LESSON MAKER PRO

Change Over Time

Model continuous growth and decay with exponential functions.

HIGH SCHOOL · MA.912.C.5.3

MA.912.C.5.3 "Solve differential equations of the form dY/dt=kY as applied to growth and decay problems."

NAME _____ DATE _____

THE BIG IDEA

When dY/dt=kY, the quantity changes by a constant fraction of its current amount. If Y(0)=Y0, the solution is Y=Y0e^(kt), where positive k means growth and negative k means decay.

WORKED EXAMPLE

Solve dY/dt=13Y, given Y(0)=17.

1. Separate variables: dY/Y=13 dt.
2. Integrate: ln|Y|=13t+C, so Y=Ce^(13t).
3. Use Y(0)=17 to get C=17.

Answer: Y=17e^(13t)

PRACTICE 6 problems

1 Solve dY/dt=2Y, given Y(0)=5.

ANSWER _____

2 Solve dY/dt=-3Y, given Y(0)=8.

ANSWER _____

3 If dY/dt=(1/4)Y and Y(0)=12, find Y when t=4 ln 2.

ANSWER _____

4 If dY/dt=-(1/2)Y and Y(0)=18, find Y when t=2 ln 3.

ANSWER _____

5 Solve dY/dt=Y/3, given Y(1)=12.

ANSWER _____

6 If dY/dt=-4Y and Y(0)=1/3, find Y when t=(ln 3)/4.

ANSWER _____

APPLY IT Show your work

1 A student's music channel has 120 followers at t=0 days. Its follower count F follows dF/dt=(1/5)F. How many followers will the channel have after 5 ln 2 days?

WORK SPACE

ANSWER _____

2 A phone battery starts at 90 percent charge. Its charge B, measured in percentage points, follows dB/dt=-(1/6)B, where t is in hours. What will the charge be after 6 ln 3 hours?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A streaming creator has 16 followers at t=0 days and 128 followers at t=3 days. Assume the follower count V follows dV/dt=kV. Find k, write a formula for V, and find V(4).

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ANSWER KEY

Change Over Time

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Solve dY/dt=2Y, given Y(0)=5.	**Y=5e^(2t)**
2	Solve dY/dt=-3Y, given Y(0)=8.	**Y=8e^(-3t)**
3	If dY/dt=(1/4)Y and Y(0)=12, find Y when t=4 ln 2.	**24**
4	If dY/dt=-(1/2)Y and Y(0)=18, find Y when t=2 ln 3.	**6**
5	Solve dY/dt=Y/3, given Y(1)=12.	**Y=12e^((t-1)/3)**
6	If dY/dt=-4Y and Y(0)=1/3, find Y when t=(ln 3)/4.	**1/9**

PART 2 · APPLY IT

1. **240 followers** Use F=120e^(t/5). At t=5 ln 2, F=120e^(ln 2)=240.
2. **30 percent** Use B=90e^(-t/6). At t=6 ln 3, B=90e^(-ln 3)=30.

CHALLENGE

k=ln 2; V=16e^((ln 2)t)=16(2^t); V(4)=256

Accept equivalent exponential forms, including forms with e^(ln 2) simplified to 2. For the challenge, accept k=(ln 8)/3 because it is equal to ln 2.