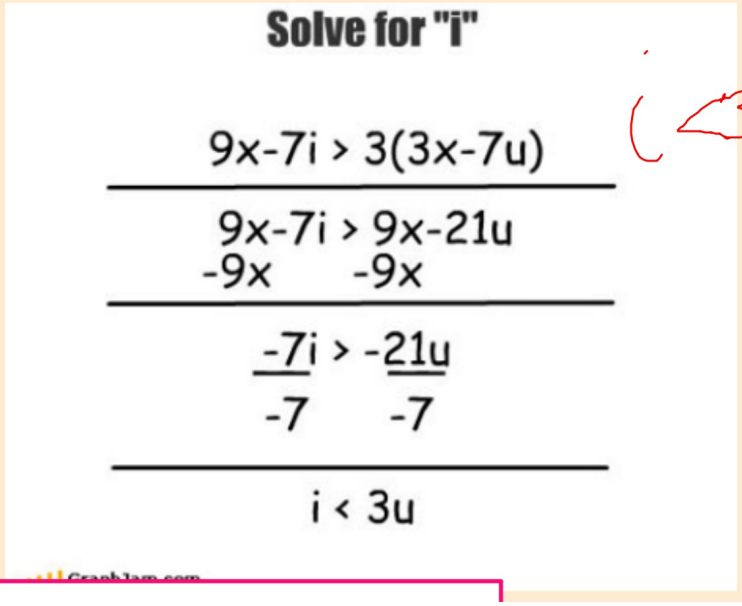
Welcome Back MYP Math 9!

	Assignment Effort Grade (Circle One)	Comments (What was interesting or challenging?)
Monday Date: 2/12 Topic: Nothing due... Index Laws Quiz was Friday!	0 1 2	
Tuesday Date: 2/13 Topic: 23B Exponential Functions, 23C Graphs	0 1 2	
Wednesday Date: 2/14 Topic: 23D: Exponential Growth	0 1 2	I <3 U
Thursday Date: _____ Topic: _____	0 1 2	
Friday Date: _____ Topic: _____	0 1 2	

Solve a Valentine message,
or create a "Solution Key" to a Valentine Card



Class Plan:

1. Warm-up - Homework Questions??
2. 23D Decay Investigation
3. Examples

D	GROWTH
E	DECAY

4. Practice

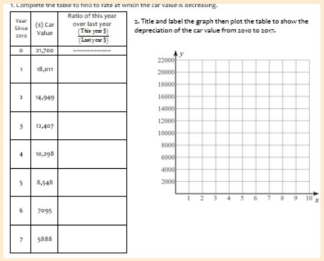
Investigate: Decay.

1) **Do:** Car value Depreciaton Task

2) Complete table & graph.

3) Verify Equation

3) Examine patterns



1. Complete the table to find the rate at which the car value is decreasing.

Year Since 2010	(t) Car Value	Ratio of this year over last year (This year $) / (Last year $)
0	21,700	
1	18,411	
2	14,949	
3	11,407	
4	10,298	
5	8,548	
6	7095	
7	5888	

2. Title and label the graph then plot the table to show the depreciation of the car value from 2010 to 2017.

4) Make predictions
Car value in 2024?

5) Defend realism - or ***unrealism.***

Investigate: Decay

A brand new Mini Cooper cost $21,700 when it was purchased in 2010. As soon as the car is driven off the lot, the value of the car begins to depreciate- decrease in value. The table below shows the value of the car since 2010.

Questions: (Record responses in your notebook)

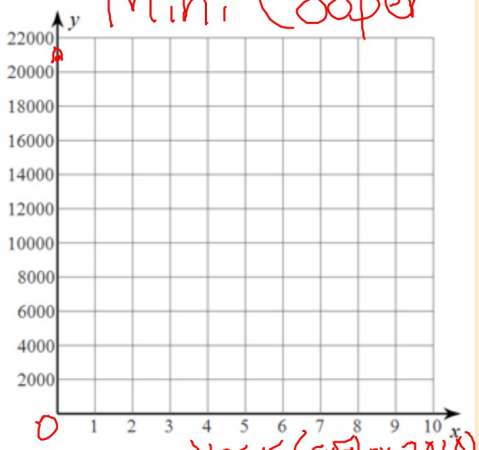
1) What do you notice about the graph? Describe the shape and any patterns you see.
2) Verify your equation works using 2014. Show that your equation will produce a value of $10,298.
3) Predict the value of the car in 2018. (*The value of the car after it is owned for 8 years*). Show work.
4) Predict the value of the car in 2024. Show your work.
5) When would the car be worth ***less than*** $200? How did you determine this many years?
6) Defend whether your predictions are realistic, ***or not realistic.***

1. Complete the table to find to rate at which the car value is decreasing.

Year Since 2010	($) Car Value	Ratio of this year over last year $\frac{\text{(This year \$)}}{\text{(Last year \$)}}$
0	21,700	~~~~~~~~~~~~
1	18,011	$\frac{18,011}{21,700} \approx .83$
2	14,949	$\frac{14,949}{18,011} \approx$
3	12,407	$\approx$
4	10,298	$\approx$
5	8,548	$\approx$
6	7095	$\approx$
7	5888	

2. Title and label the graph then plot the table to sho
depreciation of the car value from 2010 to 2017.

Mini Cooper



Writing a rule:

a) The starting value of the car is _____

b) Each year the car value is multiplying by a fractional - constant rate of .83.

Equation: _____

Modeling Investigation, Key

IB MYP 9 Math Name Key

Modeling Growth and Decay

A brand new Mini Cooper cost $21,700 when it was purchased in 2010. As soon as the car is driven off the lot, the value of the car begins to depreciate- decrease in value. The table below shows the value of the car since 2010.

1. Complete the table to find to rate at which the car value is decreasing.

Year Since 2010	($) Car Value	Ratio of this year over last year $\frac{\text{(This year \$)}}{\text{(Last year \$)}}$
0	21,700	———
1	18,011	$\frac{18,011}{21,700} = .83$
2	14,949	$\frac{14,949}{18,011} \approx .83$
3	12,407	$\frac{12,407}{14,949} \approx .83$
4	10,298	$\frac{10,298}{12,407} \approx .83$
5	8,548	$\frac{8,548}{10,298} \approx .83$
6	7095	$\frac{7095}{8,548} \approx .83$
7	5888	$\frac{5888}{7095} \approx .83$

2. Title and label the graph then plot the table to show the depreciation of the car value from 2010 to 2017.

Questions:

1) What do you notice about the graph? Describe the shape and any patterns you see.

- curve
- car value ($) is decreasing as time increases

Modeling Investigation, Key

2) Verify your equation works using 2014. Show that your equation will produce a value of $10,298.

② Verification of equation

Year 2014, $x = 4$ (years since 2010)

$y = 21{,}700(.83)^4$

$y = 21{,}700(.475)$

$y \approx \$10{,}298$

The table of car value shows $10,298 is the value in 2014. The equation produces this value which verifies the equation is a great model for the data.

Modeling Investigation, Key

3) Predict the value of the car in 2018. (*The value of the car after 8 years*). Show work.

(3) Predictions

Year 2018; $x = 8$

$y = 21{,}700(.83)^8$

$y = 21{,}700(.225)$

$y \approx \$4887.5$

4) Predict the value of the car in 2024. Show your work.

(4) Year 2024, $x = 14$

$y = 21{,}700(.83)^{14}$

$y = 21{,}700(.0736)$

$y \approx \$1546$

Modeling Investigation, Key

5) When would the car be worth ***less than*** $200? How did you determine this many years?

⑤ I put $y = 21,700(.83)^x$ in my calculator to determine the year. My table shows:

Year	$
25	205.78
26	170.8

This means between 25 & 26 years after 2010, 2035 & 2036.

Modeling Investigation, Key

6) Defend whether your predictions are realistic, ***or not realistic.***

(6) The predictions seem realistic.

A car that is 25 years old is not worth a lot of money, so a value of $205.78 could be possible. Car dealerships want to make money and the car looses value as soon as it is driven off the lot.

One piece to consider is that Mini-Coopers are popular today, so the value may not go down as fast as 17% each year.

Conclusion: 23E Decay

How did you know the data was *decaying* based on the equation?

$$y = a(1-r)^x$$

a: starting value

r: rate of decay

$1 - r = .83$

$1 - .83 - r = 0$

$+r \quad +r$

$.17 = r$

Example: Car Value

$y = 21{,}700(1-.17)^x$ $\quad Y = 21{,}700(.83)^x$

17% depreciation each year

(From 2-13) Conclusion: 23D Growth

How did you know the data was *growing* based on the equation?

$$y = a(1+r)^x = a \cdot b^x$$

a: starting value (y-int)

r: rate of growth

Example: Ant Population

$y = 16(1+.5)^x = 16(1.5)^x$

50% growth in population each year

D GROWTH

Example 6 Self Tutor

The population of rabbits on a farm is given by the function $R = 50 \times (1.07)^n$ where n is the number of weeks after the rabbit farm was established.

a What was the original rabbit population?

b How many rabbits were present after 15 weeks?

c How many rabbits were present after 30 weeks?

d Sketch the graph of R against n for $n \geqslant 0$.

e How long will it take for the population to reach 500?

a When $n = 0$, $R = 50 \times (1.07)^0$

$= 50 \times 1$

$= 50$ $\therefore$ there were 50 rabbits originally.

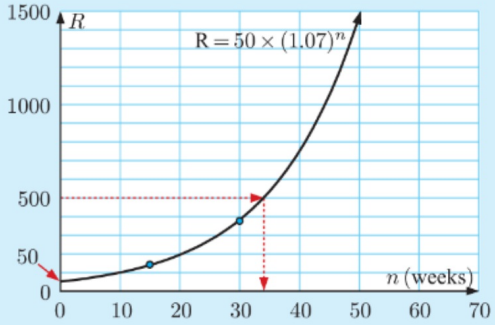
b When $n = 15$, $R = 50 \times (1.07)^{15}$

≈ 137.95 $\therefore$ there were 138 rabbits after 15 weeks.

c When $n = 30$, $R = 50 \times (1.07)^{30}$

≈ 380.61 $\therefore$ there were 381 rabbits after 30 weeks.

d



e From the graph, the number of weeks to reach 500 rabbits is approximately 34.

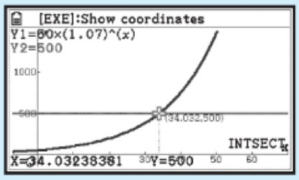
GRAPHICS

e From the graph, the number of weeks to reach 500 rabbits is approximately 34.

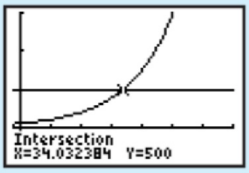
Alternatively, we could use technology to find where the graph cuts the line $R = 500$.

GRAPHICS CALCULATOR INSTRUCTIONS

Casio fx-CG20



TI-84 Plus



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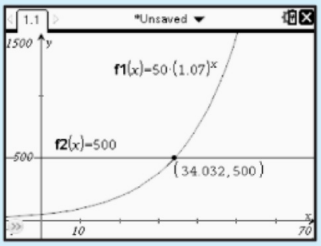


$\therefore$ it will take about 34 weeks.

E DECAY

When the value of a variable decreases exponentially over time, we call it **exponential decay**.

Example 7 Self Tutor

When a diesel-electric generator is switched off, the current decays according to the formula $I = 24 \times (0.25)^t$ amps, where t is the time in seconds.

a Find the value of I when $t = 1$, 2, and 3.

b What current flowed in the generator at the instant when it was switched off?

c Plot the graph of I against t for $t \geqslant 0$ using your results from **a** and **b**.

d How long will it take for the current to fall to 4 amps?

a When $t = 1$, $I = 24 \times (0.25)^1 = 6$ amps

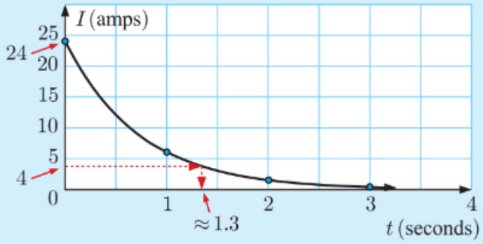
When $t = 2$, $I = 24 \times (0.25)^2 = 1.5$ amps

When $t = 3$, $I = 24 \times (0.25)^3 = 0.375$ amps

b When $t = 0$, $I = 24 \times (0.25)^0 = 24$

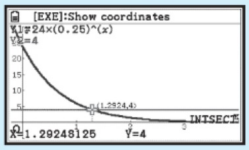
$\therefore$ 24 amps of current flowed at the instant the generator was switched off.

c

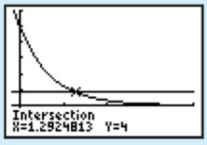


d

Casio fx-CG20



TI-84 Plus



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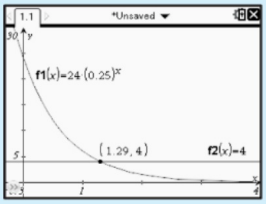
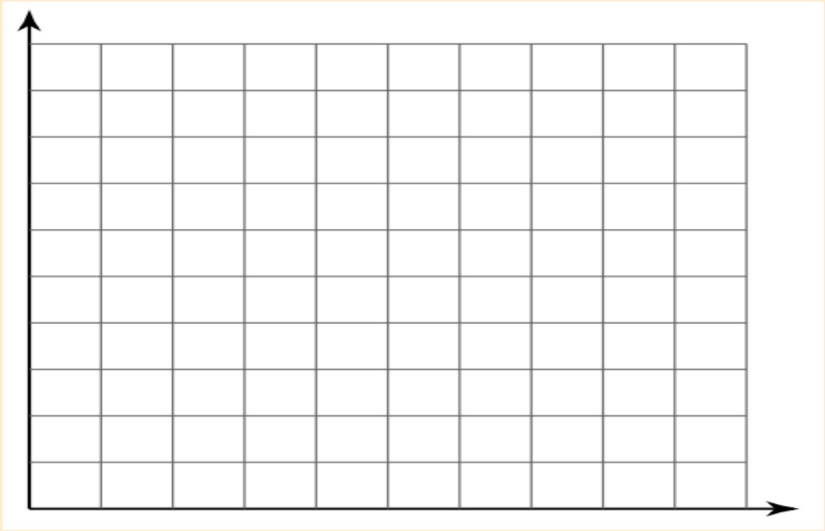


It will take ≈ 1.29 seconds for the current to fall to 4 amps.



Exercises...
23E Decay

Wednesday After school: Garages :)
No After School Thursday 2-15

(Thursday 2-15)
Parent - Teacher Conferences
Thursday 4 - 8 pm
Friday 8am - 12 pm

Exponential Decay Exercises...

EXERCISE 23E

1 When a container of liquid is left to cool, its temperature in °C is given by $T = 100 \times (0.933)^t$, where t is the time in minutes.

a Find the initial temperature of the liquid.

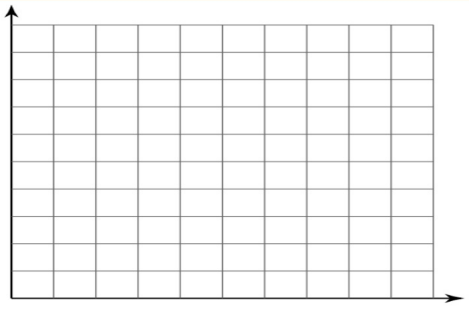
b Find the temperature after:

i 10 minutes **ii** 20 minutes **iii** 30 minutes.

c Draw the graph of T against t for $t \geqslant 0$, using your results from **a** and **b**.

d How long will it take for the liquid's temperature to fall to:

i 40°C **ii** 10°C?



Exercises...

2 The weight of a radioactive substance t years after being discovered is given by $W = 150 \times (0.997)^t$ grams.

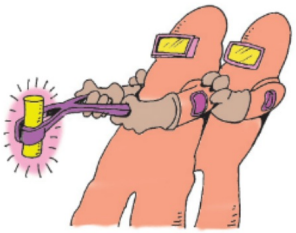
a How much radioactive substance was discovered?

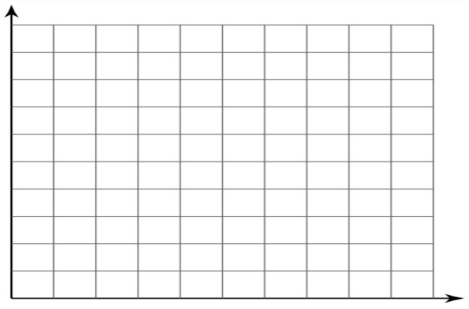
b Determine the weight of the substance after:

i 100 years **ii** 200 years **iii** 400 years.

c Sketch the graph of W against t for $t \geqslant 0$, using your results from **a** and **b**.

d How long will it take for the substance to decay to 25 grams?





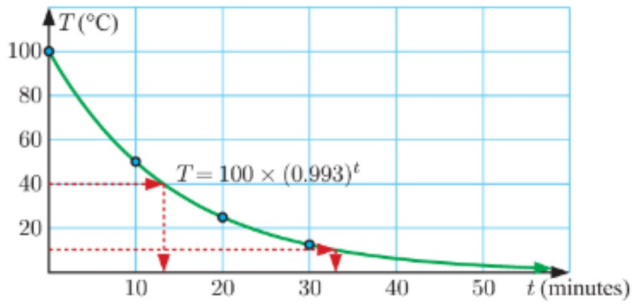
Solutions
(23E Decay)

EXERCISE 23E

1 **a** $100°C$

b **i** $50.0°C$ **ii** $25.0°C$ **iii** $12.5°C$

c



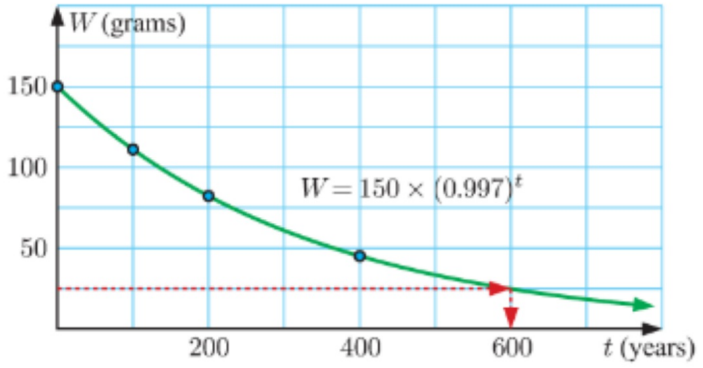
d **i** ≈ 13 mins **ii** ≈ 33 mins

Solutions
(23E Decay)

2 **a** 150 g

b **i** ≈ 111 g **ii** ≈ 82.2 g **iii** ≈ 45.1 g

c



d ≈ 596 years