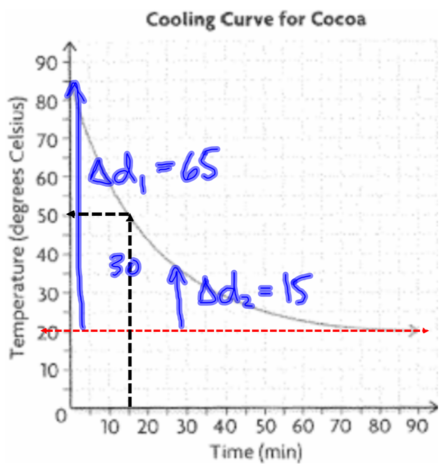
Exponential Applications (part 1)

Apr. 13/2011

Ex.1 A cup of hot cocoa left on a desk in a classroom had its temperature measured once every minute...



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a) What was the temperature at the start? 85°C

b) What was the temperature after 1 hour? 23°C

c) What was the temperature of the classroom? 20°C (asymptote)

d) At what time was the cocoa 35°C? ~30 min

e) Comment on the ratio of the y-values:

Compare Δd_y values (distance from asymptote)

$\frac{30}{65} \doteq 0.46$ $\quad \frac{15}{30} = 0.5$ $\quad \frac{\Delta d_2}{\Delta d_1}$

∴ over equal intervals (~15 min), the temp decreases by about $\frac{1}{2}$.

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f) Determine an algebraic model using *hours*:

$$\frac{\Delta d_{t=1h}}{\Delta d_{t=0h}} = \frac{3}{65}$$

$b \doteq 0.046$

$y = a\,b^{x} + q$

$q =$ asymptote

$a =$ initial Δd
$= 65$

$$\boxed{y = 65(0.046)^{x} + 20}$$

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g) Determine an algebraic model using *minutes*:

$$\frac{\Delta d_{t=60}}{\Delta d_{t=0}} = \frac{3}{65}$$

$b \doteq 0.046$

$k = 20$

$a = 65$

$y = 65(0.046)^{x} + 20$

to change time scale,

$x \rightarrow \frac{x}{60}$
(hours) (minutes)

$y = 65(0.046)^{x/60} + 20$.

Check model $t=30$: $y = 65(0.046)^{30/60} + 20$
$y \doteq 33.94$

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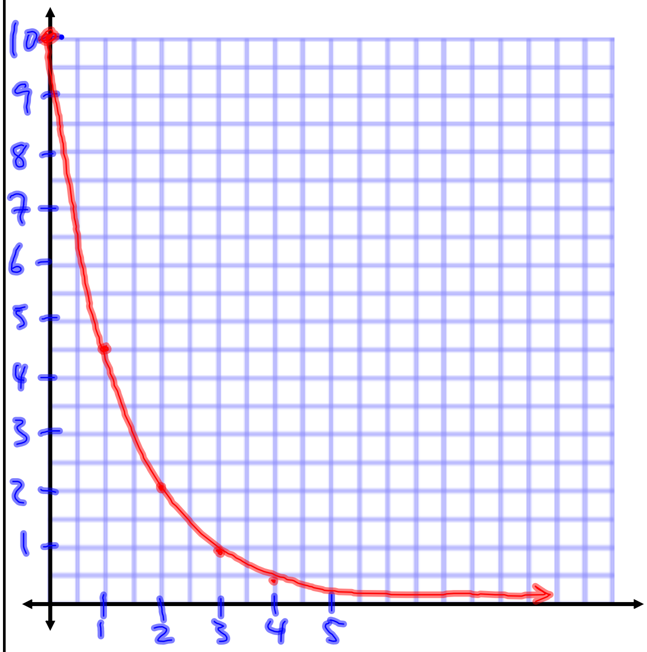
Ex.2 A tennis ball is dropped from 10 m. After each bounce, its height is 45% of the previous height.

a) Create a TOV and graph



# bounces	height (m)
0	10
1	4.5
2	2.025
3	0.91125
4	0.4100

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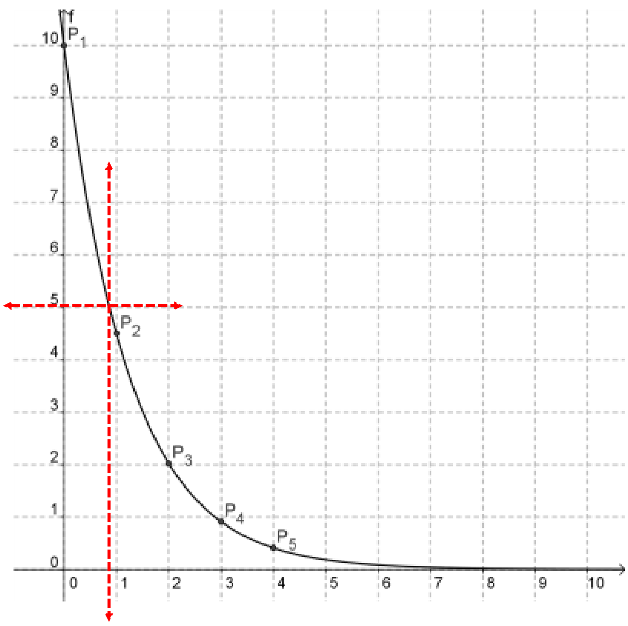
a) Create a TOV and graph



# bounces	height (m)
0	
1	
2	
3	
4	

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b) Estimate when the ball's height will be half.

between 0.8 and 0.9 (0.87)

c) Determine the equation that models the max height after *n* bounces.

$y = ab^x + q$

$a \rightarrow 10$ (starting value since $y=0$ is asymptote)

$q \rightarrow 0$

$b = \dfrac{\Delta d_2}{\Delta d_1}$ (consecutive points)

$= \dfrac{4.5}{10}$

$= 0.45$

$$y = 10(0.45)^n$$

$n=4$: $y = 10(0.45)^4$

$\doteq 0.4100$

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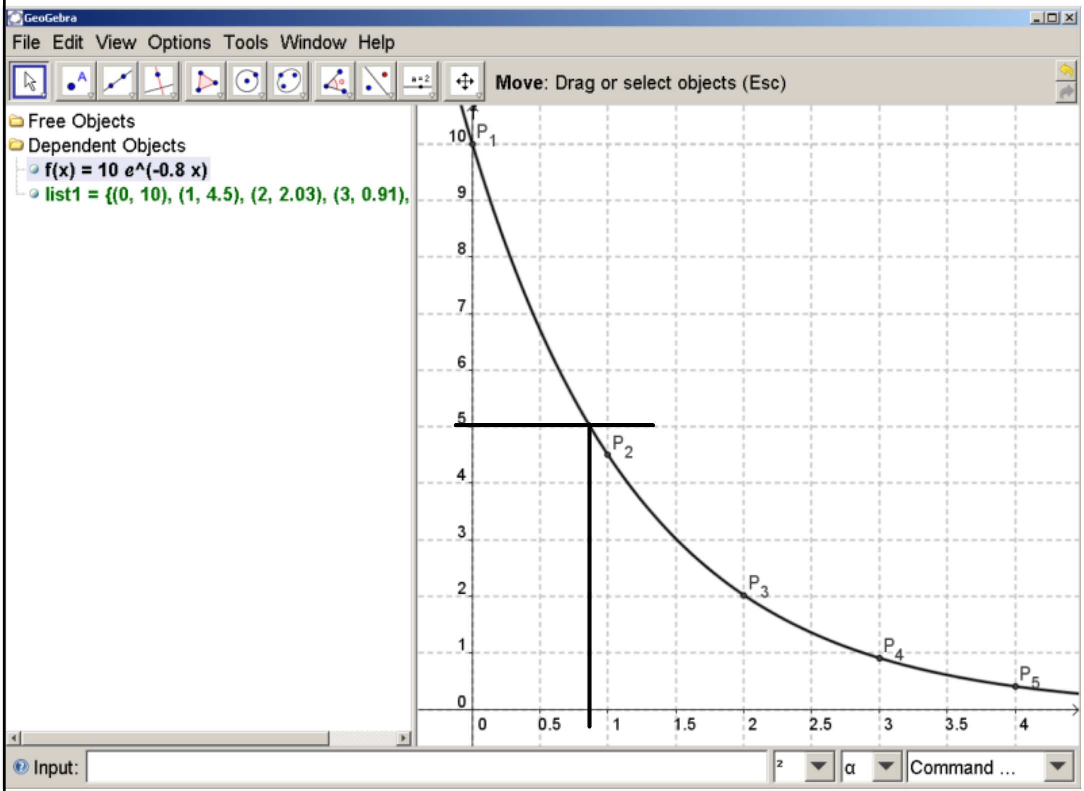

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Exercises:

handout # 1-4

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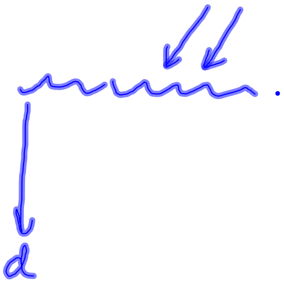

$s = 0.8^d \times 100\%$

(a) $s = 64\%$, $d = ?$

$\frac{64\%}{100\%} = \frac{0.8^d \times 100\%}{100\%}$

$0.64 = 0.8^d$

$\Rightarrow d = 2$ $\quad 0.8^2 = 0.64$

(b) $d = 10m$, $s = ?$

$s = 0.8^{10} \times 100\%$

$s \doteq 11\%$

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