

Solve the following equation for the value of

x

$$\frac{4x - 35}{3} = 9(1 - x)$$

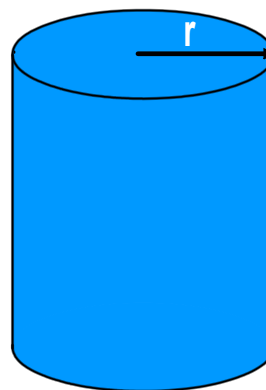
$$4x - 35 = (9 - 9x)3$$

$$\cancel{35} + 27x \quad \cancel{4x} - \cancel{35} = 27 - \cancel{27x} + \cancel{27x} + 35$$

$$31x = 62$$

$$x = 62/31 = 2$$

Determine the radius r of a cylindrical tank whose cross-sectional area is 5.00 m^2



$$A = \pi r^2$$

$$5 \text{ m}^2 = \pi r^2$$

$$\frac{5 \text{ m}^2}{\pi} = r^2$$

$$1.59 \text{ m}^2 = r^2$$

$$r = \sqrt{1.59 \text{ m}^2} = 1.26 \text{ m}$$

Orders of magnitude (powers of 10)

$$10^0 = 1$$

$$10^3 = 1,000 \text{ Kilo}$$

$$10^6 = 1,000,000 \text{ Mega}$$

$$10^{-3} = .001 \text{ milli}$$

$$10^{-6} = .000001 \text{ micro}$$

$$10^{-9} = .000000001 \text{ nano}$$

$$10^1 = 10 \text{ deka}$$

$$10^9 = 1,000,000,000 \text{ Giga}$$

Scientific notation with your calculator...

$$(6.67 \times 10^{-34}) (9.81 \times 10^{-27}) = ? \quad 6.54327 \times 10^{-60}$$

Type in 6.67 as you normally would then keystroke
 [2nd] [EE] [change sign] 34 [times]
 9.81 [2nd] [EE] [change sign] 27
 [Enter]

DO NOT use the ^ sign for exponent powers

DO NOT use 10^x for powers of ten in your calculations

ONLY USE 2nd EE to enter scientific notation into calculations

kms

Orders of magnitude

Determine the order of magnitude difference between the force of gravity between a proton and an electron separated by a distance of 1 mm (0.001m) and the electrostatic force between the two charges. Use the following relationships:

<p>Gravitational Force</p> $F_g = G \frac{m_1 m_2}{d^2}$ <p>G = gravitational constant m_1 = mass of one particle m_2 = mass of other particle d = distance of separation</p>	<p>Electrostatic Force</p> $F_e = k \frac{q_1 q_2}{d^2}$ <p>k = electrostatic constant q_1 = charge of one particle q_2 = charge of other particle d = distance of separation</p>
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$1.015 \times 10^{-61} \text{ kg} \frac{\text{m}}{\text{s}^2} = \text{N}$

$$F_g = \frac{(6.67 \times 10^{-11} \frac{\text{N} \cdot \text{m}^2}{\text{kg}^2}) (9.11 \times 10^{-31} \text{ kg}) (1.67 \times 10^{-27} \text{ kg})}{(0.001 \text{ m})^2}$$

$$F_e = \frac{k q_1 q_2}{d^2} = \frac{(8.99 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2}) (-1.6 \times 10^{-19} \text{ C}) (1.6 \times 10^{-19} \text{ C})}{(0.001 \text{ m})^2}$$

$$F_e = 2.301 \times 10^{-22} \text{ N}$$

Orders of magnitude

Calculate using powers of ten only

Determine the order of magnitude difference between the force of gravity between a proton and an electron separated by a distance of 1 mm (0.001m) and the electrostatic force between the two charges. Use the following relationships:

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$$F_g = \frac{(10^{-10}) (10^{-30}) (10^{-27})}{(10^{-3})^2} = \frac{10^{-67}}{10^{-6}} = 10^{-61}$$

gravitational force

$$F_e = \frac{(10^{10}) (-10^{-19}) (10^{-19})}{(10^{-3})^2} = \frac{10^{-28}}{10^{-6}} = 10^{-22}$$

Electrostatic Force

F_g
 10^{-61}

F_e
 10^{-22}
 BIGGER

Significant Figure Rules

Addition and subtraction:

Answers can only be significant to the least significant quantity's decimal place

$$4.523 \text{ cm} + 1.0 \text{ cm} = 5.5 \text{ cm}$$

$$2.567 \text{ mm} + 2 \text{ cm} = 5 \text{ cm}$$

Multiplication and division:

Answers are limited to the least number of significant figures in any quantity

$$(4.25 \text{ cm})(1.0 \text{ cm}) = 4.3 \text{ cm}^2$$

$$2 \times 4.5 \text{ cm} = 9 \text{ cm} \quad \text{NOT } 9.0 \text{ cm}$$

Fermi Questions

Approximately how many regular marshmallows can fit into this classroom?

How long would it take a turtle to walk from our high school to KMS?
to Cato?

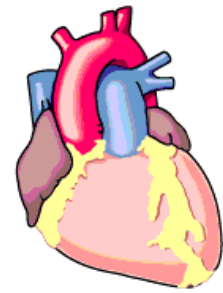
Approximately how many times does a person's heart beat in their lifetime?



1 beat/sec = Avg Rate

Avg lifetime = 75 yrs

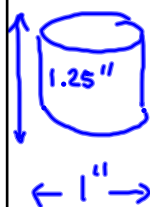
1 beat	60s	60 min	24hr	365 days	75 yr
sec	1 min	1 hr	1 day	yr	life



$$= 2.3652 \times 10^9 \text{ beats/life}$$

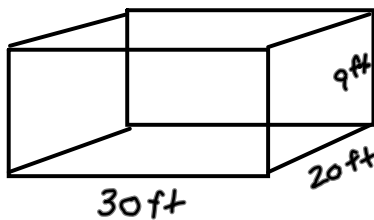
What is the order of magnitude of your answer?

$$10^9$$



lg marshmallow volume?

$$\text{Volume} \sim 1 \text{ in}^3 \Rightarrow 10^0 \text{ in}^3$$



classroom Volume?

$$\sim 6000 \text{ ft}^3 \Rightarrow 10^4 \text{ ft}^3$$

How many in^3 are there in one cubic foot?

$$1 \text{ ft}^3 \Rightarrow \frac{12 \text{ in}}{\text{ft}} \times \frac{12 \text{ in}}{\text{ft}} \times \frac{12 \text{ in}}{\text{ft}} \approx 1000 \frac{\text{in}^3}{\text{ft}^3} \Rightarrow 10^3 \frac{\text{in}^3}{\text{ft}^3}$$

How many marshmallows would fit?

$$\left(\frac{10^4 \text{ ft}^3}{\text{classroom}} \right) \left(\frac{10^3 \text{ in}^3}{\text{ft}^3} \right) \left(\frac{1 \text{ marshmallow}}{1 \text{ in}^3} \right) = 10^7 \frac{\text{marshmallows}}{\text{classroom}}$$