

PHYSICS  
PROBLEMS: FREE FALL

NAME \_\_\_\_\_  
DATE \_\_\_\_\_ PERIOD \_\_\_\_\_

1. If air resistance is negligible, free fall considerations may be used to determine heights of structures, cliffs, etc., where direct measurement is often not feasible.

a) What is the height of a bridge if a rock dropped over the edge takes 1 second to hit the water? SHOW METHOD CLEARLY, INCLUDING EQUATION AND UNITS.

b) Complete the following table, showing the distance an object falls in the time indicated.

TIME (s)	1	2	3	4	5
DISTANCE (ft)					

c) What is the height of a flagpole if a ball thrown from the ground to the top of the flagpole returns to the ground in 4 seconds?

2. Batman, in the spirit of scientific curiosity consistent with his work in the bat cave, determines to test the law of gravity for himself. He walks off a Gotham City skyscraper 900 ft high, stopwatch in hand, and starts his free fall. Robin, the Boy Wonder, notices that the Joker (that evil fellow!) has unfastened the Batrope, which was to have saved Batman from crashing to death by jerking him to a stop just before hitting the pavement. Clark Kent, strolling on the roof, notices the situation, and 5 seconds after Batman leaves the roof, Superman arrives at the scene and dives off the roof to save Batman. Even Superman, however, does have a crucial kinematic limitation, in that he must choose between zero initial velocity and and variable acceleration, or variable initial velocity and the same acceleration as any freely falling body. IN ALL PARTS BELOW, SHOW METHOD CLEARLY, INCLUDING EQUATION AND UNITS.

a) If Superman's acceleration is that of any freely falling body, what must his initial velocity be in order that he catch Batman just before Batman reaches the ground?

b) If Superman's initial velocity is zero, what acceleration must he have to catch Batman just before Batman reaches the ground?

c) If the skyscraper was not tall enough, even Superman could not save Batman, since Batman would hit the ground before Superman even arrived on the scene. What is the minimum height of the building which allows Superman to save Batman.



3. A ball is thrown upward with a velocity of 80 ft/s. How long after leaving the thrower's hand will the ball have the velocities indicated? SHOW METHOD CLEARLY, INCLUDING EQUATION AND UNITS.

a) 16 ft/s upward

b) 16 ft/s downward

4. A ball is thrown vertically upward from a point near the corner of the roof of a tall building. It just misses the corner on the way down, and passes a point 160 ft below its starting point 5 seconds after it leaves the thrower's hand. FOR EACH PART BELOW, SHOW METHOD CLEARLY, INCLUDING EQUATION AND UNITS.

a) What was the initial velocity of the ball?

b) How high did it rise above its starting point?

c) What was the velocity as it passed a point 64 ft below the starting point?

5. A juggler performs in a room whose ceiling is 9 ft above the level of her hands. She throws a ball vertically upward so that it just reaches the ceiling. FOR EACH PART BELOW, SHOW METHOD CLEARLY, INCLUDING EQUATION AND UNITS.

a) With what initial velocity does she throw the ball?

b) What time is required for the ball to reach the ceiling?