Name________________________

Freefall without drag

Consider the *vertical* motion of a basketball as described below.
[0] At $t = 0$ seconds, it is moving straight *upwards* with a speed of 2.0 m/s. (Assume that it has long since left the hand of the person throwing it, and neglect any effect of air resistance throughout its motion.)
[1] At some unknown time, it reaches it maximum height.
[2] At some unknown time, it is moving *downwards* with a speed of 2.0 m/s, past the point at which it started its motion at $t = 0$ seconds.

1. Draw a $v(t)$ graph for the basketball, and scale the vertical v and horizontal t axes. What time did the basketball reach its highest height?

2. Determine the maximum height of the basketball, above the point at which it started its motion at $t = 0$ seconds. (*use the area under your graph)*

3. What is the slope of your $v(t)$ graph at each of the instances in time described above? *Is the ± sign of your slope consistent with the direction of your acceleration vector?*

4. Find the total area bounded by your $v(t)$ graph from $t = 0$ seconds to when the basketball reaches it maximum height? What is the total area bounded by your $v(t)$ graph from $t = 0$ seconds to when the basketball falls downwards past its starting point?

5. On the same $v(t)$ graph that you have drawn on the board, show the motion of a basketball that just after released from rest, and allowed to fall downwards towards the floor.

*Name*________________________

Analysis of ⊥ contact forces

Put up the force diagrams assigned to you on the board. Also, make sure that you copy them all onto a piece of graph paper to be handed in.

1. Consider a 7 kg bowling ball on the floor. Draw a properly labeled and scaled force diagram for the 7 kg b.b. for each of the following cases (a)-(f). **Use a scale of 0.5 cm ↔ 10 N (but also write down the magnitude of each force, in N)**. Off to the side of each diagram, show $\boxed{}$. Label and scale the length of these net force vectors, in N. Use g = 9.8 N/kg in your calculations.

(a) 7 kg bowling ball resting on the floor.
(b) 7 kg b.b. on the floor with you pulling up (say, with an attached rope) with a force of 10 N.
(c) 7 kg b.b. on the floor with you pulling up with a force of 65 N.
(d) 7 kg b.b. on the floor with you pushing down with a force of 10 N.
(e) 7 kg b.b. on the floor with you pushing down with a force of 65 N.
(f) 7 kg b.b. with you pulling up with a force of 70 N.

Look at all the force diagrams (a)-(f). Put up brief explanations for your answers to these multiple choice questions. There can be more than one possible answer.

3. The magnitude of the ⊥ contact force can be $\begin{bmatrix} \text{less than} \\ \text{equal to} \\ \text{more than} \end{bmatrix}$ to the weight of an object.

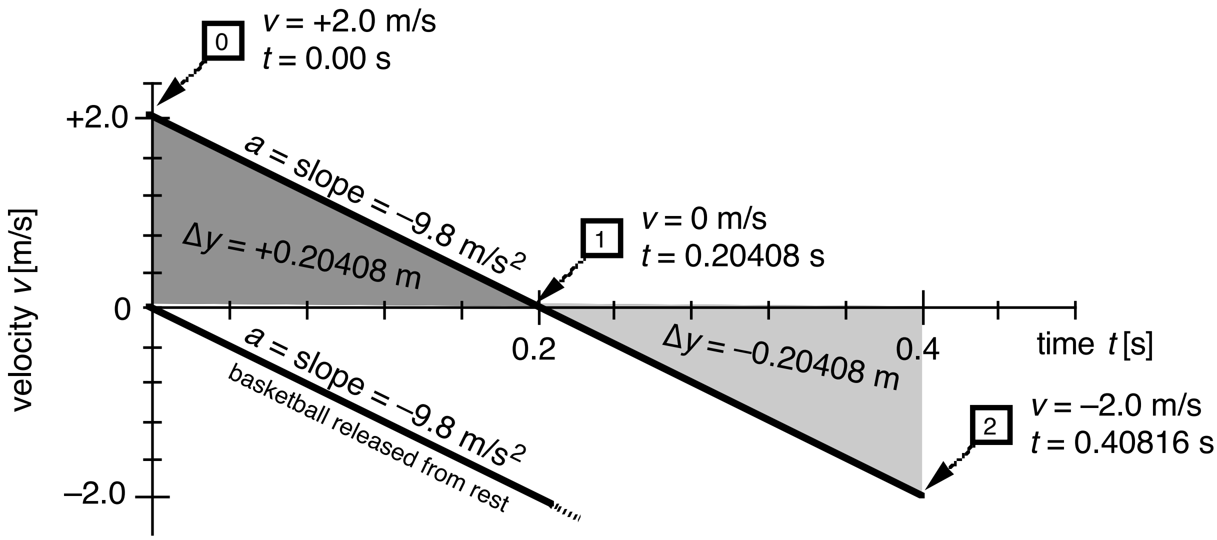
4. The ⊥ contact force always points in the direction $\begin{bmatrix} \text{directly opposite of } \mathbf{F}_{gravity}. \\ \perp \text{ to the surface.} \end{bmatrix}$.

Name________________________

Activity Cycle 8.2.1: TA instructions

The slope of the $v(t)$ graph is -9.8 m/s^2, that is, if the students choose up as the positive direction. Knowing that the rise of the slope must be $\Delta v = -2.0$ m/s (the basketball has a velocity of $+2.0$ m/s at [0], and slows down to $v = 0$ m/s at [1]), the run must be $\Delta t = 0.20408$ s.

The triangular area bounded by the $v(t)$ graph is $+0.20408$ m from [0]$\rightarrow$[1], which is the maximum height of the basketball. The triangular area bounded by the $v(t)$ graph from [1]$\rightarrow$[2] is -0.20408 m, such that the total area from [0]$\rightarrow$[2] is 0 m, as it returns back to the same place. (The factor of ten or 0.1 that seems to propagate throughout is because $g = 9.8$ m/s$^2 \approx 10$ m/s^2.)



Drawing the force diagrams is where many students have conceptual difficulties—should = 0 at [1]? After all, isn't velocity zero there? What about the $\perp$ contact force of the hand that originally put the basketball into motion? Note that the force diagrams are identical *throughout* this process.