1. You IRA pays an APR 2.5% compounded monthly. If you contribute $140 per month for 13 years, how much will your IRA contain at the end of that time?

2. Leslie deposits $100 at the end of each month in the account with an APR of 1.2%, while Robert deposits $300 at the end of each quarter in an account with an APR of 1.5%. After 10 years whose account has a higher balance? By how much in $ and % terms?

3. Suppose that you have a savings plan that pays 2.5% compounded monthly. You make payments of $75 at the end of each month for 15 years, and then you make monthly payments of $110 for an additional 6 years.
   a) What is the value of the account at the end of 21 years?
   b) How much did you earn in interest during those 21 years?

4. Three years after buying 200 shares of XYZ stock for $25 per share, you sell the stock for $8,500. Find the total and annual return.

5. Suppose that you take a loan for $8,300 over a period of 4 years at an APR of 7%. Determine your monthly payments, your total payments over the term of the loan, and the amount of interest paid over the loan term (in $ and percentage).

6. You need a loan for $80,000.
   Choice I: 30-year fixed-rate at 7.25% with closing costs of $1,000 and 1 point.
   Choice II: 15-year fixed-rate at 6% with closing cost of 5 points.

   Discuss (for both choices) how much would the closing cost be, how much are the monthly payments, and how much would you pay in interest over the loan term.
   How much (over-all) would you save if you decide on Choice II?

7. If prices increase at a monthly rate of 1.4%, how much do they increase in a year (in % terms)?
   Is this linear or exponential model? Why?

8. A snow plow has a maximum speed of 30 miles per hour on a dry highway. Its maximum speed decreases by 0.5 mile per hour for every inch of snow on the highway.
   a) Determine the independent and dependent variable.
   b) Write the equation that describes this situation in the form y=mx+b.
   c) At what snow depth will the plow be unable to move?
9. If you deposit $1,000 in an account that earns an APR of 5% compounded once per year
   a) How long will it take for an initial deposit to triple?
   b) How much will you have after 20 months?

10. The population of Colorado was 1.33 million in 1950 and 2.89 million in 1980.
   a) Find the average growth rate between 1950 and 1980.
   b) Predict the population in 2020.

11. If the half-life of a drug in the bloodstream is 18 hours.
   a) How much drug is left in the bloodstream 2 days after 250 mg dose?
   b) When will the amount of that drug decay to 23% of its original amount?

12. The population of a certain city is increasing at a rate of 3% per year.
   a) Find the approximate doubling time.
   b) Find the exact doubling time.
   c) If the population is 55,000 now, what will it be in 35 years?

13. Suppose a chess board has four grains of wheat on the first square, eight grains on the
    second square, sixteen grains on the third square, thirty two grains on the fourth square, and
    so on, up to and including the 38th square. Find the total number of grains on the board.

14. Suppose that a single bacterium is in a bottle at 1 pm. It divides into two bacteria at 1:01
    pm, and the population continues to double every minute until the bottle is completely full at
    3 pm.
    a) Find the population at 1:30.
    b) When was the bottle half full?

15. Suppose that a population has a doubling time of 15 years. By what factor will it grow in
    90 years?

16. Suppose that a savings account increases its value by 2% per year.
    a) Find the approximate doubling time.
    b) Find the exact doubling time.

17. Suppose that a country’s population is 64 million and its population growth rate is 3.7% per
    year. If the population growth follows a logistic growth model with r=0.053, what is the
    country’s carrying capacity?

\[\text{growth rate} = r \times \left(1 - \frac{\text{population}}{\text{carrying capacity}}\right)\]
18. The amount of sugar in a fermenting batch of beer is 5 grams. It decreases with time at a rate of 0.6 grams every 4 days.

a) Determine the independent and dependent variable.
b) Write the linear equation that describes this situation.
c) How long will it take the amount of sugar to reach 3 grams?

19. Suppose the population of a country changes due to births, deaths, and immigration/emigration. The annual birth rate is 5.6 births per 1000 people, the death rate is 4.3 deaths per 1000 people, the immigration rate into the country is 7.8 per 1000, and the emigration rate out of the country is 2.4 per 1000. Find the net growth rate as a percentage.

20. The following data represents measurements of the concentration of a substance in a patient’s bloodstream, after the start of treatment meant to boost the concentration.

<table>
<thead>
<tr>
<th>Days after start of treatment</th>
<th>2</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration in ppm</td>
<td>5.4</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

a) Draw the graph of the function.
b) Identify the independent and dependent variable.
c) What are the domain and range of this function?
d) Use words to describe the function.
e) Find the concentration on day 6 (using your graph).
f) Find the day on which the concentration is 6.6 ppm (using your graph).
g) Write a linear function that will describe this situation. Check your answers e) and f).

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**SOLUTIONS**

1. $25,775.42
2. Leslie = $12,742.92
   Robert = $12,920.67
   Robert, $177.75; 1.395%
3. a) part I = $19,003.79
   part II = $8,535.2
   total = $27,539.07
   b) $6,119.07
4. total return = 70%
   annual return = 19.35%
5. $198.75; $9,540.18;
   $1,240.18; 13%
9. a) 22.52 years
   b) $1,084.71
10. a) 2.62%
   b) 8.13 million
6. Loan I: closing cost = $1,800
   payment = $545.77
   total repayment = $196,477.20
   interest = $116,477.20
   59.28%
11. a) 39.37 mg
   b) 38.17 hours
12. a) 23.33 years
   b) 23.45 years
   c) 154,762
Loan II: closing cost = $4,000
    payment = $675.11
    total repayment = $121,519.80
    interest = $41,519.80 (34.17 %)
You would save $74,957.40 in interest charges.

7. exponential model 18.2%
8.a) independent var. = height
    dependent var. = speed
    b) y=-0.5x+30
    c) 60 in.
You would save $74,957.40 in interest charges.

13. $2^{40} - 40$ grains
14. a) $2^{30}$ bacteria
    b) 2:59 p.m.
15. 64
16. a) 35 years
    b) 35.003 years
17. 212 million
18. a) (days, amount of sugar)
    b) y = -0.15x +5
    c) 13.3 days
19. 0.67% per year

20. a)

\[\begin{array}{c}
\text{conc.} \\
(\text{ppm})
\end{array}\]
\[\begin{array}{c}
\text{time (days)}
\end{array}\]

b) indep. var. = time (days)
    depend. var. = concentration (ppm)

c) domain: t = 0
    range: c = 5

d) This function relates the concentration of a substance to the number of days that passed after the initial dose.

e) 6.2 ppm

f) 8

g) slope : choose any 2 points
    m=\frac{(7-6)}{(10-5)} = 0.2
    y = 0.2 x + b
use any point to find b: ex. (5,6)
    6=0.2 (5) + b, b=5
    y = 0.2 x + 5