Cash Hilinski
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AP Physics 1 OL v2 A

Activity: Free Falling

Trial	Coffee Filters	d (m)	Vo (m/s)	Final Velocity (m/s)	Time (s)	a (m/s^2)
1	1	2	0	2.16	1.85	1.17
2	2	2	0	2.76	1.45	1.90
3	3	2	0	3.28	1.22	2.69
4	4	2	0	3.39	1.18	2.87
5	5	2	0	3.51	1.14	3.08
6	6	2	0	3.67	1.09	3.37
7	7	2	0	3.85	1.04	3.70
8	8	2	0	3.88	1.03	3.77
9	9	2	0	4.08	0.98	4.16
10	10	2	0	4.21	0.95	4.43

1. Does there appear to be other forces other than gravity at work on the falling coffee filters? How do you know? Justify your response.

The air resistance seems to be slowing the descent of the coffee filter. I know there is another force acting on the coffee filter besides gravity because the acceleration is below 9.8 m/s^2 (the acceleration of gravity).

2. What is the trend in the calculated accelerations? The accepted value is 9.8 m/s^2. Do the acceleration calculations seem to be heading in this direction? Justify your response.

The acceleration is increasing every time a filter gets added. This is likely because the weight of stacking the coffee filters reduces to the air resistance leading to faster acceleration. The calculations show this to be true.

3. What are some experimental conditions that should be met so that the acceleration of gravity can be accurately measured?

The experiment should be done in an air vacuum to eliminate the air resistance. Additionally you could use sensors to more accurately measure when the filters hit the ground.

In the absence of air resistance (friction), the final velocity of the filter(s) is calculated from:

$$vf2=v02+2a(d-d0)$$

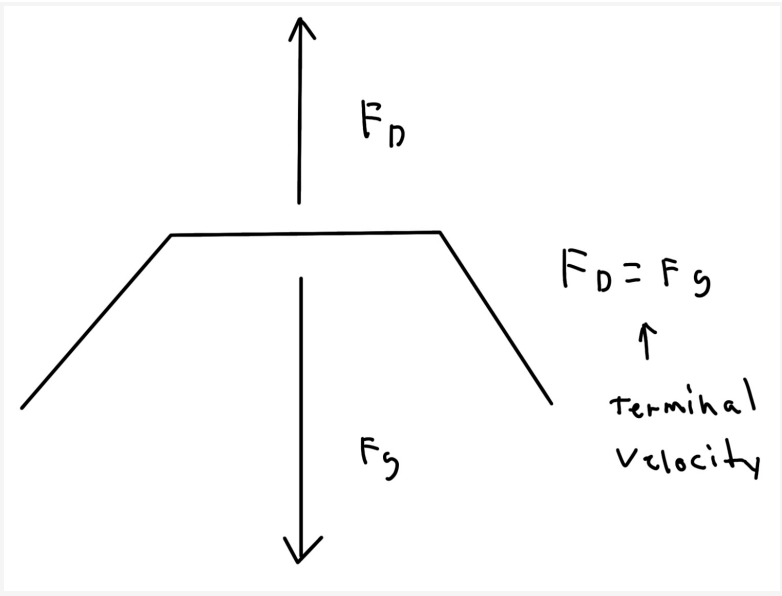
4. Apply the initial conditions and solve for vf. Use $a=9.8\ m/s2$ How does this value for vf compare to the calculated values from the experiment? Justify your response.

$v_f = \sqrt{2 \cdot 9.8 \cdot 2}$

$= 6.260990337$

This value of 6.26 m/s is much higher than the calculated values from the experiment because it ignores the air resistance.

5. Draw the Free Body Diagram that illustrates the relationship between the forces when the coffee filter has reached terminal velocity. What forces are equal to each other?



The gravitational pull is equal to the air resistance when in terminal velocity.

6. Explain a real-world societal issue or technological innovation that applies the knowledge of the physics principle(s) investigated in this activity.

Developing parachutes seems like the most prominent technological innovation that applies the physics principles we investigated in this activity. The parachute helps to increase air resistance, and after the gravitational force becomes equal with the air resistance, it reaches terminal velocity, allowing the person to land at a safe speed.