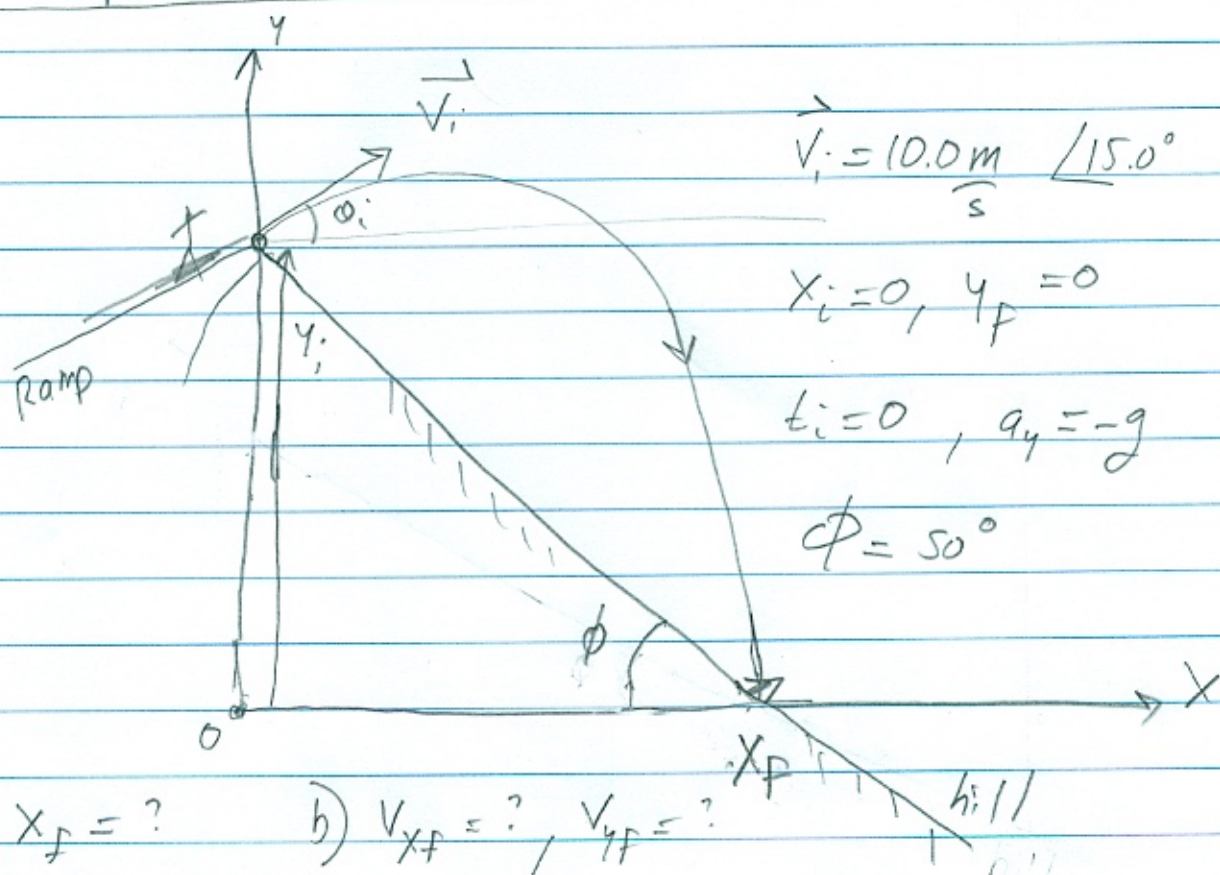


Example Problem 4.2

1-28-2021



also unknown, $y_i = ?, t_f = ?$

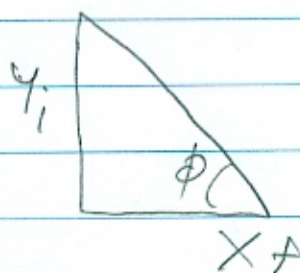
→ 5 unknowns

- 1st step, Find velocity (initial) components

$$V_{xi} = V_i \cos \theta_i = V_{xf} \quad \checkmark$$

$$V_{yi} = V_i \sin \theta_i$$

- From geometry



Example Problem 4.2 (cont'd)

1-28-2021

$$\tan \phi = \frac{y_i}{x_f} \Rightarrow x_f = \frac{y_i}{\tan \phi} \rightarrow \text{now 3 unknowns}$$

• Find $x_f = x_i + \frac{1}{2}(V_{x_i} + V_{x_f})(t_f - t_i)$ eq. 1

$$x_f = V_{x_i} t_f \quad \text{since } V_{x_i} = V_{x_f}$$

$$= \frac{y_i}{\tan \phi} \rightarrow \boxed{y_i = \tan \phi V_{x_i} t_f}$$

• Find y_i

$$y_f = y_i + V_{y_i} t_f - \frac{g}{2} t_f^2 \quad \text{eq. 2}$$

Since V_{y_i} is unknown

$$\Rightarrow y_i = y_f - \cancel{V_{y_i} t_f} + \frac{g}{2} t_f^2 = \tan \phi V_{x_i} \cancel{t_f}$$

$$\Rightarrow -V_{y_i} + \frac{g}{2} t_f = \tan \phi V_{x_i}$$

$$\text{solve for } t_f = \frac{2}{g} [\tan \phi V_{x_i} + V_{y_i}]$$

$$\text{or } t_f = \frac{2}{g} [\tan \phi V_i \cos \theta_i + V_i \sin \theta_i]$$

Example Problem 4.2 (cont'd)

1-28-2024

- Plug in numbers

$$t_f = \frac{2(10)}{9.8} \left[\tan 50^\circ \cos 15^\circ + \sin 15^\circ \right] = 2.8774 \text{ s}$$

↑
hardest part

$$\begin{aligned} x_f &= v_{xi} t_f = v_i \cos \theta_i t_f \\ &= (10) \cos 15^\circ (2.8774) = \boxed{27.78 \text{ m}} \end{aligned}$$

$$\begin{aligned} v_{yf} &= v_{yi} - g t_f = v_i \sin \theta_i - g t_f \\ &= (10) \sin 15^\circ - (9.81)(2.8774) = \boxed{-25.6 \text{ m/s}} \end{aligned}$$

$$v_{xi} = v_i \cos \theta_i = (10) \cos 15^\circ = \boxed{9.66 \text{ m/s}}$$

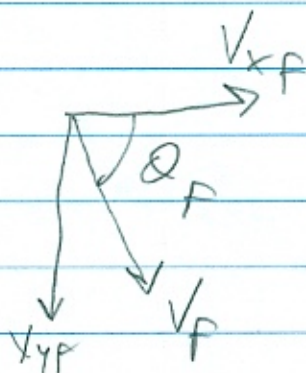
$$\boxed{\vec{v}_f = (9.66 \hat{i} - 25.6 \hat{j}) \text{ m/s}}$$

• Initial height $y_i = \tan \theta x_f$

$$y_i = \tan 50^\circ (27.78) = 33 \text{ m}$$

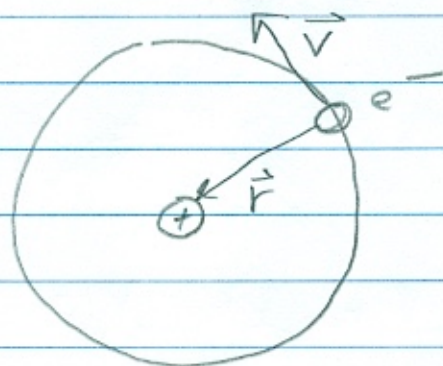
• Final velocity angle

$$\theta_f = \tan^{-1} \left(\frac{-25.6}{9.66} \right) = -69.3^\circ$$



Example Problem 4.3 The Bohr Atom 1-25-2021

$$|\vec{r}| = 0.529 \times 10^{-10} \text{ m}$$



$$= 5.29 \text{ nm}$$

(nanometers)

$$= 0.529 \text{ \AA}$$

$$1 \text{ nm} = 10^{-9} \text{ m}$$

$$1 \text{ \AA} = 10^{-10} \text{ m}$$

$$|\vec{v}| = 2.18 \times 10^6 \text{ m/s} = v_T$$

a) $v_T = r \omega$

$$\omega = \frac{v_T}{r} = \frac{2.18 \times 10^6 \text{ m/s}}{0.529 \times 10^{-10} \text{ m}} = \boxed{4.12 \times 10^{16} \frac{\text{rad}}{\text{s}}}$$

b) Period $T = \frac{2\pi r}{v} = \frac{2\pi (0.529 \times 10^{-10} \text{ m})}{2.18 \times 10^6 \text{ m/s}}$

$$= 1.52468 \times 10^{-16} \text{ s}$$

$$\text{or } \# \frac{\text{cycles}}{\text{sec}} = \frac{1}{T} = \boxed{6.559 \times 10^{15} \text{ cycles/sec}}$$