Section (2)

Physics (I)

Done By: Noha Younis

Revision question

Suppose $A = BC$, where A has the dimension L/M and C has the dimension L/T. Then B has the dimension:

A. T/M
B. L^2/TM
C. TM/L^2
D. L^2T/M
E. M/L^2T

Ans: A

1) The speed-skating record for women is held by Bonnie Blair, who completed a 500-m race in 39.10 s. What is the corresponding average speed? Give the answer in m/s and in km/h.

Solution:

$$Average\ speed = \frac{total\ distannce}{time\ taken} = \frac{500}{39.1} = 12.8\frac{m}{s} = 12.8 \times \frac{3600}{1000} = 46.0\frac{km}{h}$$

2) A particle moves along the x axis, with the following equation for the position as a function of time:

$$x = 2.0 + 6.0t - 3.0t^2$$

where x is measured in meters and t is measured in seconds.

(a) What is the position of the particle at $t = 0.50$ s?

(b) What is the instantaneous velocity at this time?

(c) What is the instantaneous acceleration at this time?

Solution:

(a) The position at t = 0.5 s is: $x = 2.0 + 6.0 \times 0.5 - 3.0 \times 0.5^2 = 4.3\,m$

(b) The instantaneous velocity at t = 0.5 s is:

$$v = \frac{dx}{dt} = 6.0 - 6.0t = 6 - 6 \times 0.5 = 3.00\ m/s$$

(c) The instantaneous acceleration at t = 0.5 s is:

$$a = \frac{dv}{dt} = -6.0\ m/s^2$$

101. A particle is initially at rest. Beginning at $t = 0$, it begins moving, with an acceleration given by $a = a_o\{1 - [t^2/(4.0s^2)]\}$ for $0 \le t \le 2$ s and $a = 0$ thereafter. The initial value is $a_o = 20\ m/s^2$. What is the particle's velocity after 1.0 s? After a long time? How far has the particle traveled after 2.0 s?

Answer:

$$v = \int a\,dt = \int a_o\left\{1 - \left[\frac{t^2}{(4.0s^2)}\right]\right\}dt$$

$$v = a_o\left\{t - \left[\frac{t^3}{(12s^2)}\right]\right\}$$

After 1.0 s:

$$v = 20\left\{1 - \left[\frac{1}{(12)}\right]\right\} = 18.3\frac{m}{s}$$

$$v = 20\left\{2 - \left[\frac{8}{(12)}\right]\right\} = 26.7\ m/s$$

$$x = \int v dt = \int a_o\left\{t - \left[\frac{t^3}{(12s^2)}\right]\right\}dt = a_o\left\{\frac{t^2}{2} - \left[\frac{t^4}{(48s^2)}\right]\right\}$$

At $t = 2$ s:

$$x = 20\left\{\frac{2^2}{2} - \left[\frac{2^4}{(48)}\right]\right\} = 33.3\ m$$

A particle moves along the x axis from x_i to x_f. Of the following values of the initial and final coordinates, which results in the displacement with the largest magnitude?

A. $x_i = 4\,\text{m},\ x_f = 6\,\text{m}$
B. $x_i = -4\,\text{m},\ x_f = -8\,\text{m}$
C. $x_i = -4\,\text{m},\ x_f = 2\,\text{m}$
D. $x_i = 4\,\text{m},\ x_f = -2\,\text{m}$
E. $x_i = -4\,\text{m},\ x_f = 4\,\text{m}$

Ans: E

A particle moves along the x axis from x_i to x_f. Of the following values of the initial and final coordinates, which results in a negative displacement?

A. $x_i = 4\,\text{m},\ x_f = 6\,\text{m}$
B. $x_i = -4\,\text{m},\ x_f = -8\,\text{m}$
C. $x_i = -4\,\text{m},\ x_f = 2\,\text{m}$
D. $x_i = -4\,\text{m},\ x_f = -2\,\text{m}$
E. $x_i = -4\,\text{m},\ x_f = 4\,\text{m}$

Ans: B

Each of four particles move along an x axis. Their coordinates (in meters) as functions of time (in seconds) are given by

particle 1: $x(t) = 3.5 - 2.7t^3$
particle 2: $x(t) = 3.5 + 2.7t^3$
particle 3: $x(t) = 3.5 + 2.7t^2$
particle 4: $x(t) = 3.5 - 3.4t - 2.7t^2$

Which of these particles have constant acceleration?

A. All four
B. Only 1 and 2
C. Only 2 and 3
D. Only 3 and 4
E. None of them

Ans: D