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Recitation 1

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- Units

Table.1: Systems of Units

Name	Length	Time	Mass	Force
International System of Units SI	meter m	second s	kilogram kg	newton* N $\left(\frac{kg \cdot m}{s^2}\right)$
U.S. Customary FPS	foot ft	second s	slug* $\left(\frac{lb \cdot s^2}{ft}\right)$	pound lb

	SI	US
distance	"m" meter 1m = 100 cm 1m = 1000 mm	"ft" foot. 1 ft = 12 in 1 ft = 0.3048 m
time	"s" seconds	"s" seconds
	1 min = 60 seconds 1 hr = 60 min 1 day = 24 hrs	
mass	"kg" Kilogram	slug
	1 slug = 14.59 Kg	
angle	"rad" radian	"rad" radian
	degrees x $\frac{\pi}{180}$ = rad.	
Force	"N" newton	"lb" Pounds
	$N = kg \cdot \frac{m}{s^2}$	
	1 lb = 4.448 N	
	nano- "n" $\times 10^{-9}$ micro- "μ" $\times 10^{-6}$ milli- "m" $\times 10^{-3}$ Kilo- "K" $\times 10^{3}$	Mega- "M" $\times 10^{6}$ giga- "G" $\times 10^{9}$

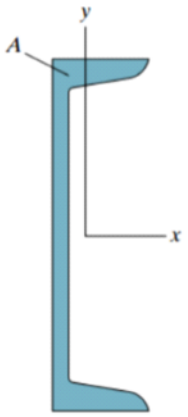
- Units

Table.2: Units Conversion

Time	1 minute	=	60 seconds
	1 hour	=	60 minutes
	1 day	=	24 hours
Length	1 foot	=	12 inches
	1 mile	=	5280 feet
	1 inch	=	25.4 millimeters
	1 foot	=	0.3048 meters
Angle	2π radians	=	360 degrees
Mass	1 slug	=	14.59 kilograms
Force	1 pound	=	4.448 newtons

- Problem 1

The cross-sectional area of the C12×30 Ai
Standard Channel steel beam is $A = 8.81$ in^2. Wl
cross-sectional area in mm^2?



1 inch = 25.4 millimeters

$8.81 \times (25.4)^2 = 5683.86\ mm^2$

- Problem 2

Suppose that in Einstein's equation

$$E = mc^2,$$

the mass m is in kilograms and the velocity of light c is in meters per second.

(a) What are the SI units of E?

(b) If the value of E in SI units is 20, what is its value in U.S. Customary base units?

(a) $\Rightarrow kg \cdot m^2/s^2$

(b) $kg \cdot m/s^2 \Rightarrow N$ $\quad 1N = \frac{1}{4.448} lbs$

$E \triangleq lbs \cdot m$ $\quad \left(\frac{1}{4.448} \times 32.88\right) = 0.7376 lbs \cdot ft$

$\Rightarrow 20 \times 0.7376 = 14.751 lbs \cdot ft$

Problem 3

- The force of gravity that acts on an object on the surface of Mars is 20 N. What force of gravity will act on the same object on the surface of the Earth? (use gravitational field strength g = 9.8 N/Kg on the surface of the Earth).

M_mars (= 6.39×10^{23}kg) is the mass of Mars, R_mars (= 3.39×10^{6}m)

$$F_{mar} = G\frac{m_o m_{mar}}{r_m^2} \Rightarrow m_o = \frac{F_{mar} r_m^2}{G m_{mar}} = 5.3926 kg$$

$$F_{Ear} = G\frac{m_o m_{ear}}{r_e^2} = \underbrace{\frac{G m_{ear}}{r_e^2}}_{g} m_o = 52.8748 N$$