Problem Set I

University Physics 1
February 3, 2026

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Problem 1:

A sports car starts from rest and accelerates uniformly at $5.0\ m/s^2$. Calculate the distance the car travels in the first 4.0 seconds.

Solution

We are given the following values:

- Initial velocity $v_0 = 0\,\text{m/s}$
- Acceleration $a = 5.0\,\text{m/s}^2$
- Time $t = 4.0\,\text{s}$

We use the kinematic equation for displacement:

$$d = v_0 t + \frac{1}{2}at^2$$
$$d = (0)(4.0) + \frac{1}{2}(5.0)(4.0)^2$$
$$d = 0 + 0.5(5.0)(16)$$
$$d = 40\,\text{m}$$

Answer:

$d = 40\,\text{m}$

Problem 2:

Vector $\vec{A}$ has a magnitude of 10 units pointing East. Vector $\vec{B}$ has a magnitude of 15 units at 60° North of East. Find the magnitude of the resultant vector $\vec{R} = \vec{A} + \vec{B}$. Include a vector diagram.

Solution

First, we resolve the vectors into components:

$$A_x = 10, \quad A_y = 0$$
$$B_x = 15\cos(60^\circ) = 7.5$$
$$B_y = 15\sin(60^\circ) \approx 12.99$$

Summing the components:

$$R_x = 10 + 7.5 = 17.5$$
$$R_y = 0 + 12.99 = 12.99$$

Calculating the magnitude:

$$|\vec{R}| = \sqrt{(17.5)^2 + (12.99)^2} \approx 21.79$$

Vector Diagram: *(Diagram not accurate. Example use only.)*

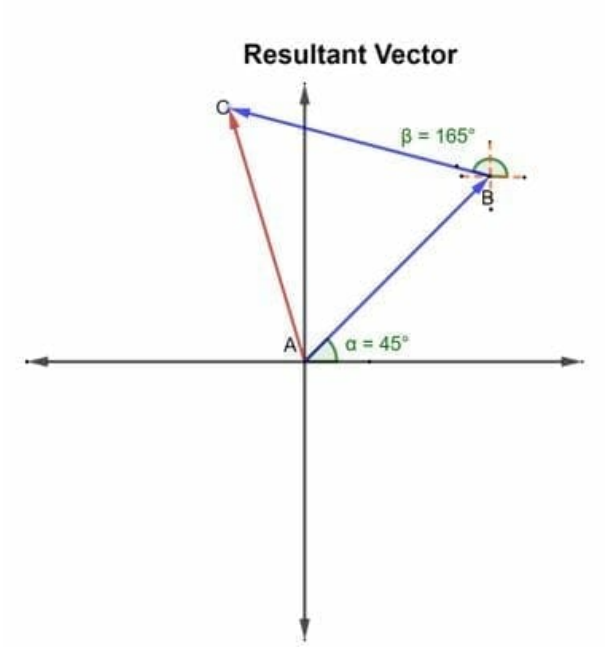


Figure 1: Example of captioned figure.

Answer:

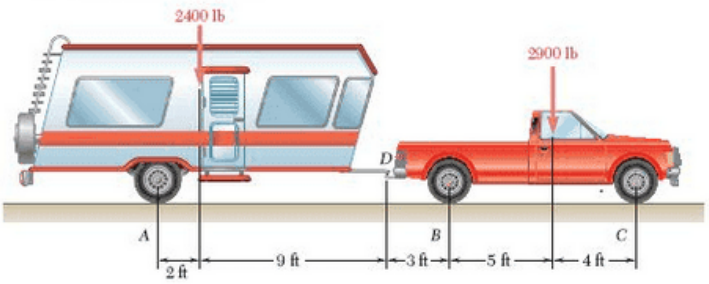
$|\vec{R}| \approx 21.8$ units

Problem 3:

A crate of mass m sits on the back of a flatbed truck as shown in the figure below. If the truck accelerates to the right at $a = 3\,m/s^2$, what is the minimum coefficient of static friction μ_s required to keep the crate from sliding off?

Solution

Refer to the diagram of the truck below: *(Diagram not accurate. Example use only.)*



For the crate to move with the truck without sliding, the static friction force f_s must provide the acceleration. Using Newton's Second Law in the horizontal direction:

$$f_s = ma$$

The maximum static friction is $f_{s,max} = \mu_s N$. Since the vertical forces balance, $N = mg$. Therefore:

$$\begin{aligned} \mu_s mg &= ma \\ \mu_s g &= a \\ \mu_s &= \frac{a}{g} = \frac{3.0}{9.8} \approx 0.306 \end{aligned}$$

Answer:

$\mu_s \approx 0.31$

Problem 4:

Problem statement/details.

Solution

– Solution Content –

You can do anything here.

$$e = mc^2$$

Answer:

Answer example