

## Drop an Object

You will calculate and measure how long it takes for the sound of a dropped object to reach you and will then compare the difference. Pick an object that will not break and drop it from a height of *at least* 5 meters. You will need a thermometer to determine the ambient temperature. **Use three decimal places for all measurements and calculated values.**

dropped object:  $y = d_{fall} = \frac{1}{2} g t_{fall}^2$

sound:  $d_{fall} = v_{T_{amb}} t_{surface}$

total time:  $t_{total} = t_{fall} + t_{surface}$

speed of sound at 0°C =  $v_{s0} = 331 \text{ m/s}$

speed of sound in air  $v_{T_{amb}}$  at temperature  $T_{amb}$ , where  $T_{amb}$  is in °C:  $v_{T_{amb}} = v_{s0} \sqrt{1 + \frac{T_{amb}}{273}}$

Table 1 Object Calculated Sound Data

A	B	C	D	E	F = B + E
Measured object fall distance $d_{fall}$ in m to contact surface	Calculated time $t_{fall}$ in s to fall that distance to the contact surface	Measured ambient temperature $T_{amb}$ in °C in the environment in which you are dropping the object	Calculated speed of sound $v_{T_{amb}}$ in m/s at temperature $T_{amb}$	Calculated time $t_{surface}$ in s for sound to reach you from the time the object contacts the surface on which you are dropping it	Calculated total time $t_{calc}$ in s from the time you drop the object until the sound reaches you

Now drop the object and time how long it takes for the sound to reach you from the time the object is dropped.

Table 2 Object Experimental Sound Data

G	H	I = F	J = (H - I)/I x 100
Trial	Measured total time $t_{exp}$ in s from the time you drop the object until the sound reaches you	Calculated total time $t_{calc}$ in s from the time you drop the object until the sound reaches you	Percent difference between $t_{exp}$ and $t_{calc}$
1			
2			
3			

1. Explain why the experimental and calculated times are different.
2. How does an increase in the ambient temperature affect the speed of sound?
3. Given that the speed of sound  $v_{T_{amb}} = \underline{\hspace{2cm}}$  m/s, find the ambient temperature in:

centigrade:                     

kelvin:                     

Fahrenheit: