## Drawing Projectile Motion Graphs

A projectile is shot from the ground and lands on the ground. Its initial velocity is $26 \mathrm{~m} / \mathrm{s}$ at $49^{\circ}$.

1. Calculate the initial x and y velocities:
2. Calculate the time the object is in the air:
3. Calculate the range (final x position):

| $y$-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $\mathrm{y}(\mathrm{m})$ |  |  |  |  |  |  |
| $v(\mathrm{~m} / \mathrm{s})$ |  |  |  |  |  |  |

4. Fill in the data tables at the right, doing whatever additional calculations that are necessary.

| x-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $\mathrm{x}(\mathrm{m})$ |  |  |  |  |  |  |
| $v(\mathrm{~m} / \mathrm{s})$ |  |  |  |  |  |  |

5. Transfer your table information to the duplicate tables on the back.
cstephenmurray.com
Copyright © 2011, C. Stephen Murray

## Drawing Projectile Motion Graphs

A projectile is shot from the ground and lands on the ground. Its initial velocity is $26 \mathrm{~m} / \mathrm{s}$ at $49^{\circ}$.

1. Calculate the initial x and y velocities:
2. Calculate the time the object is in the air:
3. Calculate the range (final x position):

| y-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $\mathrm{y}(\mathrm{m})$ |  |  |  |  |  |  |
| $\mathrm{v}(\mathrm{m} / \mathrm{s})$ |  |  |  |  |  |  |

4. Fill in the data tables at the right, doing whatever additional calculations that are necessary.

| $x$-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $x(\mathrm{~m})$ |  |  |  |  |  |  |
| $v(\mathrm{~m} / \mathrm{s})$ |  |  |  |  |  |  |

5. Transfer your table information to the duplicate tables on the back.

| y-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $\mathrm{y}(\mathrm{m})$ |  |  |  |  |  |  |
| $v(\mathrm{~m} / \mathrm{s})$ |  |  |  |  |  |  |


| x-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $\mathrm{x}(\mathrm{m})$ |  |  |  |  |  |  |
| $\mathrm{v}(\mathrm{m} / \mathrm{s})$ |  |  |  |  |  |  |

6. Use your data tables to draw the following graphs.

cstephenmurray.com


Copyright © 2011, C. Stephen Murray

| $y$-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\mathrm{sec})$ | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |  |
| $\mathrm{a}\left(\mathrm{m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $\mathrm{y}(\mathrm{m})$ |  |  |  |  |  |  |
| $v(\mathrm{~m} / \mathrm{s})$ |  |  |  |  |  |  |


| x-direction |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t(\sec )$ | 0 | $t / 4$ | $t / 2$ | $3 t / 4$ | $t$ |  |
| $a\left(\mathrm{~m} / \mathrm{s}^{2}\right)$ |  |  |  |  |  |  |
| $x(\mathrm{~m})$ |  |  |  |  |  |  |
| $v(\mathrm{~m} / \mathrm{s})$ |  |  |  |  |  |  |

6. Use your data tables to draw the following graphs.


## Drawing Projectile Motion Graphs

A projectile is shot from the ground and lands on the ground. Its initial velocity is $26 \mathrm{~m} / \mathrm{s}$ at $49^{\circ}$.

1. Calculate the initial x and y velocities:

$$
\begin{aligned}
& \text { Calculate the initial } x \text { and } y \text { velocities: } \\
& V_{y}=26 \sin 49^{\circ}=19.6 \mathrm{~m} / \mathrm{s} \mid V_{x}=26 \cos 49^{\circ}=17.1 \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

2. Calculate the time the object is in the air:

$$
\begin{aligned}
V_{F} & =V_{i}+2 t \\
-19.6 & =19.6-9.8 t \\
-39.2 & =-9.8 t
\end{aligned} \quad t=4 \sec
$$

| y -direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| $\mathrm{a} \mathrm{m} / \mathrm{s}^{2}$ | -8 | - | - |  | $\rightarrow$ |
| $\mathrm{y}(\mathrm{m} / \mathrm{m}$ | 0 | 14.7 m | 19.6 | 14.7 | 0 |
| $\mathrm{v} / \mathrm{m} / \mathrm{s}$ | 19.6 | $9.8 \mathrm{~m} / \mathrm{s}$ | 0 | -9.8 | -19.6 |

3. Calculate the range (final $x$ position):

$$
S=\frac{D}{T} \quad D=5 T=17.1(4)=68.4 \mathrm{~m}
$$

4. Fill in the data tables at the right, doing whatever additional calculations that are necessary.

| x -direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| a | 0 | - |  |  | $\rightarrow$ |
| $\mathrm{x}(\mathrm{m})$ | 0 | 17.1 | 34.2 | 51.3 | 68.4 |
| v | 17.1 |  |  |  | $\rightarrow$ |

$$
\begin{gathered}
V_{F}^{2}=V_{i}^{2}+2 \Delta \Delta y \text { (at top) } \\
0=19.6^{2}+2(-a .8) \Delta y \\
0=384.16-19.6 \Delta y \\
-384.16=-19.6 \Delta y \\
\Delta y=19.6 \mathrm{~m}
\end{gathered}
$$

$$
\begin{aligned}
& \Delta y=v_{i} t+\frac{1}{2} \partial t^{2} \\
& \Delta y=19.6(1)-4.9\left(1^{2}\right) \\
& \Delta y=14.7 \mathrm{~m} \\
& \text { Uat lsec: } \\
& V_{F}=v_{i}+2 t=19.6-9,8(1) \\
& \left.\begin{array}{l}
=9.8 \mathrm{~m} / \mathrm{s} \\
\partial t \quad 3 s e= \\
\Delta y=v_{i} t+\frac{1}{2} \partial t^{2}, ~
\end{array} \quad \begin{aligned}
\Delta y & =19.6(3)-4.9\left(3^{2}\right) \\
\Delta y & =14.7 \mathrm{~m}
\end{aligned} \right\rvert\, \begin{aligned}
v_{f} & =v_{1}+2 t \\
v_{F} & =19.6-9.8(3) \\
& =-9.8 \mathrm{~m} / \mathrm{s}
\end{aligned}
\end{aligned}
$$

5. Transfer your table information to the duplicate tables on the back.
cstephenmurray.com
Copyright © 2011, C. Stephen Murray

## Drawing Projectile Motion Graphs

A projectile is shot from the ground and lands on the ground. Its initial velocity is $26 \mathrm{~m} / \mathrm{s}$ at $49^{\circ}$.

1. Calculate the initial $x$ and $y$ velocities:
$V_{y}=26 \sin 49^{\circ}=19.6 \mathrm{~m} / \mathrm{s} \mid V_{x}=26 \cos 49^{\circ}=17.1 \mathrm{~m} / \mathrm{s}$
2. Calculate the time the object is in the air:
$V_{F}=V_{i}+2 t$

$$
\begin{aligned}
V F & =v .12 t \\
-19.6 & =19.6-9.8 t \\
-39.2 & =-9.8 t
\end{aligned} \quad t=45 e c
$$

| y -direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| $\mathrm{a} \mathrm{m} / \mathrm{s}^{2}$ | -8 | - | - | - | $\rightarrow$ |
| $\mathrm{y}(\mathrm{mm})$ | 0 | 14.7 m | 19.6 | 14.7 | 0 |
| $\mathrm{v} \mathrm{m} / \mathrm{s}$ | 19.6 | $9.8 \mathrm{~m} / \mathrm{s}$ | 0 | -9.8 | -19.6 |

3. Calculate the range (final $x$ position):

$$
S=\frac{D}{T} \quad D=5 T=17.1(4)=68.4 \mathrm{~m}
$$

4. Fill in the data tables at the right, doing whatever additional calculations that are necessary.

$$
\begin{gathered}
V_{f}^{2}=V_{i}^{2}+2 \Delta \Delta y(a t \text { top) } \\
0=19.6^{2}+2(-9.8)^{\Delta y} \\
0=384.16-19.6 \Delta y \\
-384.16=-19.6 \Delta y \\
\Delta y=19.6 \mathrm{~m}
\end{gathered}
$$

$$
\begin{aligned}
& \text { at } 1 \leq=<= \\
& \text { at isec= } \\
& \Delta y=v_{i} t+\frac{1}{2} \partial t^{2} \\
& \Delta y=19.6(1)-4.9\left(1^{2}\right) \\
& \Delta y=14.7 \mathrm{~m} \\
& \text { Vat isec: } \\
& V_{F}=v_{i}+2 t=19.6-9.8(1)
\end{aligned}
$$

5. Transfer your table information to the duplicate tables on the back.

| y-direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| $\mathrm{a} \mathrm{m} / \mathrm{s}^{2}$ | $-马$ | - |  | - | $\rightarrow$ |
| $\mathrm{y}(\mathrm{m})$ | 0 | 14.7 m | 19.6 | 14.7 | 0 |
| $\mathrm{v} \mathrm{m} / \mathrm{s}$ | 19.6 | $9.8 \mathrm{~m} / \mathrm{s}$ | 0 | -9.8 | -19.6 |


| x -direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| a | 0 | - |  |  | $\rightarrow$ |
| $\mathrm{x}(\mathrm{m})$ | 0 | 17.1 | 34.2 | 51.3 | 68.4 |
| v | 17.1 |  |  |  | $\rightarrow$ |


cstephenmurray.com


Copyright © 2011, C. Stephen Murray

| y-direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| $\mathrm{a} \mathrm{m/s}$ | -8 | - |  |  | $\rightarrow$ |
| y (ms $)$ | 0 | 14.7 m | 19.6 | 14.7 | 0 |
| $\mathrm{v} \mathrm{m} / \mathrm{s}$ | 19.6 | $9.8 \mathrm{~m} / \mathrm{s}$ | 0 | -9.8 | -19.6 |


| x-direction |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| t | 0 | $\mathrm{t} / 4$ | $\mathrm{t} / 2$ | $3 \mathrm{t} / 4$ | t |
| a | 0 | - |  |  | $\rightarrow$ |
| $\mathrm{x}(\mathrm{m})$ | 0 | 17.1 | 34.2 | 51.3 | 68.4 |
| v | 17,1 |  |  |  | $\rightarrow$ |

6. Use your data tables to draw the following graphs.


Copyright © 2011, C. Stephen Murray

