Homework 14: Exponential Growth, Decay, and Interest MATH 1215

Name: _____ **Section:** _____

Instructor: _____ **Date:** _____

Directions. Show all work clearly. Write a formula or model first, substitute carefully, and include units for all application problems. Round money to the nearest cent and population to the nearest whole number unless otherwise stated.

Formula Reference

Exponential growth	$A = P(1+r)^t$, where r is the growth rate written as a decimal.
Exponential decay	$A = P(1-r)^t$, where r is the decay rate written as a decimal.
Simple interest	$I = Prt$ and $A = P + I = P(1+rt)$.
Compound interest	$A = P\left(1+\frac{r}{n}\right)^{nt}$, where n is the number of compounding periods per year.

A. Identify the model

For each situation, decide whether it represents growth or decay. Then identify the initial amount and the rate.

1. $A = 10{,}000(0.90)^t$

Growth or decay: _____

Initial amount: _____

Rate: _____

2. $A = 350(1.08)^t$

Growth or decay: _____

Initial amount: _____

Rate: _____

3. $P = 75{,}000(0.985)^t$

Growth or decay: _____

Initial amount: _____

Rate: _____

4. $V = 42(1.025)^t$

Growth or decay: _____

Initial amount: _____

Rate: _____

B. Exponential growth and decay

Write an equation first, then answer the question.

1. A car was purchased for \$10,000 and depreciates by 10% each year. Write a model for the value of the car and find its value after 8 years.

2. A baseball card was purchased for \$5 and appreciates by 5% each year. Write a model for the value of the card and find its value after 25 years.

3. A city has a population of 100,000 and is decreasing by 1% each year. Write a model for the population and estimate the population after 100 years.

4. The price of a gallon of milk was \$0.50 in 1939 and increases by 3% each year. Use t for the number of years after 1939. Find the predicted price in 2009.

C. More growth and decay applications

Use the exponential growth or decay formula. Clearly state what each variable means.

5. Medicine decay. A medicine has an initial amount of 250 mg in the body. Each hour, 18% of the medicine leaves the body. Write an exponential decay model and find the amount remaining after 6 hours.

6. College enrollment growth. A college program has 420 students. Enrollment is expected to grow by 4.5% each year. Write an exponential growth model and estimate the enrollment after 7 years.

Reminder. In a growth model, the factor is greater than 1, such as 1.06. In a decay model, the factor is less than 1, such as 0.82.

D. Simple interest

Use $I = Prt$ and $A = P + I$. Time must be measured in years.

7. Compute the interest and the total amount owed on a simple interest loan of \$2,100 at an annual interest rate of 11.5% for each time period.

(a) 1 year _____

(b) 36 months _____

(c) 5 years _____

8. A student borrows \$1,850 at a simple interest rate of 6.2% for 4 years. Find the interest and the total amount repaid.

9. A small business takes out a simple interest loan of \$7,500 for 18 months at an annual interest rate of 8.4%. Find the interest and the total amount owed.

E. Compound interest

Use $A = P\left(1 + \frac{r}{n}\right)^{nt}$. Show the substitution before using a calculator.

10. Suppose \$3,000 is invested at an annual interest rate of 5%, compounded quarterly. Find the balance after 8 years.

11. A savings account earns 4.2% annual interest compounded monthly. If \$5,500 is deposited initially, find the account balance after 10 years.

12. Compare the balances after 6 years for a \$2,000 investment at 6% annual interest.

(a) Compounded annually

(b) Compounded monthly

Which balance is larger? Explain briefly.

F. Mixed review

Choose the correct formula and solve.

13. A laptop costs \$1,200 and loses 22% of its value each year. Find its value after 3 years.

14. A bank account has \$900 and grows by 2.8% each year. Find the balance after 12 years using exponential growth.

15. A loan of \$4,600 is charged simple interest at 7.25% for 30 months. Find the total amount owed.

G. Formula and setup practice

Answer each question briefly. These should help you check whether the correct formula was chosen.

16. Convert each time to years: (a) 18 months _____ (b) 30 months _____ (c) 6 months _____

17. For compound interest, identify n for each compounding period: annually _____ quarterly _____ monthly _____

18. Write only the setup for this problem. Do not solve: \$1,500 invested at 3.8% annual interest compounded monthly for 5 years.

19. Write only the setup for this problem. Do not solve: \$800 decreases in value by 14% each year for 4 years.

Final check before submitting: Did you convert each percent to a decimal? Did you convert months to years for simple interest? Did you round money to the nearest cent?