Physics

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Sept. 26, 2015

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1. a $250\,\not{s}\left(\frac{1\,\mu s}{10^{-6}\,\not{s}}\right) = 250 \times 10^{6}\,\mu s$

$$\boxed{250\,s = 2.5 \times 10^{8}\,\mu s}$$

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$1\,\mu s = 10^{-6}\,s$

b. $250\,\not{s}\left(\frac{1\,ms}{10^{-3}\,\not{s}}\right) = 250 \times 10^{3}\,ms$

$$\boxed{250\,s = 2.5 \times 10^{5}\,ms}$$

$1\,ms = 10^{-3}\,s$

c. $250\,\not{s}\left(\frac{1\,ks}{10^{3}\,\not{s}}\right) = 250 \times 10^{-3}\,ks$

$$\boxed{250\,s = 2.5 \times 10^{-1}\,ks}$$

$1\,ks = 10^{3}\,s$

d. $250\,\not{s}\left(\frac{1\,Ms}{10^{6}\,\not{s}}\right) = 250 \times 10^{-6}\,Ms$

$$\boxed{250\,s = 2.5 \times 10^{4}\,Ms}$$

$1\,Ms = 10^{6}\,s$

2. $E = 150\,MJ\left(\frac{10^{6}\,J}{1\,MJ}\right)\left(\frac{1\,mJ}{10^{-3}\,J}\right)$

$E = 150 \times 10^{9}\,mJ$

$$\boxed{E = 1.5 \times 10^{11}\,mJ}$$

$1\,MJ = 10^{6}\,J$
$1\,mJ = 10^{-3}\,J$

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3. $m = 10.2\ \text{mg}\left(\frac{10^{-3}\,\text{g}}{1\,\text{mg}}\right)\left(\frac{1\,\text{kg}}{10^{3}\,\text{g}}\right)$

$1\,\text{mg} = 10^{-3}\,\text{g}$

$1\,\text{kg} = 10^{3}\,\text{g}$

$m = 10.2 \times 10^{-6}\ \text{kg}$

$\boxed{m = 1.02 \times 10^{-5}\ \text{kg}}$

4. $A = 23.5\ \text{cm}^2\left(\frac{10^{-2}\,\text{m}}{1\,\text{cm}}\right)^2$

$1\,\text{cm} = 10^{-2}\,\text{m}$

$= 23.5\ \text{cm}^2\left(\frac{10^{-4}\,\text{m}^2}{1\,\text{cm}^2}\right)$

$= 23.5 \times 10^{-4}\ \text{m}^2$

$\boxed{A = 2.35 \times 10^{-3}\ \text{m}^2}$

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9. $T = 2\pi\sqrt{\frac{l}{g}}$

T is in units of time (s).
l, a length is in units of length (m).
g, an accelation is in m/s^2 or $m\,s^{-2}$.

I can ignore the 2π, because it does not carry any units. (True for all unitless quantities).

$\sqrt{\frac{l}{g}} \propto \sqrt{\frac{m}{m\,s^{-2}}} = \sqrt{s^2} = s$ ✓

So T (s) is homgeneous with $\sqrt{\frac{l}{g}}$ (s).

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5. Perform the following conversions. Show all units and cancellations.

a) $25 \frac{km}{h} \left(\frac{1000 m}{1 km}\right)\left(\frac{1 h}{60 min}\right)\left(\frac{1 min}{60 s}\right) = 6.9 m/s$

b) $150 \frac{km}{h} \left(\frac{1000 m}{1 km}\right)\left(\frac{1 h}{3600 s}\right) = 41.7 m/s$

c) $2.0 \frac{m}{s} \left(\frac{1 km}{1000 m}\right)\left(\frac{3600 s}{1 h}\right) = 7.2 km/h$

d) $50 \frac{m}{s} \left(\frac{1 km}{1000 m}\right)\left(\frac{3600 s}{1 h}\right) = 180 km/h$

6. Given that $1 J = 1 kg\, m^2/s^2$, verify the homogeneity of the formula for kinetic energy.

$E_k = \frac{1}{2} m v^2 \propto kg \left(\frac{m}{s}\right)^2 \Rightarrow kg \cdot \frac{m^2}{s^2}$ ✓

m in kg
v in m/s

7. Write the names of the following units using the submultiple prefixes defined by the SI.

a) $\ell = 10^{-6} m$ = 1 micrometer (= 1 μm)
b) $t = 10^{-15} s$ = 1 femtosecond (= 1 fs)
c) $m = 10^{-9} kg$ = 1 microgram (= 1 μg)

8. Write the symbols for the names of the following units using the symbols for the multiple prefixes defined by SI.

a) $\ell = 10^{3} m$ = 1 km
b) $E = 10^{6} J$ = 1 MJ
c) $P = 10^{9} W$ = 1 GW