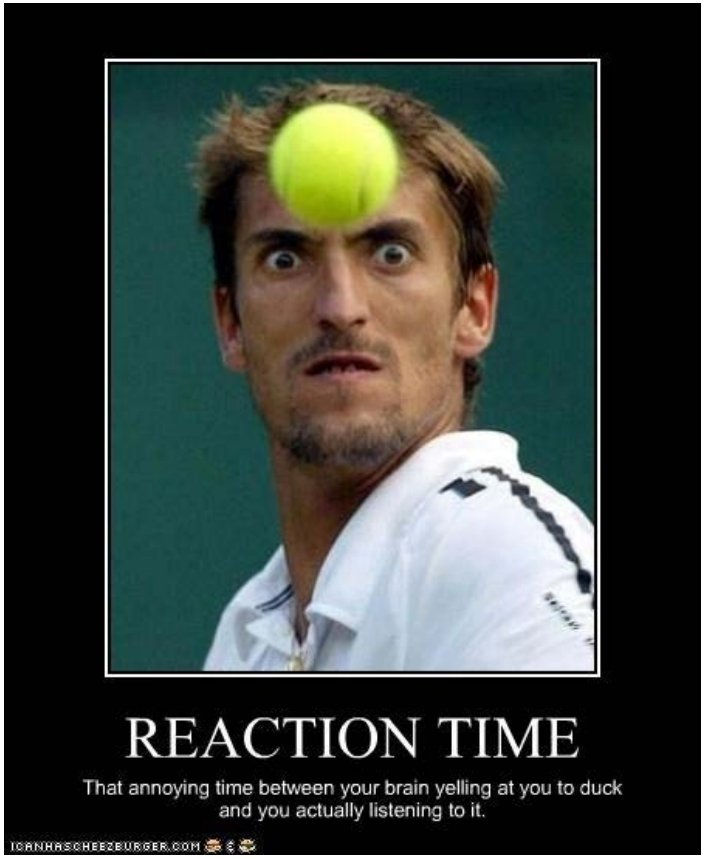
Reaction Time & Braking Distance



Outcome:

S2-3-11 Investigate the factors that influence braking distance. *Include: reaction time, friction, condition of driver, speed, etc.*

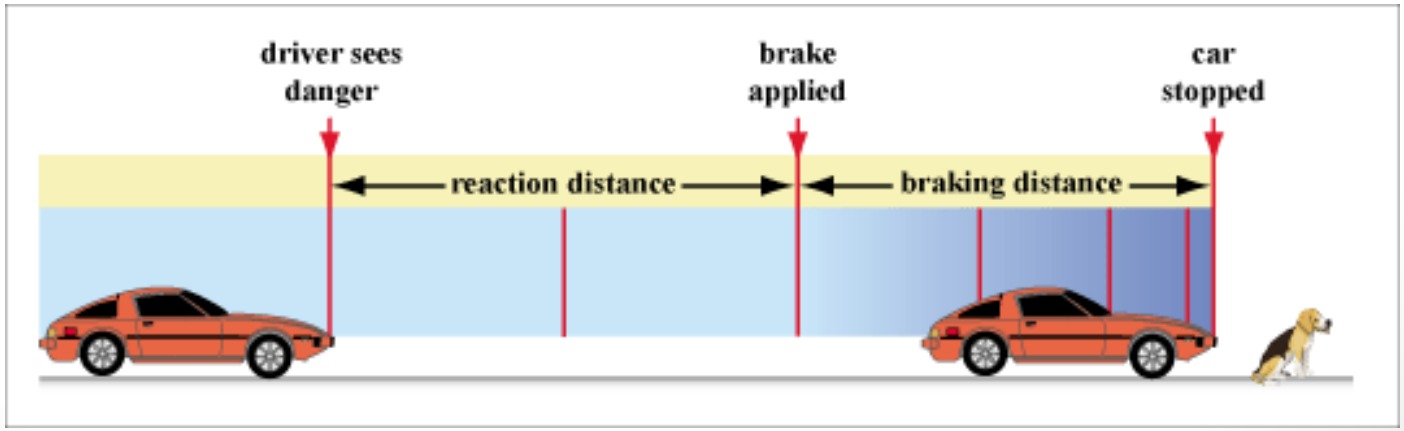
Reaction Time and Reaction Distances…

REACTION TIME

- is the amount of time it takes for you to **RECOGNIZE** a situation and **REACT** to it.

REACTION DISTANCE

- is the **DISTANCE** the car travels **WHILE** you are **REACTING** to a hazard (that is identifying the hazard, analyzing the situation, making a decision and moving your foot over to the brake pedal).
- Is increased if:
  - you take **LONGER TO REACT** and apply the brakes.
  - the **SPEED** of your car is greater.



Factors Affecting Reaction Time …

1. **VEHICLE RESPONSE TIME**
   - tire **TREAD** and tire **PRESSURE**
   - vehicle **WEIGHT**
   - **SUSPENSION** system of the car

2. **HUMAN PERCEPTION TIME**
   - How long it takes to see a hazard and **REALIZE** there is a hazard
   - Can vary from **0.5 s TO 3-4 s**

3. **HUMAN REACTION TIME**
   - time it takes to move your **FOOT** from the **GAS** pedal to the **BRAKE** pedal

What are some things that will affect your perception and reaction time?

Braking Distance and Stopping Distance …

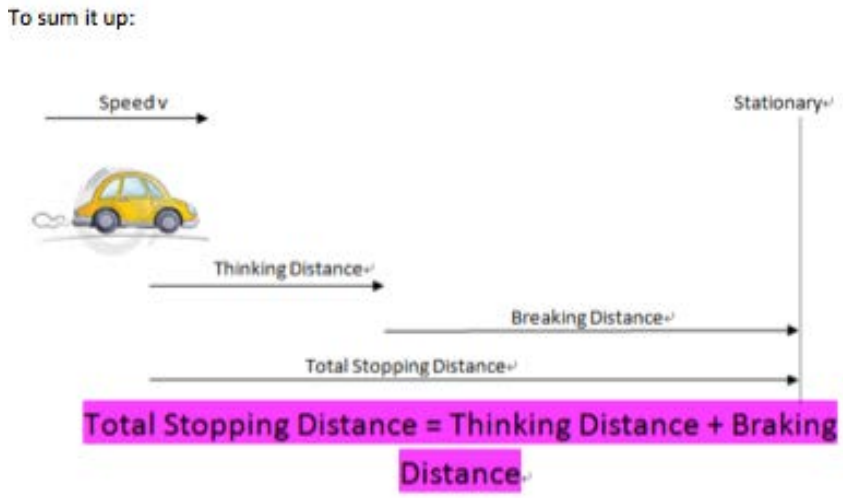
Braking Distance:

- The **DISTANCE** you cover while **BRAKING**.

Stopping Distance:

- The **TOTAL** distance a car travels from the moment a **HAZARD IS NOTICED** until the car comes to a **COMPLETE STOP**.
- Stopping distance **CONSISTS** of **REACTION** distance and **BRAKING** distance.

Stopping Distance = Reaction Distance + Braking Distance



Calculating Stopping Distance …

1. REACTION DISTANCE

- The distance that a car travels **BEFORE** the **BRAKES** are applied.
- Equal to the **VELOCITY** multiplied by the **REACTION TIME** (vehicle response time, human perception time, human reaction time)

$$d = (v)(t) \qquad v = \frac{\Delta d}{\Delta t}$$

2. BRAKING DISTANCE

- Braking distance depends upon two factors:
  - **VELOCITY OF CAR**
  - **FRICTION** between the road and tires
- The mathematical relationship between velocity and braking distance is

$$d \propto v^2$$

- braking distance is **PROPORTIONAL** to the square of the **VELOCITY**

That is, if you **DOUBLE** your speed, the braking distance increases **FOUR** times and if your speed **TRIPLES**, your braking distance increases **NINE** times.

Calculating Stopping Distance …

Braking distance also depends on the friction.

Physicists account for the frictional effects by using a mathematical constant **(k)** for different kinds of surfaces. In this way, the proportion can be represented by an equation such as:

$$d = kv^2$$

- Surfaces with a **LOT OF FRICTION** have a **LOW** value for k, and **SLIPPERY** surfaces have a **HIGH** value of k.

Approximate values for the constant k can be found in the table. The values are given for velocities in m/s.

Rubber tire on	Frictional Constant (k) in m/s
Dry Pavement	0.15
Wet concrete	0.1
Snow and Ice	0.6

Calculating Stopping Distance …

Examples:

1. Find the braking distance for a car with a velocity of 50 km/h on dry pavement. → 0.15

÷ 3.6

13.8 m/s

$d = kv^2$

$d = (0.15)(13.8\ m/s)^2$

$d = 28.56\ m$

at 100km/hr ÷ 3.6 = 27.8 m/s

$d = kv^2$

$d = (0.15)(27.8)^2$

$d = 115.92\ m$

Calculating Stopping Distance …

Examples:

2. Suppose you are riding in a car 19.4 m/s on wet pavement. You spot a hazard and your reaction time is 1.15 s. Calculate your stopping distance.

0.1

Stopping distance = reaction dist + braking dist

Reaction dist

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

$19.4\,m/s = \frac{d}{(1.15)s}$

$d = (19.4\,m/s)(1.15\,s)$

$d = 22.31\,m$

Braking dist

$d = kv^2$

$d = (0.1)(19.4)^2$

$d = 37.63\,m$

total = 22.31m + 37.63m

= 59.9 m

Calculating Stopping Distance …

Try this one…

You are driving down a dry highway at 100km/h. You see a deer in the road ahead. You have a reaction time of 2.1s. Find your stopping distance.