Solutions

PHYS-203A-002 (Midterm Exam 01) Fall 2020

Problem 1

Example: volume

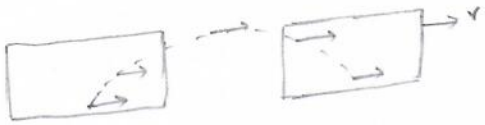
$$13\ m^3 = 13\ (100\ cm)^3$$
$$= 1.3 \times 10^7\ cm^3$$

Problem 2

Both reach the same height. Kinematics equations do not have any dependence on mass.

Problem 3

The orange will return back to his hands.



The horizontal velocity of orange and vehicle is same.

Problem 4

The ball will hit the target. The ball, the student, and the target, are falling.

Problem 5

$$[E] = [m^2 c^4]^{\frac{1}{2}} \Rightarrow M L^2 T^{-2} = M [c]^2$$

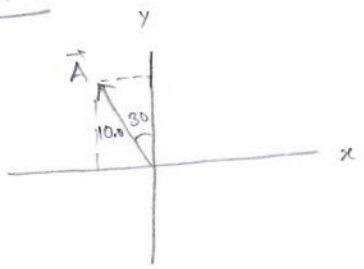
$$\Rightarrow [c] = L T^{-1}$$

$$[E] = [p^2 c^2]^{\frac{1}{2}} \Rightarrow M L^2 T^{-2} = [p][c]$$

$$\Rightarrow M L^2 T^{-2} = [p] L T^{-1}$$

$$\Rightarrow [p] = M L T^{-1}$$

Problem 6

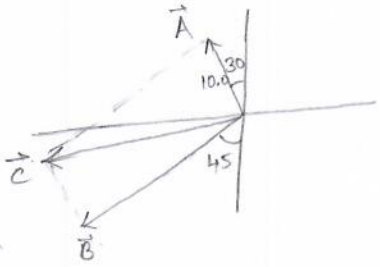


$$\vec{A} = A_x \hat{i} + A_y \hat{j}$$

$$A_x = -10.0 \sin 30.0 = -5.00 \text{ m}$$

$$A_y = +10.0 \cos 30.0 = +8.66 \text{ m}$$

Problem 7



$$\vec{A} = -10.0 \sin 30.0 \, \hat{i} + 10.0 \cos 30.0 \, \hat{j}$$

$$= -5.00 \, \hat{i} + 8.66 \, \hat{j}$$

$$\vec{B} = -20.0 \cos 45.0 \, \hat{i} - 20.0 \sin 45.0 \, \hat{j}$$

$$= -14.1 \, \hat{i} - 14.1 \, \hat{j}$$

$$\vec{C} = \vec{A} + \vec{B} = -19.1 \, \hat{i} - 5.44 \, \hat{j}$$

magnitude: $|\vec{C}| = \sqrt{(-19.1)^2 + (-5.44)^2} = 19.9 \text{ m}$

direction: $\theta = \tan^{-1}\left(\frac{5.44}{19.1}\right) = 15.9^\circ$ counterclockwise with respect to $-x$.

Problem 8

(a) 0

(b) $9.8 \frac{m}{s^2}$ downwards.

Problem 9

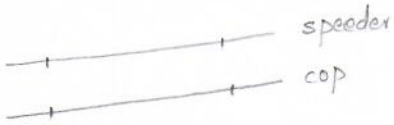
$\Delta y = ?$ $\quad V_i = +15 \frac{m}{s}$ $\quad a = -9.8 \frac{m}{s^2}$

$\Delta t =$ $\quad V_f = 0$

$$2a\,\Delta y = V_f^2 - V_i^2$$

$$2(-9.8)\,\Delta y = 0 - 15^2 \quad \Rightarrow \quad \Delta y = 12\ m.$$

Problem 10



speeder : $\Delta x_s = V_s\,\Delta t$

cop : $\Delta x_c = V_c\,\Delta t + \frac{1}{2} a\,\Delta t^2$

$$\Delta x_c = \Delta x_s$$

$$V_c\,\Delta t + \frac{1}{2} a\,\Delta t^2 = V_s\,\Delta t$$

$$30.0\Delta t + \frac{1}{2}(3.0)\,\Delta t^2 = 40.0\,\Delta t$$

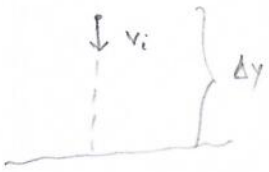
$$\frac{1}{2}(3.0)\,\Delta t^2 = 10.0\,\Delta t$$

$$\Delta t = \frac{(10.0)\,2}{3.0} = 6.7\ sec$$

Problem 11

$\Delta y = -12.0\,m \qquad v_i = -6.0\,\frac{m}{s} \qquad a = -9.8\,\frac{m}{s^2}$

$\Delta t = ? \qquad v_f =$



$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-12.0 = -6.0\,\Delta t + \frac{1}{2}(-9.8)\,\Delta t^2$$

$$4.9\,\Delta t^2 + 6.0\,\Delta t - 12.0 = 0$$

$$\Delta t = \frac{-6.0 \pm \sqrt{(6.0)^2 - 4(4.9)(-12.0)}}{2(4.9)}$$

$= 1.1$ sec (OR) -2.3 sec ↳ not physical for this problem.

↓ answer.

Problem 12

$$\Delta y = \frac{1}{2} g \Delta t^2 \Rightarrow (0.25) = \frac{9.8}{2} \Delta t^2$$

$$\Rightarrow \Delta t = 0.226 \text{ sec}$$

$$\Delta x = v_i \Delta t$$

$$= 750\,(0.226)$$

$$= 170\,m$$

↳ answer.