Section (1)

Physics (I)

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Question 1:

Which of the following equations are dimensionally correct?

(a) $v_f = v_i + ax$

(b) $y = (2m)\cos(kx), where\ k = 2m^{-1}$

Solution Q1:

(a) $v_f = v_i + ax$

This is incorrect since the dimensions of [ax] are L^2/T^2, while the dimensions of [*v*] are L / T.

(b) $y = (2m)\cos(kx), where\ k = 2m^{-1}$

This is correct since the dimension of [*y*] *are L*, and $\cos(kx)$ is dimensionless if k is in m^{-1}.

Question 2:

a) A worker is to paint the walls of a square room 8.00 ft high and 12.0 ft along each side. What surface area in square meters must she cover?

b) The volume of a wallet is $8.50\ in^3$ Convert this value to m^3, using the definition $1\ in. = 2.54\ cm.$

Solution Q2:

a) Each of the four walls has area $(8.00\ ft)(12.0\ ft) = 96.0\ ft^2$ .Together, they have area $4(96.0\ ft^2)\left(\frac{1\ m}{3.28\ ft}\right)^2 = 35.7\ m^2$

b) $8.50 = in.^3 = 8.50\ in.^3\left(\frac{0.0254\ m}{1\ in.}\right)^3 = 1.39 \times 10^{-4}\ m^3$

Question 3:

41. The distance from our Galaxy to the Andromeda galaxy is 2.2×10^6 light-years. Express this distance in meters.

Answer:

The distance is 2.2×10^6 (ly) $\times 3 \times 10^8$ (m/s) $\times 365 \times 24 \times 60 \times 60 = 2.1 \times 10^{22}$ m.

Suppose we are told that the acceleration a of a particle moving with uniform speed v in a circle of radius r is proportional to some power of r, say r^n, and some power of v, say v^m. Determine the values of n and m and write the simplest form of an equation for the acceleration.

Solution Let us take a to be

$$a = kr^n v^m$$

where k is a dimensionless constant of proportionality. Knowing the dimensions of a, r, and v, we see that the dimensional equation must be

$$\frac{\mathrm{L}}{\mathrm{T}^2} = \mathrm{L}^n\left(\frac{\mathrm{L}}{\mathrm{T}}\right)^m = \frac{\mathrm{L}^{n+m}}{\mathrm{T}^m}$$

This dimensional equation is balanced under the conditions

$$n + m = 1 \quad \text{and} \quad m = 2$$

Therefore $n = -1$, and we can write the acceleration expression as

$$a = kr^{-1}v^2 = k\frac{v^2}{r}$$

When we discuss uniform circular motion later, we shall see that $k = 1$ if a consistent set of units is used. The constant k would not equal 1 if, for example, v were in km/h and you wanted a in m/s^2.

A nanosecond is:

A. 10^{9} s
B. 10^{-9} s
C. 10^{-10} s
D. 10^{-10} s
E. 10^{-12}

Ans: B

Suppose $A = B^n C^m$, where A has dimensions LT, B has dimensions L^2T^{-1}, and C has dimensions LT^2. Then the exponents n and m have the values:

A. 2/3; 1/3
B. 2; 3
C. 4/5; −1/5
D. 1/5; 3/5
E. 1/2; 1/2

Ans: D