

Educational Innovations[®]

PHY-200

G-Ball

Discover the Wonders of Gravity using the G-ball!

In the absence of air friction, objects near the Earth's surface fall at the same rate... the acceleration of gravity g . Let's determine a value for g : Using a small piece of masking tape, mark a horizontal line on a smooth wall, at 0.50 m from the floor. Depress the timer button of the g-ball to reset it to 0:00. Gently positioning the ball as in FIG.1 and with the lowest point of the ball at the 0.50 m mark, use a ceramic cup or coffee mug to push on the ball so that the timer button is depressed by the wall (you will hear a faint click when the button is depressed and ready for timing). Release the ball, quickly moving the cup away to avoid interfering with the ball's fall. The timer will start when you release the ball, and it will stop when the ball hits the floor. **Caution: To protect the timer from damage, the ball should always drop onto a soft surface, such as a lawn or a carpet; never on a hard surface such as concrete, vinyl or wood.**

1. Value of g : Take 6 measurements of t , the time for the ball to drop. $d = 0.50$ m (t should range between 0.30-0.33 sec). Repeat for the three other heights. For each value of d , average the times (to 3 significant figures), and calculate $g = 2(d)/(t_{ave})^2$.

$d = 0.50$ m: $t(\text{sec}) = \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}$. $t(\text{ave}) = \underline{\quad}$ $g = \underline{\quad}$ m/s[^]

$d = 1.00$ m: $t(\text{sec}) = \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}$. $t(\text{ave}) = \underline{\quad}$ $g = \underline{\quad}$ m/s[^]

$d = 1.50$ m: $t(\text{sec}) = \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}$. $t(\text{ave}) = \underline{\quad}$ $g = \underline{\quad}$ m/s[^]

$d = 2.00$ m: $t(\text{sec}) = \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}, \underline{\quad}$. $t(\text{ave}) = \underline{\quad}$ $g = \underline{\quad}$ m/s[^]

$g(\text{ave}) = \underline{\quad}$ m/s^{^2}.

Using sophisticated equipment, it is found that g is independent of d . Your values of g are affected by air friction and may as a result... decrease/increase (circle one)... as the drop height d increases.

2. Speed V of a vertical toss: Reset the timer to 0:00 by pressing the timer button. Now press and hold the button until you release the ball, tossing it upward with an initial speed V from a height of 1.50 m. Use your value of $g(\text{ave})$, and time t , to find V , from

$$V = - (1.50)/(t) + (g)(t/2)$$

$t = \underline{\quad}$ sec

$V = \underline{\quad}$ m/s

This formula has two parts... the 1st part gives the initial speed (downward) if there were no gravity. The 2nd part shows the effect of gravity.

3. Maximum height $d(\text{max})$ of your vertical toss: Use your value of $g(\text{ave})$ to find the maximum height $d(\text{max})$ that the ball reached during the vertical toss from step 2 above. Use $d(\text{max}) = V^2/(2g)$.
 $d(\text{max}) = \underline{\quad}$ m



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4. Horizontal speed: Now gently toss the ball a distance D of 5 - 6 m to a friend. Find the horizontal speed V of the toss from D and the time of flight t . Notice that g is not involved here, since the ball's horizontal motion is not affected by g . Be sure to reset the timer to 0.00, and then press and hold the timer button until you toss the ball.

Use $V=D/t$

$D =$ _____ m, $t =$ _____ sec

$V =$ _____ m/s

5. Height of a stairwell: If there is a stairwell nearby where you can drop the ball **vertically onto a soft surface such as a blanket or carpet**, you can use your value of g (ave) and the time of drop t to find the height d of the stairwell. First reset the timer, then depress the timer button and drop the g-ball. **Do not drop the ball from a height of more than 8 m.**

Use $d = (g)(t^2/2)$

$t =$ _____ sec

$d =$ _____ m

When you measure d directly with a tape measure to get d (meas), what is the stairwell height?

d (meas)= _____ m

How do you explain the difference?

6. Time of fall is unaffected if initial speed is horizontal!

Q: On a level field, Lynette drops a bullet at the same time and from the same height that she shoots another bullet horizontally at 100 m/s. Which bullet hits the ground first?

A: They both hit simultaneously, because both started with a downward-directed speed of zero, and both accelerated downward with the same value of g .

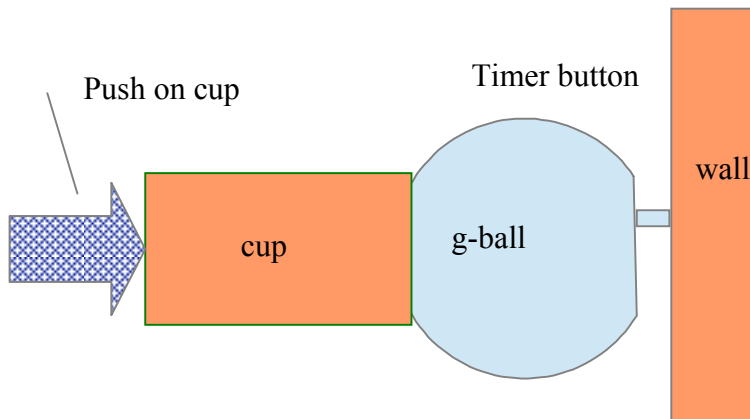


FIG.1