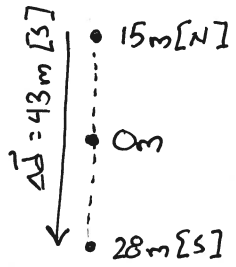
KEY

First Name:_____ Last Name:_____

## L07 – Worksheet – Motion in 1-Dimension / 30 marks

**Part 1:** Uniform Motion Equation

$$\vec{v}_{ave} = \frac{\Delta \vec{d}}{\Delta t}$$




*Use the following information to answer Q1 – Q5:*

John starts 15m [N] of his house and runs until he is 28 m [S] of his house. This run takes him 50 seconds.

**Q1:** John ran a total distance of ***a.bc*** x $10^{d}$ m, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four digit** answer in the Numerical Response boxes below)*

| | | | |
|---|---|---|---|
| 4 | 3 | 0 | 1 |

$d = 43 = 4.30 \times 10^{1}$
$= a.bc \times 10^{d}$

**Q2:** Which of the following best describes John's initial position?

a. $\vec{d_i}$ = 13m [S]
b. $\vec{d_i}$ = 15m [N]
c. $\vec{d_i}$ = 28m [S]
d. $\vec{d_i}$ = 43m [S]

**Q3:** Which of the following best describes John's final position?

a. $\vec{d_f}$ = 13m [S]
b. $\vec{d_f}$ = 15m [N]
c. $\vec{d_f}$ = 28m [S]
d. $\vec{d_f}$ = 43m [S]

KEY

**Q4:** Which equation best models how to calculate John's displacement?

a. $\Delta\vec{d} = 15m\,[N] + 28m[N]$
b. $\Delta\vec{d} = -28m\,[N] + 15m[N]$
c. $\Delta\vec{d} = -28m\,[N] - 15m[N]$ ⟵
d. $\Delta\vec{d} = 28m\,[N] - 15m\,[N]$

$\Delta\vec{d} = \vec{d}_f - \vec{d}_i$
$= 28\,m[S] - 15m[N]$
$= -28m[\,] - 15\,m[N]$
$= -43\,m[N]$ or $43\,m[S]$

**Q5:** John's velocity is ***a.bc*** x $10^{-d}$ m/s, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four digit** answer in the Numerical Response boxes below)*

| 8 | 6 | 0 | 1 |
|---|---|---|---|

$\vec{v} = \frac{\Delta\vec{d}}{\Delta t} = \frac{43\,m[S]}{50\,s} = 0.86\,m/s[S]$
$= 8.60\times10^{-1}\,m/s$
$a.bc\times10^{-d}$

**Q6:** A rabbit is 15m [E] of a rabbit hole when initially, then runs to 24m [E]. This total run takes place in 4 seconds. What is the rabbit's velocity? *(3 marks)*

$\vec{d}_i = 15m[E]$
$\vec{d}_f = 24m[E]$
$\Delta\vec{d} = ?$
$t = 4s$
$\vec{v} = ?$

$\Delta\vec{d} = \vec{d}_f - \vec{d}_i$
$= 24m[E] - 15m[E]$
$= 9\,m[E]$

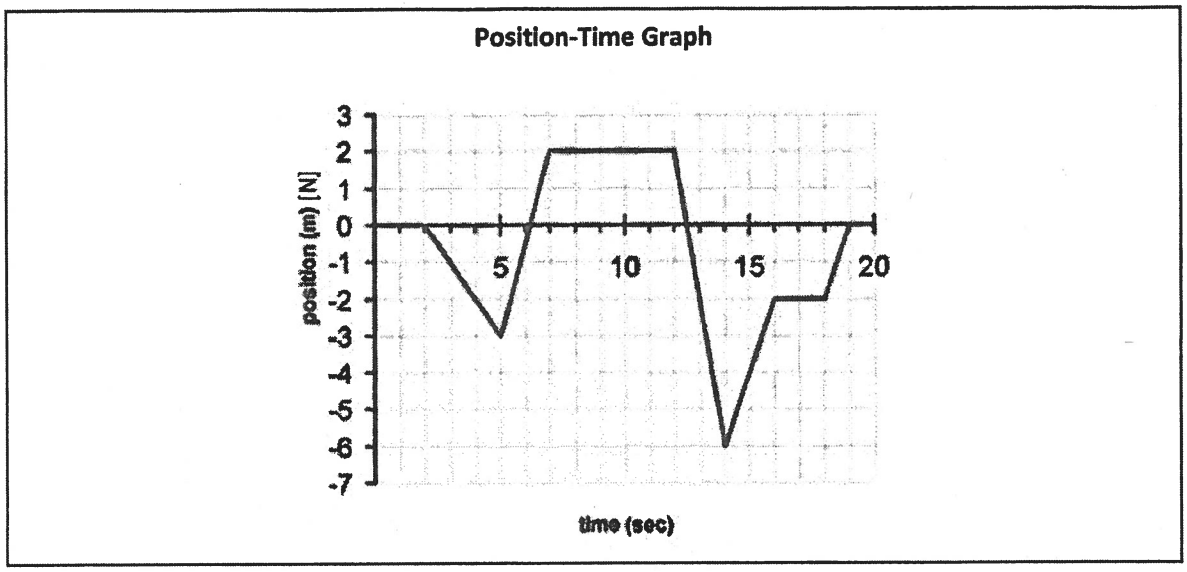
$\vec{v} = \frac{\Delta\vec{d}}{\Delta t} = \frac{9m[E]}{4s}$

$\vec{v} = 2.25\,m/s\,[E]$

KEY

**Part 2:** Interpreting Position-Time Graphs

*Use the following information to answer Q7 – Q14:*




**Q7:** During what time period(s) is the object north of the origin?

a. 5 - 7s, 14 - 16s, 18 - 19s
b. 6 - 12.5s
c. 0 - 2s, 7 - 12s, 16 - 18s, 19 - 20s
d. 2 - 5s, 12 - 14s

When position (y-axis value) is above the "zero" line (x-axis)

**Q8:** During what time period(s) is the object moving north?

e. 5 - 7s, 14 - 16s, 18 - 19s
f. 6 - 12.5s
g. 0 - 2s, 7 - 12s, 16 - 18s, 19 - 20s
h. 2 - 5s, 12 - 14s

When velocity (slope) is positive.

**Q9:** During what time period(s) is the object stationary?

a. 5 - 7s, 14 - 16s, 18 - 19s
b. 6 - 12.5s
c. 0 - 2s, 7 - 12s, 16 - 18s, 19 - 20s
d. 2 - 5s, 12 - 14s

When velocity (slope) is zero
When position (y-value) isn't changing.

KEY

**Q10:** What is the magnitude of the velocity between 5 and 7 seconds?

*(Record your **three digit** answer in the Numerical Response boxes below)*

| 2 | . | 5 | 0 |
|---|---|---|---|

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{5m[N]}{2s} = 2.5\ m/s\ [N]$

**Q11:** What is the magnitude of the acceleration of the object between 12 and 14 seconds?

*(Record your **three digit** answer in the Numerical Response boxes below)*

| 0 | . | 0 | 0 |
|---|---|---|---|

Constant velocity (slope)? No acceleration!

**Q12:** During what time period(s) is the object south of the origin?

2 - 6 s
12.5 - 19 s

**Q13:** During what time period(s) is the object moving south?

2 - 5 s
12 - 14 s

**Q14:** The displacement of the object between 14 and 16 seconds is

(a) 4m [N]
b. 4m [S]
c. 8 m [N]
d. 8 m [S]

$\Delta \vec{d} = \vec{d}_f - \vec{d}_i$
$= -2m[N] - (-6\ m[N])$
$= -2 + 6$
$= 4m\ [N]$

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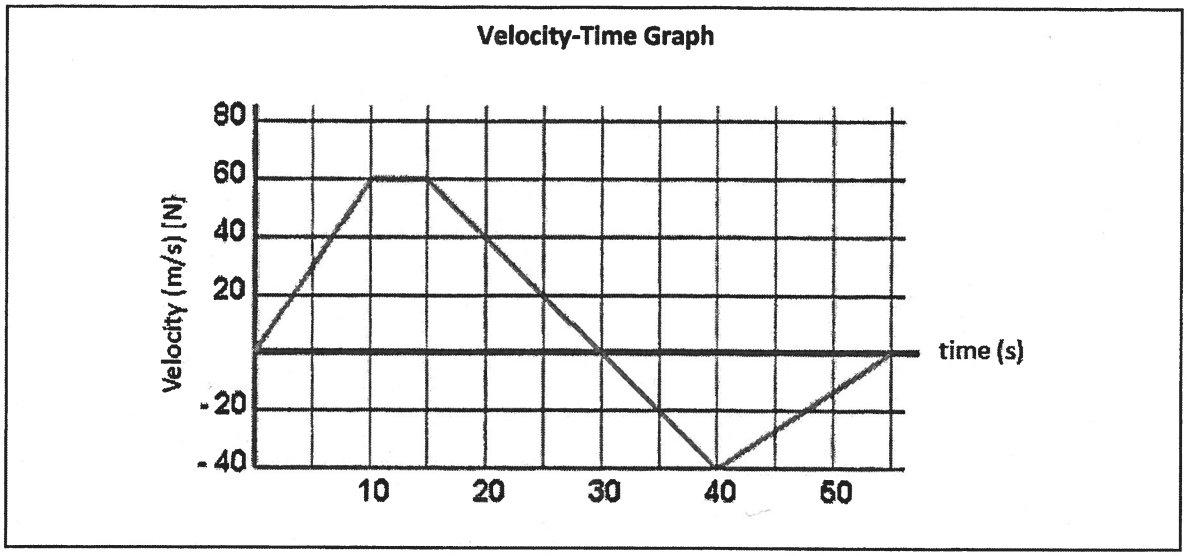
**Part 3:** Interpreting Velocity-Time Graphs

*Use the following information to answer Q15 – Q22:*




**Q15:** During what time period(s) is the object stationary?

When velocity (y-value) is zero.

a. 10 – 15s → Moving @ 60 m/s
(b.) 55 – 60s
c. All of the above
d. None of the above

**Q16:** During what time period(s) is the object moving north?

When y-value is positive.

a. 0 – 10s
(b.) 0 – 30s
c. 40 – 55s
d. Both A and C

**Q17:** During what time period(s) is the object accelerating?

When velocity is becoming more "non-zero". When it is speeding up.

a. 0 – 10s ✓
b. 0 – 30s
c. 30 – 40s ✓
(d.) Both A and C

Key

**Q18:** What is the acceleration of the object between 20 and 30 seconds?

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{-40\ m/s\ [N]}{10\ s} = -4\ m/s^2\ [N]$$

or $4\ m/s^2\ [S]$

**Q19:** What is the acceleration of the object between 40 and 55 seconds?

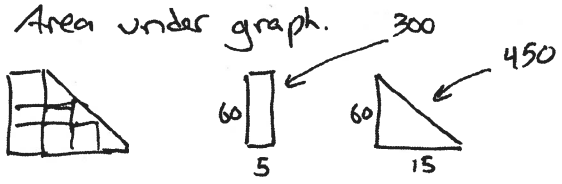
$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{40\ m/s\ [N]}{15s} = 2.\bar{6}\ m/s^2\ [N]$$

**Q20:** What is the velocity of the object at 20 seconds?

y-value is $40\ m/s\ [N]$

**Q21:** What is the displacement of the object between 10 and 30 seconds?

Area under graph.




$\Delta \vec{d} = 750m\ [N]$

**Q22:** During what time period(s) is the object decelerating?

when its velocity is becoming closer to zero.

15 - 30s
40 - 55s

KEY

**Part 4:** Horizontally Accelerated Motion

| | |
|---|---|
| | $\vec{d} = \vec{v}_f t - \frac{1}{2}\vec{a}t^2$ |
| $\vec{a}_{ave} = \frac{\Delta \vec{v}}{\Delta t}$ | $\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right) t$ |
| $\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$ | $v_f^2 = v_i^2 + 2ad$ |

**Q23:** A Honda civic can accelerate from a rest to 26.8m/s [S] in 9.8 seconds. How much distance does the Honda Civic cover during this acceleration? *(3 marks)*

$\vec{V}_i = 0 m/s$
$\vec{V}_f = 26.8 m/s [S]$
$t = 9.8 s$
$d = ?$

$\vec{d} = \left(\frac{\vec{V}_f + \vec{V}_i}{2}\right) t$

$\vec{d} = \left(\frac{26.8 m/s [S] + 0 m/s [S]}{2}\right)(9.8 s)$

$\boxed{\vec{d} = 131.32 m [S]}$

**Q24:** A stationary object is accelerated at 3.2m/s$^2$ [S] for 15m [S]. How much time elapsed ? *(3 marks)*

$\vec{V}_i = 0 m/s [S]$
$\vec{a} = 3.2 m/s^2 [S]$
$\vec{d} = 15 m [S]$
$t = ?$

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

$15 m [S] = (0 m/s) t + \frac{1}{2}(3.2 m/s^2 [S]) t^2$

$15 = 0t + 1.6t^2$

$15 = 1.6t^2$

$9.375 = t^2$

$\boxed{t = 3.06 s}$

KEY

**Part 5:** Vertically Accelerated Motion

| | |
|---|---|
| | $\vec{d} = \vec{v}_f t - \frac{1}{2}\vec{a}t^2$ |
| $\vec{a}_{ave} = \frac{\Delta\vec{v}}{\Delta t}$ | $\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right) t$ |
| $\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$ | $v_f^2 = v_i^2 + 2ad$ |

*Use the following information to answer Q25 to Q27:*

A ball at ground level is shot vertically upward at 2m/s.

**Q25:** The ball reaches a maximum height of ***a.bc*** x $10^{-d}$ m, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four digit** answer in the Numerical Response boxes below)*

| | | | |
|---|---|---|---|
| 2 | 0 | 4 | 1 |

$v_i = 2 m/s$
$a = -9.81 m/s^2$
$d_{max} = ?$
$v_f = 0 m/s$ @ top

$v_f^2 = v_i^2 + 2ad$
$0^2 = (2)^2 + 2(-9.81)d$
$0 = 4 - 19.62d$
$19.62d = 4$
$d = 0.2038 m$

$d = 0.2038 m$
$= 2.038 \times 10^{-1}$
$= 2.04 \times 10^{-1}$

**Q26:** The ball has a total flight time of ***a.bc*** x $10^{-d}$ s, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four digit** answer in the Numerical Response boxes below)*

| | | | |
|---|---|---|---|
| 4 | 0 | 8 | 1 |

$v_i = 2 m/s$
$a = -9.81 m/s^2$
$d = 0 m$ @ bottom
$t = ?$

$d = v_i t + \frac{1}{2}at^2$
$0 = 2t + \frac{1}{2}(-9.81)t^2$
$0 = 2t - 4.905t^2$
$\div t \quad \div t \quad \div t$
$0 = 2 - 4.905t$
$4.905t = 2$

$t = 0.4077 s$
$t = 4.08 \times 10^{-1} s$

**Q27:** How fast is the ball moving at *t=0.36 seconds,* in meters per second?

*(Record your **three digit** answer in the Numerical Response boxes below)*

| | | | |
|---|---|---|---|
| 1 | . | 5 | 3 |

$v_i = 2 m/s$
$a = -9.81 m/s^2$
$t = 0.36 s$
$v_f = ?$

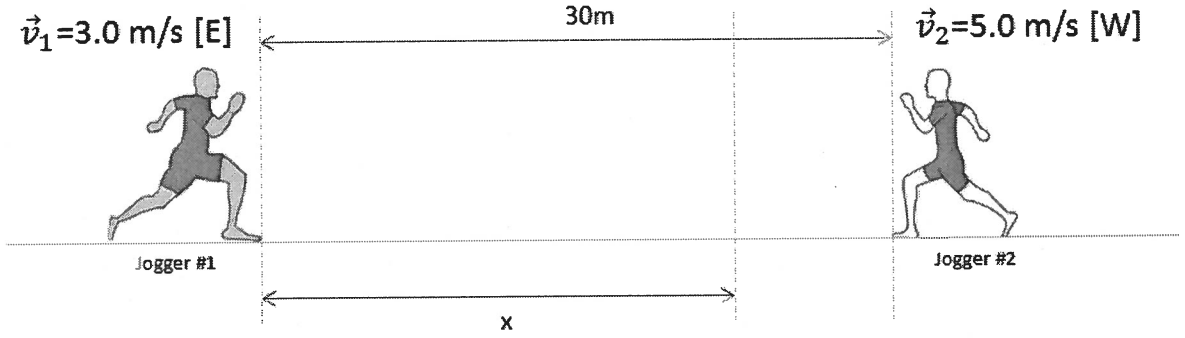
$a = \frac{v_f - v_i}{t}$
$(-9.81) = \frac{v_f - (2)}{(0.36)}$
$-3.5316 = v_f - 2$
$v_f = -1.53 m/s$

KEY

**Part 6:** Harder Questions

*Use the following information to answer Q28:*

Two men are running towards each other on a jogging trail.




**Q28:** How far from Jogger #1's original position to they meet, measured in meters?

*(Record your **three digit** answer in the Numerical Response boxes below)*

| 1 | 1 | . | 3 |
|---|---|---|---|

Jogger #1

$v = \frac{d}{t}$

$t = \frac{d}{v}$

$\boxed{t = \frac{x}{3}}$

Jogger #2

$v = \frac{d}{t}$

$t = \frac{d}{v}$

$\boxed{t = \frac{30 - x}{5}}$

$t_1 = t_2$

$\frac{x}{3} = \frac{(30 - x)}{5}$

$5x = 3(30 - x)$

$5x = 90 - 3x$

$8x = 90$

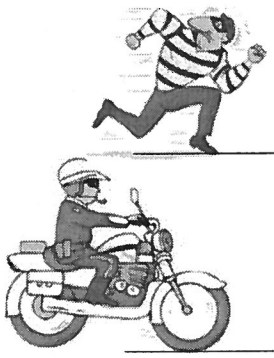
$x = 11.25\text{m}$

$\approx 11.3\text{m}$

KEY

*Use the following information to answer Q29:*

A criminal is running at a steady 5.0 m/s when he runs up parallel to a police officer. The officer, originally stationary, immediately begins to accelerate at 1.0 m/s$^2$.



$\overrightarrow{v_1} = 5.0\ m/s$ [E]

$\overrightarrow{v_{2_i}} = 0.0\ m/s$ [E]

$\vec{a} = 1.0\ m/s^2$ [E]

**Q29:** How many seconds does it take the police officer to catch up to the criminal again?

*(Record your **three digit** answer in the Numerical Response boxes below)*

| 1 | 0 | . | 0 |
|---|---|---|---|

Criminal

$v = \frac{d}{t}$

$d = vt$

$\boxed{d = 5t}$

Police officer

$d = v_i t + \frac{1}{2}at^2$

$d = (0)t + \frac{1}{2}(1)t^2$

$\boxed{d = 0.5t^2}$

$d_1 = d_2$

$5t = 0.5t^2$

$\div t \quad \div t$

$5 = 0.5t$

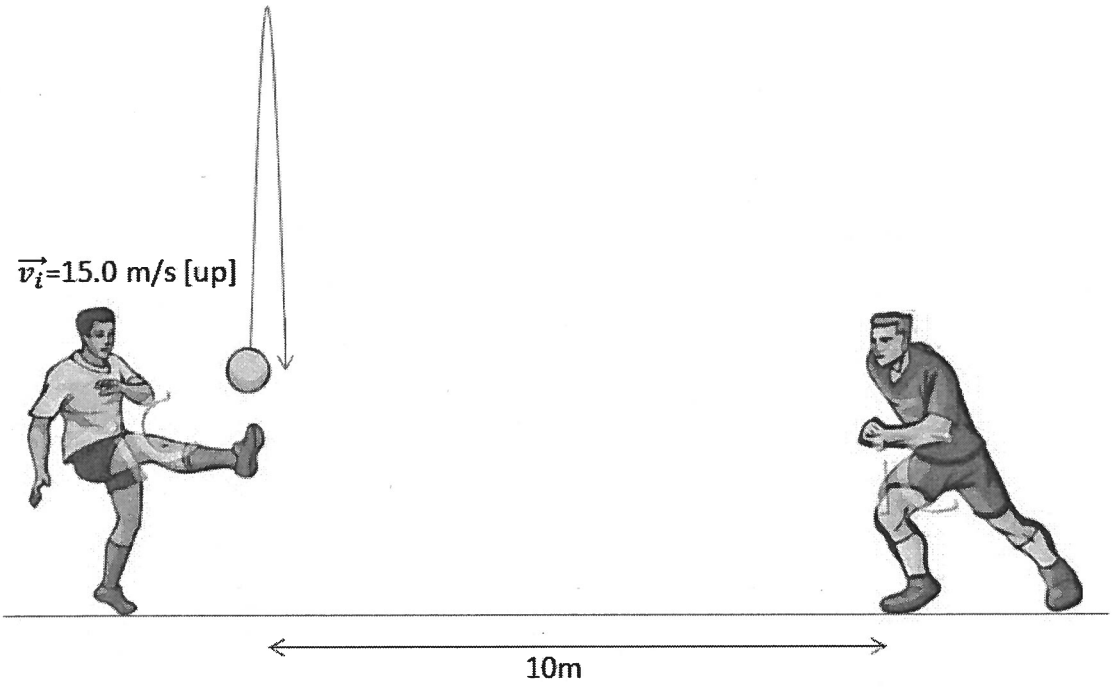
$10 = t$

$t = 10.0\ s$

KEY

*Use the following information to answer Q30:*

A football player kicks a ball vertically upward at 15.0 m/s. Another player, 10m away, runs at a steady speed to intercept the ball on its way back down.




**Q30:** If the second player intercepts the ball at exactly the height it was originally launched upward at, how fast what the second player running, in meters per second?

*(Record your **three digit** answer in the Numerical Response boxes below)*

| 3 | . | 2 | 7 |
|---|---|---|---|

Ball

$d = v_i t + \frac{1}{2}at^2$

$0 = (15)t + \frac{1}{2}(-9.81)t^2$

$0 = 15t - 4.905t^2$

$\div t \quad \div t \quad \div t$

$0 = 15 - 4.905t$

$4.905t = 15$

$t = 3.058\text{s}$

Player #2

$v = \frac{d}{t}$

$v = \frac{10\text{m}}{3.058\text{s}}$

$v = 3.269\overline{9}\ \text{m/s}$

$v \approx 3.27\ \text{m/s}$