9. State the rule for the rational functions defined below using the form $f(x) = \frac{a}{b(x - h)} + k$, and find the domain in each case.

a) $f_1(x) = \frac{2x - 3}{x - 1}$

b) $f_2(x) = \frac{6x - 15}{2x - 8}$

c) $f_3(x) = \frac{-x + 6}{2x - 8}$

d) $f_4(x) = \frac{3x}{4x - 5}$

10. Graph the following functions and find the equations of their asymptotes:

a) $f_1(x) = \frac{x - 4}{x - 5}$

b) $f_2(x) = \frac{4x - 5}{2x - 2}$

c) $f_3(x) = \frac{-6x + 1}{2x + 3}$

d) $f_4(x) = \frac{2x + 1}{4x - 3}$

11. A liquid solution that is 30% acidic is diluted with 50 mL of distilled water. The rule $C(x) = \frac{15}{x + 50}$ represents the acidic concentration based on the quantity x of water added to the solution. The given quantities are in millilitres.

a) Graph this function for all the values of x up to 150 mL.

b) What is the y-intercept of this function?

c) How much water must be added to the solution so that the concentration is less than 1%?

d) What is the rule for calculating the concentration of an 80 mL solution that is 40% acidic, if we add x mL of water?

pH

The symbol pH (short for potential of Hydrogen) is used to express a solution's hydrogen ion concentration on a logarithmic scale. If the pH is less than 7, the solution is acidic; if it is greater than 7, the solution is alkaline.

12. Financial institutions use "the rule of 72" to determine the approximate number of years required to double a principal invested at a given interest rate. This rule is $A(x) = \frac{72}{x}$, where x is the interest rate and $A(x)$ the number of years.

a) What was the interest rate if the principal doubles in 10 years?

b) Graph this function.

c) What would the domain of this function be if it were restricted to realistic interest rates?

d) What is the rule for determining the number of years left before the principal doubles if it has been invested for two years?

13. The point of intersection of a hyperbola's asymptotes is called the centre of the hyperbola. Find the centre of the hyperbolas belonging to the following functions:

a) $f_1(x) = 3 - \frac{5}{3x - 12}$

b) $f_2(x) = \frac{5 + 2x}{2x - 1}$

c) $f_3(x) = \frac{5 - 6x}{2 - 3x}$

d) $f_4(x) = \frac{-x}{4(x + 3)}$

14. To go on a field trip to an insectarium, students must pay their share of the \$300 transportation cost, plus an \$8 admission charge.

a) State the rule for determining the amount each student must pay based on the number of students taking part in the activity.

The ladybug is one of the most well known of Québec's 165 000 insect species. Because they are the natural enemies of a variety of insects, farmers often use ladybugs to rid their crops of pests.

b) What are the equations of the asymptotes to the curve defined by this function rule?

c) The bus cannot hold more than 45 students and no student is prepared to pay more than $28 for the field trip. Find the points where the function reaches a minimum and maximum.

15. Vanessa decides to sell her old records at a flea market. The cost of renting a stall is $25 and she sells each record for $2. The function $f(x) = \frac{2x - 25}{x}$ is used to express the average profit per record based on the number of records sold.

a) Graph this function.

b) What is the equation of the horizontal asymptote?

c) Explain the role of this asymptote in this example.

d) What would be the value of parameter **k** in the function rule if Vanessa sold each record for $3?

16. A merchant wants to launch an advertising campaign that will target her best customers. She has a number of flyers produced at a fixed cost of $400, plus $4 per flyer. Apart from 20 flyers that will not be distributed, she hopes each flyer will be read by at least two people. The merchant wants to know on average how much she is spending per customer for this campaign based on the number of flyers printed.

A modern printing press.

Johannes Gensfleisch, known as Gutenberg (c. 1400–1468), is credited with inventing the printing press in the Western world. Nonetheless, printing was an art that had already been widely practised in China under the T'ang dynasty (618–907). The discovery of a copy of the Diamond Supra, *printed in 868, provided us with name of the first known printer, Wang Jié.*

a) If x is the number of flyers printed, what expression represents the total cost of production?

b) What expression represents the number of customers that, in the merchant's opinion, will read the flyer?

c) State the function rule for calculating the average cost per customer of a flyer. What is the function's domain in this context?

d) Express the function rule in the form $f(x) = \frac{a}{b(x - h)} + k$.

17. Atmospheric pressure drops as altitude increases. The function $f(x) = \frac{530}{x + 5}$ is used to obtain the approximate atmospheric pressure in kilopascals based on the altitude in kilometres.

a) What is the atmospheric pressure at sea level according to this approximation?

b) At what altitude is the atmospheric pressure reduced by half?

c) What are the equations of the asymptotes of this function's curve?

d) Based on this approximation, at what altitude is the atmospheric pressure equal to zero?

18. The graph of function g is obtained by reflecting the graph of the basic rational function across the x-axis, following the translation $t_{(2, -3)}$. State the function rule for g as a quotient of two first-degree polynomials.