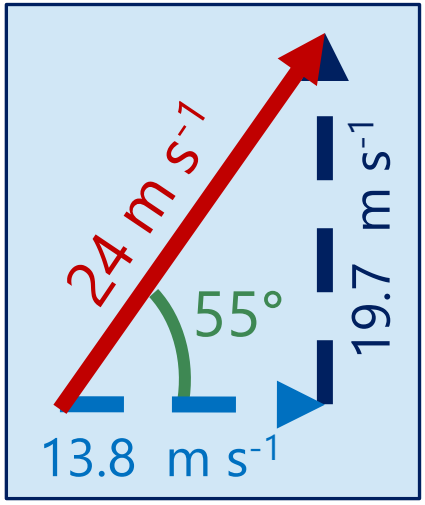
Projectile – Full Thing

$Total\ Time$	4.02 s
$Displacement_x$	55.5 m

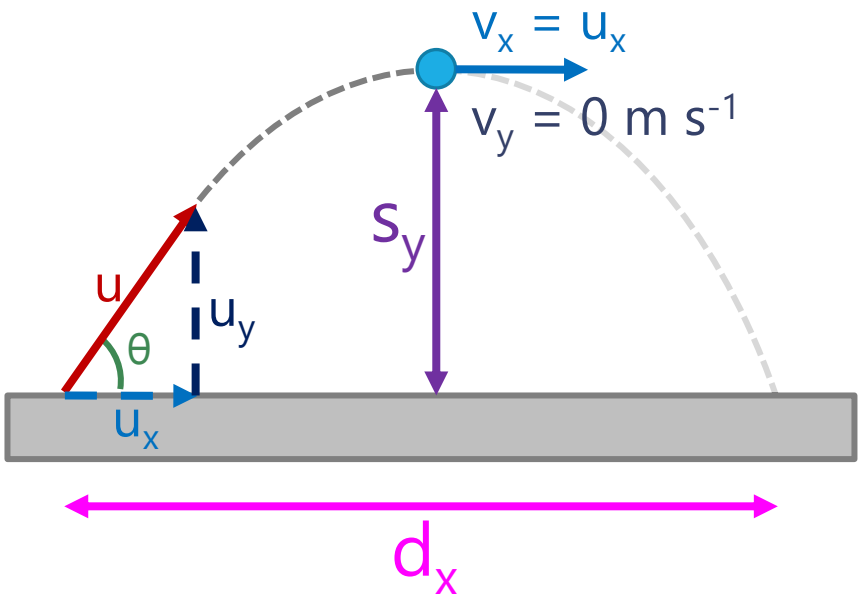
First Half = 2.01 s

Total Time = 2.01 × 2 = **4.02 s**

d = vt = (13.8)(4.02) = **55.5 m**



Projectile – In General

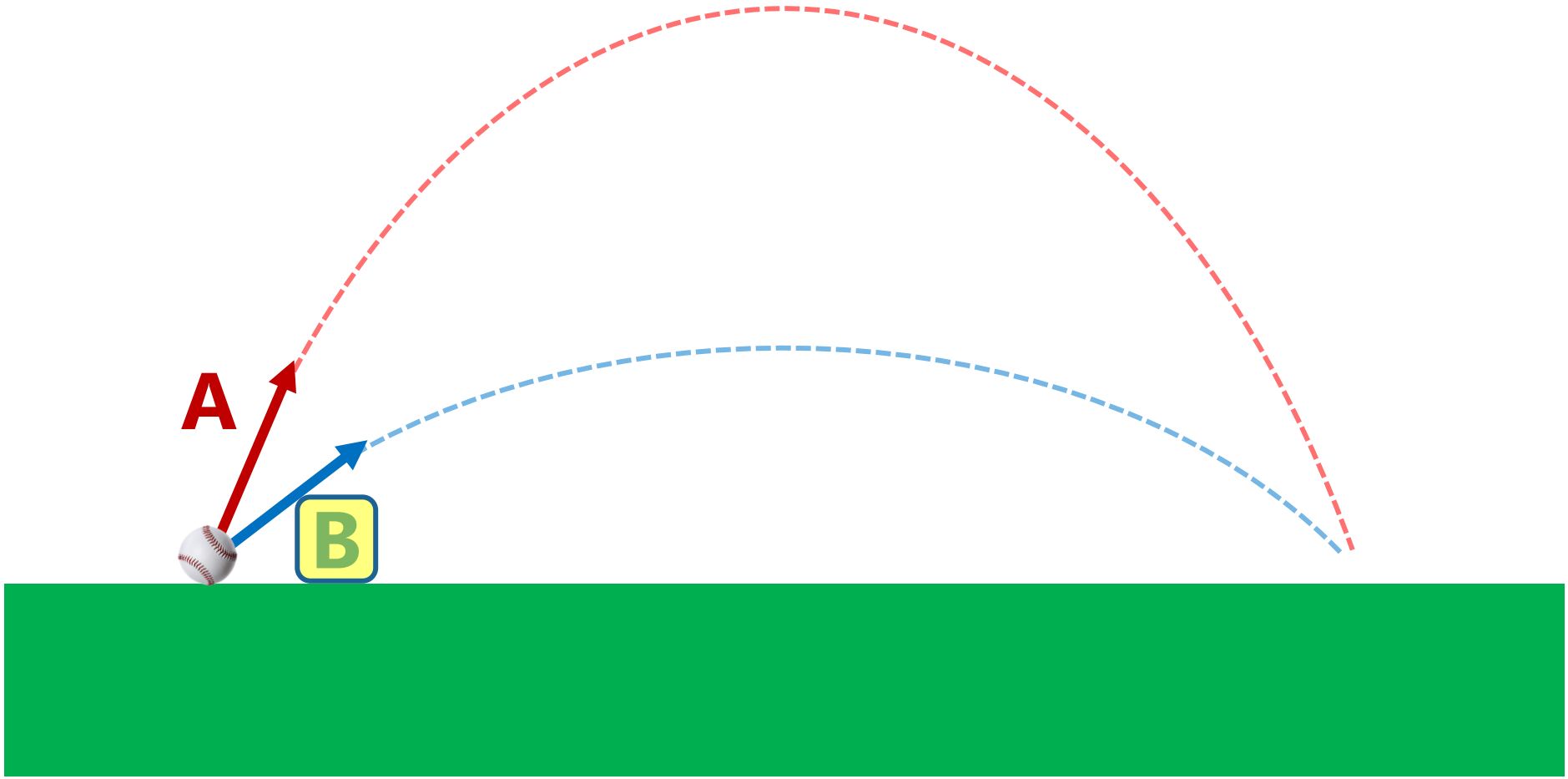


$Total\ Time$	2t
$Displacement_x$	$u_x(2t)$

1st Half Vertical	
s	Total Height
u	u_y
v	0 m s^{-1}
a	-9.8 m s^{-2}
t	

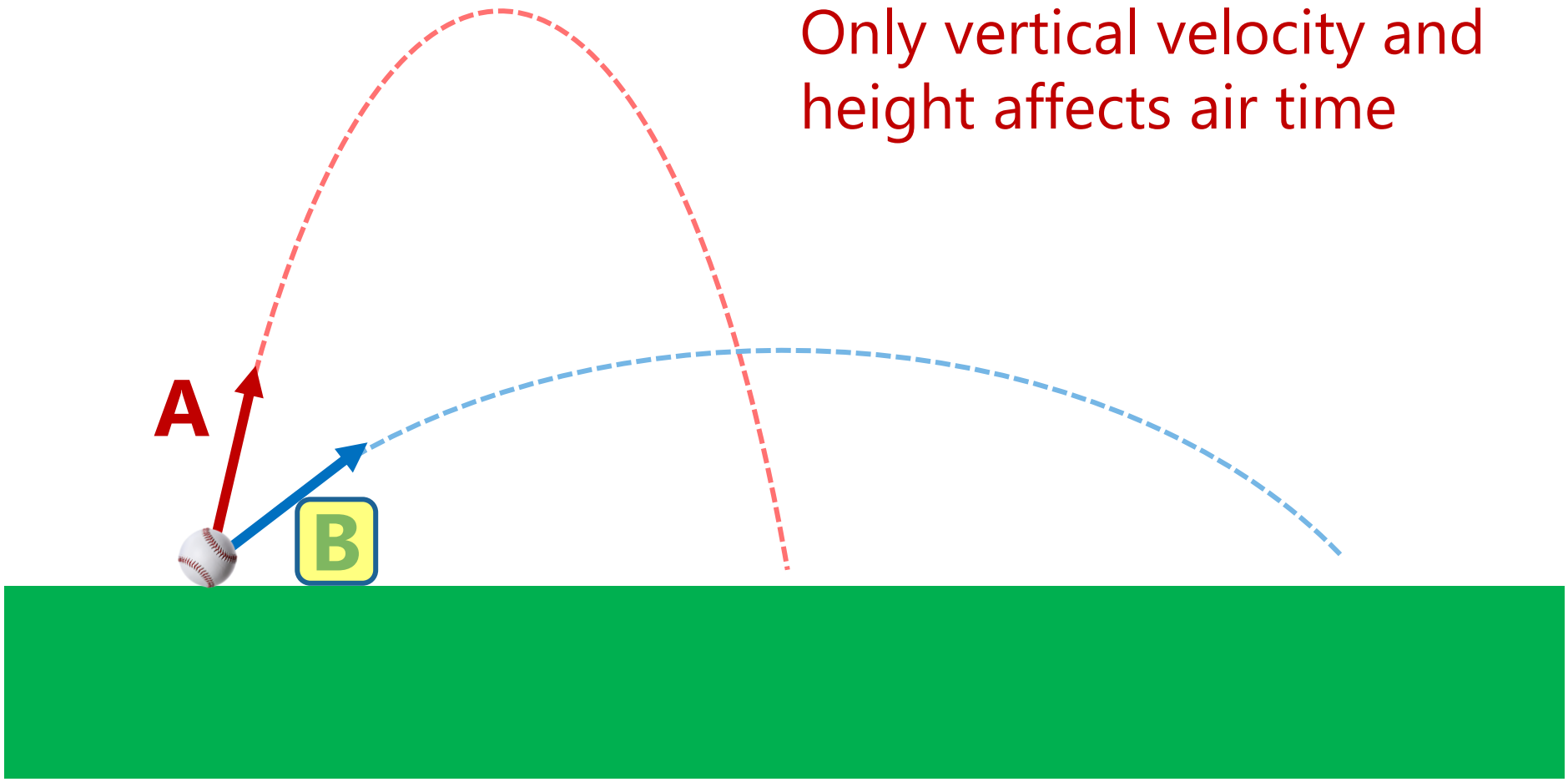
Which one lands first??

A.1



Which one lands first??

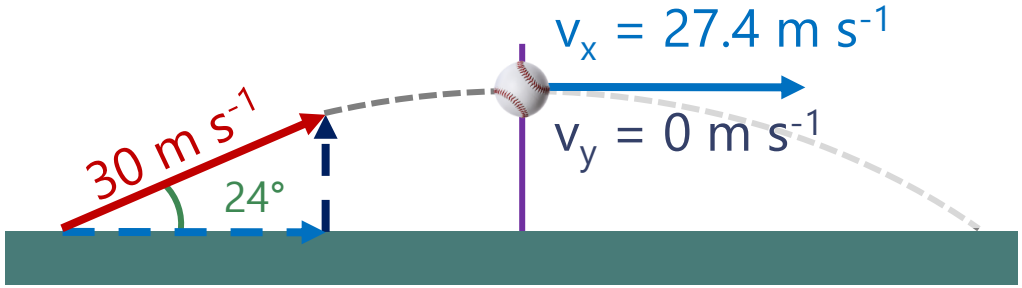
A.1



Only vertical velocity and height affects air time

A.1

Try This...



You hit a baseball at 24° above the horizontal as a speed of 30 m s^{-1}. How far does the ball travel before it hits the ground?

$u_x = 30\cos(24) = 27.4$ m s^{-1} $\quad$ $u_y = 30\sin(24) = 12.2$ m s^{-1}

$$v = u + at$$
$$0 = 12.2 + (-9.8)t$$
$$t = 1.24 \text{ s}$$

$$v^2 = u^2 + 2as$$
$$0^2 = 12.2^2 + 2(-9.8)s$$
$$s = 7.56 \text{ m}$$

Horizontal:

Total Time = 2(1.24) = 2.48 s

d = vt = (27.4)(2.48)

d = 68 m

1st Half Vertical	
s	7.56 m
u	12.2 m s^{-1}
v	0 m s^{-1}
a	-9.8 m s^{-2}
t	1.24 s

Lesson Takeaways

A.3

- ❑ I can calculate the horizontal and vertical components of an angled velocity vector
- ❑ I can calculate max height for a projectile launched at angle
- ❑ I can calculate total air-time for a projectile launched at angle
- ❑ I can calculate horizontal distance traveled for a projectile launched at angle