Phys 131 2023

Review 1

Thurs: Seminar - Cover letter

Fri: Exam I

Mon: Warm Up 6

Exam: * Covers Ch 1, 2, 3, 4
Lectures 1 → 11
HW 1 → 4
Discussion / quiz 1 → 3.

* Bring - calculator (no communicating devices...
- single 3"x5" card single side.

* Study 2018, 2022 Ex I - all questions
- HW
- Discussion probs
- Quizzes
- In-class quizzes

10am class - stay in room until 10:50am

Ch 1 → 3 Know * meanings of: displacement, velocity, acceleration
* graphical representations of motion

Equations: $v_{avg} = \frac{\Delta x}{\Delta t}$ $a_{avg} = \frac{\Delta v}{\Delta t}$

v = slope of x vs t
a = slope of v vs t
Δx = area under v vs t

$v_x = v_{0x} + a_x t$
$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$
$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$

Free fall: $a_y = -g$

Quiz 1 80% → 90% | 60% → 90%

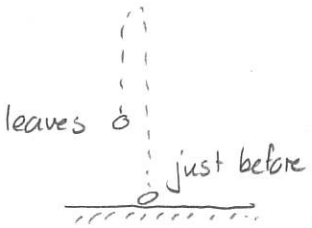
50 Ball thrown from above the ground

A ball is thrown vertically upwards, leaving the hand at a height of 1.2 m above the ground. It hits the ground 2.5 s after leaving the hand. *(131Sp2023)*

a) Determine the speed with which the ball left the hand.

b) Determine the maximum height above the ground reached by the ball.

Answer: a)



$t_0 = 0s \quad t = 2.5s$

$y_0 = 1.2m \quad y = 0m$

$V_{oy} = ?? \quad V_y =$

$a_y = -g = -9.8 m/s^2$

credit!

$y = y_0 + V_{oy} t + \frac{1}{2} a_y t^2$ credit!

$\Rightarrow 0m = 1.2m + V_{oy}(2.5s) + \frac{1}{2}(-9.8 m/s^2)(2.5s)^2$

$\Rightarrow -1.2m = 2.5s\, V_{oy} - 30.6m$

$\Rightarrow 29.4m = 2.5s\, V_{oy}$

$\Rightarrow V_{oy} = \frac{29.4\ m}{2.5\ s} = 11.8 m/s$

b) At max height $V_y = 0 \quad y = ??$

$V_y^2 = V_{oy}^2 + 2 a_y (y - y_0)$ credit!

$\Rightarrow (0 m/s)^2 = (11.8 m/s)^2 + 2(-9.8 m/s^2)(y - 1.2m)$

$\Rightarrow 0 m^2/s^2 = 139 m^2/s^2 - 19.6 m/s^2 (y - 1.2m)$

$\Rightarrow \frac{-139 m^2/s^2}{-19.6 m/s^2} = y - 1.2m \Rightarrow y = 7.07m + 1.2m$

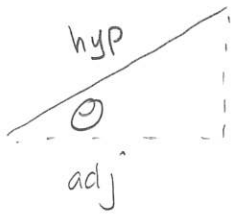
$\Rightarrow y = 8.3m$

Ch 2: Know * vector algebra

* unit vectors, components

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

$$A = \sqrt{A_x^2 + A_y^2}$$



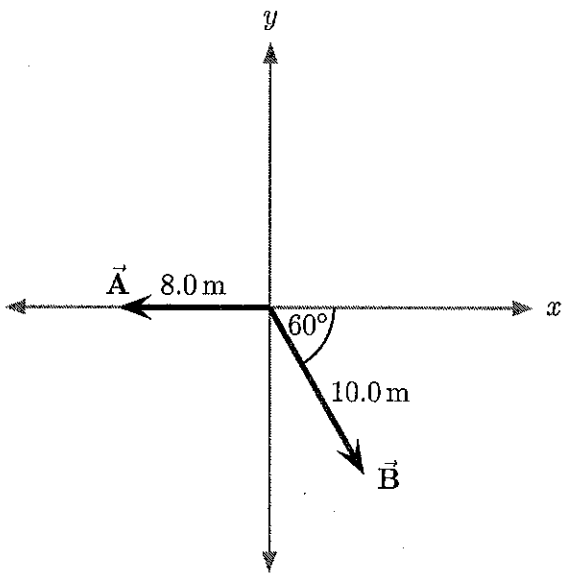
$$\sin\theta = \frac{opp}{hyp} \qquad \cos\theta = \frac{adj}{hyp}$$

$$\tan\theta = \frac{opp}{adj}$$

Quiz 2 70% - 90% } 50% → 90%

63 Vector addition: algebraic method, 2

Two displacement vectors, $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are illustrated. Determine the magnitude of $\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$. *(131Sp2023)*



We need to find the components of $\vec{C}$

$C_x = A_x + B_x$

$C_y = A_y + B_y$

Then the magnitude of $\vec{C}$ is $C = \sqrt{C_x^2 + C_y^2}$.

To get the components:

	x	y
$\vec{A}$	−8.0m	0.0m
$\vec{B}$	5.0m	−8.66m

$B_x = B\cos\theta = 10.0\text{m}\cos 60° = 5.0\text{m}$

$B_y = -B\sin\theta = 10.0\text{m}\sin 60° = -8.66\text{m}$

So $C_x = -8.0\text{m} + 5.0\text{m} = -3.0\text{m}$

$C_y = 0.0\text{m} - 8.66\text{m} = -8.7\text{m}$

The magnitude is $C = \sqrt{(-3.0\text{m})^2 + (-8.7\text{m})^2}$

$C = 9.2\text{m}$

Ch4: Know: * vector nature of displacement, velocity, acceleration.

* $\vec{v} = \frac{\Delta x}{\Delta t}\hat{i} + \frac{\Delta y}{\Delta t}\hat{j}$

* $\vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t}$

* kinematics equations: (two dimensions)

* projectile $a_x = 0$ $a_y = -g$

* circular motion $a_c = v^2/r$

Quiz 3 60% - 80% $\sum$ 30% - 40%

103 Stone thrown from a bridge

A person stands on a bridge over a small lake. The person throws a stone with speed 18.0 m/s at an angle of 40° above the horizontal. The stone leaves the hand at a height 3.0 m above the surface of the water.

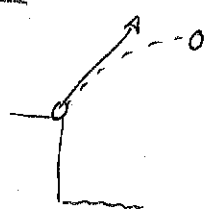
a) Determine the time taken for the stone to reach the highest point in its trajectory.

b) Determine the time taken for the stone to hit the water.

c) Determine the horizontal distance traveled by the stone between the throw and when it hits the water.

Answer:

a)



$t_0 = 0$ $\quad t = ?$

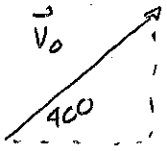
$x_0 = 0m$ $\quad x = ?$

$y_0 = 3.0m$ $\quad y = ?$

$V_{0x} = 13.8 m/s$ $\quad V_x =$

$V_{0y} = 11.6 m/s$ $\quad V_y = 0 m/s$

$a_x = 0 m/s^2$ $\quad a_y = -9.8 m/s^2$



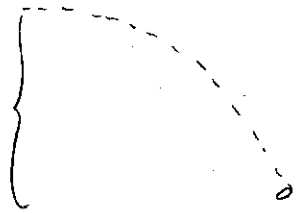
$V_{0y} = V_0 \sin 40^\circ$

$= 18.0 m/s \sin 40^\circ = 11.6$

$V_{0x} = V_0 \cos 40^\circ = 18 m/s \cos 40^\circ = 13.8$

$$V_y = V_{0y} + a_y t \Rightarrow \frac{V_y - V_{0y}}{a_y} = t \Rightarrow t = \frac{0 m/s - 11.6 m/s}{9.8 m/s^2} = 1.18 s$$

b) Find additional time for stone to drop → requires y from previous part



$x_0 = ??$

$y_0 =$ $\quad y = 0m$

$V_{0x} =$

$V_{0y} = 0 m/s$ $\quad V_y = ?$

$V_y^2 = V_{0y}^2 + 2a_y(y - y_0)$

$0 m^2/s^2 = (11.6 m/s)^2 - 2 \times 9.8 m/s^2 (y - y_0)$

$$\Rightarrow y - y_0 = \frac{-(11.6 m/s)^2}{19.6 m/s^2} = 6.87 m$$

$\Rightarrow y = 3.0m + 6.87m$

$= 9.87m$

This is the new y_0.

Then: $y = y_0 + v_{oy}t + \frac{1}{2}a_y t^2$ (y, v_{oy} are 0)

$\Rightarrow 0m = 9.87m - \frac{1}{2}(9.8m/s^2)t^2 \Rightarrow t = \sqrt{\frac{2 \times 9.87m}{9.8m/s^2}}$

$= 1.42s$

The total travel time is $1.18s + 1.42s = 2.6s$

c)

$t_0 = 0s \quad t = 2.6s$

$x_0 = 0m \quad x = ?$

$v_{ox} = 13.8m/s \quad v_x =$

$a_x = 0m/s^2$

$x = x_0 + v_{ox}t + \frac{1}{2}a_x t^2 \Rightarrow x = 13.8m/s \times 2.6s = 35.9m$