

Problem :

Here are a couple of facts about a 9mm bullet:

Mass = 115 gr. ( i.e., 7.45 grams)

Muzzle velocity = 1200 ft/sec. (i.e., 36576 cm/sec.)

If a 9 mm bullet was fired so that all of its energy could be deposited into a cup containing 8 oz. water, by how much would the temperature of that water be raised?

Before doing the calculation, make an 'educated guess' of the outcome.

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Solution :

Assuming that all of the bullet's initial energy is kinetic, and all of that energy heats the water, then we can equate the before- and - after energies.

$$E_{BEFORE} = \frac{1}{2} mV^2 \quad \text{and} \quad E_{AFTER} = M \cdot C \cdot \Delta T \quad \text{where;}$$

$m$  = mass of bullet (7.45 grams; assume this *excludes* shell casing & powder)

$V$  = speed of bullet (36576 cm/sec)

$M$  = mass of water in the cup (8 oz. = 226.8 grams)

$C$  = specific heat of water (1.00 cal/gram per deg. C)

$\Delta T$  = temperature change (deg. C)

Make the substitutions, noting that we're in the CGS system of units. We'll need to convert ergs (on the left side) to calories (which are the units on the right)...

$$\frac{1}{2} (7.45)(36576)^2 \cdot \left[ \frac{0.239 \text{ cal}}{10^7 \text{ erg}} \right] = (226.8)(1.00)(\Delta T)$$

$$226.8(\Delta T) = 119.1$$

$$\Delta T = 0.53^\circ C$$

Converting to deg. F, this result is...

$$\Delta T = 0.95^\circ F, \quad \text{about } \underline{\text{one degree}} \text{ (F) temperature change.}$$

Did you guess a much higher temperature change than this?

NOTE: convert the temperature change from one unit to another by writing the conversion formula twice (once for each temperature, and subtracting).

