Running Broad Jump

Your teacher is going to show you how to do a running broad jump! Using only a stopwatch, a measuring tape and bathroom scales, you must analyze the teacher's motion.

Rest	the teacher is at rest, with a velocity of zero.
Acceleration	the teacher is speeding up toward the jumping bar
Inertial Motion	in the air, at fastest speed, neither speeding up nor slowing down
Deceleration	the teacher's heels dig into the sand (how far?) slowing and stopping the teacher.
Stop	the teacher has stopped moving, and has velocity of zero again.

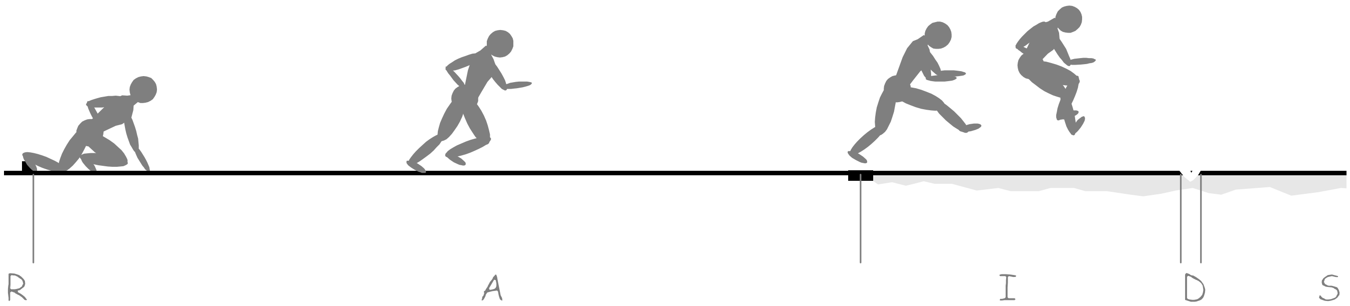
1. **Read over the whole lab exercise**. Decide what you are trying to find out.

2. **Plan your measurements.** Watch the teacher practice a few times. How will you make the measurements that you need? Write your plans here.

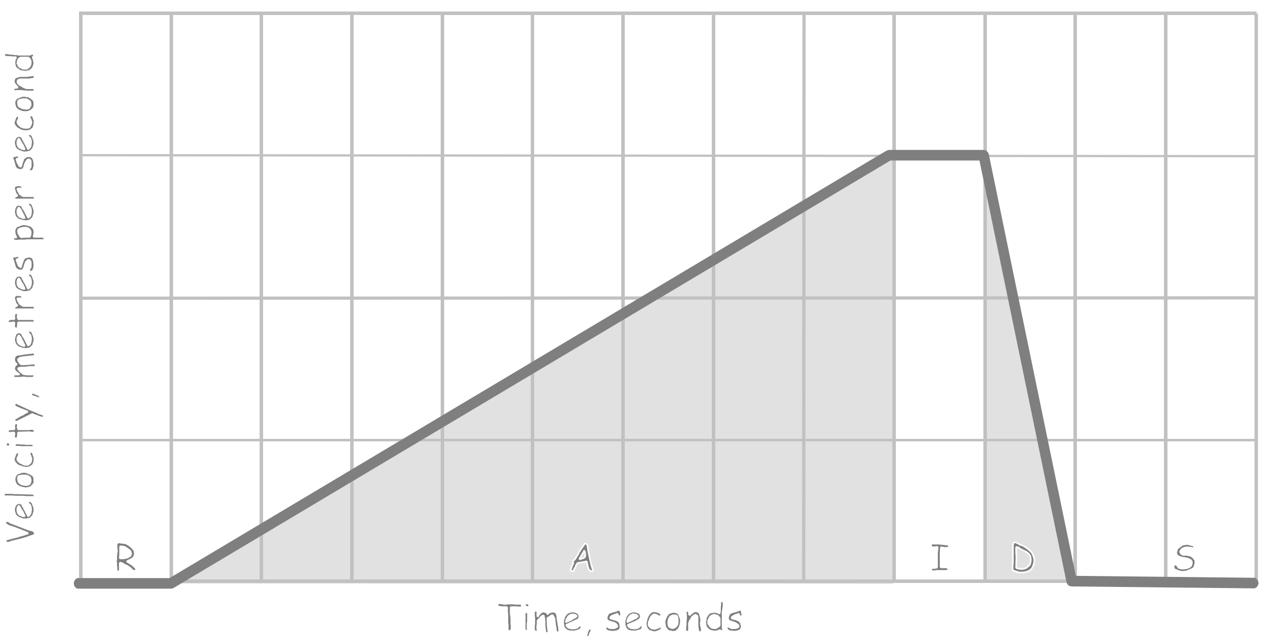
Things you need to know:

Running Broad Jump

1. **Make the measurements** on the teacher's running broad jump. Record the teacher's **m**ass, and all of the **t**ime and **d**istance measurements on the diagram below.

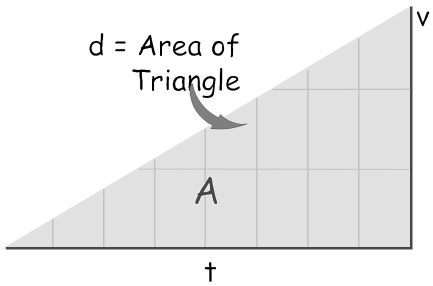


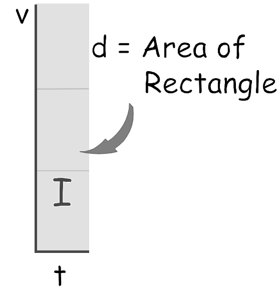
2. **Print your time measurements** on the v:t graph below. (not to scale)

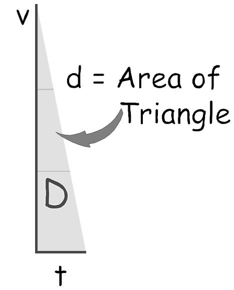


3. **Calculate your teacher's maximum speed** and print that on the v:t graph above.

1. **The area under a v:t graph is the distance traveled in that part of the graph!!** Calculate the time **t**, the displacement **d** and the greatest velocity **v** for each section of the graph.







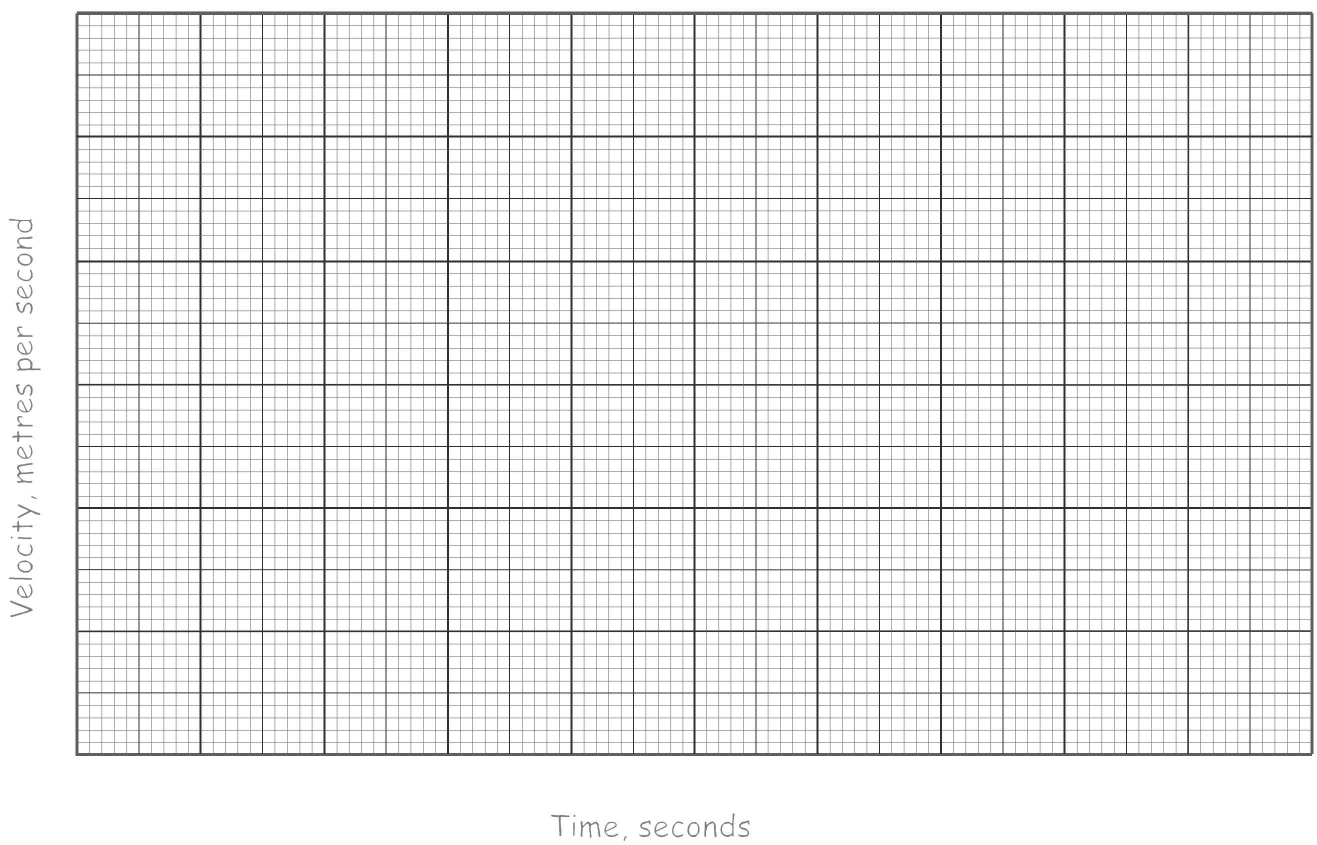
t_a = __________ t_i = __________ t_d = __________

d_a = __________ d_i = __________ d_d = __________

v_a = __________ v_i = __________ v_d = __________

Note: Since the *R* and *S* sections of the graph have v = 0, and d = 0, we will only work on the *A*, *I* and *D* sections.

2. **Compare the velocities** of each section of the graph. The maximum velocity should be the same.
3. **Compare the displacements.** The three sections should add up to your total measurements.
4. **Compare the times.** The times in the three sections should add up to your measured total times.
5. **Make changes to your graphs** to make a closer fit to your measurements.
6. **Sketch a new v:t graph** with all of your changes.

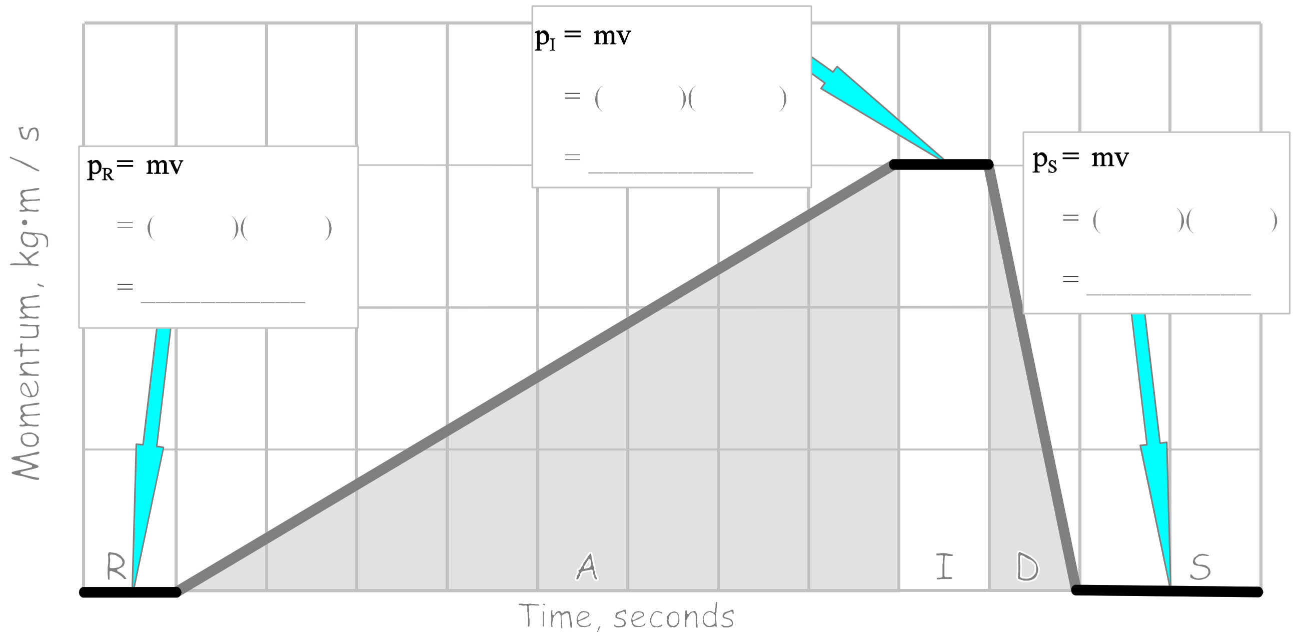


 Sketch New Momentum : time graph

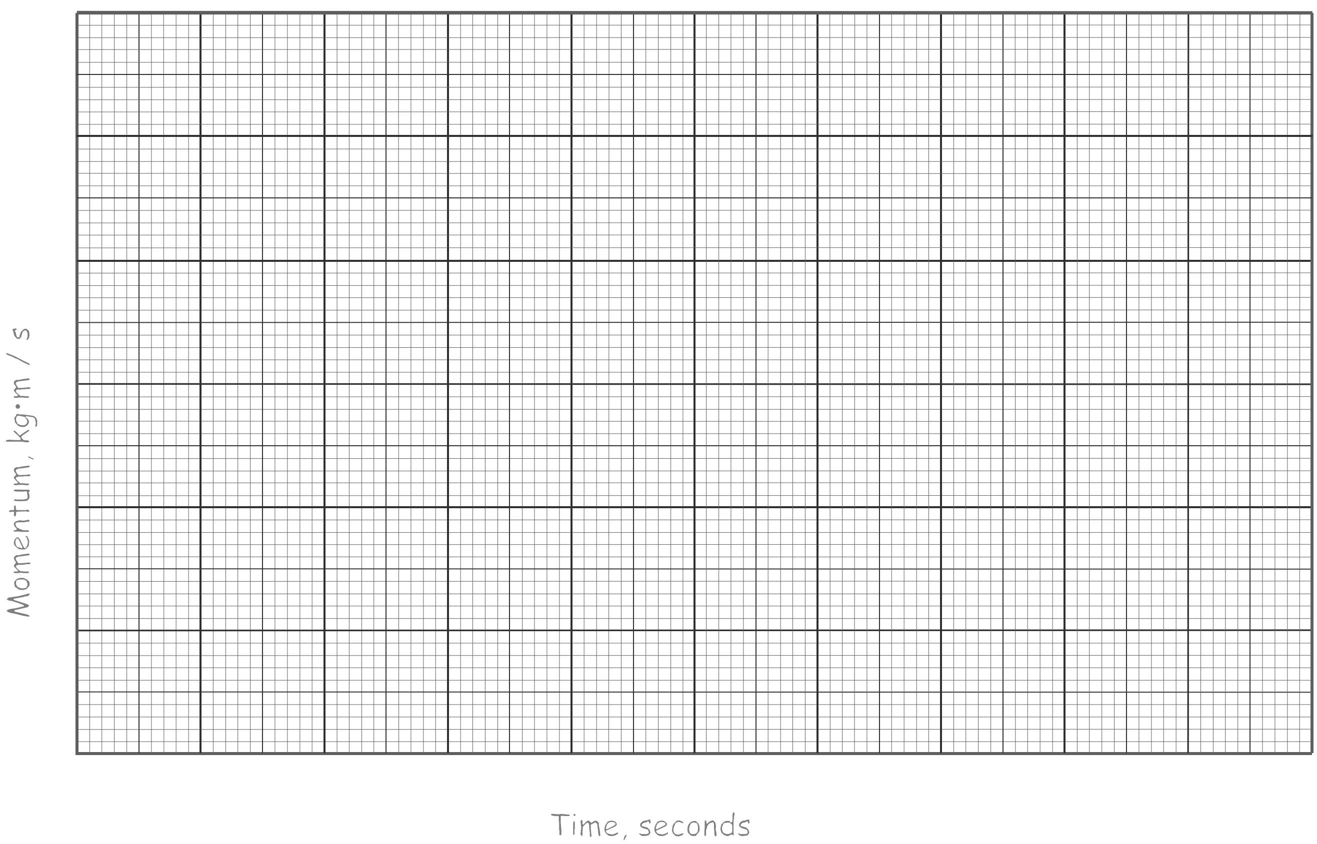
Running Broad Jump

Momentum is "mass in motion." It is easily found by multiplying the mass of your teacher by the velocity of the teacher. Bigger teacher, greater momentum. Faster teacher, more momentum. A big fast teacher: Lots of momentum!! Of course, when your teacher isn't moving, there is no momentum at all.

1. **Calculate the momentum at R, I and S.** Remember... Momentum $p = mv$



2. **Sketch a new p:t graph** with the same time scale as your v:t graph on pg 3.

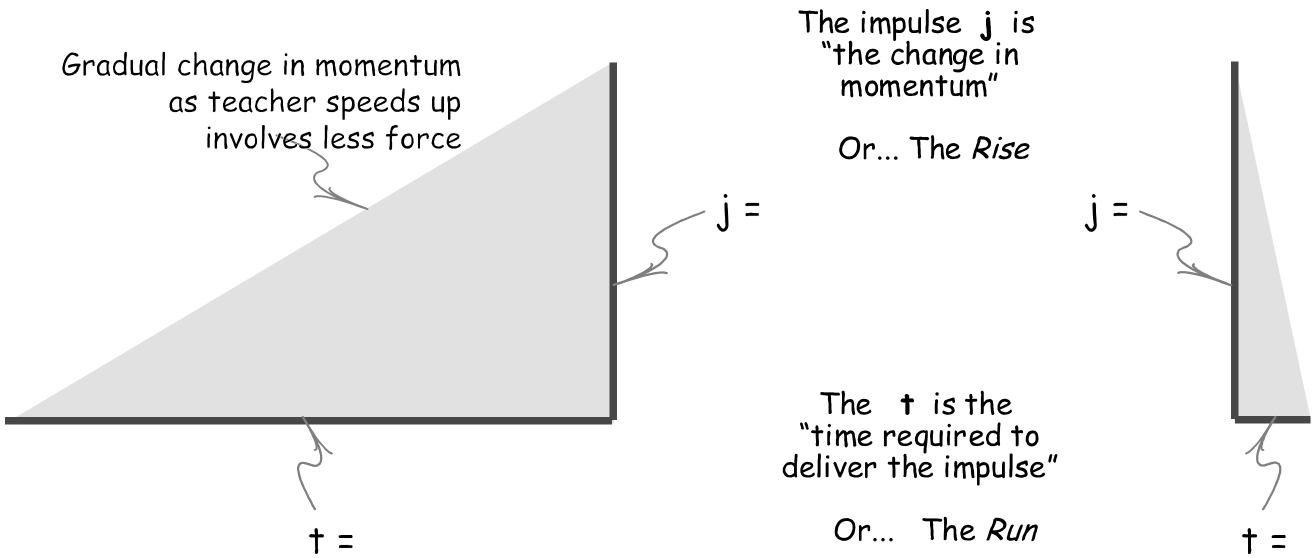


5 Find Impulse j and Force F — Running Broad Jump

Impulse **j** is the "jolt" or the "oomph" that is given to any object when it changes its velocity. The impulse is the "change in momentum." On your *momentum : time* graph, the impulse **j** is the *height* of the triangle, or the *rise* of the triangle.

The time taken to deliver the "jolt" or "oomph" on your *momentum : time* graph is **t**.

3. **Find the impulse j and the time t** for the running broad jump and mark them on the graph below.



An impulse always involves a force. The force that is exerted can be great or small. A gradual change in momentum involves less force. A sudden change in momentum involves greater force. The size of the force can be found by the equation $F = j \div t$.

4. **Find the Force that was exerted.**

Force as teacher accelerates

$j = (\_\_\_\_\_\_\_\_)$

$t = (\_\_\_\_\_\_\_\_)$

$F = \frac{j}{t}$

$= \frac{(\_\_\_\_\_\_\_\_)}{(\_\_\_\_\_\_\_\_)}$

$=$

Force of sand stopping the teacher

$j = (\_\_\_\_\_\_\_\_)$

$t = (\_\_\_\_\_\_\_\_)$

$F = \frac{j}{t}$

$= \frac{(\_\_\_\_\_\_\_\_)}{(\_\_\_\_\_\_\_\_)}$

$=$

What did you learn?

Running Broad Jump