Quiz-Quiz-Trade

Modeling Situations with Differential Equations

There are 22 cards in this set.

Information from *Calculus Concepts: An Informal Approach to the Mathematics of Change*; LaTorre, Kenelly, Fetta, Harris, Carpenter (Clemson University)

- Laminate the cards and cut them out.
- Place a post-it on the back of each card or use a dry erase marker.
- Give each student one card. They are to write a **differential equation that represents the verbal model.**
- Students stand up and find a partner. Partner 1 answers the question on Partner 2's card and vice versa.
- After both agree on the answers, the partners switch cards and the process begins again.

1

The rate of change of *G* with respect to *t* is proportional to the square of *G*.

2

The rate of change of *H* with respect to *t* is proportional to the square root of *H*.

3

The rate of change of *J* with respect to *t* is inversely proportional to the square of *J*.

4

The rate of change of *M* with respect to *t* is inversely proportional to the cube root of *M*.

5	6
The rate of change of a population of bees, *b*, over time is proportional to the population of bees.	The rate of growth of a population of zombies, *z*, over time is proportional to the population of zombies.
7	**8**
Newton's Law of Heating states that the rate of heating an object is proportional to the temperature difference between the surrounding air and the object. A cake is put into the oven which has been preheated to 350º. Let *C* be the temperature of the cake after *t* minutes.	Newton's Law of Heating states that the rate of heating an object is proportional to the temperature difference between the surrounding air and the object. A casserole put into the oven which has been preheated to 400º. Let *C* be the temperature of the casserole after *t* minutes.
9	**10**
Newton's Law of Cooling states that the rate of cooling an object is proportional to the temperature difference between the object and the surrounding air. A cup of hot chocolate is put on a table in a room that is 70º. Let *H* be the temperature of the hot chocolate after *t* minutes.	Newton's Law of Cooling states that the rate of cooling an object is proportional to the temperature difference between the object and the surrounding air. A hot cake from the oven is put on a table in a room that is 76º. Let *C* be the temperature of the cake after *t* minutes.

11 Newton's Law of Cooling states that the rate of cooling an object is proportional to the temperature difference between the object and the surrounding air. Some left-over soup is put in a refrigerator that is 40º. Let S be the temperature of the soup after t minutes.	**12** Newton's Law of Cooling states that the rate of cooling an object is proportional to the temperature difference between the object and the surrounding air. A jar of jelly is put in a refrigerator that is 38º. Let J be the temperature of the jelly after t minutes.
13 In a community of F farmers, the number x of farmers who own a certain combine changes with respect to time t at a rate that is jointly proportional to the number of farmers who own the combine and to the number of farmers who do not own the combine.	**14** The rate of change in the height h of a tree with respect to its age a is inversely proportional to the tree's height.
15 Suppose a virus is spreading in a network of computers. There are M computers in the network. The rate of change in the number of infected computers is jointly proportional to the number of computers already infected, j, and the number of computers not yet infected.	**16** The rate of change of a level of response R with respect to the level of a stimulus s is a joint proportionality between the level of the response and the inverse of the level of the stimulus. This DE is known as the Brentano-Stevens Law.

17

For the first 9 months of life, the average weight w, in pounds, of a certain breed of dog increases at a rate that is inversely proportional to time t, in months.

18

The height h, in feet, of a certain tree increases at a rate that is inversely proportional to time t, in years.

19

An object that has been dropped falls at a velocity v (in feet per second) that is proportional to the number of seconds t after it has been dropped. [Remember that velocity is the rate of change of distance s as a function of time.]

20

Barometric pressure p (measured in millibars) changes with respect to altitude a (measured in feet above sea level) at a rate that is directly proportional to the altitude.

21

Let S represent the total sales of a computer product t years after the product was introduced. The total sales of the computer product are growing in inverse proportion to $\ln(t+1.4)$.

22

The rate of change of the intensity of a response R with respect to the intensity of a stimulus s is inversely proportional to the intensity of the stimulus. This DE is known as Fechner's Law.

Quiz- Quiz-Trade Modeling Situations with Differential Equations Solutions

1. $\frac{dG}{dt} = kG^2$	12. $\frac{dJ}{dt} = k(J - 38)$
2. $\frac{dH}{dt} = k\sqrt{H}$	13. $\frac{dx}{dt} = kx(F - x)$
3. $\frac{dJ}{dt} = \frac{k}{J^2}$	14. $\frac{dh}{da} = \frac{k}{h}$
4. $\frac{dM}{dt} = \frac{k}{\sqrt[3]{M}}$	15. $\frac{dj}{dt} = kj(M - j)$
5. $\frac{db}{dt} = kb$	16. $\frac{dR}{ds} = k\frac{R}{s}$
6. $\frac{dz}{dt} = kz$	17. $\frac{dw}{dt} = \frac{k}{t}$
7. $\frac{dC}{dt} = k(350 - C)$	18. $\frac{dh}{dt} = \frac{k}{t}$
8. $\frac{dC}{dt} = k(400 - C)$	19. $\frac{ds}{dt} = kt$
9. $\frac{dH}{dt} = k(H - 70)$	20. $\frac{dp}{da} = ka$
10. $\frac{dC}{dt} = k(C - 76)$	21. $\frac{dS}{dt} = \frac{k}{\ln(t + 1.4)}$
11. $\frac{dS}{dt} = k(S - 40)$	22. $\frac{dR}{ds} = \frac{k}{s}$