

# Classical Physics

Year 10 Pathway C

Mr. D. Patterson

# Outcomes

- ▶ Define acceleration as the change in velocity that occurs in a unit of time.
- ▶ Realise that acceleration is caused by an unbalanced force.
- ▶ Perform calculations using the relationship:

$$a = \frac{v-u}{t}$$

# A car and a bus have a race

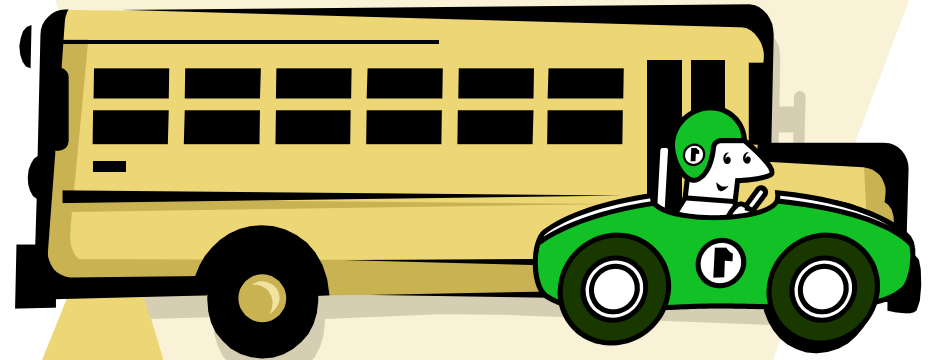
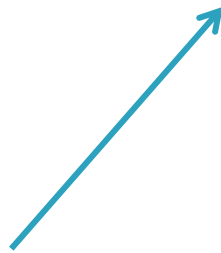
- ▶ Both car and bus have a top speed of 100km/h
- ▶ Who will win? Why?



# A car and a bus have a race

- ▶ The car reaches its top speed faster than the bus
- ▶ Acceleration is the change in velocity that occurs over a unit of time

Unit means “1”  
le: 1 second



# Acceleration

- ▶ If a bike has an **acceleration of  $5 \text{ m/s}^2$**  this means the **velocity of the bike increases by  $5\text{m/s}$  every second**
- ▶ The bike starts at rest (stopped)
- ▶ **Time (s)**                      **Velocity**
- ▶ 0
- ▶ 1
- ▶ 2
- ▶ 3
- ▶ 4

# Acceleration

- ▶ If a bike has an **acceleration of  $5 \text{ m/s}^2$**  this means the **velocity of the bike increases by  $5 \text{ m/s}$  every second**
- ▶ The bike starts at rest (stopped)
- ▶ **Time (s)**                      **Velocity**
- ▶ **0**                                      **0 m/s**
- ▶ **1**                                      **5 m/s**
- ▶ **2**                                      **10 m/s**
- ▶ **3**                                      **15 m/s**
- ▶ **4**                                      **20 m/s**

# Acceleration

- ▶ If a truck which is slowing down has an **acceleration of  $-3 \text{ m/s}^2$**  this means the **velocity of the truck decreases by 3m/s every second**
- ▶ The truck is travelling at 20 m/s before it applies the brakes.
- ▶ **Time (s)**                      **Velocity**
- ▶ 0
- ▶ 1
- ▶ 2
- ▶ 3
- ▶ 4

# Acceleration

- ▶ If a truck which is slowing down has an **acceleration of  $-3 \text{ m/s}^2$**  this means the **velocity of the truck decreases by  $3 \text{ m/s}$  every second**
- ▶ The truck is travelling at  $20 \text{ m/s}$  before it applies the brakes.
- ▶ **Time (s)**                      **Velocity**
- ▶ **0**                                       **$20 \text{ m/s}$**
- ▶ **1**                                       **$17 \text{ m/s}$**
- ▶ **2**                                       **$14 \text{ m/s}$**
- ▶ **3**                                       **$11 \text{ m/s}$**
- ▶ **4**                                       **$8 \text{ m/s}$**



# Acceleration

- ▶ Acceleration is a measure of how quickly velocity changes. It is a vector.

$$\mathbf{a}_{av} = \frac{\Delta \mathbf{v}}{\Delta t} = \frac{\mathbf{v} - \mathbf{u}}{\Delta t}$$

- ▶  $a$  is the acceleration (Units are  $m/s^2$  )
- ▶  $v$  is the final velocity
- ▶  $u$  is the initial velocity
- ▶  $t$  is the time taken to change the velocity

# Example

- ▶ Determine the acceleration for the following measurements

- ▶ 1)  $u=0$ ,  $v=5$  m/s,  $t=5$  s

- ▶ 2)  $u= 100$  m/s,  $v= 150$  m/s,  $t= 3$  s

- ▶ 3)  $u= 20$  m/s,  $v = -20$  m/s,  $t= 1$  min

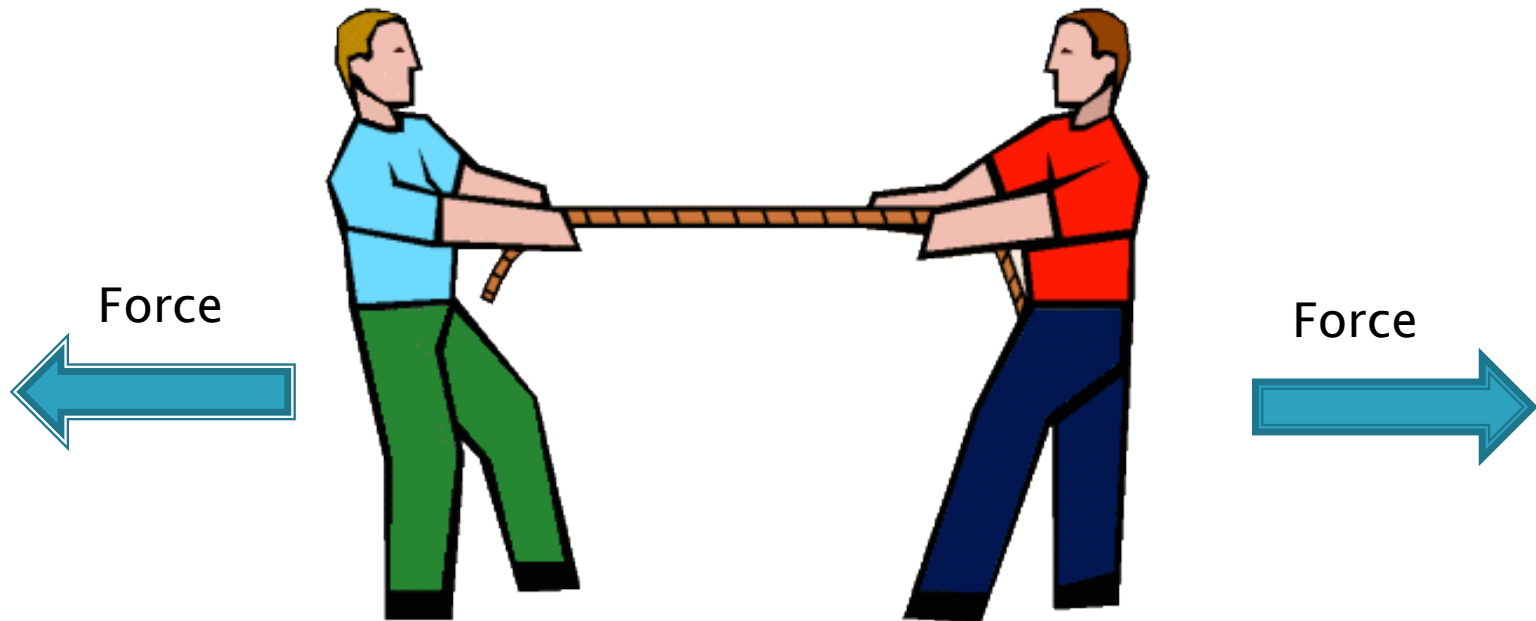
- ▶ 1)  $a = \frac{v - u}{t} = \frac{5 - 0}{5} = 1 \text{ m/s}^2$

- ▶ 2)  $a = \frac{v - u}{t} = \frac{150 - 100}{3} = 16.7 \text{ m/s}^2$

- ▶ 3)  $a = \frac{v - u}{t} = \frac{(-20) - 20}{60} = -0.67 \text{ m/s}^2$

# What causes acceleration

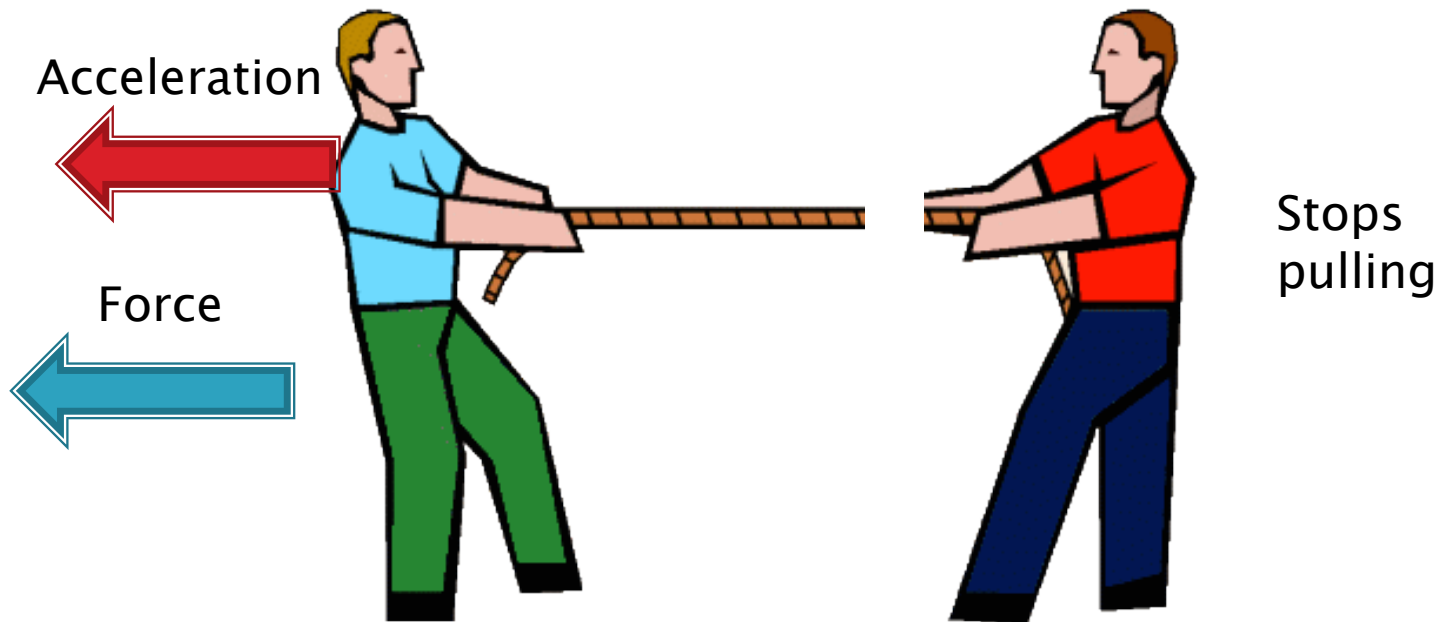
- ▶ Acceleration is caused by unbalanced forces



- ▶ Because the forces balance each other, there is NO acceleration

# What causes acceleration

- ▶ Acceleration is caused by unbalanced forces



- ▶ Forces are not balanced, so acceleration occurs in the direction of the unbalanced force

# Advanced problems

- ▶ How do we work out the final velocity if we know initial velocity, acceleration and time?

$$a = \frac{v - u}{t}$$

$$at + u = v - \cancel{u} + \cancel{u}$$

$$at = \frac{v - u}{\cancel{t}} * \cancel{t}$$

$$at + u = v$$

$$at = v - u$$

You will be asked to find a, u, v and t!

Brush up on your algebra

# Outcomes

- ▶ Define acceleration as the change in velocity that occurs in a unit of time.
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- ▶ Perform calculations using the relationship:

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- ▶ Matthew and Winters Set 8, 9