**Vertical Jump – Analysis Sheet**

**File Name:_____** **Name:_____**

**In all the diagrams, represent the person with just a point, and represent weight with a vector 2.0cm long. Draw the maximum acceleration with a vector 4.0cm long. Draw all other forces and acceleration in proportion. Use a ruler.**

- Draw a free-body diagram for the person standing still on the force plate. Draw the reaction force for each of the forces you identified on the free body diagram. Color-code the action-reaction pairs.

- Explain why the upward force, at any given instant, has the same magnitude as the force the muscles in the body produce to make the person jump.

- Explain how you can use your graphs to determine in which direction (up or down) the center of mass was moving at a given instant.

| **Magnitude of Weight:_____** **Magnitude of Max Acceleration:_____** | | | | |
|---|---|---|---|---|
| **Description** | **Numerical Values** | **Free Body Diagram** | **Direction of Motion** | **Acceleration** |
| **a. Start of the jump** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |

| Magnitude of Weight:_____ Magnitude of Max Acceleration:_____ | | | | |
|---|---|---|---|---|
| **Description** | **Numerical Values** | **Free Body Diagram** | **Direction of Motion** | **Acceleration** |
| **b. Max downward acceleration** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |
| **c. Acceleration=0** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |
| **d. Lowest point of the center of mass** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |

| **Magnitude of Weight:_____** **Magnitude of Max Acceleration:_____** | | | | |
|---|---|---|---|---|
| **Description** | **Magnitude of upward force (N)** | **Free Body Diagram** | **Direction of Motion** | **Acceleration** |
| **e. Maximum upward velocity** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |
| **f. Instant of take-off** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |
| **g. Peak of the jump** | **Magnitude of upward force (N)** | | | |
| | **Magnitude of acceleration ($m/s^2$)** | | | |

- Compare the direction of acceleration with the direction of the net force. What do you conclude?

- Compare the direction of acceleration with the direction of motion. What do you conclude?

- Notice the velocity at the instances when the acceleration is zero. What do you observe?

  Does your observation agree with the fact that the slope of *velocity vs time* graph is acceleration? Explain.

- Notice the position at the instances when the velocity is zero. What do you observe?

  Does your observation agree with the fact that the slope of *position vs time* graph is velocity? Explain.

- Notice how the upward force on the body (force produced by the muscles) changes relative to the weight during the jump in the CMJ. At what point (a, b, ..g) does this force start to become greater than the weight?

  In which direction (up or down) is the person moving at this instant?

  Where is the Center-of-Mass when the upward force is at its peak?

  How is the force production different in the SJ?