Solution 245

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Initial velocity $v_i = 0$, $a = g = 9.8 m/s^2$, $t = 8.1$ s, $v_s = 343$ m/s.

If we let t_1 = time for the rock to fall, and t_2 = time of sound travel, then the total time $t = t_1 + t_2 = 8.1$ s.

Because the depth $s = 1/2gt^2$ and $v_s = s/t$, upon substitution after solving for t_1 and t_2, $t = t_1 + t_2 = (2s/g)^{1/2} + s/v_s = 8.1$

Writing this as $(2s/g)^{1/2} = - s/v_s + 8.1$, then squaring both sides and solving for s becomes the quadratic equation: $s^2 - 2s(8.1v_s + v_s^2/g) + 8.1^2 v_s^2 = 0$

1. Choosing the appropriate solution to this equation yields: s = 263.4 m.
2. This differs by a decrease of 58.1 m, a practical correction of around 18%.
3. The rock time travel $t_1 = (2s/g)^{1/2} = 7.332$ s
4. The sound interval is $t_2 = s/v_s = 0.768$ s.