الجامعة المصرية
للتعلم الإلكتروني الأهلية

EELU
THE EGYPTIAN E-LEARNING UNIVERSITY

Section 3

Physics (I)

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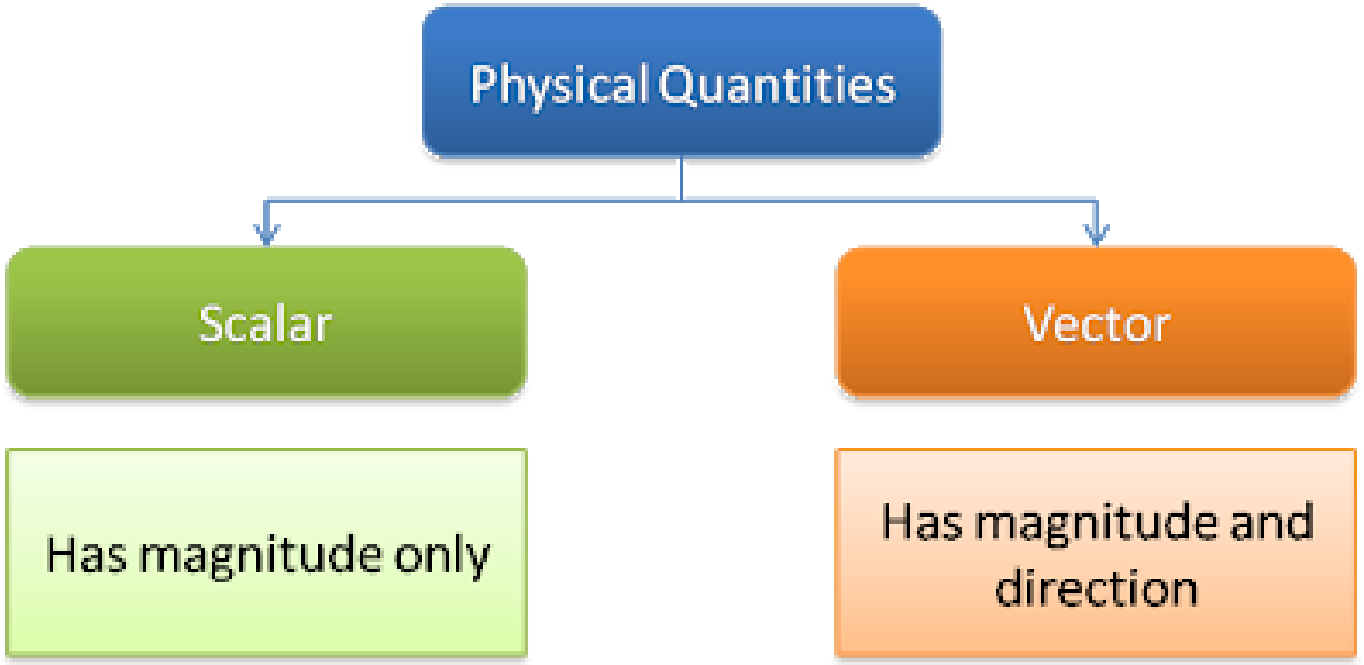
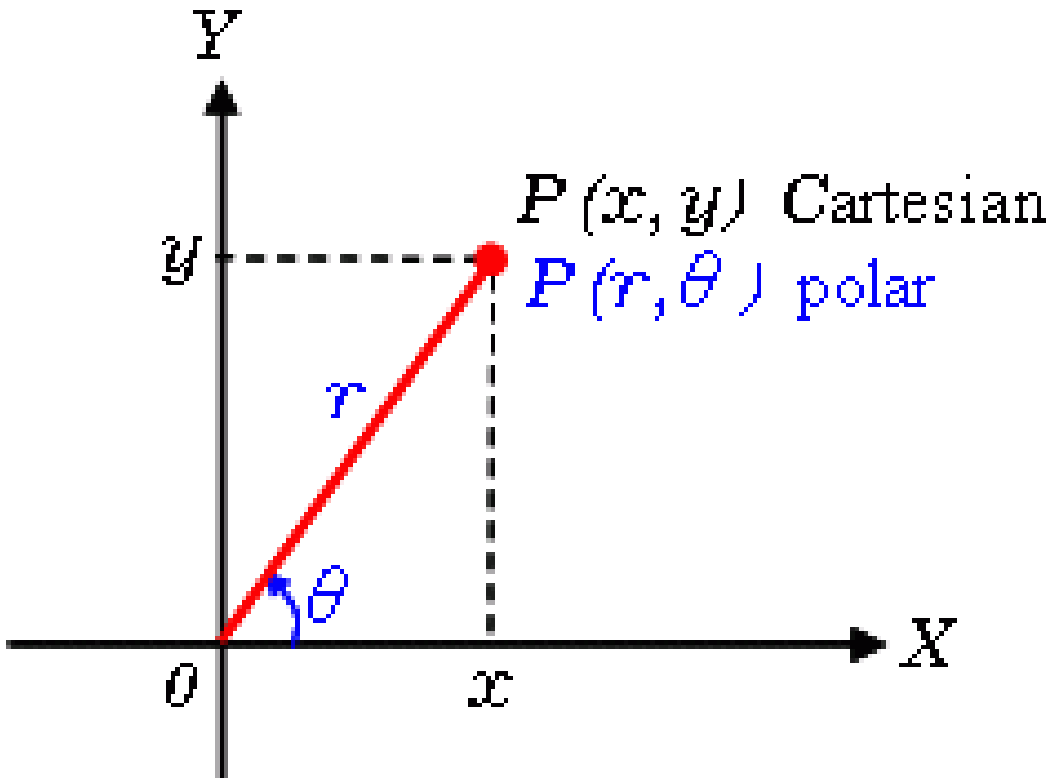
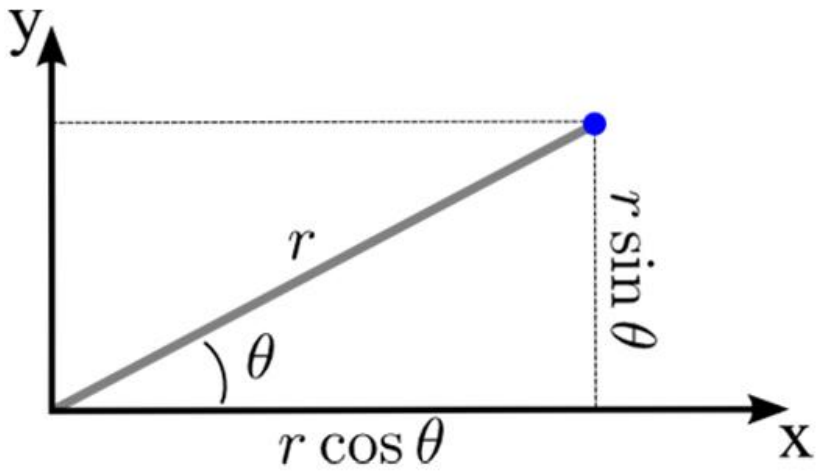


Ex: Mass, Length, Area, Volume, Spead, Temperature, Density, Energy, … etc.

Ex: Displacement, Velocity, Acceleration, Force, Momentum, … etc.

Cartesian and polar coordintaes





Convert Polar to Cartesian

$$x = r\cos\theta$$

$$y = r\sin\theta$$

Convert Cartesian to Polar

$$r = \sqrt{x^2 + y^2}$$

$$\theta = \tan^{-1}\frac{y}{x}$$

5. If the rectangular coordinates of a point are given by $(2, y)$ and its polar coordinates are $(r, 30°)$, determine y and r.

P3.5 We have $2.00 = r\cos 30.0°$

$$r = \frac{2.00}{\cos 30.0°} = \boxed{2.31}$$

and $y = r\sin 30.0° = 2.31\sin 30.0° = \boxed{1.15}$.

Motion in one dimension with constant acceleration

1. $v = v_0 + at$
2. $\Delta x = (\frac{v + v_0}{2})t$
3. $\Delta x = v_0 t + \frac{1}{2}at^2$
4. $v^2 = v_0^2 + 2a\Delta x$

An object is thrown vertically downward with an initial speed 1 m/s. After 5 s the object will have travelled:

This is a free fall motion so we can apply the following equation:

$$y = v_o t - \frac{1}{2} g t^2$$

With $t = 5s, v_o = -1\ m/s$ because it's downward, and $g = 9.8\ m/s^2$

$$y = -1 \times 5 - \frac{1}{2} 9.8 \times 5^2 = -127.5 \cong -128m$$

An object moving with uniform acceleration has a velocity of 12.0 cm/s in the positive x direction when its x coordinate is 3.00 cm. If its x coordinate 2.00 s later is -5.00 cm, what is its acceleration?

Solution:

Given $v_i = 12.0$ cm/s when $x_i = 3.00$ cm$(t = 0)$, and at $t = 2.00$ s, $x_f = -5.00$ cm,

$$x_f - x_i = v_i t + \frac{1}{2}at^2 : -5.00 - 3.00 = 12.0(2.00) + \frac{1}{2}a(2.00)^2$$

$$-8.00 = 24.0 + 2a \qquad a = -\frac{32.0}{2} = \boxed{-16.0 \text{ cm/s}^2}.$$

3) An electron in a cathode ray tube (CRT) accelerates from 2.00×10^4 m/s to 6.00×10^6 m/s over 1.50 cm. (a) How long does the electron take to travel this 1.50 cm? (b) What is its acceleration?

We have $v_i = 2.00 \times 10^4 \text{ m/s}$, $v_f = 6.00 \times 10^6 \text{ m/s}$, $x_f - x_i = 1.50 \times 10^{-2} \text{ m}$.

(a) $$x_f - x_i = \frac{1}{2}(v_i + v_f)t : t = \frac{2(x_f - x_i)}{v_i + v_f} = \frac{2(1.50 \times 10^{-2} \text{ m})}{2.00 \times 10^4 \text{ m/s} + 6.00 \times 10^6 \text{ m/s}} = \boxed{4.98 \times 10^{-9} \text{ s}}$$

(b) $$v_f^2 = v_i^2 + 2a_x(x_f - x_i):$$

$$a_x = \frac{v_f^2 - v_i^2}{2(x_f - x_i)} = \frac{(6.00 \times 10^6 \text{ m/s})^2 - (2.00 \times 10^4 \text{ m/s})^2}{2(1.50 \times 10^{-2} \text{ m})} = \boxed{1.20 \times 10^{15} \text{ m/s}^2}$$

MCQ

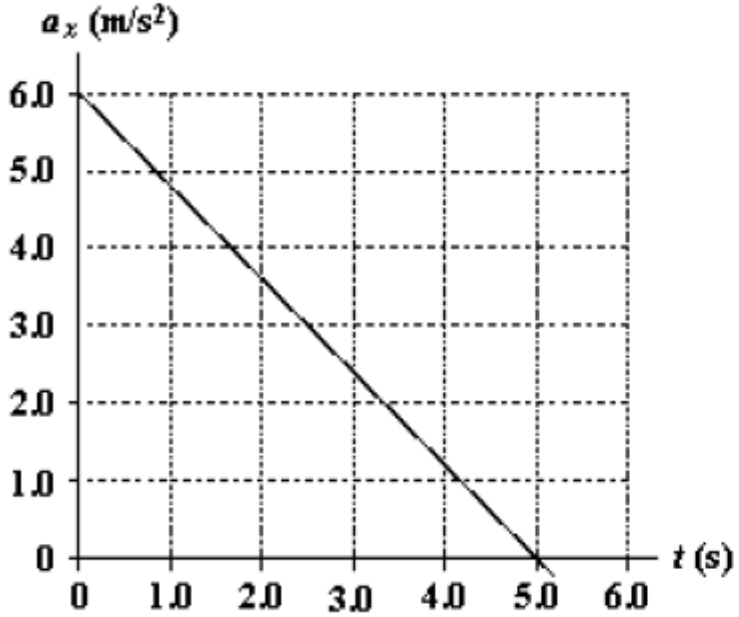
The position of a particle moving along the x axis is given by $x = (21 + 22t - 6.0t^2)$m, where t is in s. What is the average velocity during the time interval $t = 1.0$ s to $t = 3.0$ s?

−6.0 m/s	a.
−4.0 m/s	b.
−2.0 m/s	c.
−8.0 m/s	d.
8.0 m/s	e.

The position of a particle as it moves along the x axis is given by $x = 15e^{-2t}$ m, where t is in s. What is the acceleration of the particle at $t = 1.0$ s?

22 m/s^2	a.
60 m/s^2	b.
8.1 m/s^2	c.
15 m/s^2	d.
35 m/s^2	e.

At $t = 0$, a particle is located at $x = 25$ m and has a velocity of 15 m/s in the positive x direction. The acceleration of the particle varies with time as shown in the diagram. What is the velocity of the particle at $t = 5.0$ s?



+15 m/s	a.
−15 m/s	b.
+30 m/s	c.
0	d.
−1.2 m/s	e.

A proton moving along the x axis has an initial velocity of 4.0×10^6 m/s and a constant acceleration of 6.0×10^{12} m/s^2. What is the velocity of the proton after it has traveled a distance of 80 cm?

5.1×10^6 m/s	a.
6.3×10^6 m/s	b.
4.8×10^6 m/s	c.
3.9×10^6 m/s	d.
2.9×10^6 m/s	e.