



Calculus 1 Workbook

Exponential growth and decay

krista king
MATH

HALF LIFE

- 1. Find the half-life of Tritium if its decay constant is 0.0562.
- 2. Find the half-life of Cobalt-60 if its decay constant is 0.1315.
- 3. Find the half-life of Berkelium-97 if its decay constant is 0.000503.
- 4. Radium-224 has a half life of 3.66 days. If 3.25 g of Radium-224 remains after 9 days, what was the original mass of Radium-224?
- 5. The half-life of Potassium-40 is 1.25 billion years. A scientist analyzes a rock that contains only 9.5 % of the Potassium-40 it contained originally when the rock was formed. How old is the rock?
- 6. 25 grams of a substance decayed to 13.25 grams in 13 seconds. Determine the half-life of a substance.



NEWTON'S LAW OF COOLING

- 1. A cup of coffee is 195°F when it's brewed. Room temperature is 74°F . If the coffee is 180°F after 5 minutes, to the nearest degree, how hot is the coffee after 25 minutes?
- 2. A boiled egg that's 99°C is placed in a pan of water that's 24°C . If the egg is 62°C after 5 minutes, how much longer, to the nearest minute, will it take the egg to reach 32°C .
- 3. Suppose a cup of soup cooled from 200°F to 161°F in 10 minutes in a room whose temperature is 68°F . How much longer will it take for the soup to cool to 105°F ?
- 4. A thermometer is measuring 18°C indoors. The thermometer is moved outdoors where the temperature is -5°C , and after 2 minutes the thermometer reads 11°C . How many more minutes will it take for the thermometer to read 0°C ?
- 5. A cake baking inside an oven currently has a temperature of 220°C . Find the decay constant if the cake's temperature is 168°C 5 minutes after it's removed from the oven, given that the room temperature is 23°C .



■ 6. Using the decay constant we calculated in the previous problem, determine the number of minutes that will pass before the cake's temperature will be 50°C .



SALES DECLINE

- 1. Suppose a pizza company stops a special sale for their three-topping pizza. They will resume the sale if sales drop to 70 % of the current sales level. If sales decline to 90 % during the first week, when should the company expect to start the special sale again?

- 2. Suppose a donut store experiments with raising the price of a dozen donuts to see if sales are affected. They'll resume the sale if sales drop to 80 % of the current sales level. If sales decline to 90 % after two weeks, when should the store change back to the original price?

- 3. Suppose a flower shop decides to stop ordering roses in the winter time to see if sales are affected. They will resume the sale if sales drop to 90 % of the current sales level. If sales decline to 96 % after three weeks, when should the shop begin ordering roses again?

- 4. Mark has been selling lemonade for the last 5 years. Five years ago, he sold 3,850 glasses of lemonade, but this year he's only sold 2,985. Assuming that sales have declined exponentially, what's been the annual rate of decline?



- 5. A bakery sold 5,465 croissants 3 years ago. If the sales declined at a rate of 1.5% per month, how many croissants were sold last year?
- 6. Suppose a convenience store decides to stop their sale on ice cream in the summer time to see if sales are affected. They will resume the sale if sales drop to 87% of their current level. If sales fall to 87% of their current level after two weeks, what was the monthly rate of decline?



COMPOUNDING INTEREST

- 1. Suppose you borrow \$15,000 with a single payment loan, payable in 2 years, with interest growing exponentially at 1.82 % per month, compounded continuously. How much will it cost to pay off the loan after 2 years?

- 2. Your parents deposit \$5,000 into a college savings account, with interest growing exponentially at 0.875 % per quarter, compounded continuously. How much will be in the account after 18 years?

- 3. Suppose you win \$50,000 in a contest and you decide to save it for your retirement. You deposit it into an annuity account that pays 2.4 % semi-annually, compounded continuously. How much will the account contain after 25 years, when you plan to retire?

- 4. At a 7.5 % interest rate compounded semi-annually, how much money would we have to deposit now to have \$15,500 after 10 years?

- 5. How many years would it take for \$25,000 to turn into \$50,000, at an interest rate of 4.75 % , compounded annually?



■ 6. At 6.5% interest compounded quarterly, how long would it take to triple an initial investment of \$10,000?



