Good morning!

Please, sign in, login into webassing, locate LectureMCQ_L2 (PY105) and answer question 1 (but ONLY Q1 !)

Lab 2 is in SCI 134

Students who talked to me yesterday about switching the lab section should see me after the lecture to sign add/drop form

Please, note, if yesterday you missed lab 1 because you had no access to webassign, you can make it up TODAY!

LectureMCQ L2 Q2

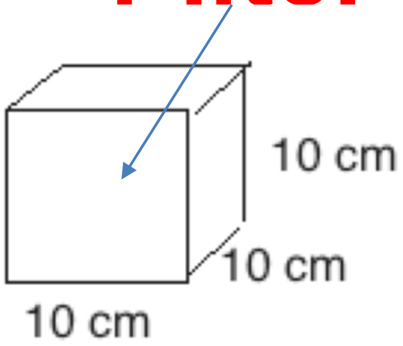
1 meter = 3.281 feet

1 ft = 0.3048 m

1 mi = 1.609 km

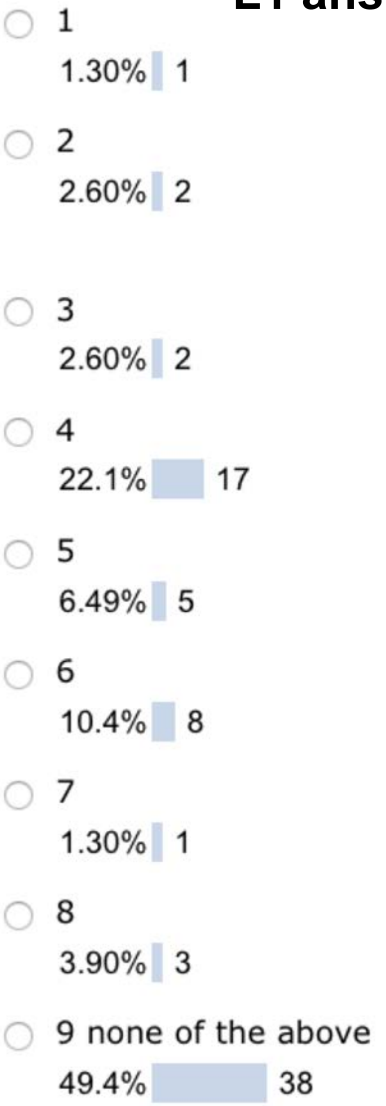
1 hp = 746 W

1 liter = ? (SI)



1. 1 cm
2. 10 cm
3. 100 cm
4. 1000 cm
5. 1 m
6. 10 m
7. 100 m
8. 1000 m
9. None of the above

L1 answers



○ 1

1.30% 1

○ 2

2.60% 2

○ 3

2.60% 2

○ 4

22.1% 17

○ 5

6.49% 5

○ 6

10.4% 8

○ 7

1.30% 1

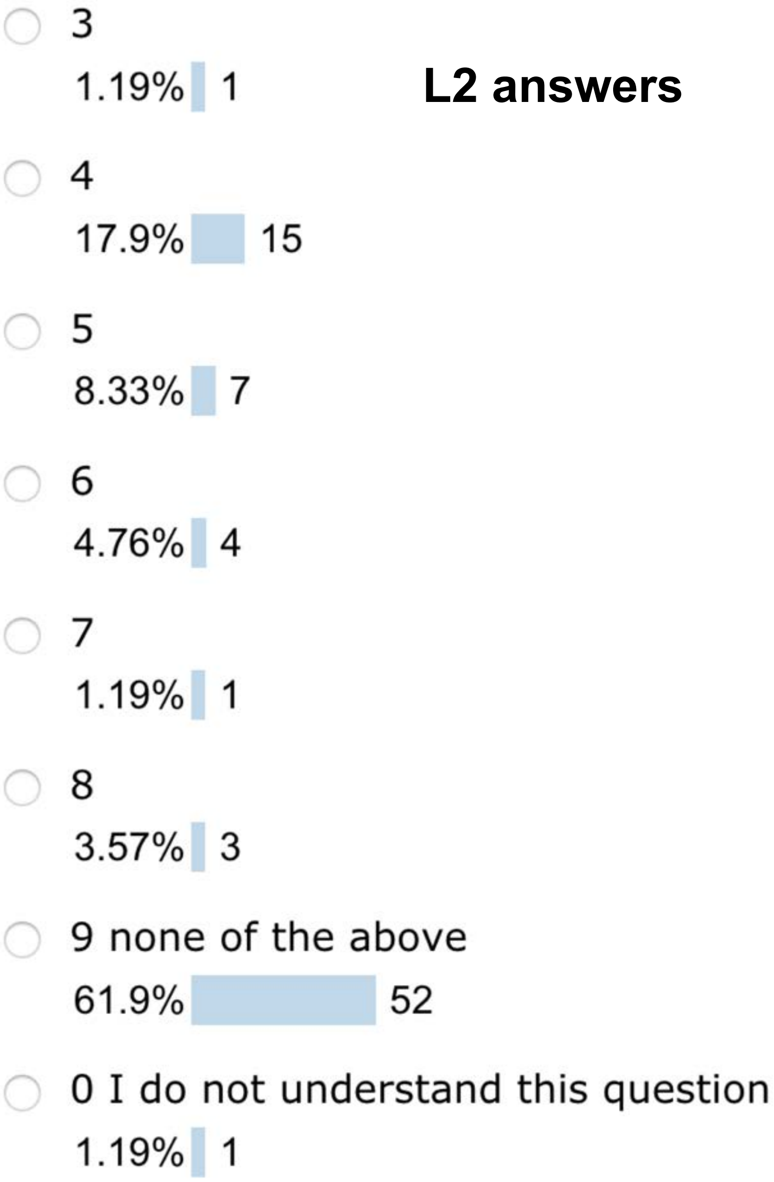
○ 8

3.90% 3

○ 9 none of the above

49.4% 38

L2 answers



○ 3

1.19% 1

○ 4

17.9% 15

○ 5

8.33% 7

○ 6

4.76% 4

○ 7

1.19% 1

○ 8

3.57% 3

○ 9 none of the above

61.9% 52

○ 0 I do not understand this question

1.19% 1

LectureMCQ L2 Q2

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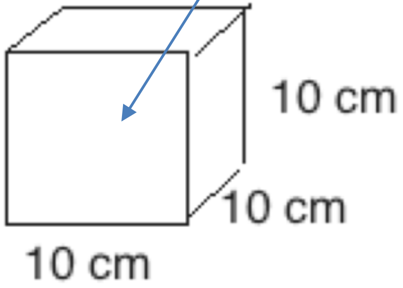

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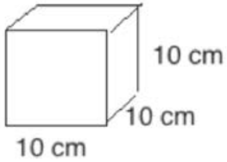
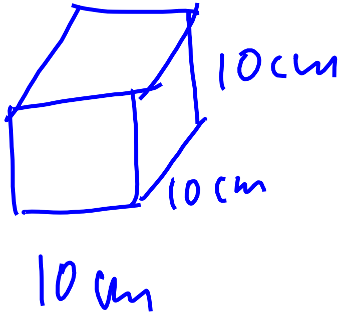
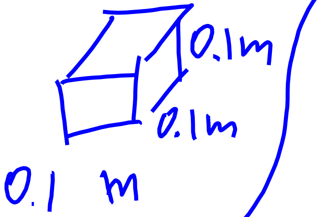


1. **1 cm**
2. **10 cm**
3. **100 cm**
4. **1000 cm**
5. **1 m**
6. **10 m**
7. **100 m**
8. **1000 m**
9. **None of the above**



$V = L \cdot W \cdot H = 10cm \cdot 10cm \cdot 10cm =$

$= 1000 \cdot cm^3$



$V = (0.1\,m)^3 = 0.001\,m^3 =$

$= 10^{-3}\,m^3$

$\frac{1m}{10} = \frac{100cm}{10}$; $\frac{1m}{100} = \frac{100cm}{100}$

$1L = V = 1000 \cdot (.01m)^3 = 10^{-3}\,m^3$

$1000L = 1m^3$

yotta- (Y-)	10^{24}	1 septillion
zetta- (Z-)	10^{21}	1 sextillion
exa- (E-)	10^{18}	1 quintillion
peta- (P-)	10^{15}	1 quadrillion
tera- (T-)	10^{12}	1 trillion
giga- (G-)	10^{9}	1 billion
mega- (M-)	10^{6}	1 million
kilo- (k-)	10^{3}	1 thousand
hecto- (h-)	10^{2}	1 hundred
deka- (da-)**	10	1 ten

deci- (d-)	10^{-1}	1 tenth
centi- (c-)	10^{-2}	1 hundredth
milli- (m-)	10^{-3}	1 thousandth
micro- (μ-)	10^{-6}	1 millionth
nano- (n-)	10^{-9}	1 billionth
pico- (p-)	10^{-12}	1 trillionth
femto- (f-)	10^{-15}	1 quadrillionth
atto- (a-)	10^{-18}	1 quintillionth
zepto- (z-)	10^{-21}	1 sextillionth
yocto- (y-)	10^{-24}	1 septillionth

1 km =

yotta- (Y-)	10^{24}	1 septillion
zetta- (Z-)	10^{21}	1 sextillion
exa- (E-)	10^{18}	1 quintillion
peta- (P-)	10^{15}	1 quadrillion
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atto- (a-)	10^{-18}	1 quintillionth
zepto- (z-)	10^{-21}	1 sextillionth
yocto- (y-)	10^{-24}	1 septillionth

1 km = 1000 m

Motion

What are some words and/or concepts we use when describing motion?

Was the object moved? What is motion?

What is a motion diagram? What is a trajectory?

What is the difference between *a* path and the *shortest* path?

What is the difference between distance traveled and displacement?

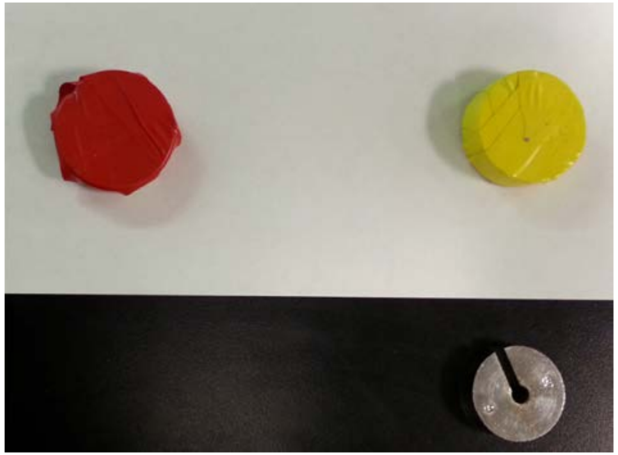
Motion

What does it mean?

How do we know it happened?

How can we describe it?

How do we know if it moved?

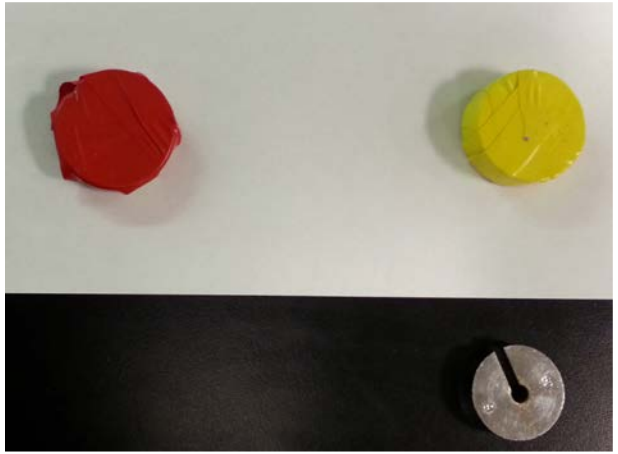


Was the yellow puck been moving?

CP2

Motion is relative !

Always keep in mind - *relative to WHAT is it happening?*



P.S. in 96.4 % problems

It is ***meant*** (assumed)

"relative to the ground"

(unless the opposite is clearly said!).

CP3

A visualization of motion

00:00

00:05

00:10

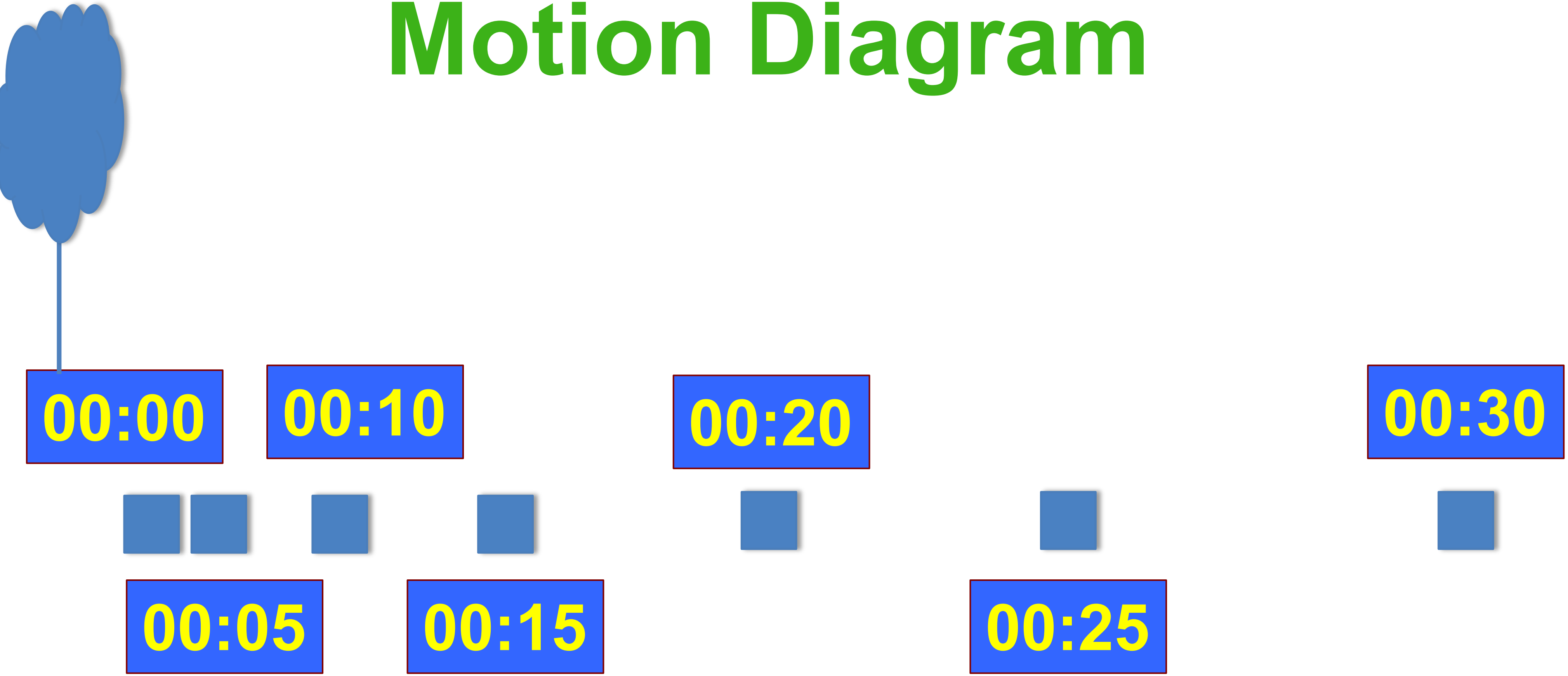
00:15

00:20

00:25

00:30

Motion Diagram



00:00

00:10

00:20

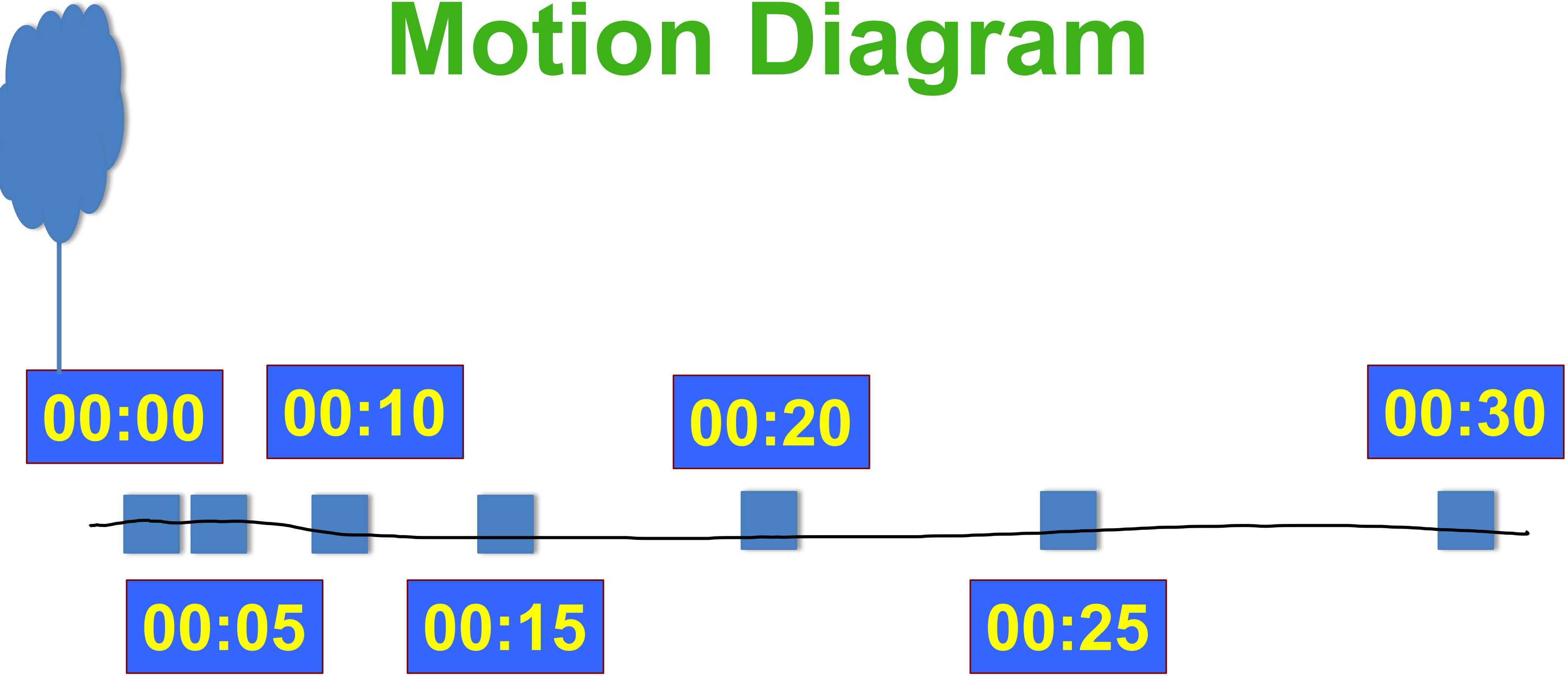
00:30

00:05

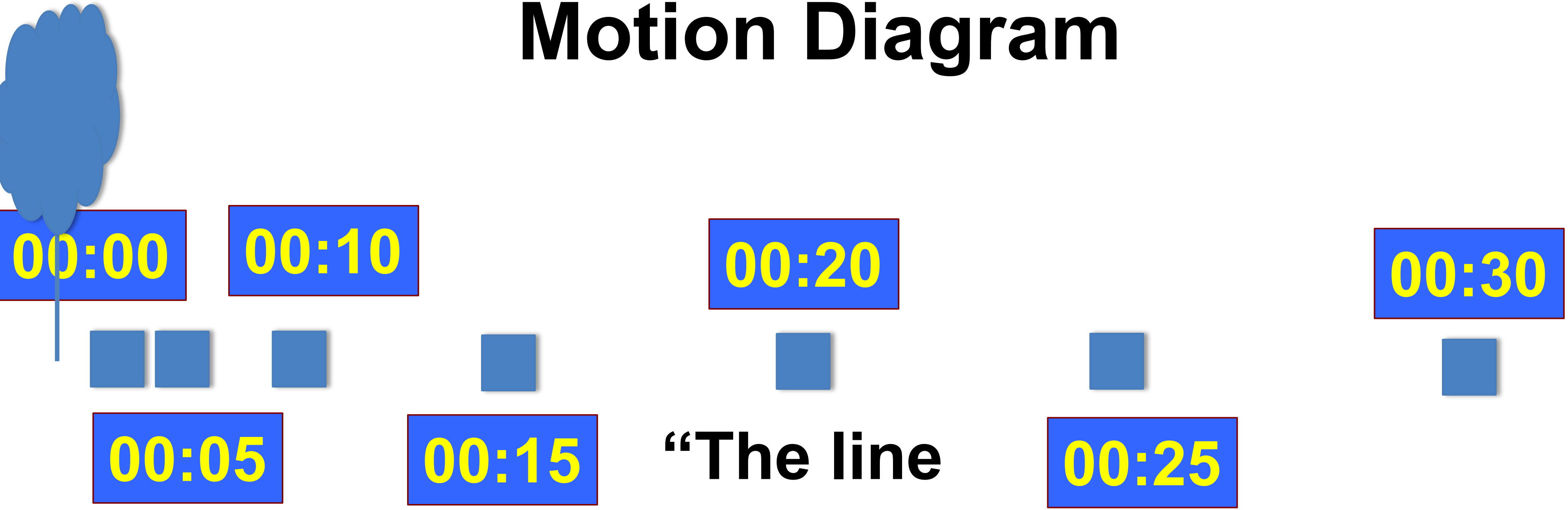
00:15

00:25

Motion Diagram



Motion Diagram

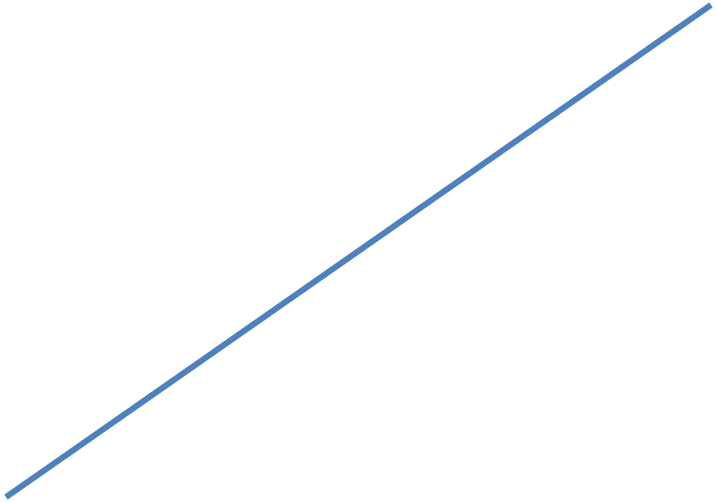


“The line of motion”

A ***trajectory*** is a line visualizing the path; a line connecting all positions.

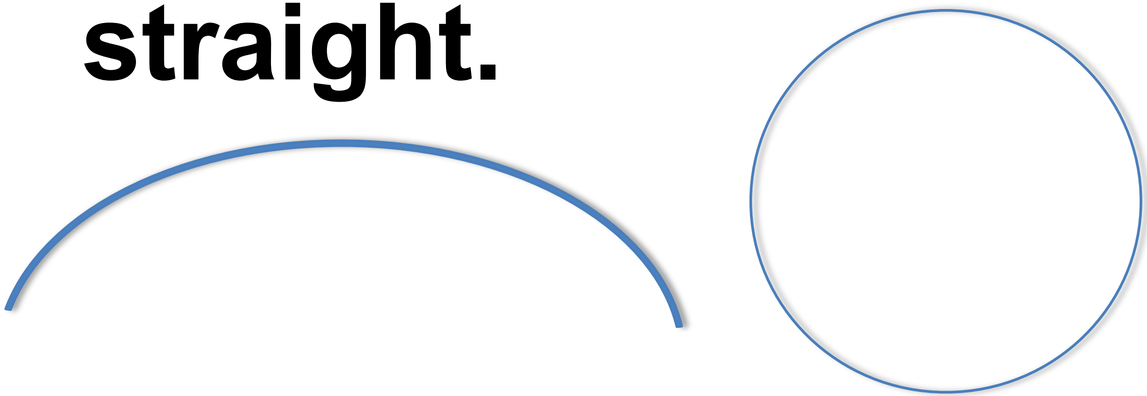
1–D motion

A trajectory is a *straight* line.



2–D motion

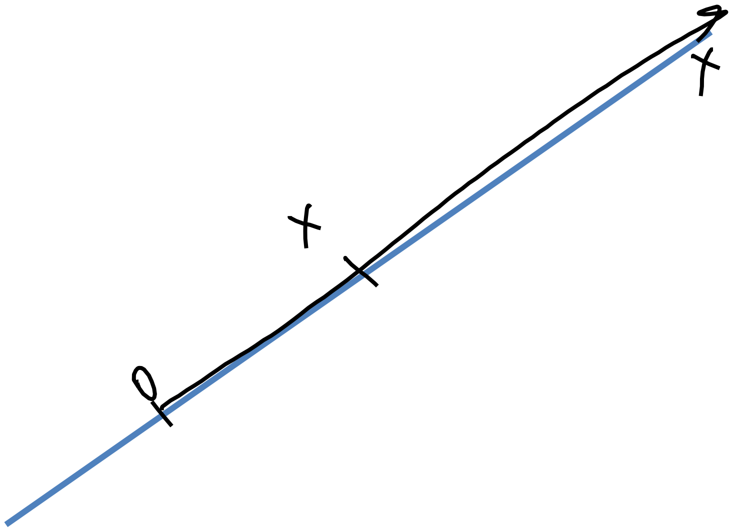
A trajectory is a line in a *plane* (a flat surface) but not straight.



3–D motion = not 1 and not 2 D

1–D motion

A trajectory is a *straight* line.



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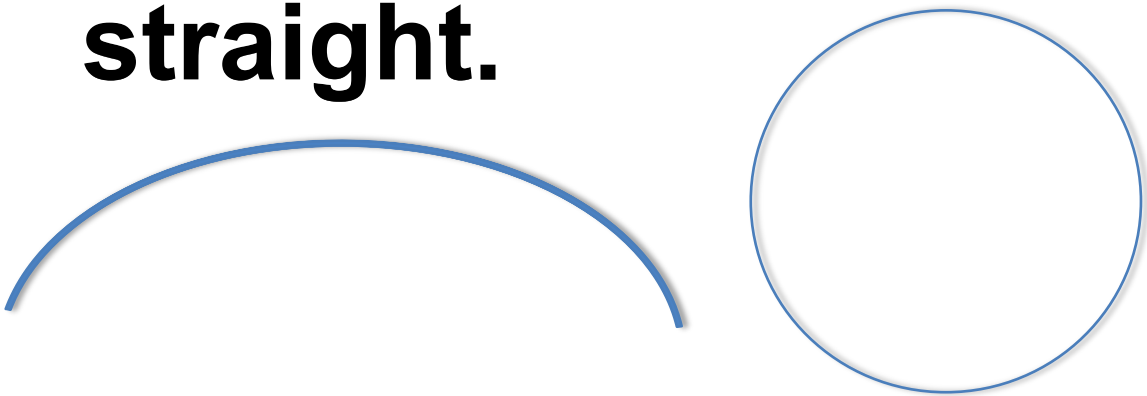
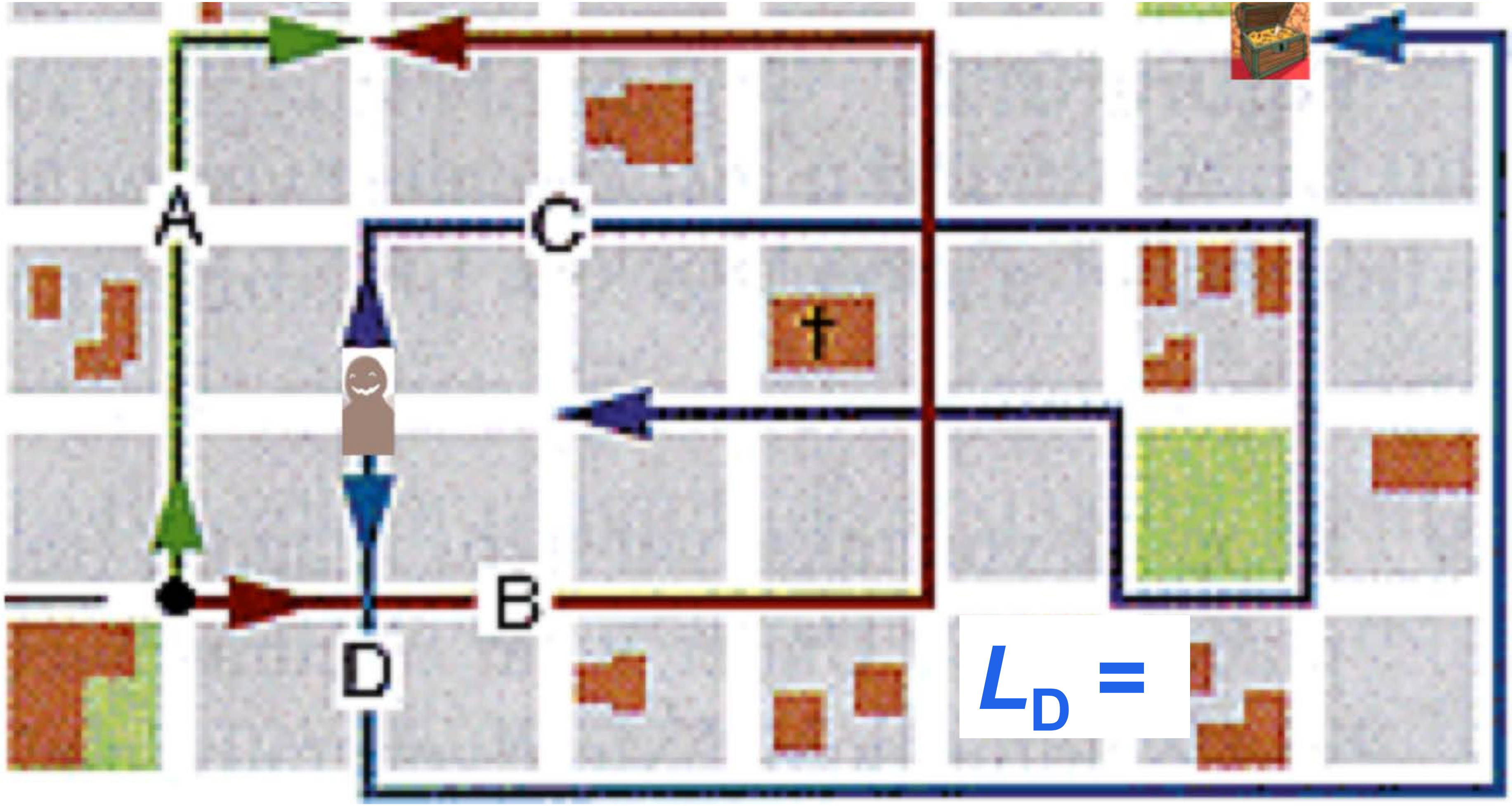


3–D motion = not 1 and not 2 D

ANY motion (1-D, 2-D, etc.)

Distance traveled =: the length of the trajectory



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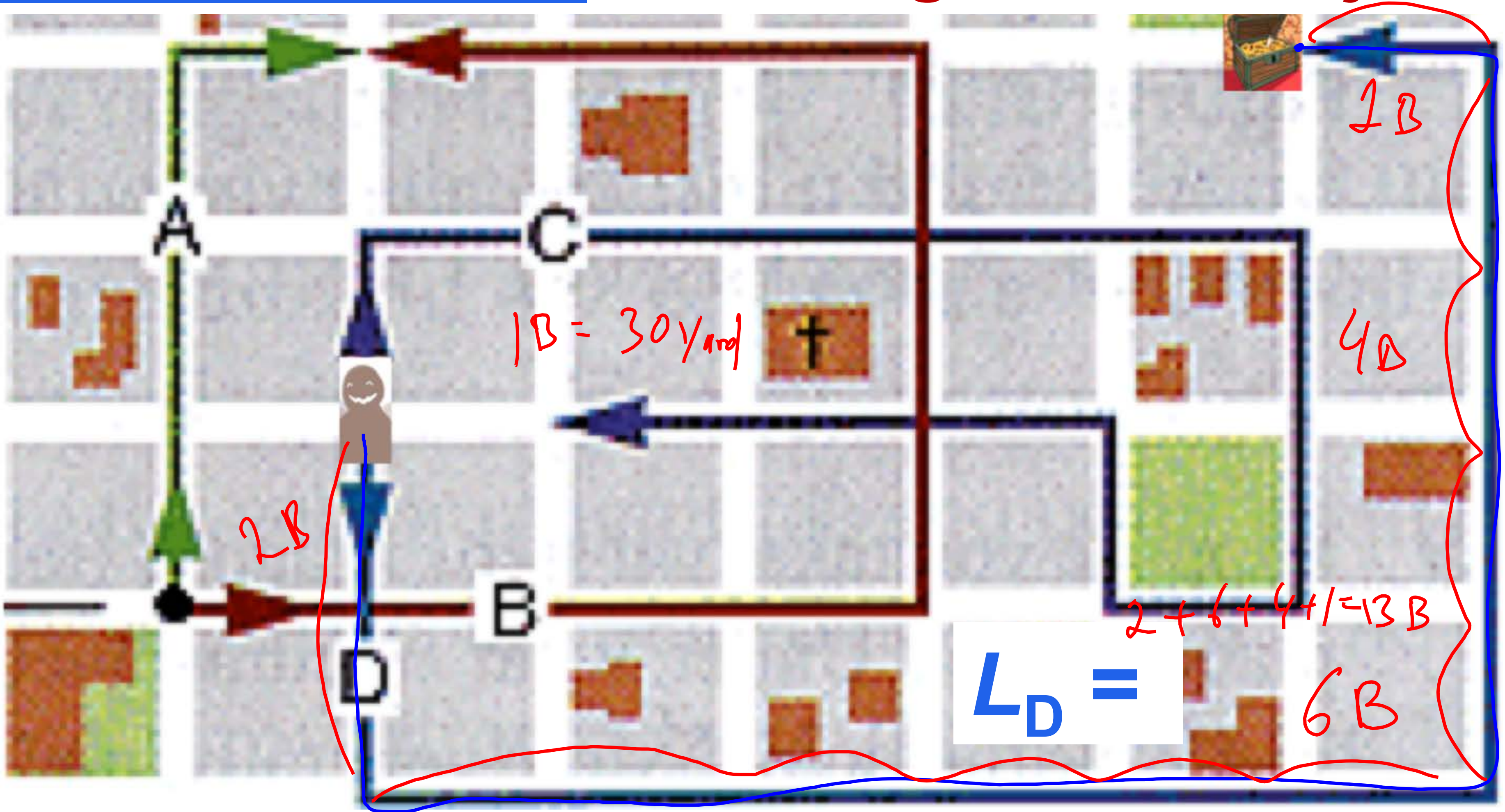
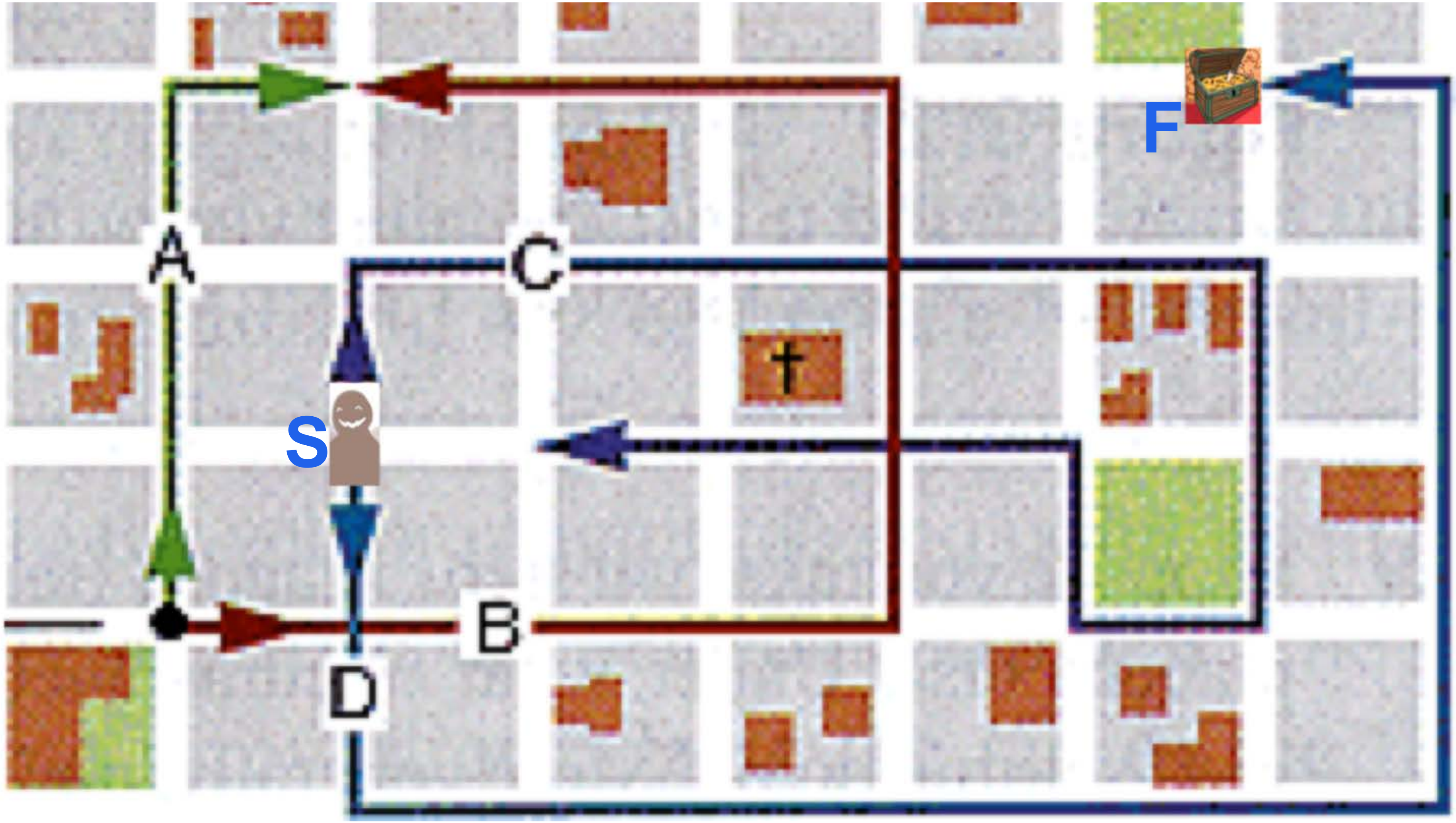


1B = 30 yard

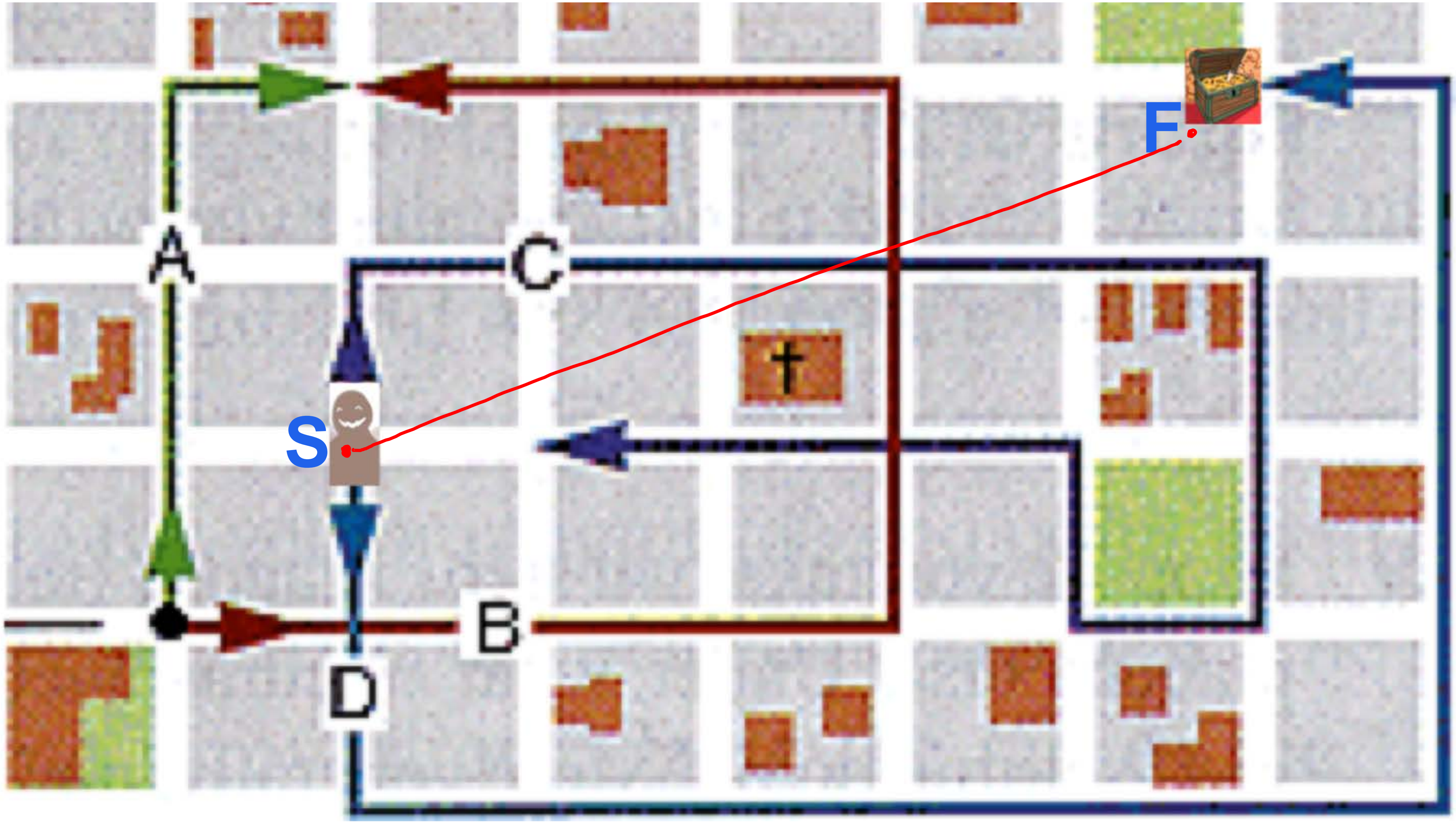
2+6+4+1=13 B

L_D =

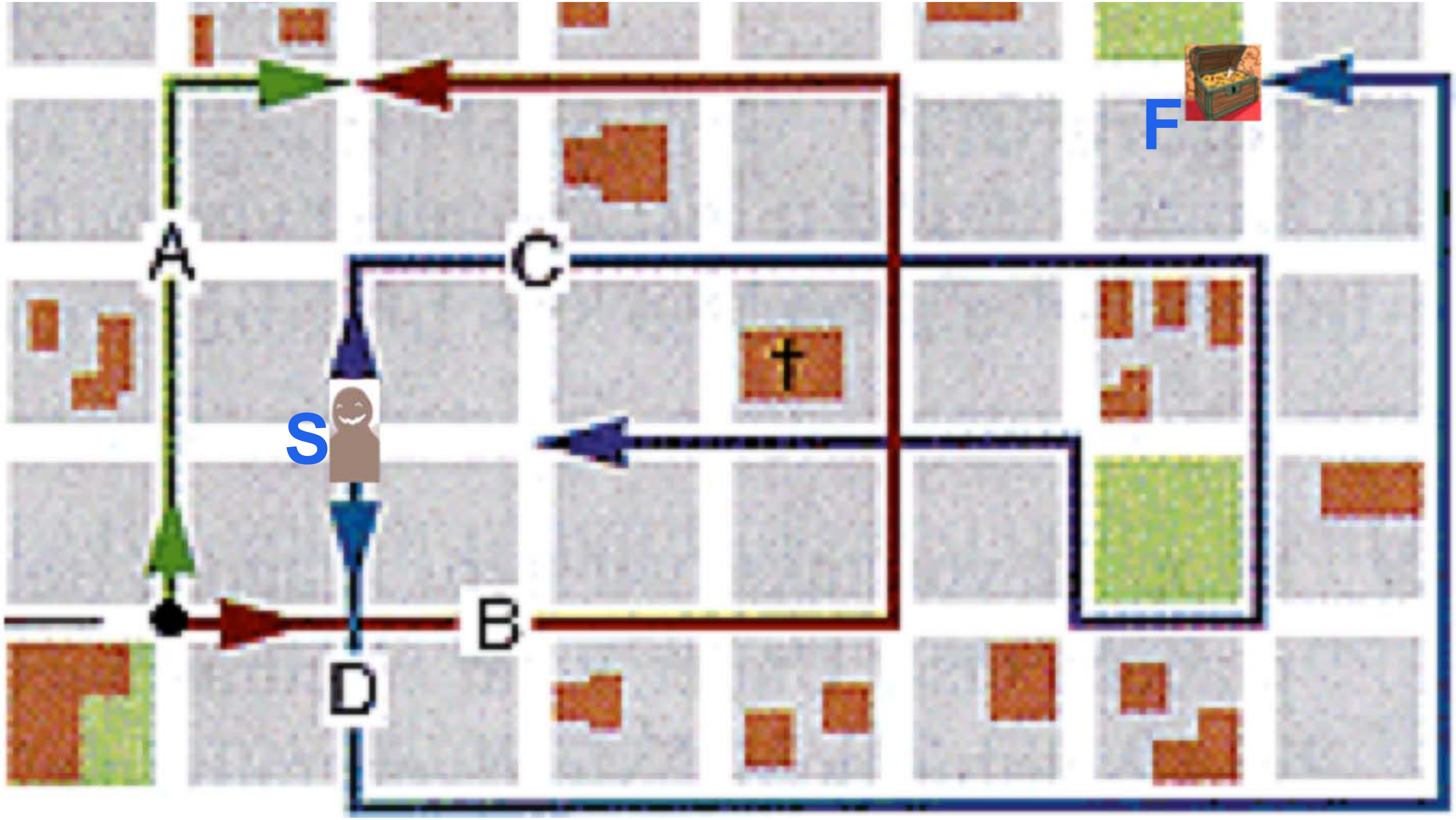
Displacement = (a) action; (b) distance from S and F



Displacement = (a) <u>action</u>; (b) <u>distance</u> from S and F



Displacement =: (c) an "arrow" pointing from S to F



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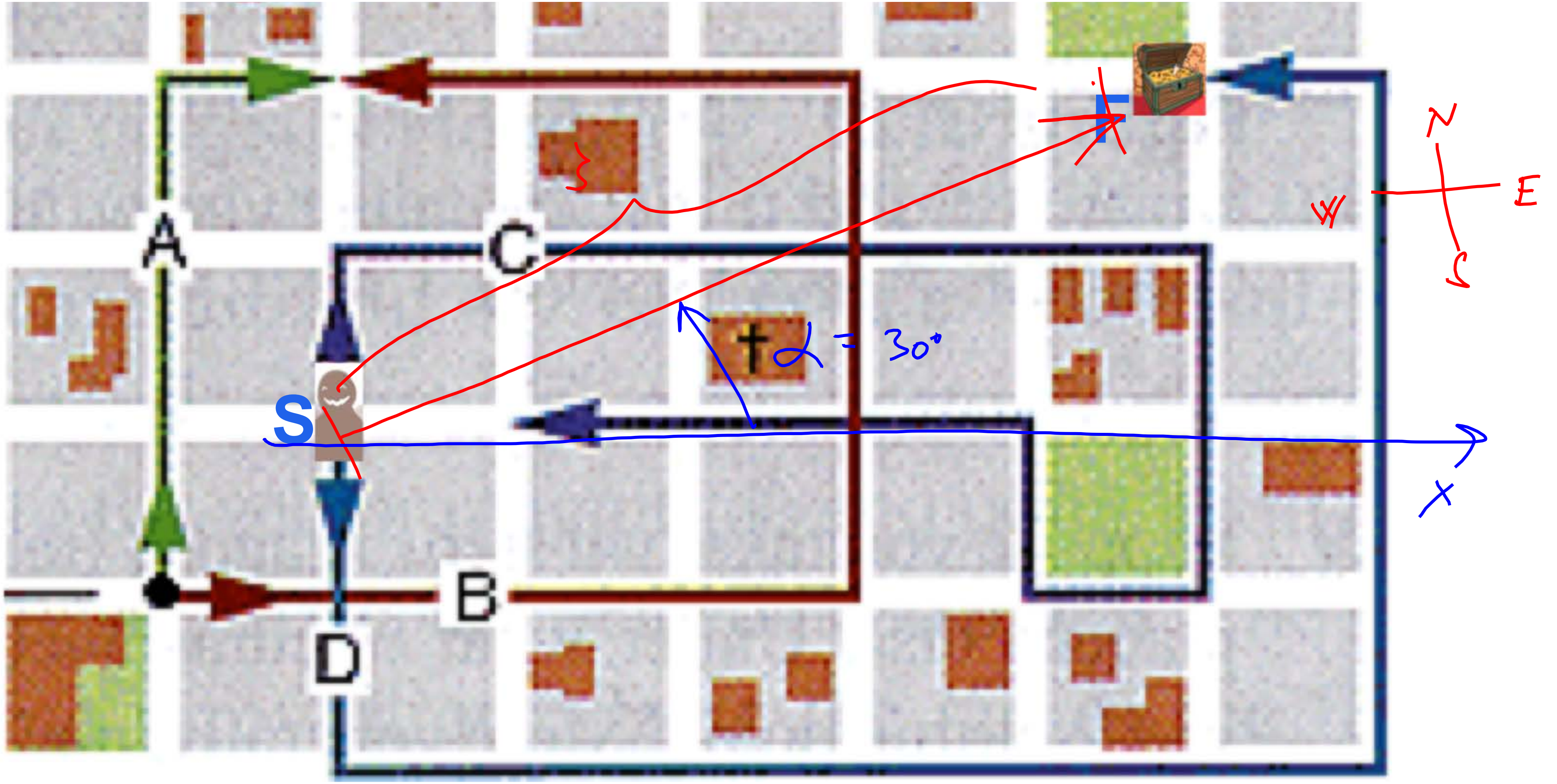
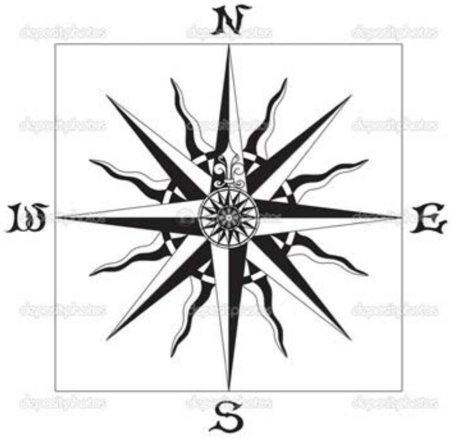


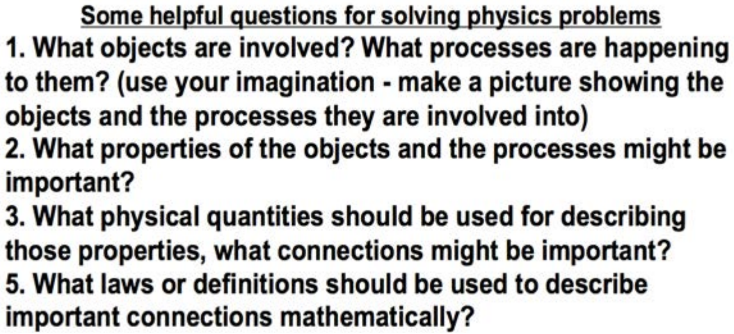
Example Problem

You walk 4 m West, make a 90^0 turn and walk 3 m South.

What is your ***total distance*** traveled?



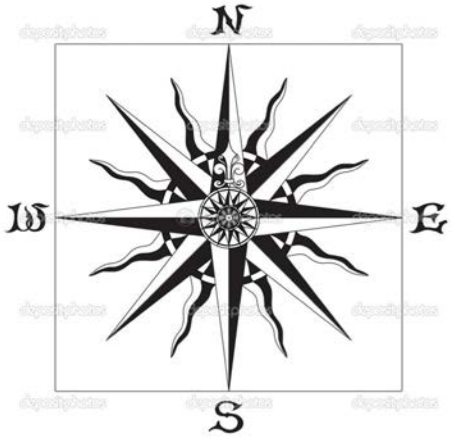
Let's use this simple problem as an illustration of the general problem-solving strategy.



<u>Some helpful questions for solving physics problems</u>

1. What objects are involved? What processes are happening to them? (use your imagination - make a picture showing the objects and the processes they are involved into)
2. What properties of the objects and the processes might be important?
3. What physical quantities should be used for describing those properties, what connections might be important?
5. What laws or definitions should be used to describe important connections mathematically?

Example Problem



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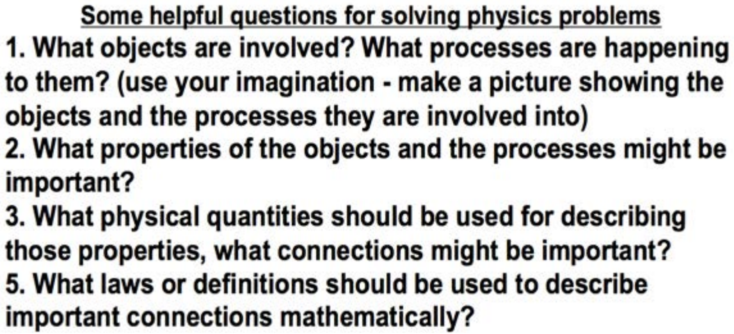

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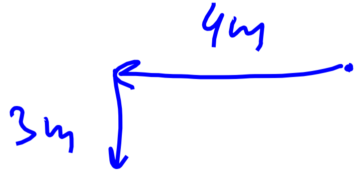
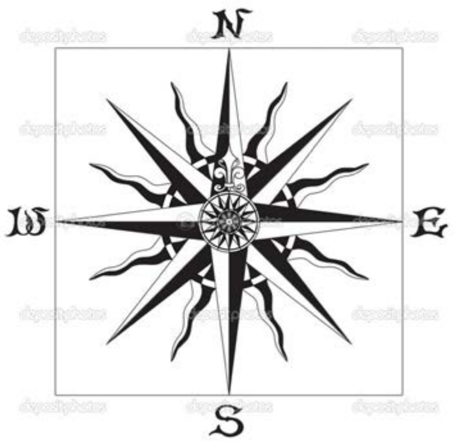


$L = 4+3 = 7m$

Example Problem: solution

You walk 4 m West, make a 90^0 turn and walk 3 m South. What is your ***total distance*** traveled?



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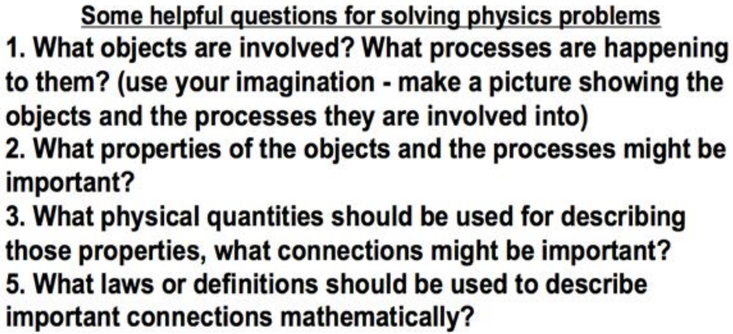

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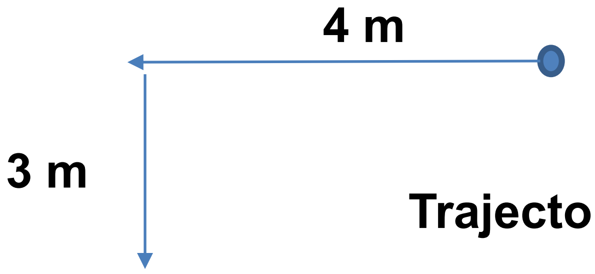
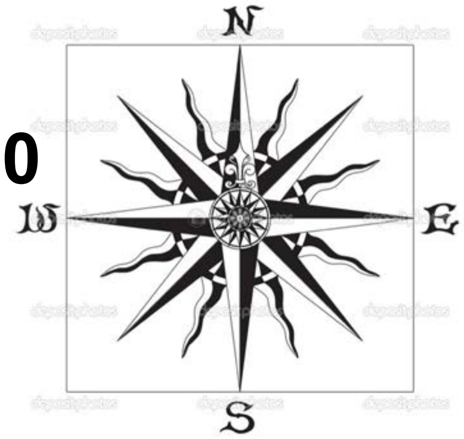


Trajectory!

Distance = length of the trajectory = 4 + 3 + 7 m

Example Problem

You walk 4 m West, make a 90^0 turn and walk 3 m South.



What is the magnitude of your **displacement?**

1. 1 m
2. 2 m
3. 3 m

Etc.

Enter your answer:

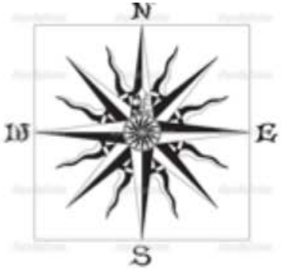
LectureMCQ L2 Q3

Example Problem

~~You~~ I walk 4 m West, make a 90^0 turn and walk 3 m South.

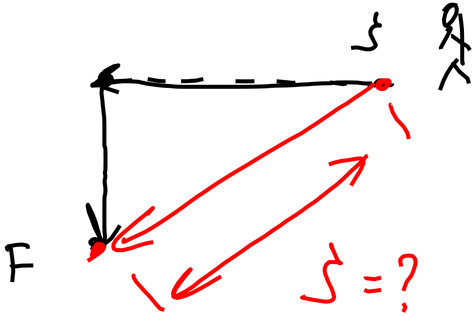
(a) What is your total distance traveled?

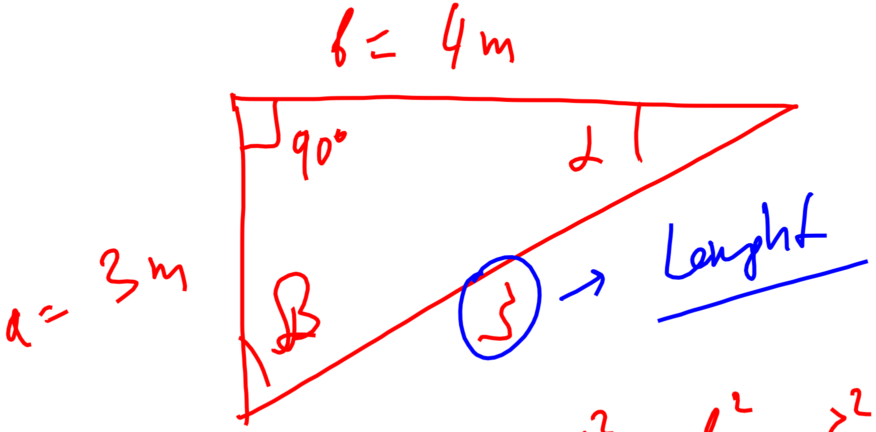
(b) What is your total displacement?

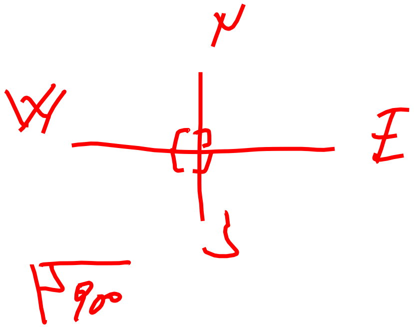


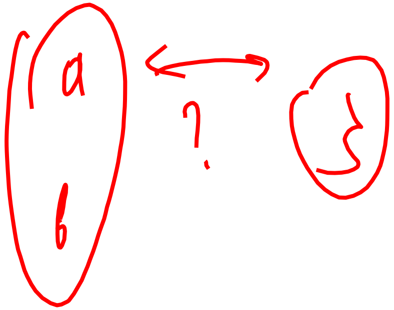
1. 1 m
2. 2 m
3. 3 m

Etc.









$$a^2 + b^2 = \varsigma^2$$

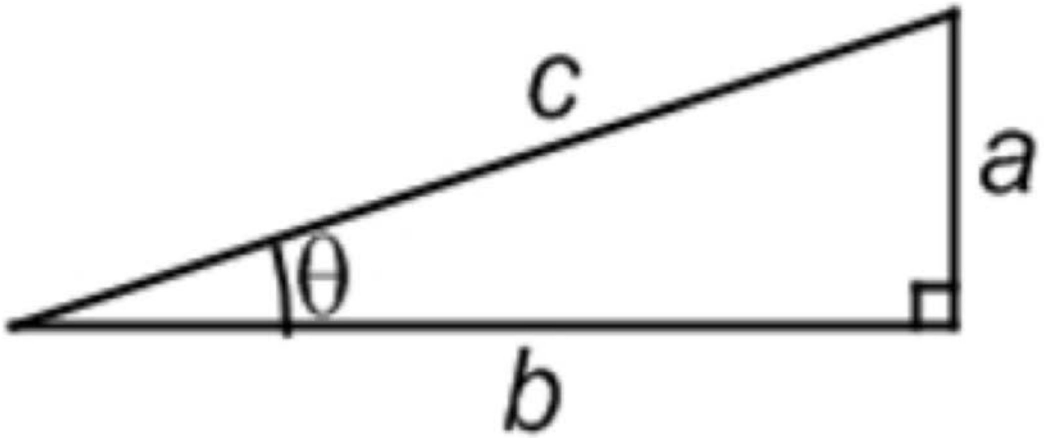
$$3^2 + 4^2 = \varsigma^2$$

$$25 = \varsigma^2 \rightarrow \varsigma$$

$$\sqrt{25} = \sqrt{\varsigma^2}$$

$$\pm 5 = \varsigma \Rightarrow \boxed{\underline{\varsigma = 5}}$$

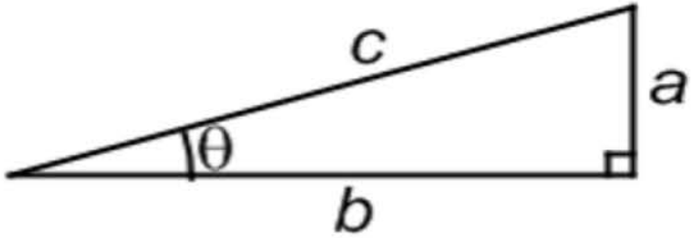
Right-angled triangle



What do we know about a “right triangle”?

Right-angled triangle

We know *everything*!



Useful relationships

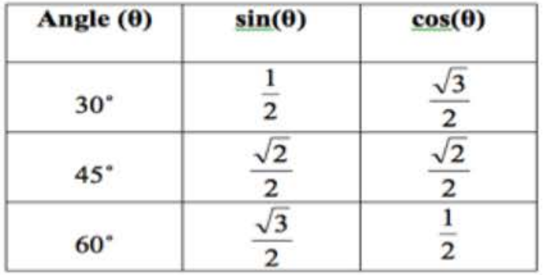
SOHCAHTOA:

$$\sin\theta = \frac{a}{c} = \frac{opposite}{hypotenuse}$$

$$\cos\theta = \frac{b}{c} = \frac{adjacent}{hypotenuse}$$

$$\tan\theta = \frac{a}{b} = \frac{opposite}{adjacent}$$

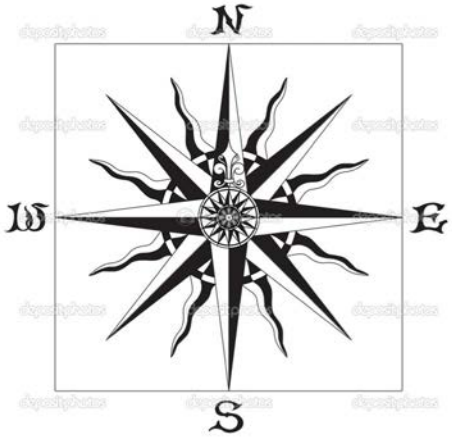
Pythagorean theorem: $c^2 = a^2 + b^2$



Angle (θ)	sin(θ)	cos(θ)
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$

Example Problem

You walk 4 m West, make a 90^0 turn and walk 3 m South. What is your ***total distance*** traveled?



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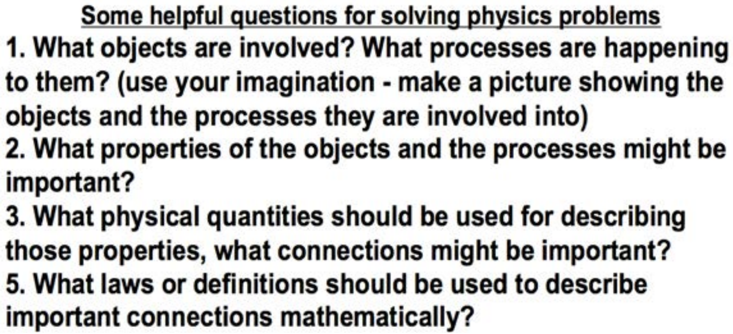

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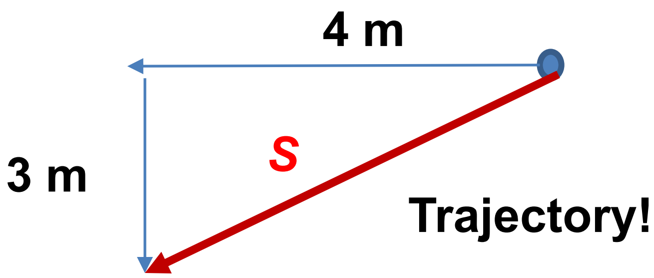
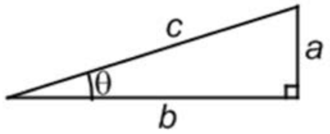


Distance = length of the trajectory = 4 + 3 + 7 m

$$S^2 = 4^2 + 3^2 = 25 \Rightarrow S = 5 \text{ m}$$

LectureMCQ L2 Q4

Right-angled triangles



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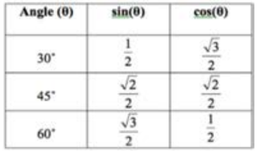


Angle (θ)	sin(θ)	cos(θ)
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$

“The 3-4-5 triangle is also a 30-60-90 triangle”

The statement above is …

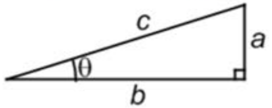
1. Correct. 2. Wrong.

3. Depends on the triangle

4. Confusing 5. Reassuring

If sides are 3 and 4, the angle θ is …

Right-angled triangles

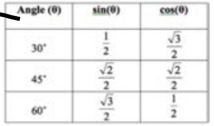


Useful relationships

SOHCAHTOA:

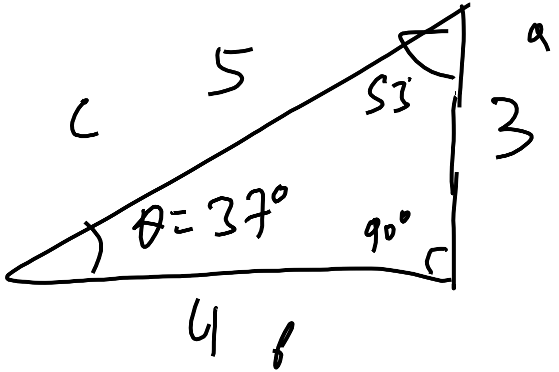
$$\sin\theta = \frac{a}{c} = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{b}{c} = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\theta = \frac{a}{b} = \frac{\text{opposite}}{\text{adjacent}}$$



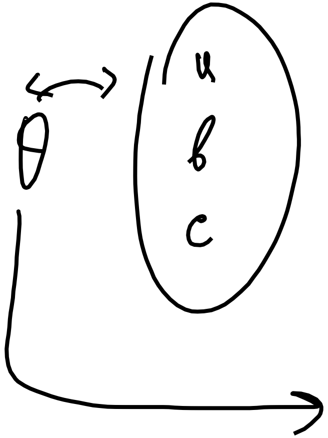
Angle (θ)	sin(θ)	cos(θ)
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$

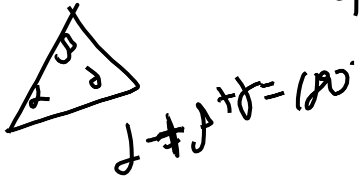
Pythagorean theorem: $c^2 = a^2 + b^2$



Q5

Solve ..
and
select your
answer to Q4.

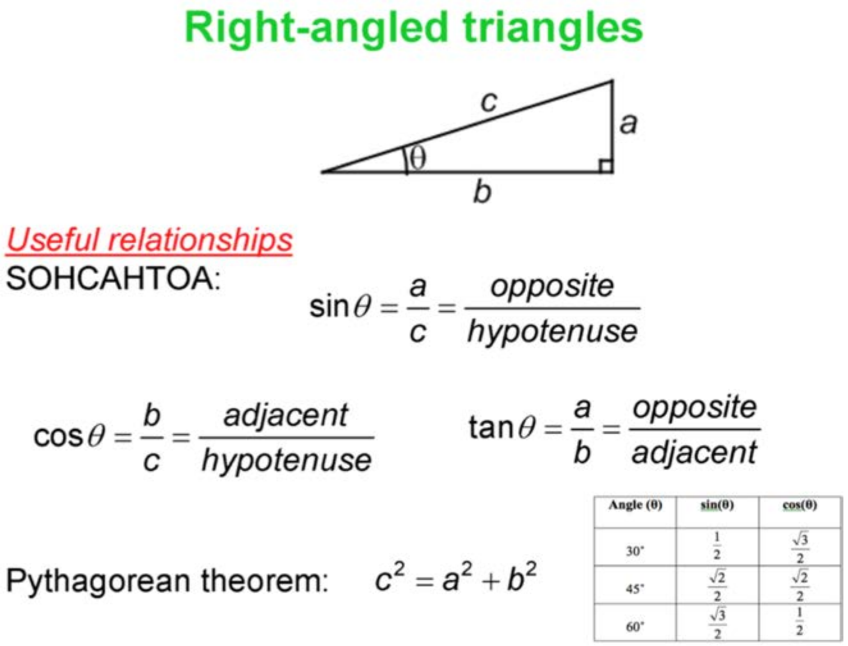




$$\cos\theta = \frac{b}{c} = \frac{4}{5}\ ;\ \theta = \cos^{-1}\left(\frac{4}{5}\right) = \underline{\underline{37^\circ}}$$

$\cos 30 = 0.87$; $\cos 60 = 0.5$

LectureMCQ L2 Q4



Right-angled triangles

Useful relationships

SOHCAHTOA: $\sin\theta = \frac{a}{c} = \frac{opposite}{hypotenuse}$

$\cos\theta = \frac{b}{c} = \frac{adjacent}{hypotenuse}$ $\tan\theta = \frac{a}{b} = \frac{opposite}{adjacent}$

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45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$

"The 3-4-5 triangle is also a 30-60-90 triangle"

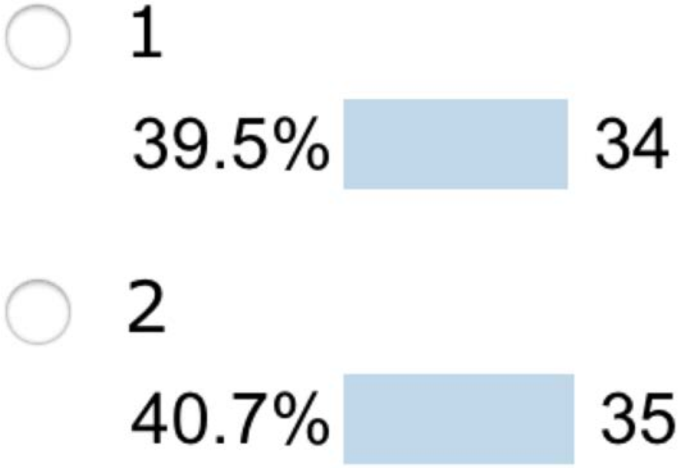
The statement above is …

1. Correct. 2. Wrong.

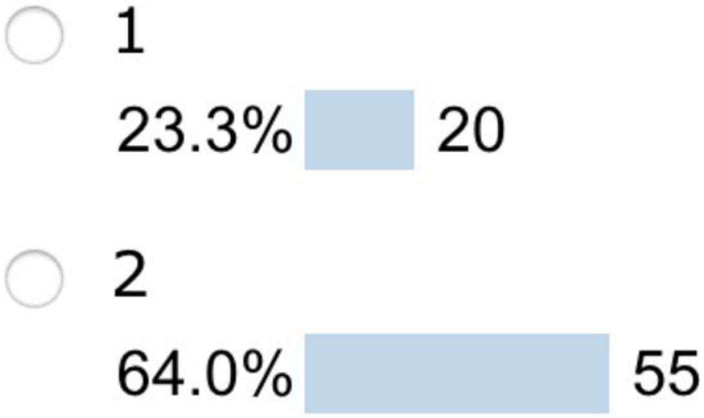
3. Depends on the triangle

4. Confusing 5. Reassuring

Thinking



Doing



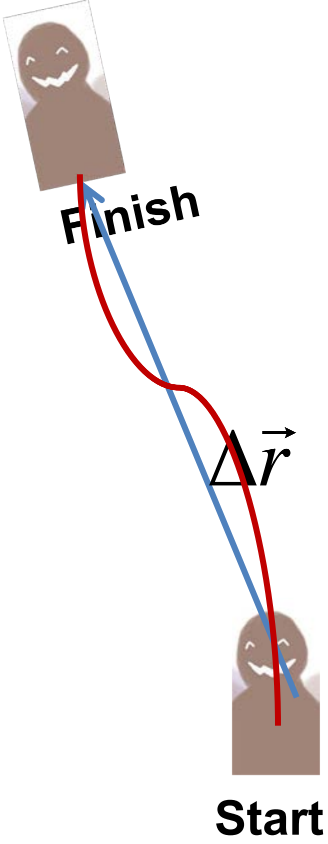
Physical terms/parameters/quantities used to describe motion:

position, trajectory/path, displacement, magnitude of the displacement, distance traveled, time of motion/elapsed time (origin, reference frame, coordinate, position vector, radius-vector,).

=> need to know each definition *literally*!

Motion = *Change* in the position.

… => HOW FAST … ??



A *displacement* is a vector representing the *change* in the position vector.

The distance traveled is the length of the trajectory

***How fast* does the object move (i.e. changes its location)?**

”How fast” => “the rate of change of” => “change per unit time”

$$\text{average velocity} = \frac{\text{net displacement}}{\text{total time}}, \text{ or, } \overset{\Longrightarrow}{v} = \frac{\Delta\vec{r}}{\Delta t}$$

Names! ***Definitions!*** **Equations!**

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}, \text{ or } v = \frac{L}{\Delta t}$$

Speed is a scalar representing how fast an object is traveling.

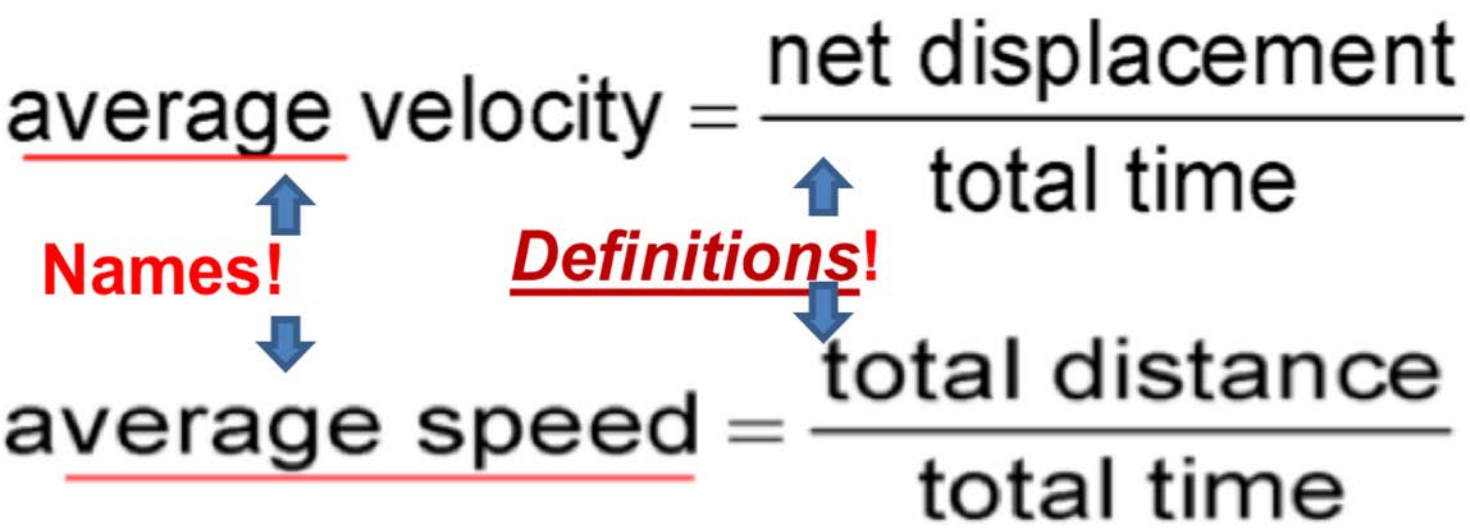
“soon”

Velocity is a vector combining the speed with the direction of motion. We can also define velocity as the rate of change of position.

LectureMCQ L2 Q~~5~~6

For 6 seconds a fly flies 4 m West, makes a 90^0 turn and for 4 more seconds flies 3 m South. Calculate is the *magnitude* of its average velocity.

1. 0.1 m/s
2. 0.2 m/s
3. 0.3 m/s
4. …



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Names!

Definitions!

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

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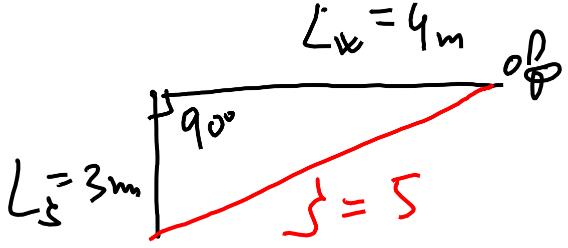


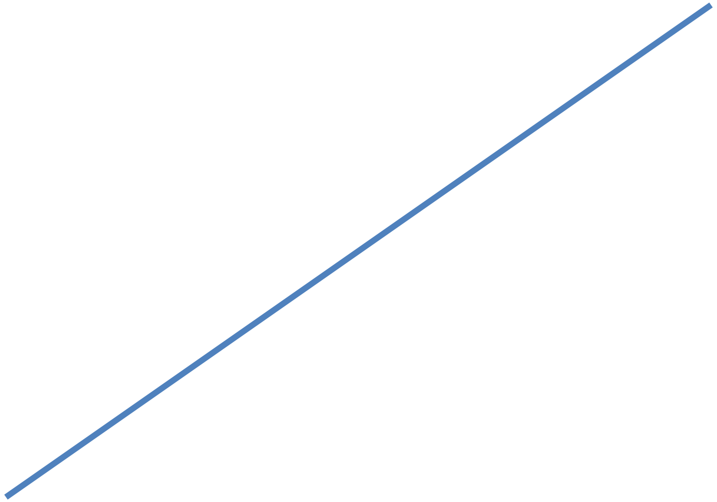
$$V_A = \frac{S}{t} = \frac{5}{6+4} = \frac{5}{10} = .5 \frac{m}{s}$$

$$|\vec{V}_A| = \frac{|\vec{S}|}{t}$$

$$V_{sp} = \frac{L}{t} = \frac{4+3}{6+4} = 0.7 \, m/s$$

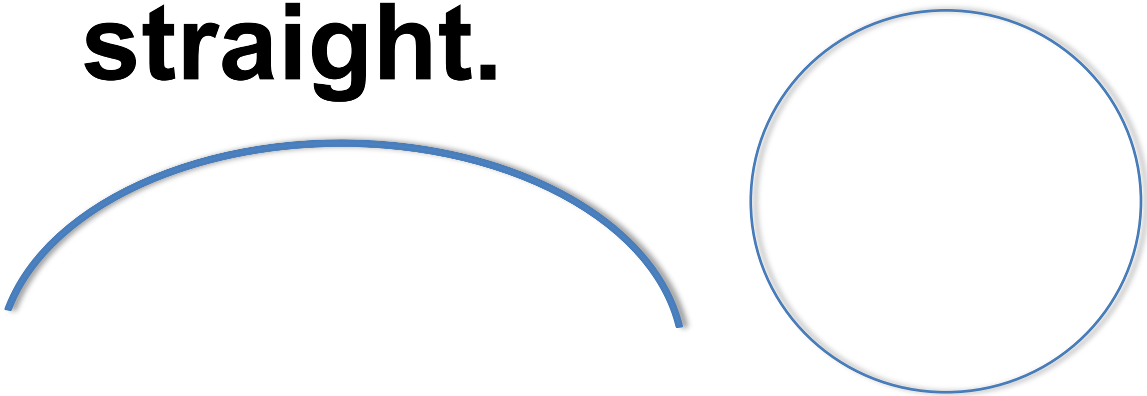
1–D motion

A trajectory is a *straight* line.



2–D motion

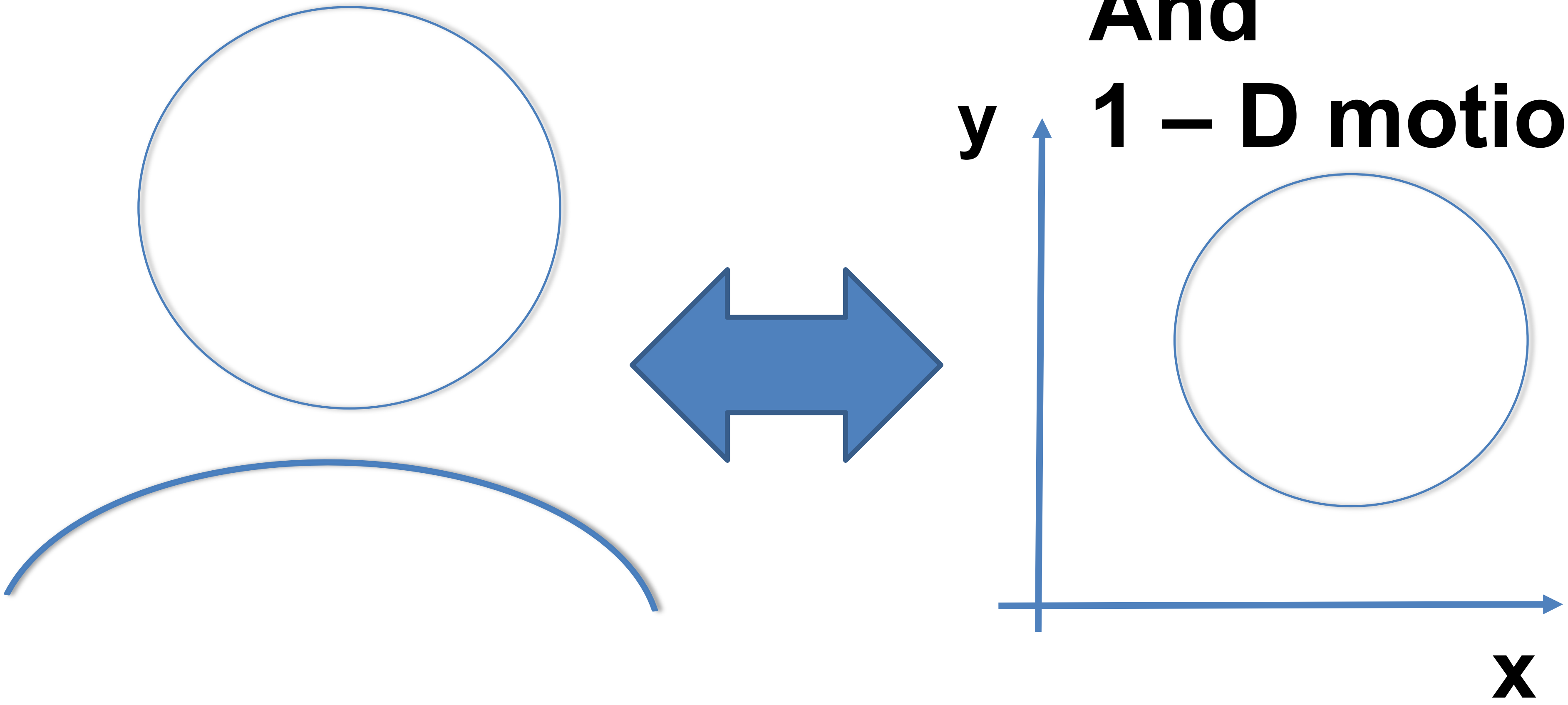
A trajectory is a line in a *plane* (a flat surface) but not straight.



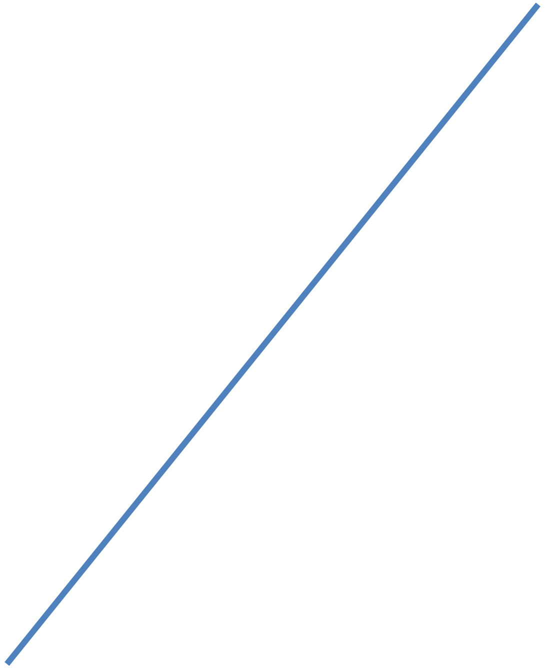
3–D motion = not 1 and not 2 D

2 – D motion

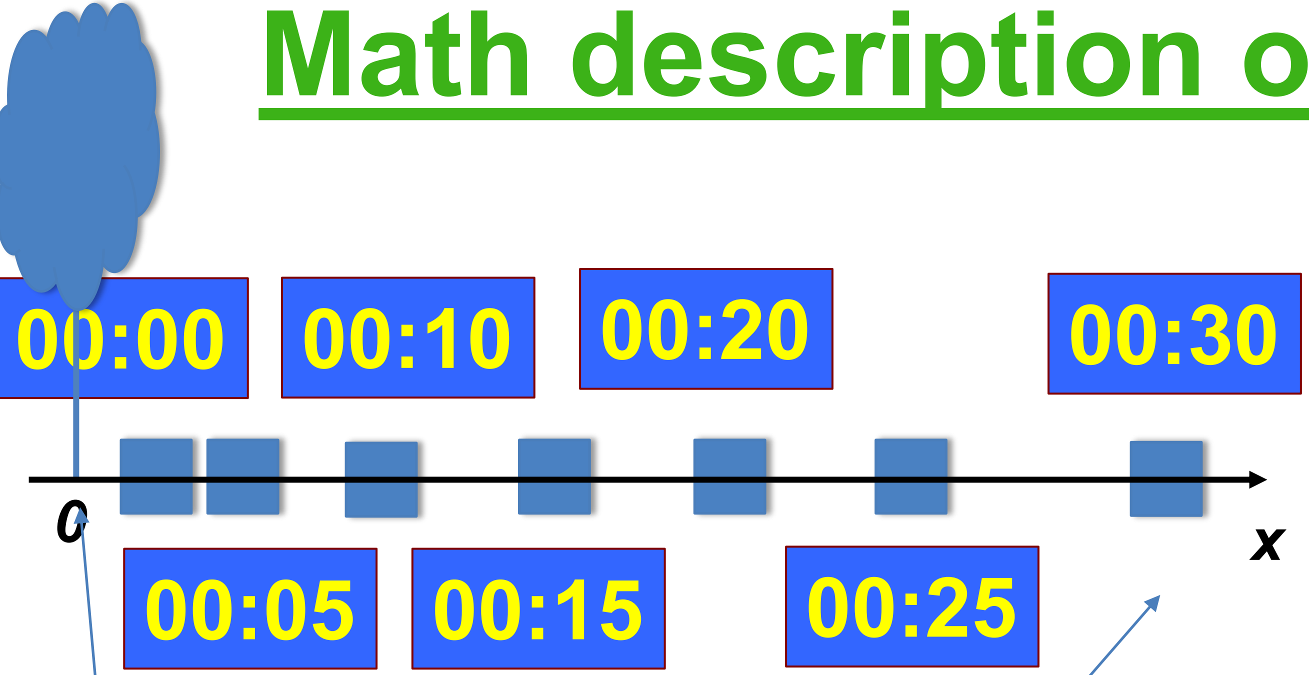
1 – D motion
And
1 – D motion



The basics of the 1 – D motion



Math description of 1-D Motion



X - axis

The origin

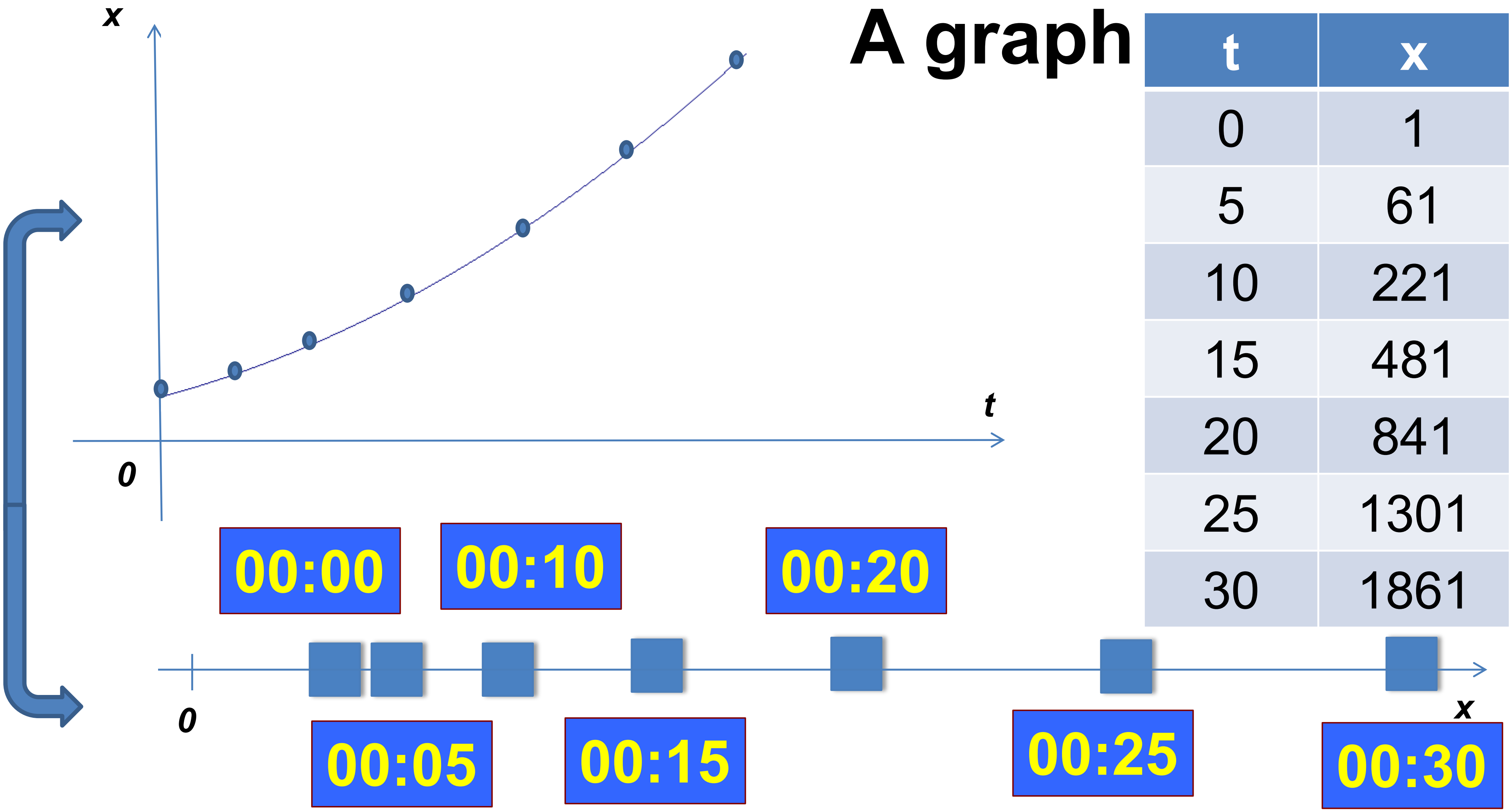
X - coordinates

A table

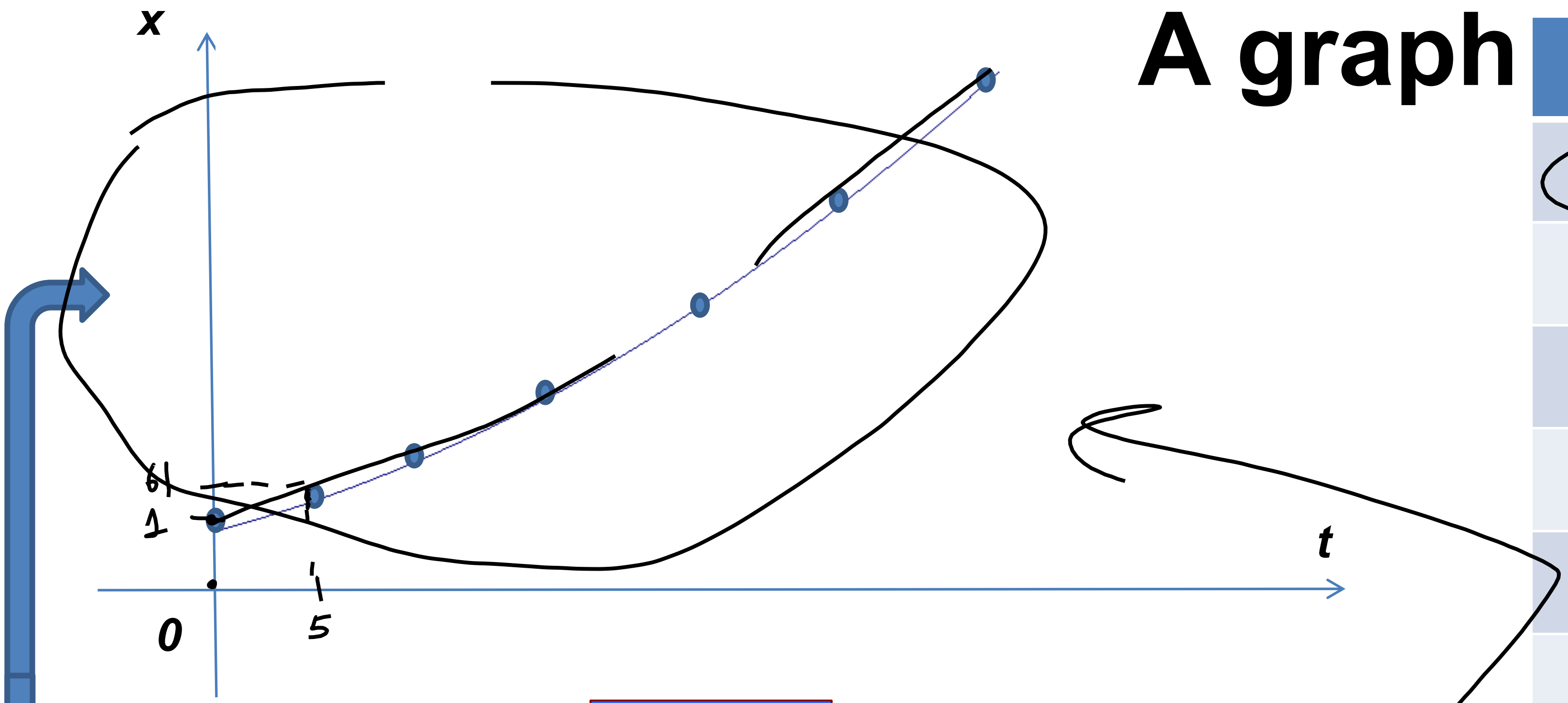
t	x
0	1
5	61
10	221
15	481
20	841
25	1301
30	1861

A graph

t	x
0	1
5	61
10	221
15	481
20	841
25	1301
30	1861



A graph



t	x
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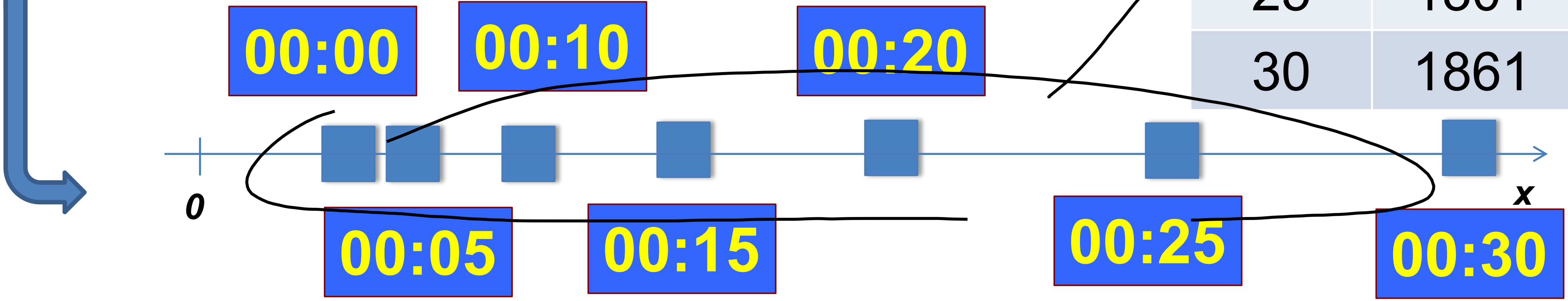
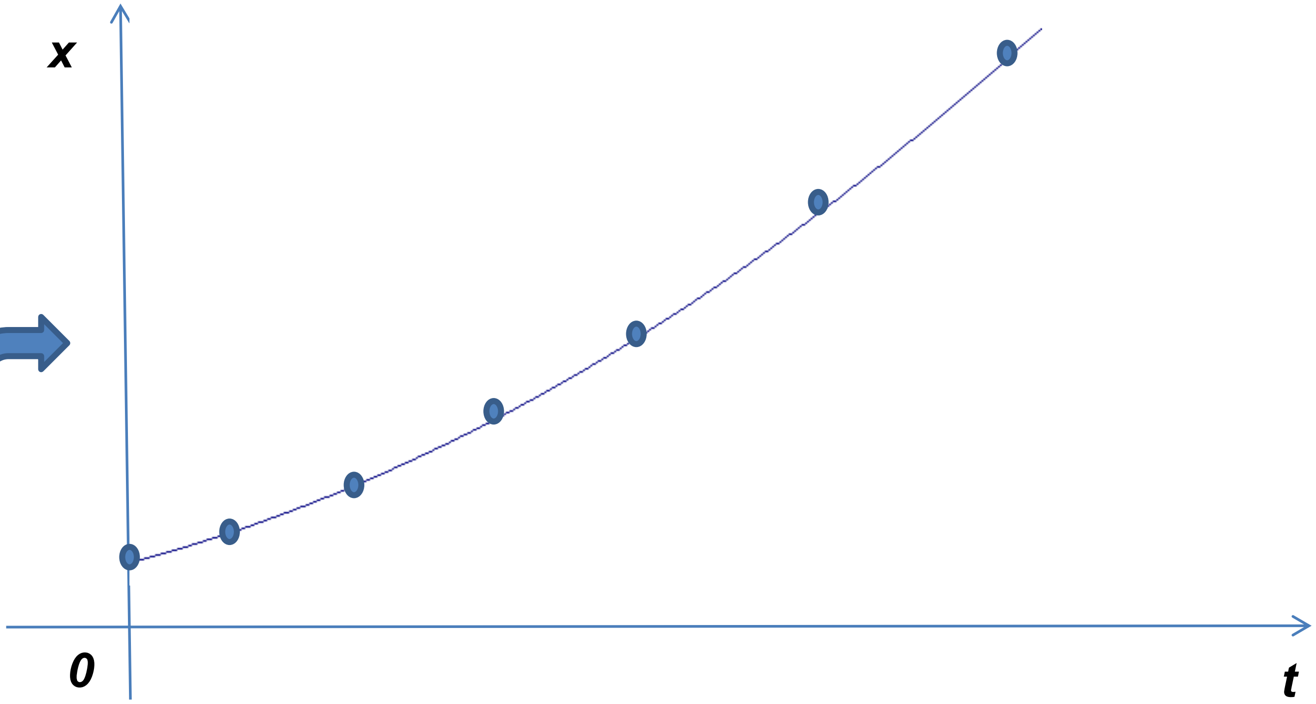


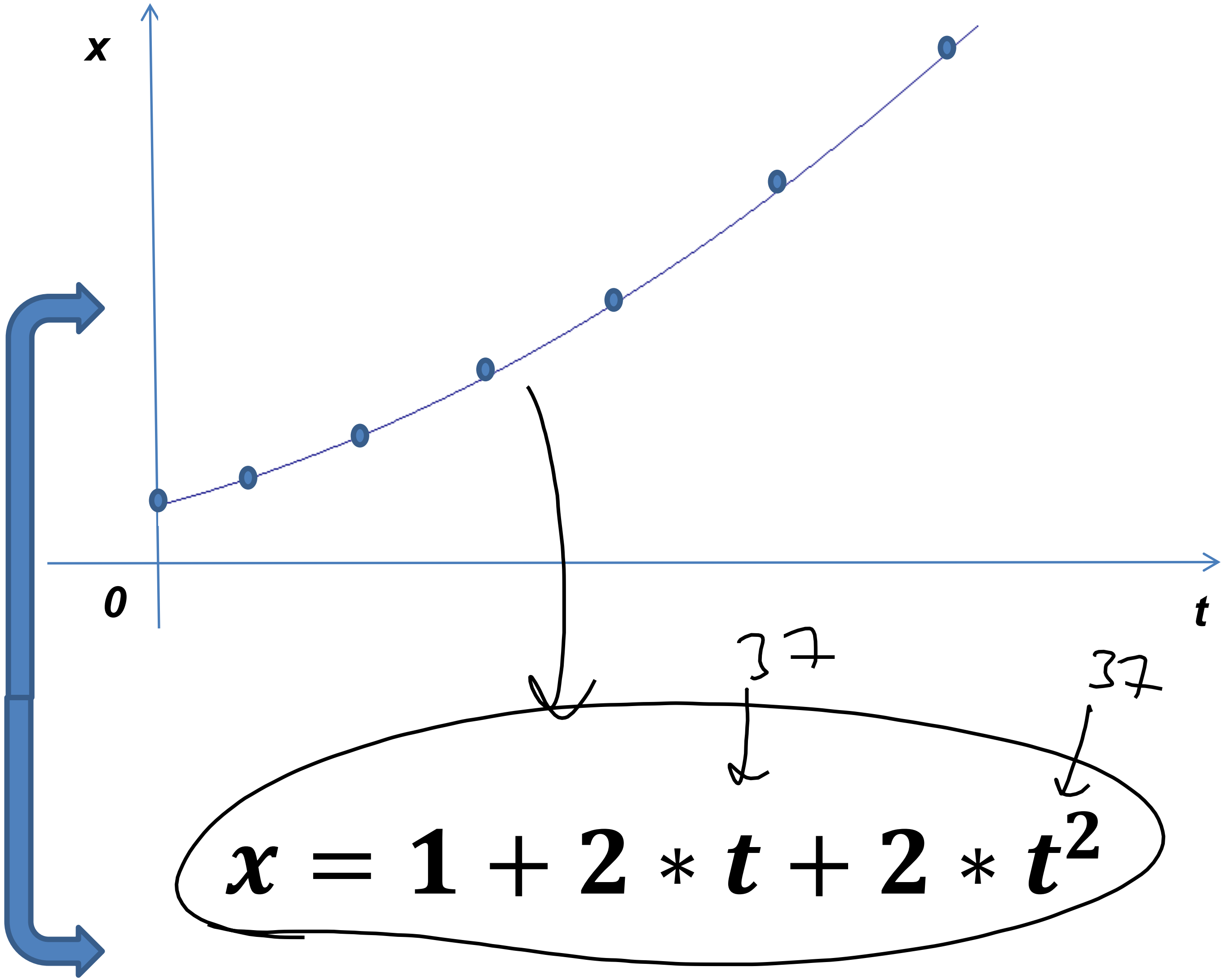
An equation



$$x = 1 + 2 * t + 2 * t^2$$

t	x
0	1
5	61
10	221
15	481
20	841
25	1301
30	1861

An equation



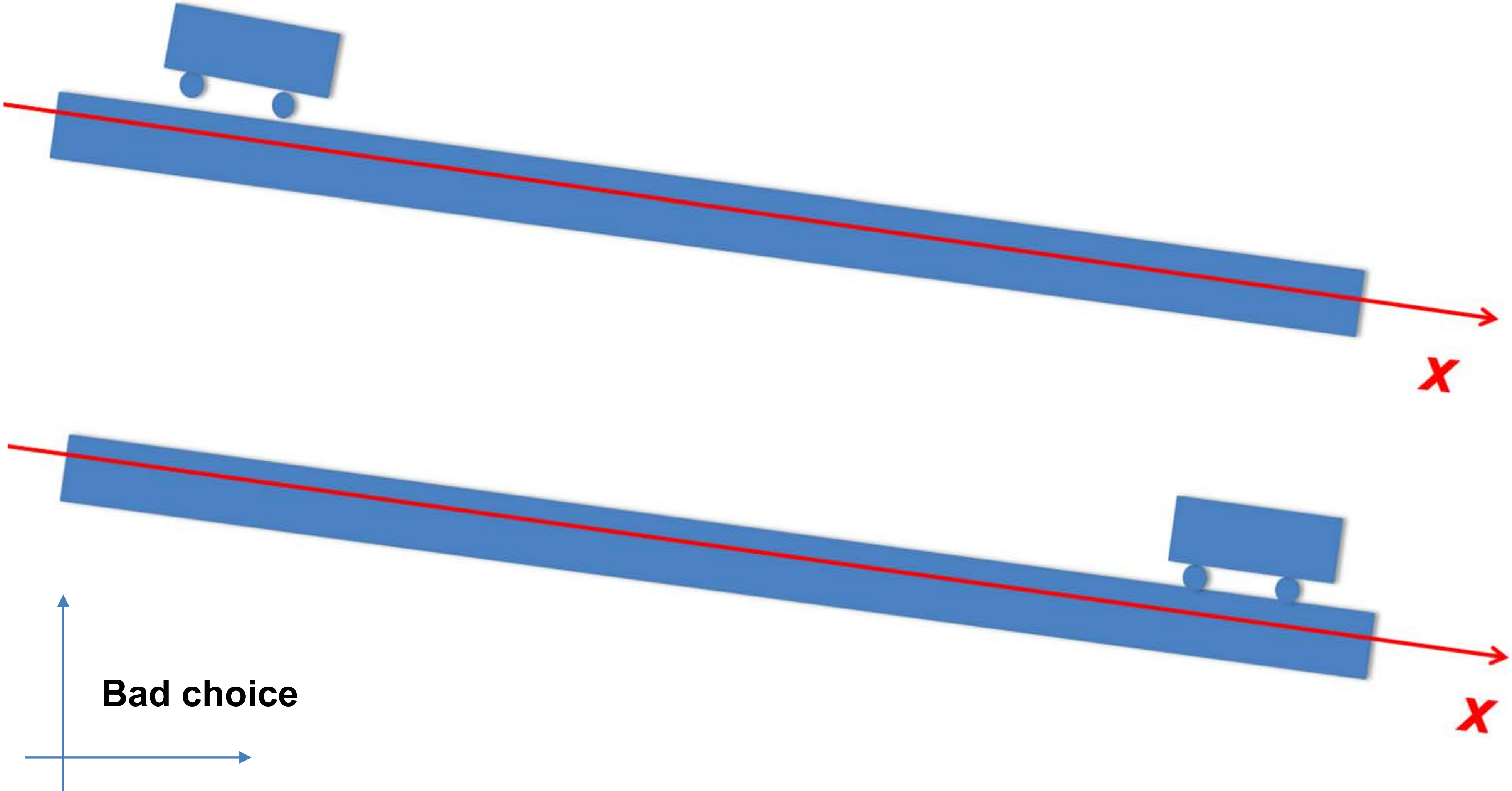
$$x = 1 + 2 * \overset{37}{t} + 2 * \overset{37}{t}^2$$

t	x
0	1
5	61
10	221
15	481
20	841
25	1301
30	1861

37

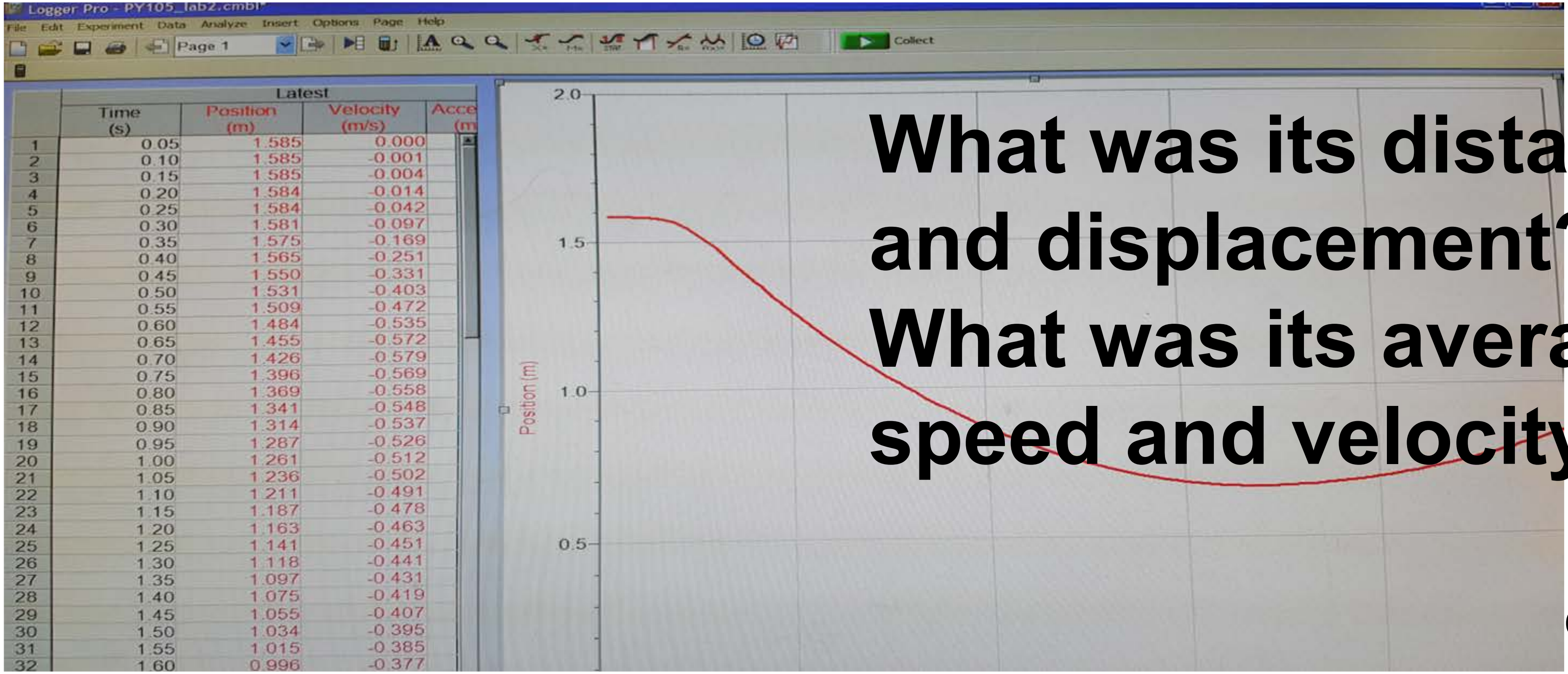
A CART ON A TRACK

1-D motion



Bad choice

Where was the object at *t* = 1?
How much time was it moving?
What is the motion equation?

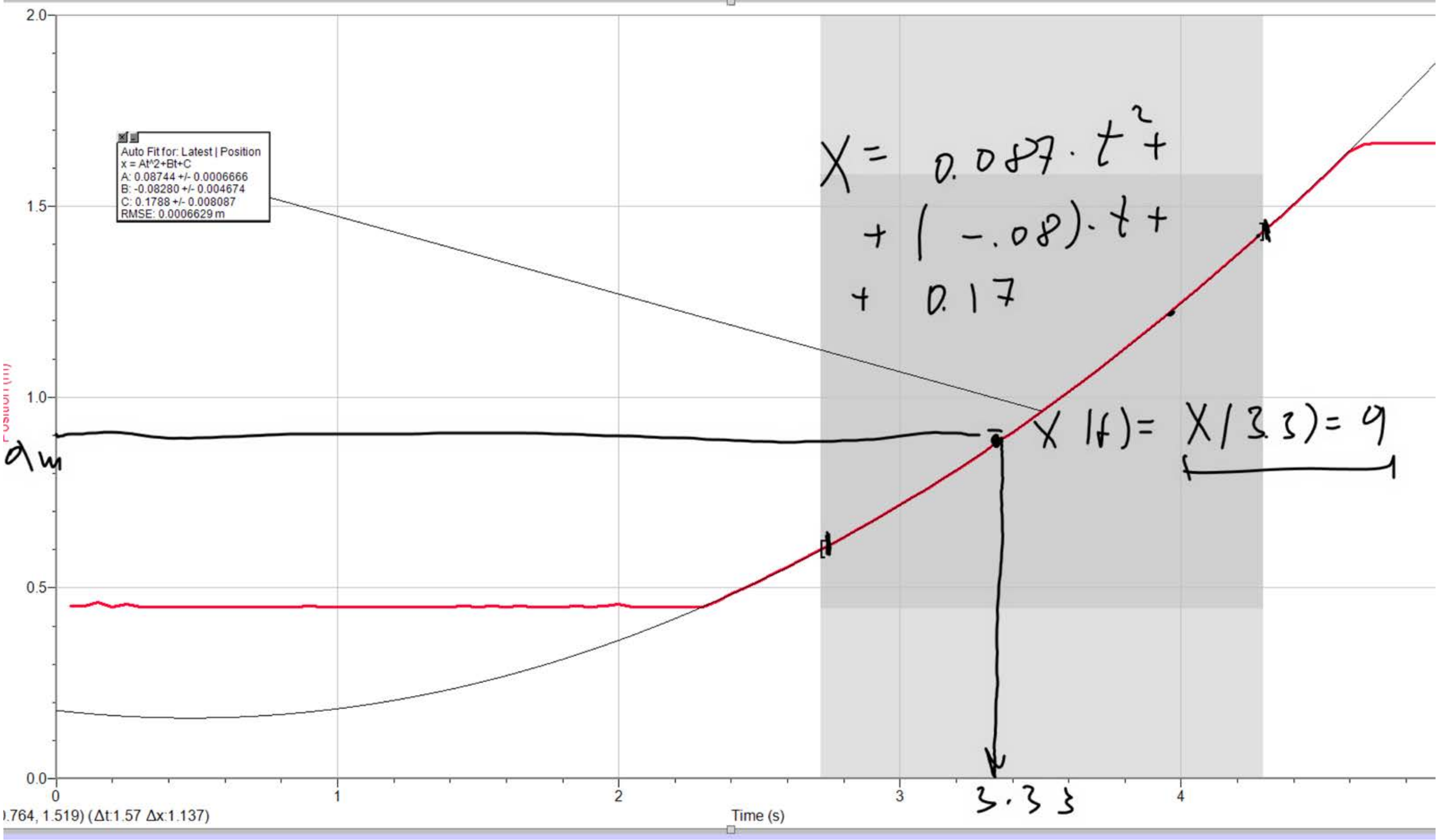


	Latest			
	Time (s)	Position (m)	Velocity (m/s)	Acce (m
1	0.05	1.585	0.000	
2	0.10	1.585	-0.001	
3	0.15	1.585	-0.004	
4	0.20	1.584	-0.014	
5	0.25	1.584	-0.042	
6	0.30	1.581	-0.097	
7	0.35	1.575	-0.169	
8	0.40	1.565	-0.251	
9	0.45	1.550	-0.331	
10	0.50	1.531	-0.403	
11	0.55	1.509	-0.472	
12	0.60	1.484	-0.535	
13	0.65	1.455	-0.572	
14	0.70	1.426	-0.579	
15	0.75	1.396	-0.569	
16	0.80	1.369	-0.558	
17	0.85	1.341	-0.548	
18	0.90	1.314	-0.537	
19	0.95	1.287	-0.526	
20	1.00	1.261	-0.512	
21	1.05	1.236	-0.502	
22	1.10	1.211	-0.491	
23	1.15	1.187	-0.478	
24	1.20	1.163	-0.463	
25	1.25	1.141	-0.451	
26	1.30	1.118	-0.441	
27	1.35	1.097	-0.431	
28	1.40	1.075	-0.419	
29	1.45	1.055	-0.407	
30	1.50	1.034	-0.395	
31	1.55	1.015	-0.385	
32	1.60	0.996	-0.377	

What was its distance and displacement?

What was its average speed and velocity?

CP2



```
Auto Fit for: Latest | Position
x = At^2+Bt+C
A: 0.08744 +/- 0.0006666
B: -0.08280 +/- 0.004674
C: 0.1788 +/- 0.008087
RMSE: 0.0006629 m
```

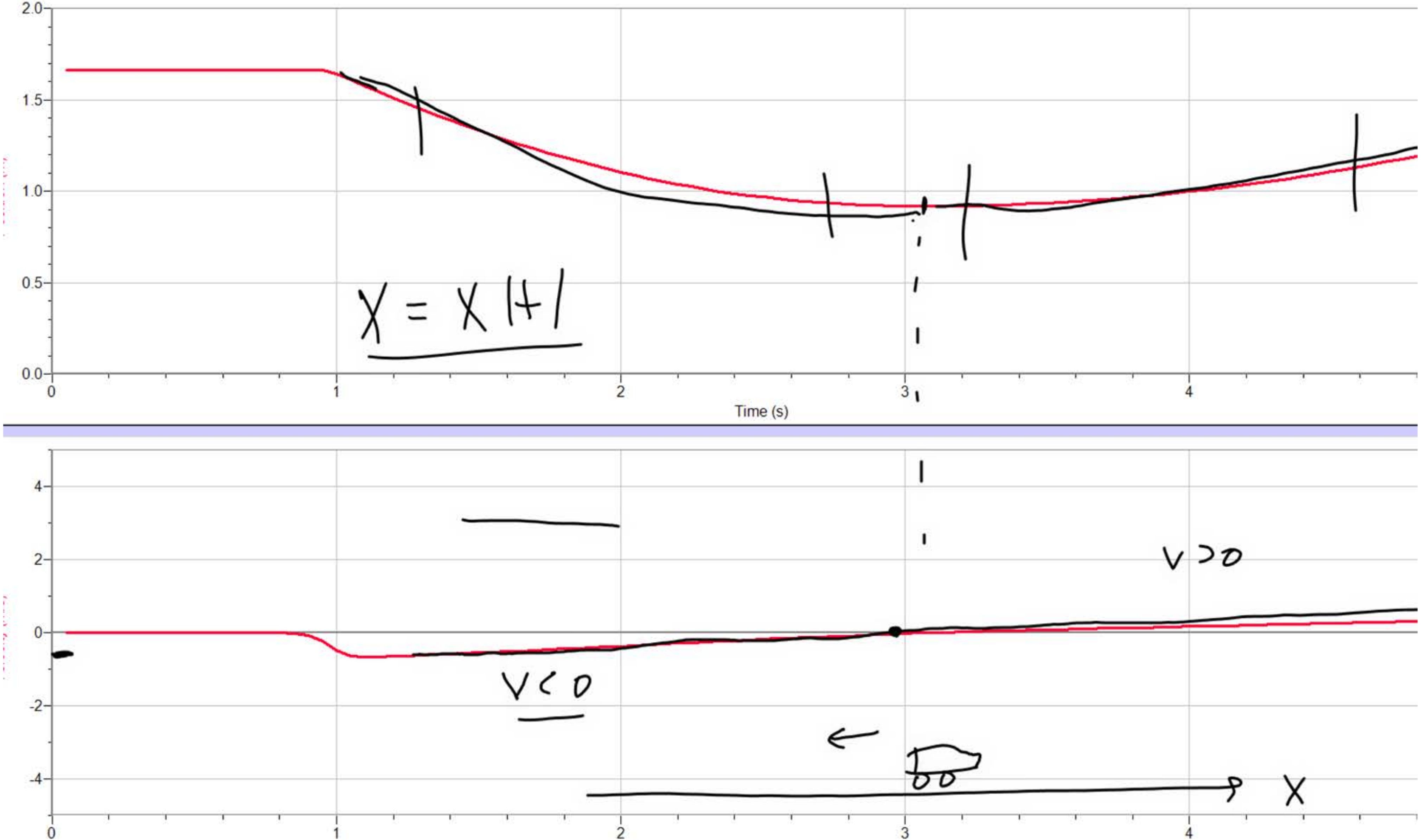
$X = 0.087 \cdot t^2 +$

$+ (-.08) \cdot t +$

$+ 0.17$

$X(t_f) = \underbrace{X(3.3) = 9}$

```
).764, 1.519) (Δt:1.57 Δx:1.137)
```


2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
Time (s)
X = X(t)
4
2
0
-2
-4
V < 0
V > 0
X

Where was the object at *t* = 1?
How much time was it moving?
What is the motion equation?

Where was the object at *t* = 1?
How much time was it moving?
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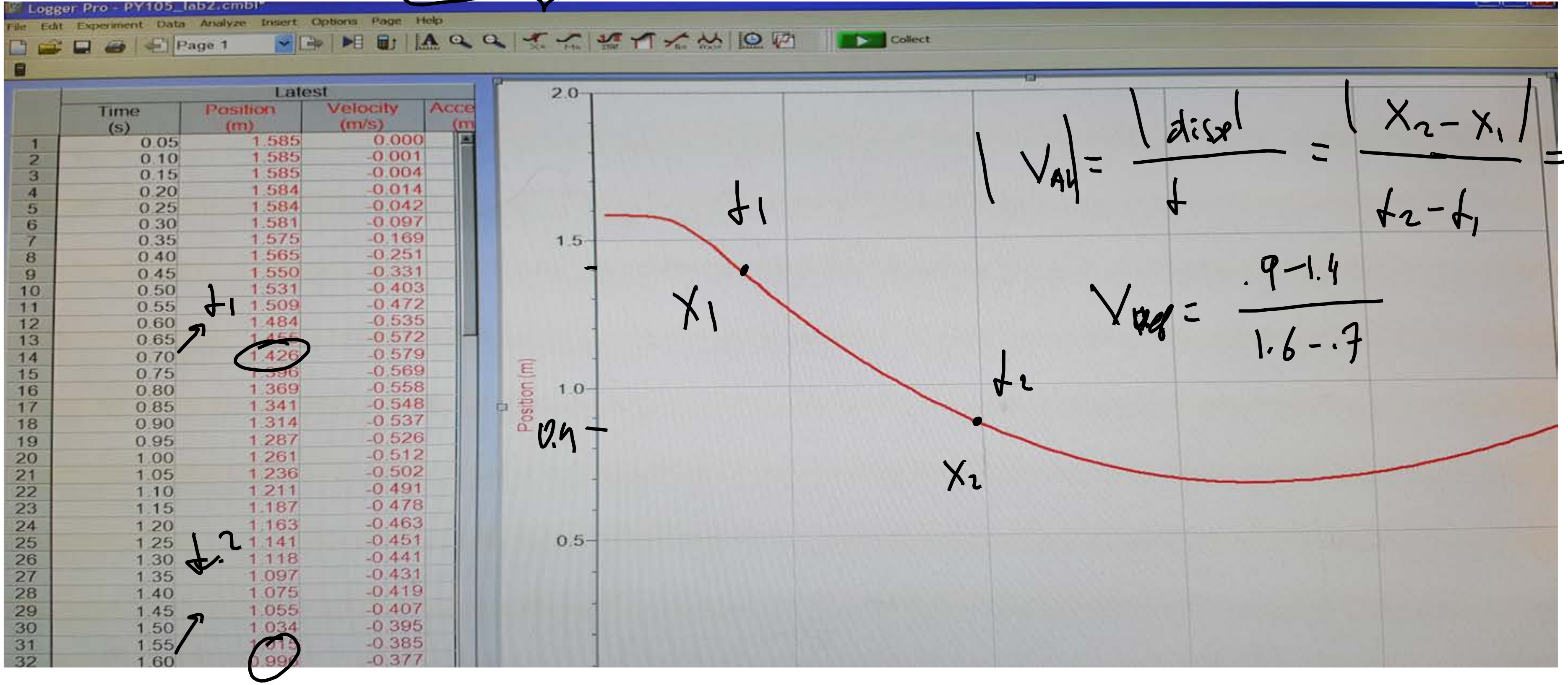

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32	1.60	0.996	-0.377	

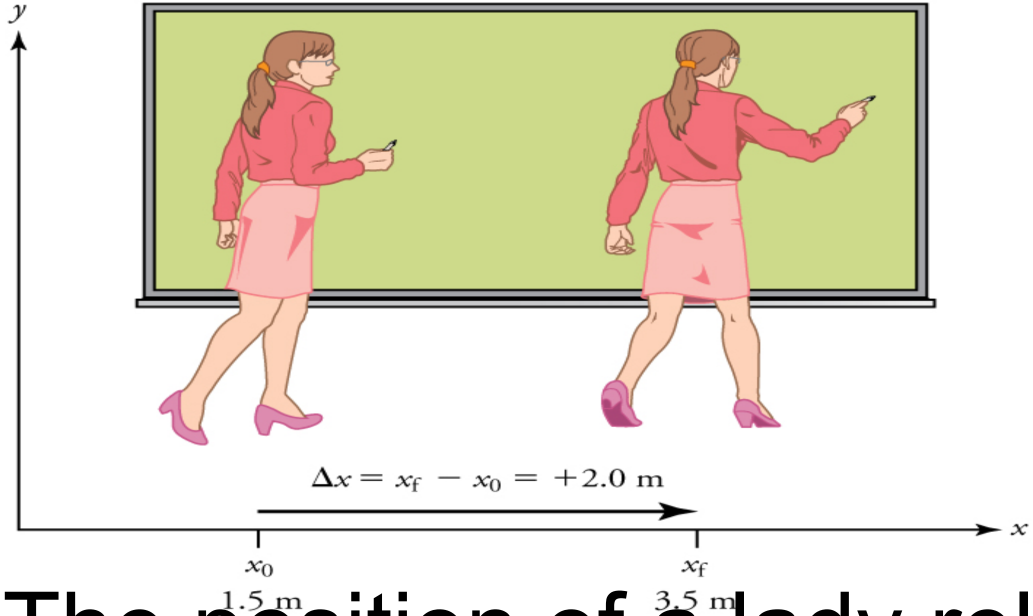
t1

t.2

$$|V_{Av}| = \frac{|\text{disp}|}{t} = \frac{|x_2 - x_1|}{t_2 - t_1} = \frac{1.4 - .9}{1.6 - .7}$$

$$V_{avg} = \frac{.9 - 1.4}{1.6 - .7}$$

CP3



1 D - motion

$$x_f = x_i + \Delta x$$

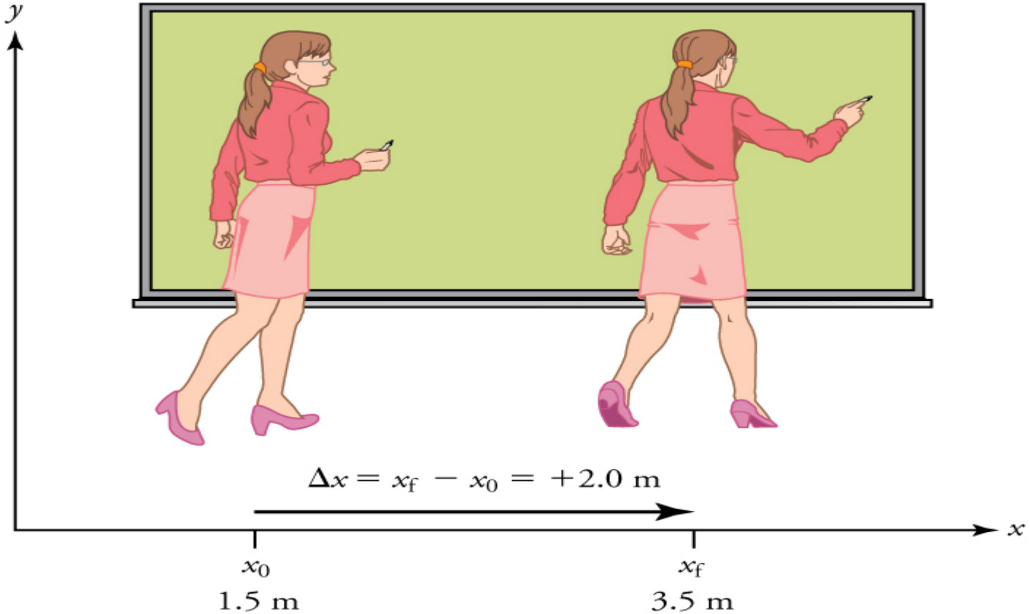
coordinates

$$\Delta x = x_f - x_i$$

The position of a lady relative to Earth is given by x . The +2.0 m displacement of the lady is represented by an arrow pointing to the right.

To know her position at any instant we use motion equation $x(t)$ (which depends on the type motion)

1 D - motion



$$x_f = x_i + \Delta x$$

coordinates

displacement

$$\Delta x = x_f - x_i$$

To describe the *position* of an object at *any* instant we use motion equation x = *x*(*t*)

Average velocity

$$v_x = \frac{\Delta x}{\Delta t}$$

Average speed

$$v = \frac{L}{\Delta t}$$

distance

$$x_f = x_i + \Delta x \qquad \Delta x = x_f - x_i$$

To describe the *position* of an object at *any* instant we use motion equation $x = x(t)$

Average velocity

$$V_x = \frac{\Delta x}{\Delta t}$$

Average speed

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distance

For 6 seconds a fly flies 4 m West, makes a U-turn and for 4 more seconds flies 3 m East. What is the *magnitude* of its average velocity?

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$$x_f = x_i + \Delta x \qquad \Delta x = x_f - x_i$$

To describe the *position* of an object at *any* instant we use motion equation x = x(*t*)

Average velocity

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Average speed

$$v = \frac{L}{\Delta t}$$

distance