57m means something probably between 56m & 58m, maybe as far off as 55m or 59m.

57.0m means probably between 56.9m & 57.1m.

5700m means probably between 5600m & 5800m.

"Exactly 5700m" means probably between 5699m & 5701m.

5.700×10^3 m means probably between 5699m & 5701m.

0.000570m means probably between 0.000569m & 0.000571m.

- absolute uncertainty ± 0.000001m
- relative uncertainty $\sim 10^{-2} = 1\%$

- absolute uncertainty ± 1m
- relative uncertainty $\sim 10^{-3} = 0.1\%$

	measures relative precision ↓
	significant figures
57 m	2
57.0 m	3
5700 m	2
5.700×10^3 m	4
0.000570 m	3
5.7×10^3 m	2
5.70×10^{-4} m	3
0.00057 m	2
5.7×10^{-4} m	2

Gas constant = 8.31447 J/(mol·K)

↖ 6 sig. figs.

Gravitational constant

$G = 6.673 \times 10^{-11}\ N \cdot m^2/(kg^2)$

↖ 4 sig. figs.

Math with uncertainty:

Add & subtract: keep the biggest absolute uncertainty

± 1 m

573 m − 558.32 m

$\pm$ 0.01 m

$= 14.68\text{ m} \pm 1\text{ m} = 15\text{ m}$

Multiply, divide, square, cube, square root, cube root, reciprocal, raising to a power:

keep the biggest relative uncertainty

$$573\text{m} \times 558.32\text{m} = 319917.36\text{m}^2$$

$$\pm 10^{-2}(573\text{m}) \qquad \pm 10^{-4}(558.32\text{m}^2)$$

$$\approx 319917.36\text{m}^2 \pm 10^{-2}(319917.36\text{m}^2)$$

$$= 320000\text{m}^2 \pm 1000\text{m}^2$$

$$= 3.20 \times 10^5\ \text{m}^2$$

573 m has 3 sig figs

558.32m has 5 sig figs

Their product has the smaller # of sig figs: 3.

Δx = change in x

dx = tiny change in x

$v = \frac{dx}{dt} \approx \frac{\Delta x}{\Delta t}$ for tiny Δx, Δt

v = velocity = instantaneous velocity

↖ speedometer measures this.

For non-tiny Δx, Δt, if v is not constant, then $\frac{\Delta x}{\Delta t} \neq v$ usually.

$\frac{\Delta x}{\Delta t}$ = average velocity

v = velocity

measure with ~~odometer~~ & watch

map

speedo-meter

If you drive 3 miles in 10 minutes, then $\frac{\Delta x}{\Delta t} = \frac{3\text{ mi}}{10\text{ min}} = \frac{18\text{ mi}}{60\text{ min}} = 18\text{ mph}$, but your velocity v was probably not 18 mph most of the time.