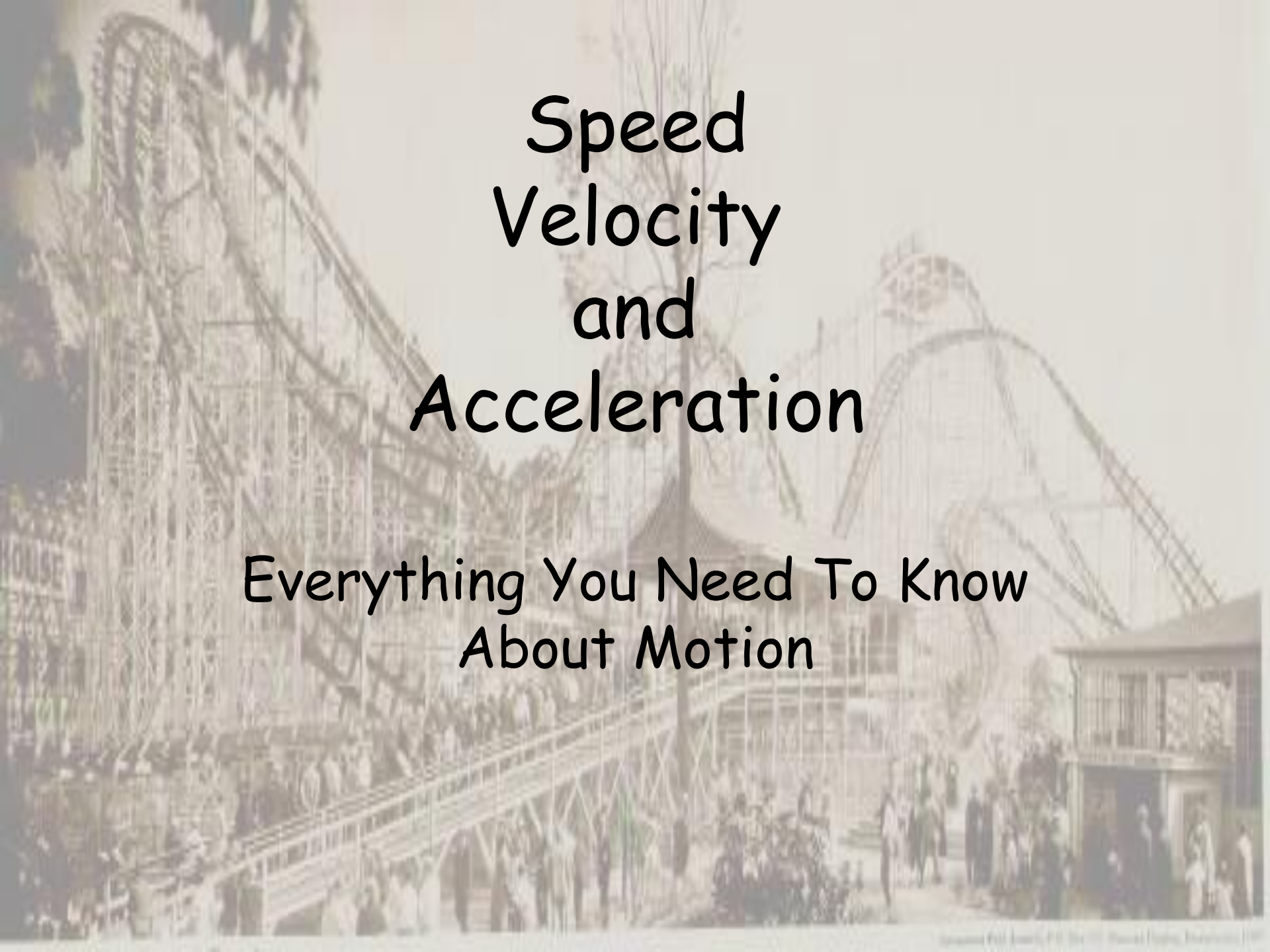
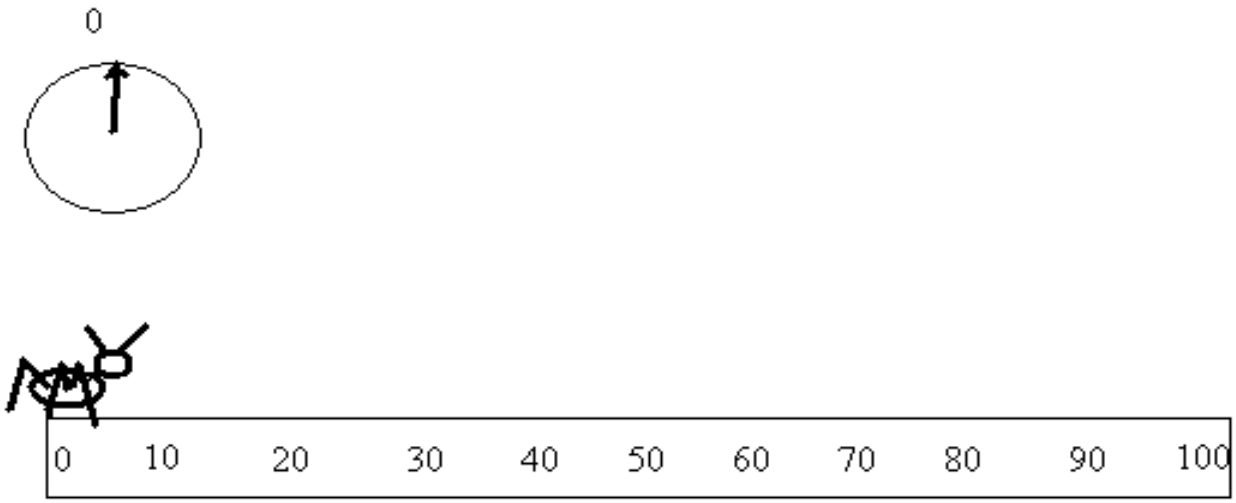


Speed Velocity and Acceleration

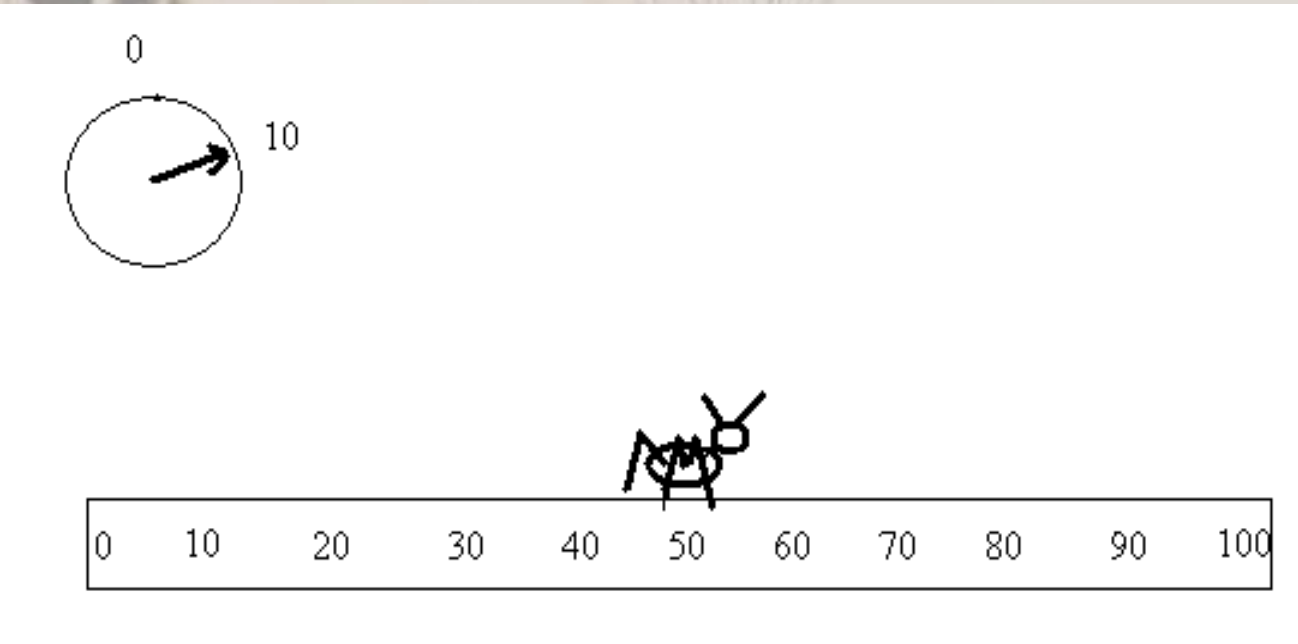
Everything You Need To Know About Motion

Motion

- Motion is just a change in position.
- To describe how an object moves you need:
  - A ruler to measure *where* an object is.
  - And a clock to measure *when* an object is.



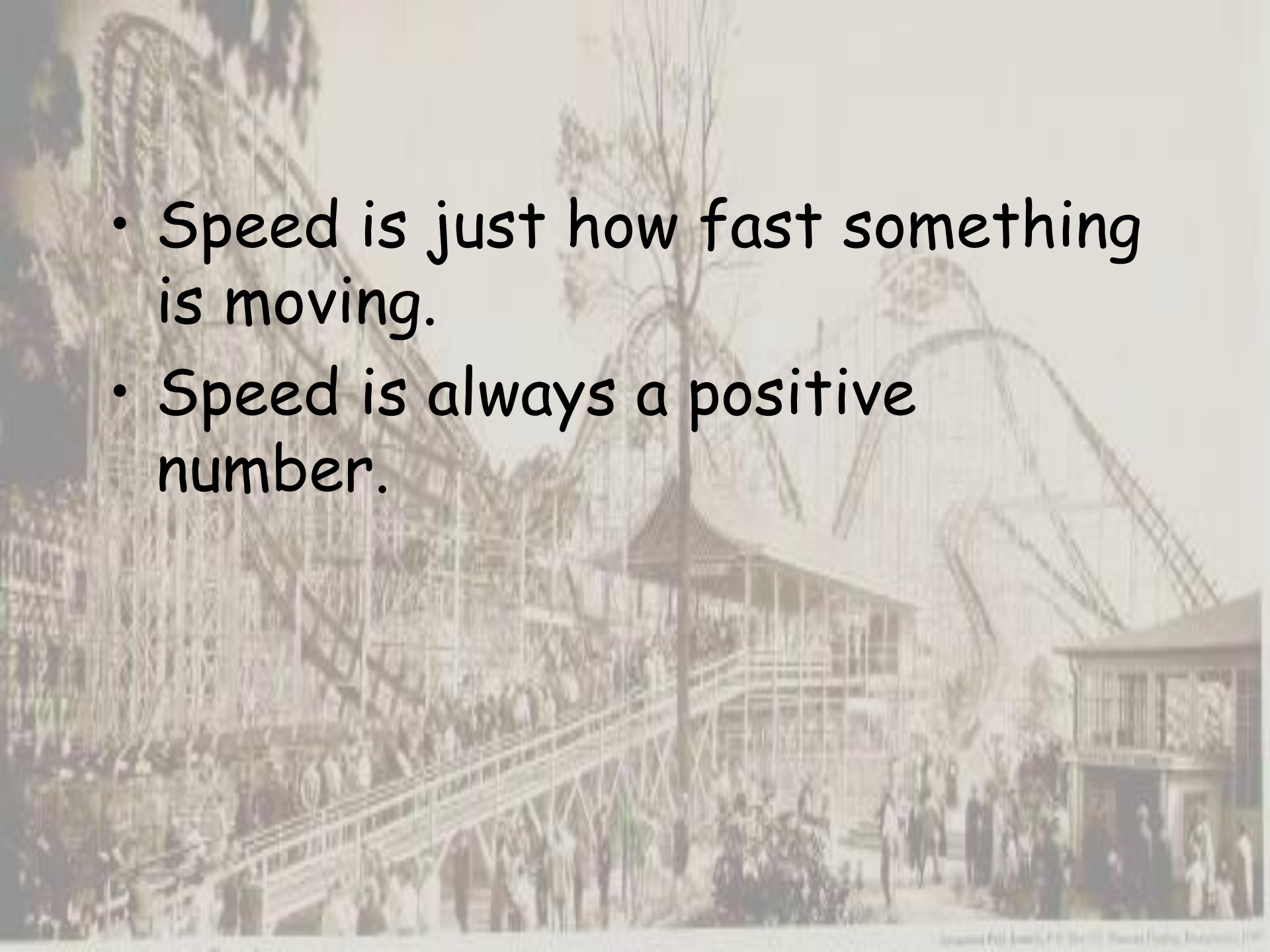
Here is a little bug located at 0 cm at 0 seconds.



- 10 seconds later he is at 50 cm.

SPEED

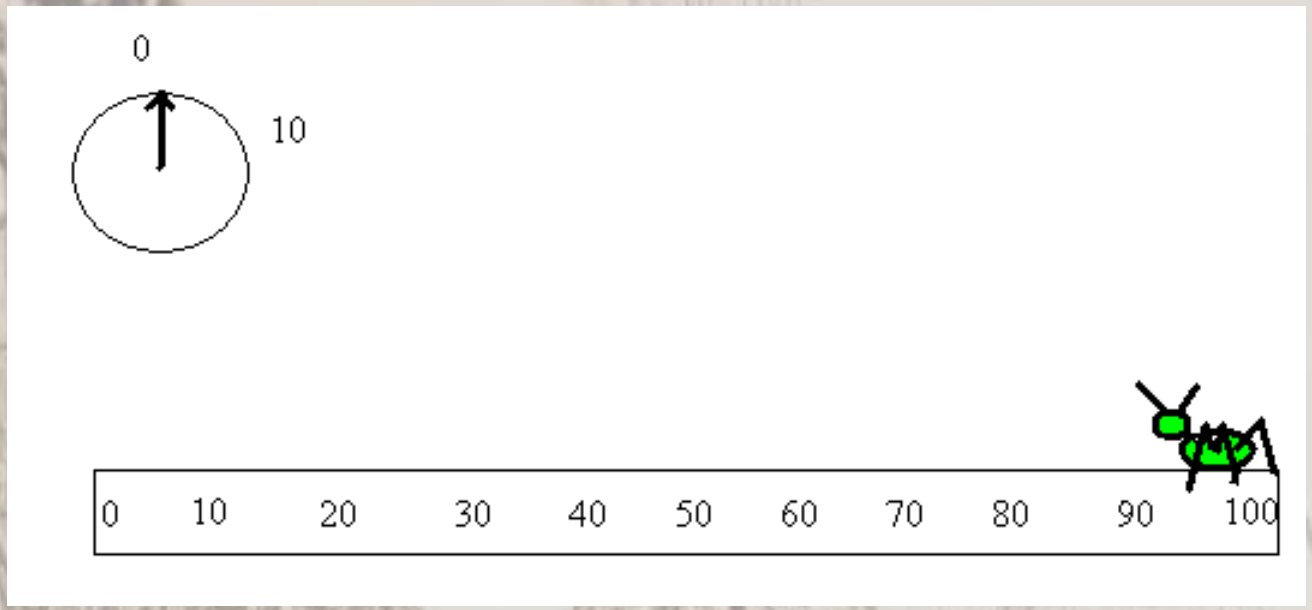
- The speed of the bug is the he distance traveled divided by how long it took.
- Speed = distance/time
- Speed = 50 cm/10 s = 5 cm/s



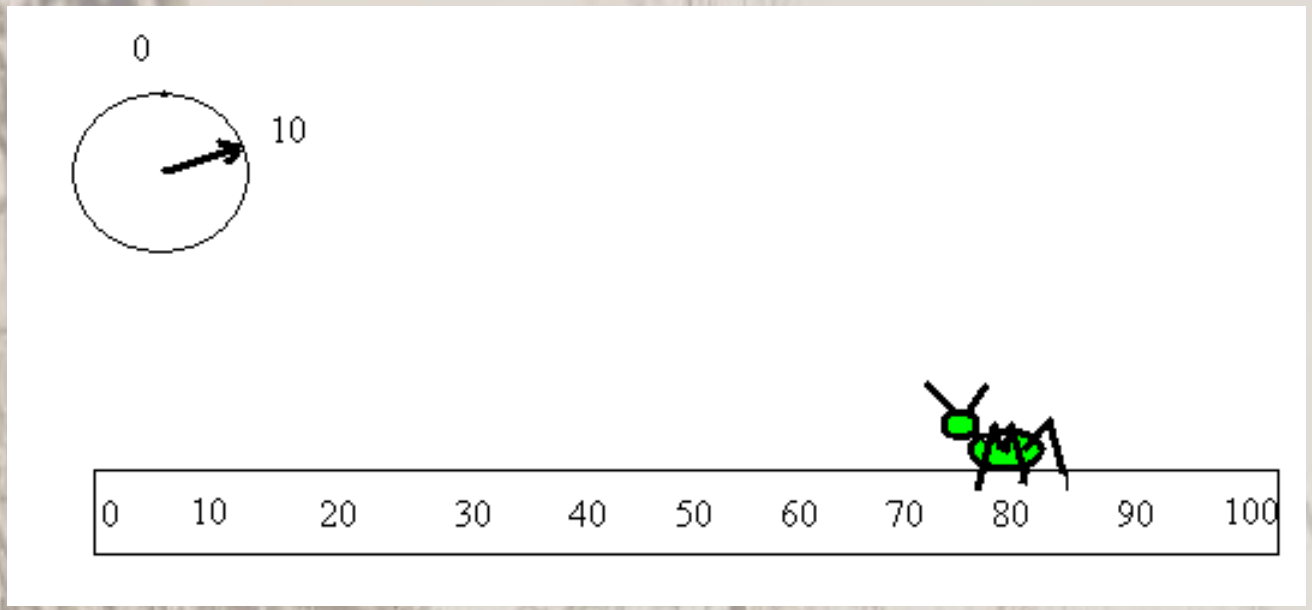
- Speed is just how fast something is moving.
- Speed is always a positive number.

VELOCITY

- Velocity is *speed* and *direction.*
- Velocity is *how fast* and *which way.*
- Quantities that have direction are called *vectors.*



- Suppose our bug stars off at 100 cm.



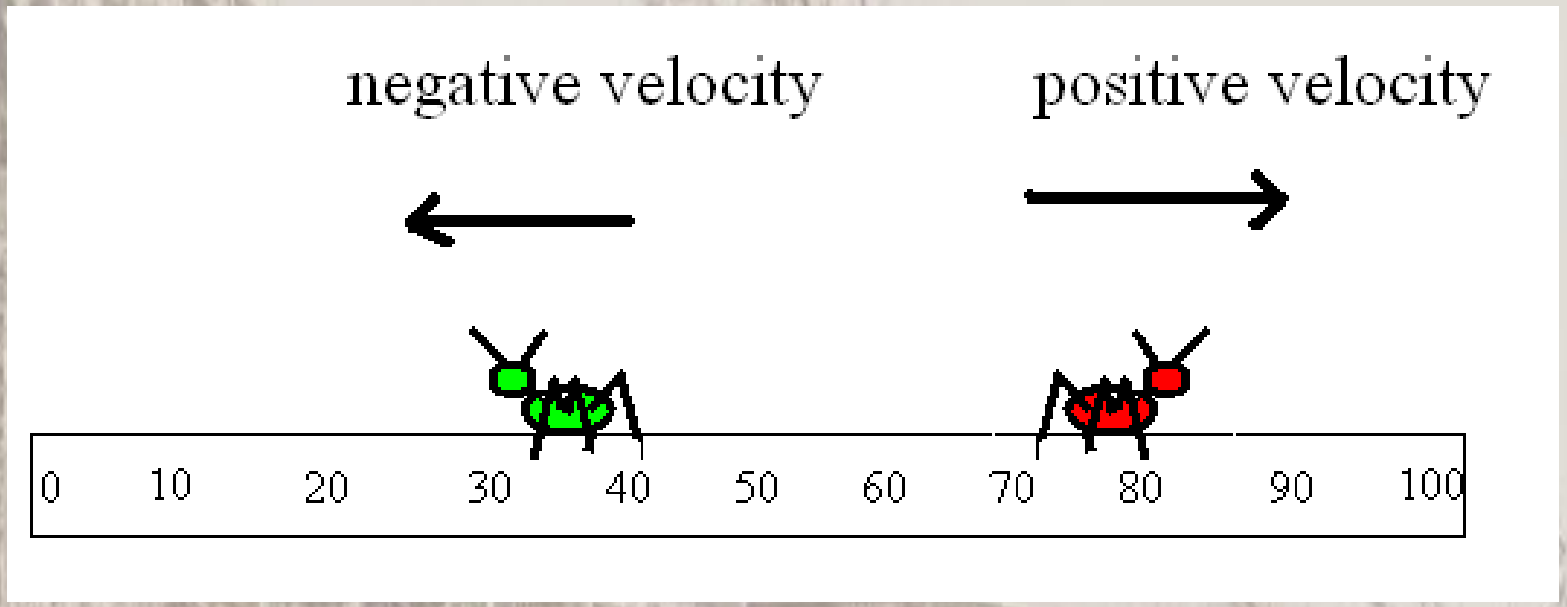
- And ends up at 80 cm 10 seconds later.

- Calculating velocity is a little more complicated than calculating speed.
- Velocity = change in position/time
  - Velocity = (final position – initial position)/time
  - Velocity = (80cm – 100cm)/10 seconds
  - Velocity = - 2 cm/s

For objects moving along a straight line

- A positive velocity means moving to the right. (usually)
- A negative means moving to the left. (usually)

- A negative velocity does not mean an object is moving slower than zero cm/s.
- You can't move slower than standing still.
- It just means an object is moving in a certain direction.


negative velocity
positive velocity
0
10
20
30
40
50
60
70
80
90
100

ACCELERATION

Acceleration is a change in velocity.

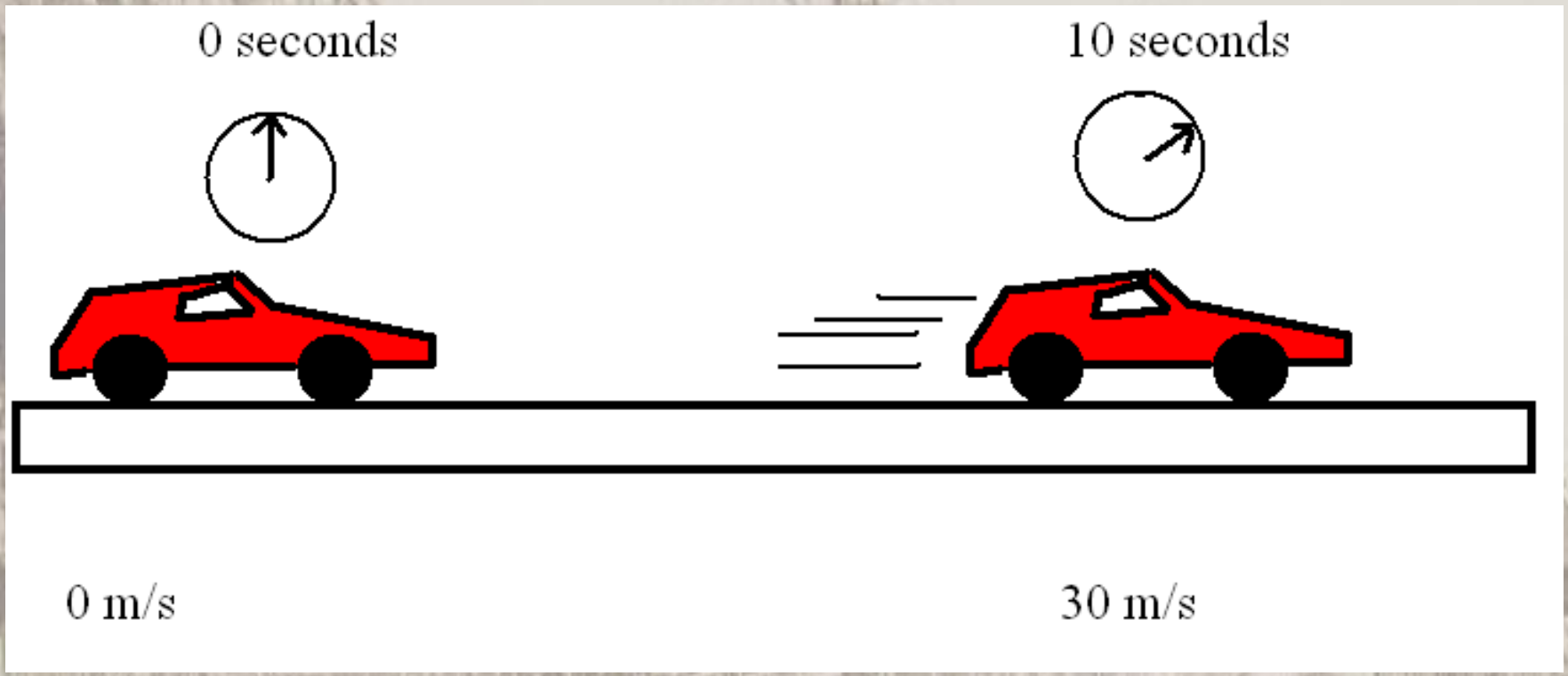
So an object accelerates if it:

- Speeds up
- Slows down
- Or changes the direction it is moving,

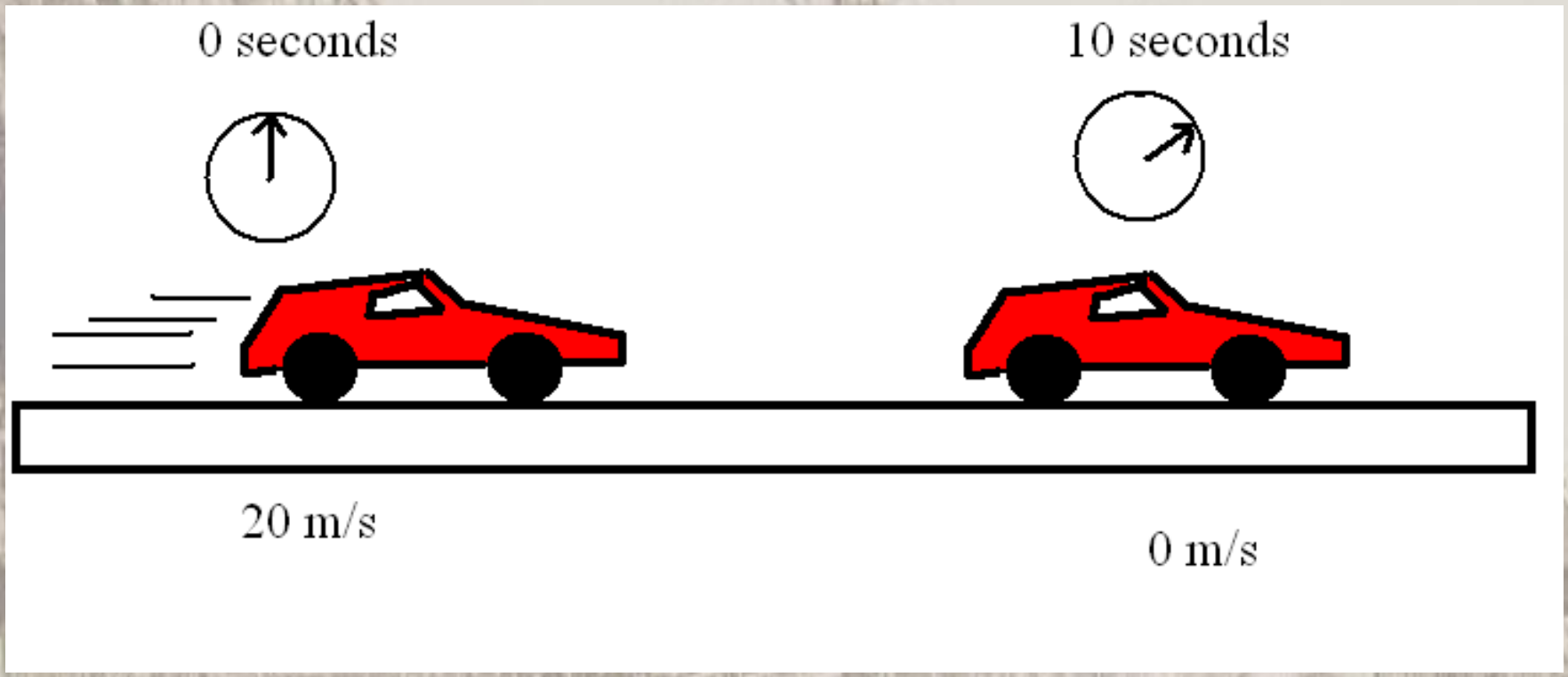
- Acceleration = change in velocity/time
- Acceleration = (final velocity – initial velocity)/time
- Acceleration has units of
- velocity/time (meters per second)/seconds Or m/s/s or m/s^2

Let's be clear

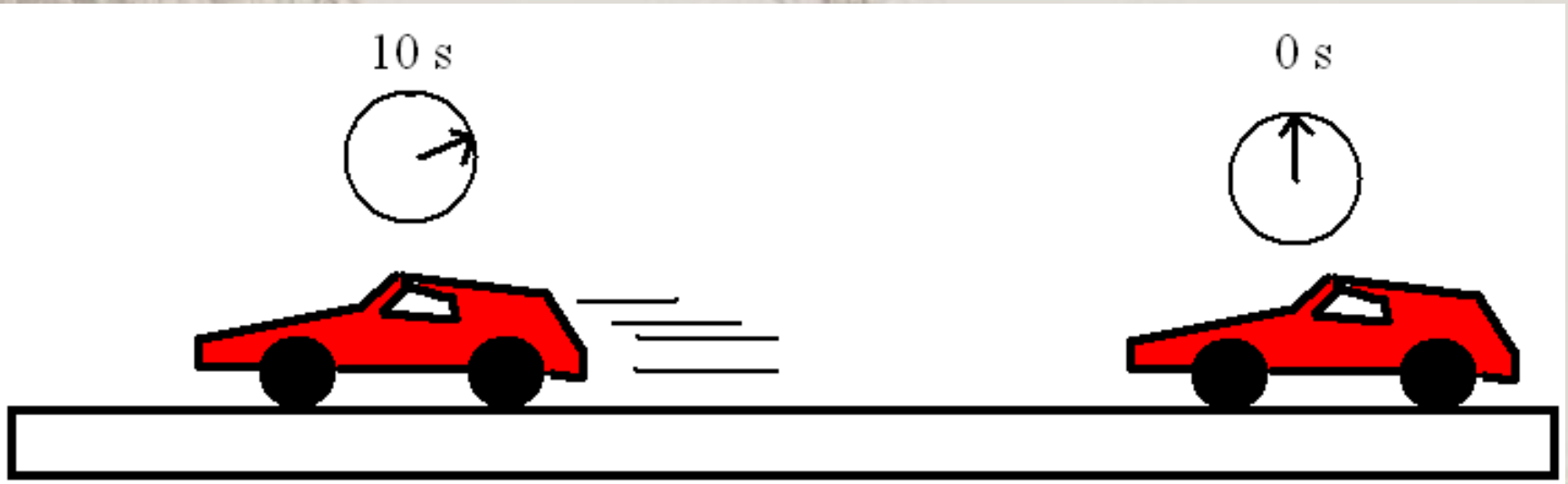
- Acceleration, like velocity, has direction.
- For objects moving along a straight line the direction of an object's acceleration is denoted by plus or minus.


0 seconds
10 seconds
0 m/s
30 m/s

- Acceleration = (30 m/s – 0 m/s)/10 s
- a = 3 m/s/s
- The car's velocity is increasing 3 m/s per second.
- The car is accelerating towards the right.


0 seconds
10 seconds
20 m/s
0 m/s

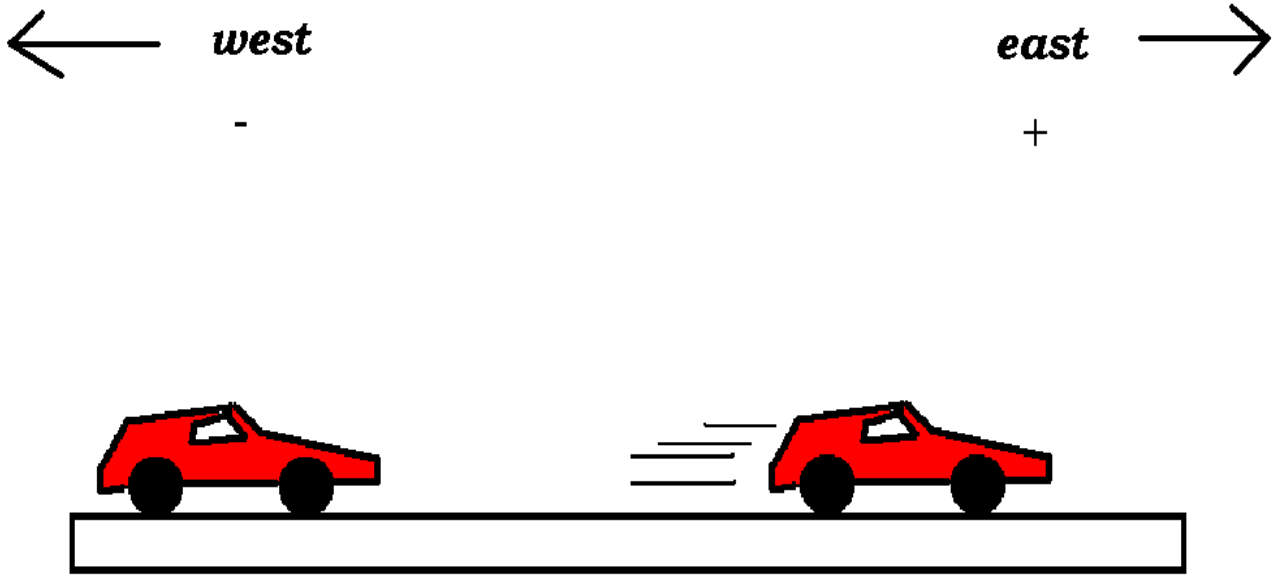
- a = (0m/s – 20 m/s)/10 s
- a = - 2 m/s/s
- Although the car is *moving* to the right
- It is *accelerating* to the left!



- 30 m/s
final velocity

0 m/s
initial velocity

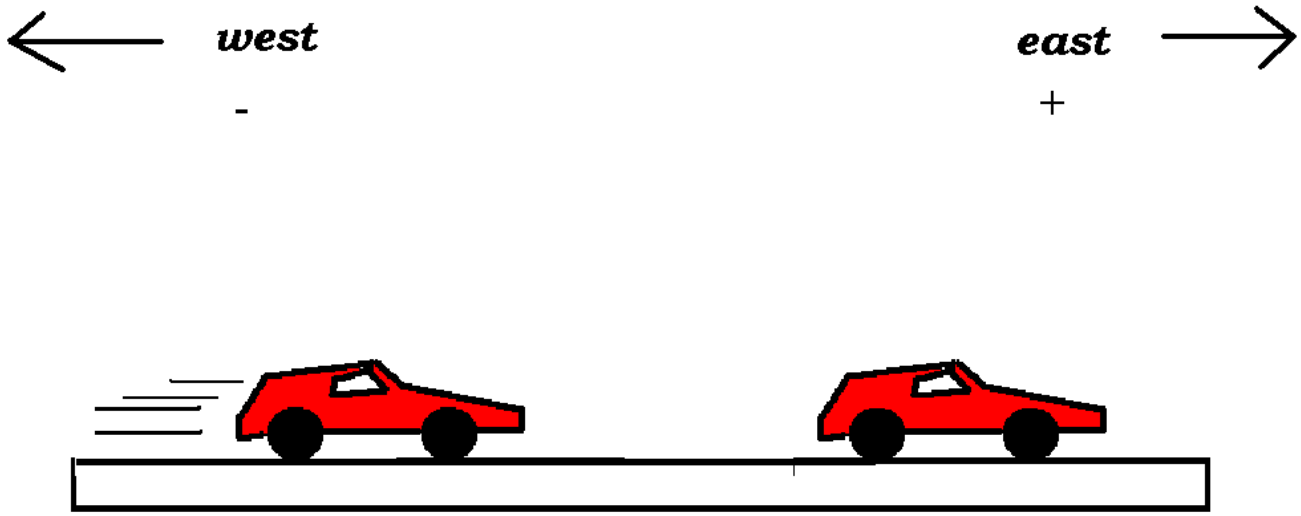
- a = (final velocity – initial velocity)/time
- a = (-30 m/s – 0 m/s)/ 10 s
- a = - 3 m/s/s
- The car is both moving to the left and accelerating to the left.
- Negative acceleration does not always mean an object is slowing down!



moving east →

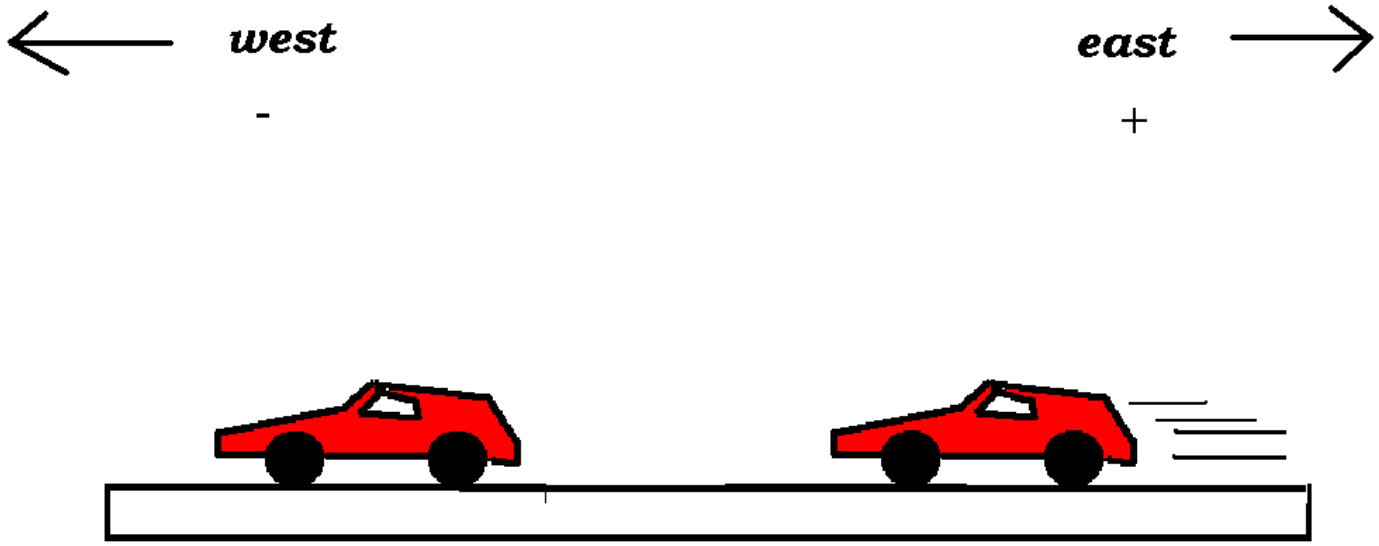
accelerating east →

positive velocity and positive acceleration

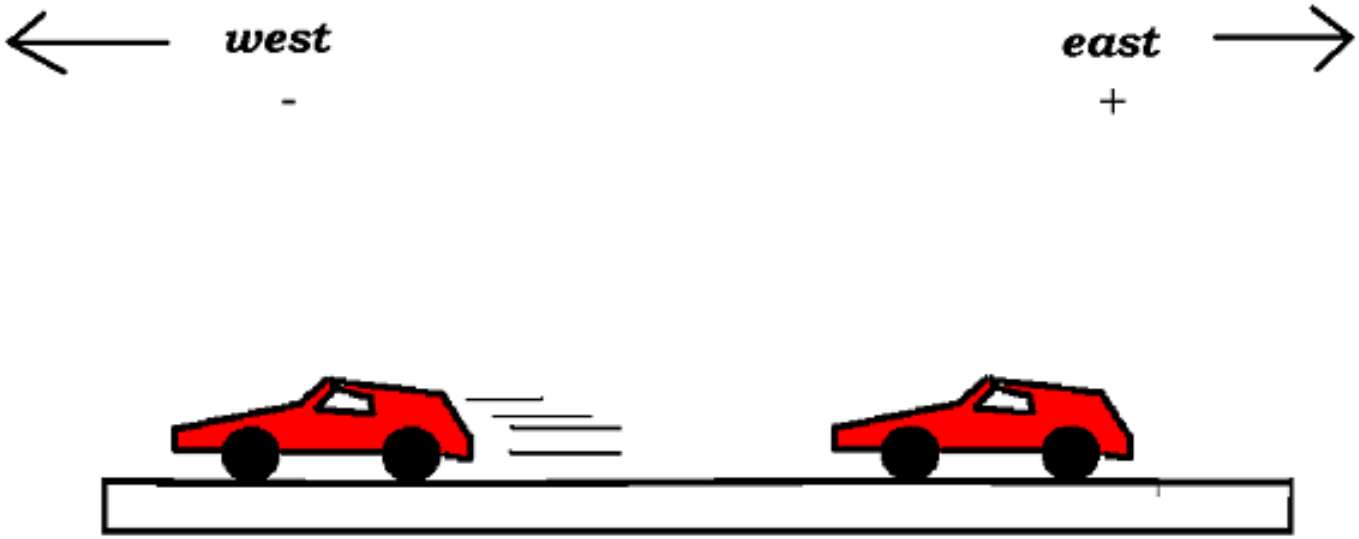


moving east →
accelerating west ←

positive velocity and negative acceleration



negative velocity and positive acceleration



moving west

accelerating west

negative velocity and negative acceleration