Calculus 1 Workbook

Exponential growth and decay

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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?

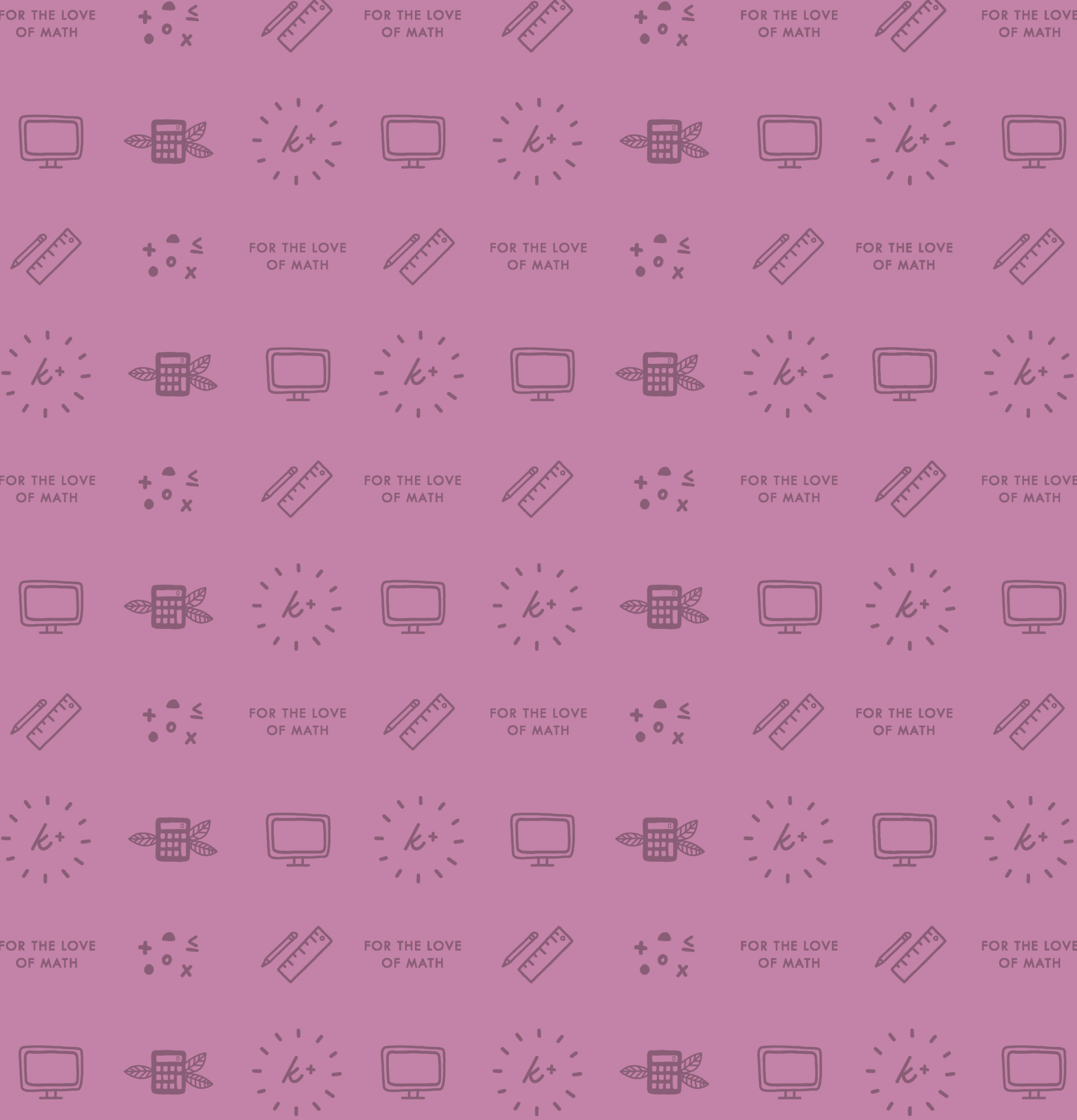
■ 2. Your parents deposit $\$5{,}000$ into a college savings account, with interest growing exponentially at $0.875\,\%$ per quarter, compounded continuously. How much will be in the account after 18 years?

■ 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 $7.5\,\%$ yearly 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 a yearly interest rate of $4.75\,\%$, compounded annually?

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



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