Solutions

Midterm Exam 01 (PHYS-205A-001) 2022 Spring

Problem 1

Only like quantities can be added, thus,

$$[m^2 c^4] = [p^2 c^2]$$

$$[m]^2 [c]^4 = [p]^2 [c]^2$$

$$\Rightarrow [p] = [m][c]$$

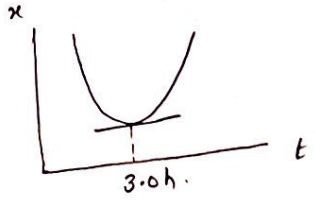
$$= M L T^{-1}$$

$\alpha = 1, \beta = 1, \gamma = -1.$

Problem 2

At $t = 3.0$ hour slope is zero.

Thus, velocity at $t = 3.0$ h is 0.



Problem 3

The orange and the car have the same velocity.

Thus, we have for,

uniform velocity — returns to hand.

accelerating forward — falls behind

accelerating backward — falls ahead.

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Problem 4

$$x(t) = 7.5t - 1.0t^3$$

$$v(t) = \frac{dx}{dt} = 7.5 - 3.0t^2$$

$$a(t) = \frac{d^2x}{dt^2} = -6.0t$$

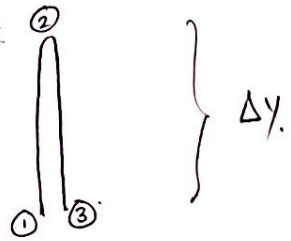
at $t = 0$ $\quad a(0) = 0.$

Problem 5

① → ③

$\Delta y = 0$ $\quad V_i = \boxed{+9.8 \frac{m}{s}}$ $\quad a = -9.8 \frac{m}{s^2}$

$\Delta t = 2.0\,s$ $\quad V_f =$



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

$$0 = V_i(2.0) - \frac{1}{2}(9.8)(2.0)^2$$

$$V_i = 9.8 \frac{m}{s}$$

① → ②

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

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

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

$$2(-9.8)\Delta y = 0^2 - (9.8)^2$$

$$\Delta y = 4.9\ m$$

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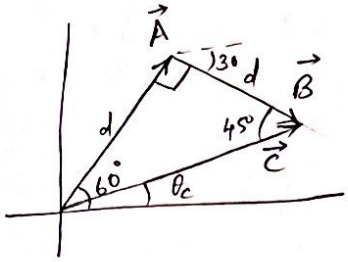
Problem 6



Using geometry of a right triangle we can conclude

$|\vec{C}| = \sqrt{2}\, d = 7.1 \text{ km}$

$\theta_c = 60° - 45° = 15°$ N of E

Using vector algebra explicitly we have

$\vec{C} = \vec{A} + \vec{B}$

$\vec{A} = 5.0 \cos 60\, \hat{i} + 5.0 \sin 60\, \hat{j}$

$= 2.5\, \hat{i} + 4.3\, \hat{j}$

$\vec{B} = 5.0 \cos 30\, \hat{i} - 5.0 \sin 30\, \hat{j}$

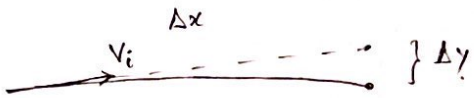
$= 4.3\, \hat{i} - 2.5\, \hat{j}$

$\vec{C} = 6.8\, \hat{i} + 1.8\, \hat{j}$

magnitude : $|\vec{C}| = \sqrt{6.8^2 + 1.8^2} = 7.0 \text{ km}$

direction $= \theta_c = \tan^{-1}\left(\frac{1.8}{6.8}\right) = 15°$ N of E.

Problem 7



$\Delta x = ?$

$\Delta t =$

$V_{ix} = 750 \frac{m}{s}$

$\Delta y = -0.25 m$

$\Delta t =$

$a = -9.8 \frac{m}{s^2}$

$V_{iy} = 0$

$V_{fy} = \text{missing}$

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

$-0.25 = 0 + \frac{1}{2}(-9.8)\, \Delta t^2$

$\Delta t = 0.23$ Seconds.

$\frac{\Delta x}{\Delta t} = V_{ix}$

$\frac{\Delta x}{0.23} = 750$

$\Delta x = 170 \text{ m}$.

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