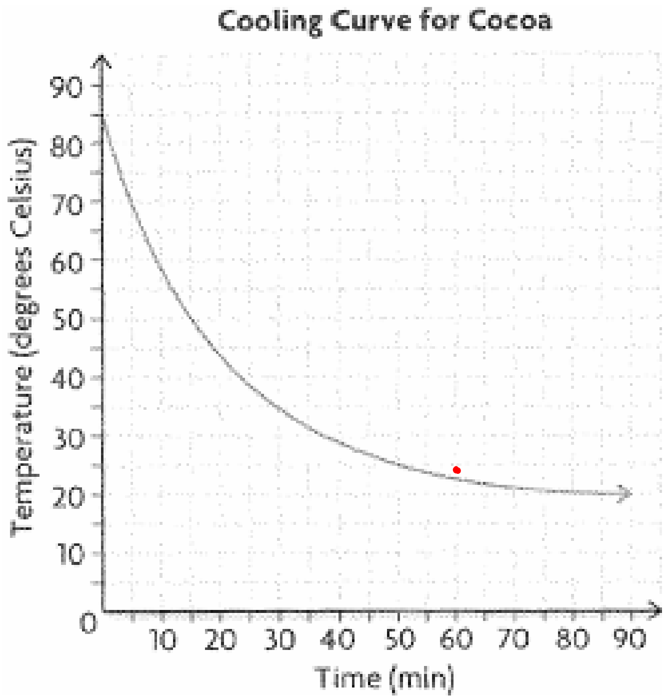
# Exponential Applications (part 1)

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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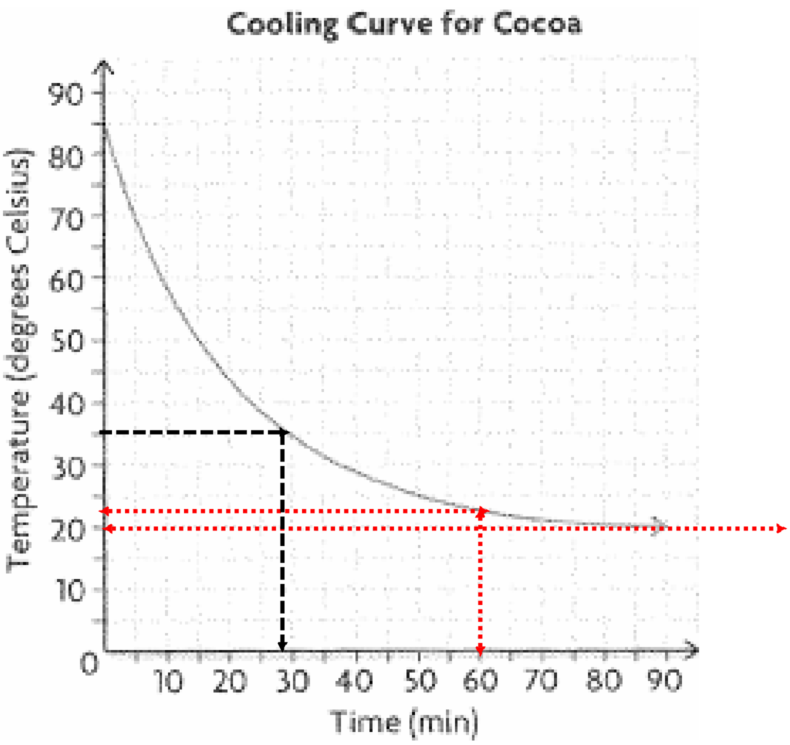


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a) What was the temperature at the start? 85°C

b) What was the temperature ~~after~~ at 1 hour? 22.5°C

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

d) At what time was the cocoa 35°C? 28 mins

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e) Determine an algebraic model using *hours*:

$y = ab^x + q \Rightarrow T = ab^t + q$

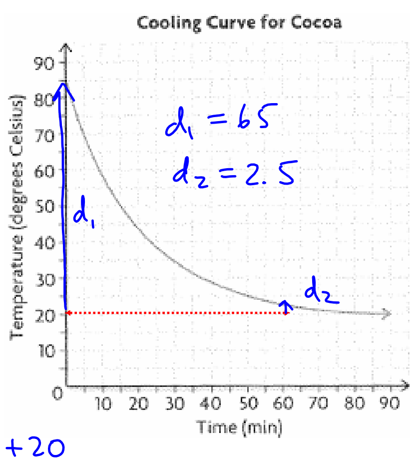
$T$ ← temperature, $t$ ← time

$q = 20$

$b \doteq \frac{d_2}{d_1}$

$\doteq \frac{2.5}{65}$

$\doteq \frac{1}{26}$




$d_1 = 65$

$d_2 = 2.5$

$y = a\left(\frac{1}{26}\right)^x + 20$

sub $P(0, 85)$

$85 = a\left(\frac{1}{26}\right)^0 + 20$

$65 = a$

$y = 65\left(\frac{1}{26}\right)^x + 20$

OR

$T = 65\left(\frac{1}{26}\right)^t + 20$

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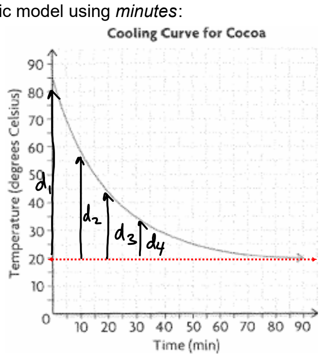
f) Modify the algebraic model using *minutes*:




$y = ab^x + q$

$y = ab^x + 20$

$d_1 = 65$

$d_2 = 35$

$d_3 = 25$

$d_4 = 15$

$\left.\begin{array}{l} \frac{35}{65} \doteq 0.538 \\ \frac{25}{35} \doteq 0.714 \\ \frac{15}{25} \doteq 0.600 \end{array}\right\}$ average $\doteq \frac{0.538+0.714+0.6}{3}$

$\underbrace{\doteq 0.617}_{\text{b value for 10min}}$

$y = a(0.617)^{\frac{x}{10}} + 20$ per 10 minutes

sub $(0,85)$

$85 = a(0.617)^{\frac{0}{10}} + 20$

$65 = a$

$\therefore y = 65(0.617)^{\frac{x}{10}} + 20$ x in minutes

sub $x=60 \Rightarrow y = 65(0.617)^{\frac{60}{10}} + 20$

$\doteq 23.6$

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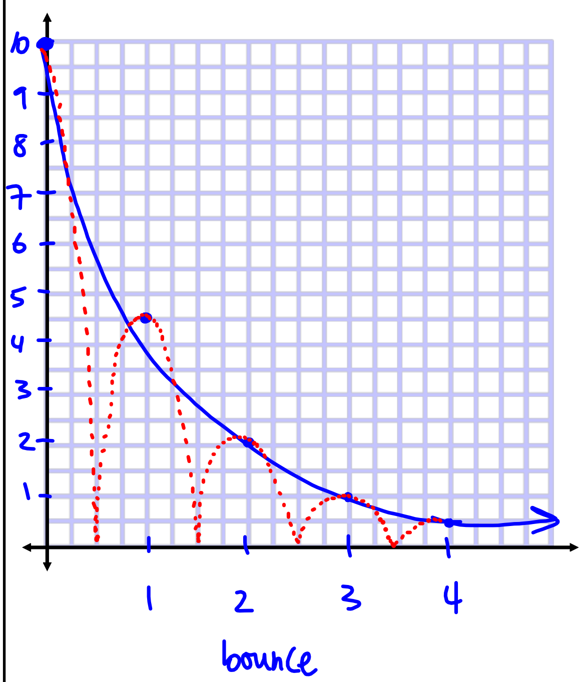
Ex.2 A tennis ball is dropped from 10 m. After each bounce, its height is 45% of the previous height.

a) Create a TOV and graph

| # bounces | height (m) | |
|---|---|---|
| 0 | 10 | $d_1$ |
| 1 | $10(0.45) =$ 4.5 | $d_2$ |
| 2 | 2.025 | $d_3$ |
| 3 | 0.911 | $d_4$ |
| 4 | 0.410 | $d_5$ |

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

$q = 0$ (HA: floor)

$y = ab^x + q$

$b = 0.45$

$\frac{d_2}{d_1} = \frac{4.5}{10} = 0.45$ $\frac{d_3}{d_2} = \frac{2.025}{4.5} = 0.45$

$y = a(0.45)^x + 0$

sub $(0,10)$

$10 = a(0.45)^0$

$a = 10$

$\boxed{y = 10(0.45)^x}$

(c) Estimate the number of bounces required for the bounce height to be ~~10%~~ 1% or less of the starting height.

what is 1% of start height? $0.01(10)$

$y = 0.1$

$\frac{0.1}{10} = \frac{10(0.45)^x}{10}$

$0.01 = 0.45^x$ solve by guess + check

| try | $0.45^x$ |
|---|---|
| 8 | 0.0016 |
| 6 | 0.008 too low |
| 5 | 0.018 too high |


must only use integers

$\therefore$ require 6 bounces for 1% or less.

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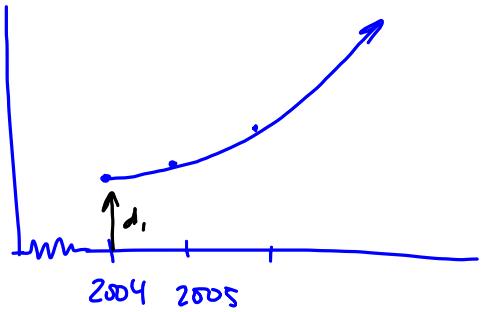
*Exercises:*

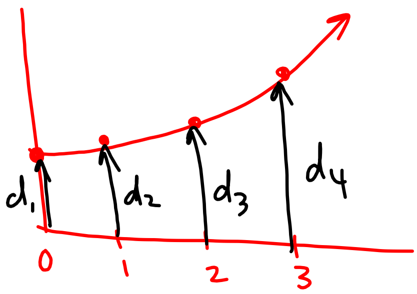
*handout # 1-4*

1. (a)




let $t = 0$ represent 2004

$\underbrace{\frac{d_2}{d_1} \quad \frac{d_3}{d_2} \quad \frac{d_4}{d_3}}_{\text{average}}$

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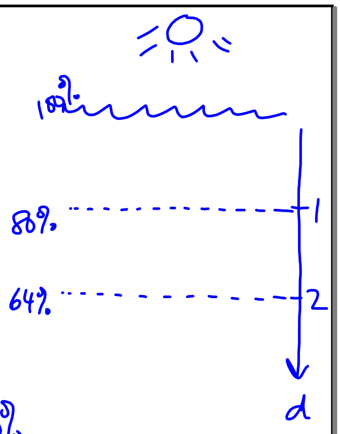
4. p.25 #16

$$S = (0.8)^d \times 100\%$$




(a) at 2m, 64% reaches diver

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

$$0.64 = (0.8)^d$$

see that $0.8^2 = 0.64$

guess & check

(b) at 10m, $d = 10$

$$S = (0.8)^{10} \times 100\%$$

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