

EPI 298 Homework 1: Due Monday, 9 October 2000

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15. Find the values of x that satisfy $-6 < x - 2 < 4$.
43. Evaluate the expression $27^{\frac{2}{3}}$.
78. Simplify the expression (assume x and y are positive):

$$\frac{5x^6y^3}{2x^2y^7}$$

114. *Celsius and Fahrenheit Temperatures.* The relationship between Celsius ($^{\circ}\text{C}$) and Fahrenheit ($^{\circ}\text{F}$) temperatures is given by the formula:

$$C = \frac{5}{9}(F - 32).$$

- a. If the temperature range for Montreal during the month of January is $-15^{\circ} < C < -5^{\circ}$, find the range in degrees Fahrenheit for the same period.
- b. If the temperature range for New York City during the month of June is $63^{\circ} < F < 80^{\circ}$, find the range in degrees Celsius in New York City for the same period.

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15. Perform the indicated operation and simplify $(x + 2y)^2$.
46. Perform the indicated operation and simplify $2kr(R - r) - kr^2$.
65. Simplify the expression

$$\frac{x^2 + x - 2}{x^2 - 4}$$

87. Perform the indicated operation and simplify

$$\frac{(2x + 1)^{\frac{1}{2}} - (x + 2)(2x + 1)^{-\frac{1}{2}}}{2x + 1}.$$

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31. Find an equation for a circle satisfying radius 5 and center at the origin.
41. Two ships leave port at the same time. Ship A sails north at a speed of 20 mph while ship B sails east at a speed of 30 mph.
 - a. Find an expression in terms of the time t (in hours) giving the distance between the two ships.

- b. Using the expression obtained in part (a), find the distance between the two ships 2 hr after leaving port.
42. Determine whether the following statement is true or false. If true, explain why; if false, give a counterexample. The point $(-a, b)$ is symmetric to the point (a, b) with respect to the y axis.

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17. Given the equation $y = 4x - 3$, answer the following questions:
- If x increases by 1 unit, what is the corresponding change in y ?
 - If x decreases by 2 units, what is the corresponding change in y ?
56. Sketch the straight line defined by $2x - 5y + 10 = 0$ by finding the x and y intercepts.
61. Show that an equation of the line through the points $(a, 0)$ and $(0, b)$, with $a \neq 0$ and $b \neq 0$, can be written in the form

$$\frac{x}{a} + \frac{y}{b} = 1.$$

(Hint: if you can show that two distinct points both satisfy an equation for a line, then the line determined by the equation is the same one determined by the points.)

72. *Ideal Heights and Weights for Women* The Venus Health Club for Women provides its members with the following table, which gives the average desirable weight (in pounds) for women of a given height (in inches):

Height, x	60	63	66	69	72
Weight, y	108	118	129	140	152

- Plot the weight y versus the height x .
- Draw a straight line, L , through the points corresponding to heights of 5 ft. and 6 ft.
- Derive an equation of the line L .
- Using the equation of part (c), estimate the average desirable weight for a woman who is 5 ft. 5 in. tall.

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7. Let f be the function defined by

$$f(t) = \frac{2t^2}{\sqrt{t-1}}.$$

Find $f(2)$, $f(a)$, $f(x+1)$, and $f(x-1)$.

9. Let f be the function defined by

$$f(x) = \begin{cases} x^2 + 1 & \text{if } x \leq 0; \\ \sqrt{x} & \text{otherwise } x > 0. \end{cases}$$

Find $f(-2)$, $f(0)$, and $f(1)$.

57. *Growth of a Cancerous Tumor* The volume of a spherical cancer tumor is given by the function

$$V(r) = \frac{4}{3}\pi r^3$$

where r is the radius of the tumor in centimeters. By what factor is the volume of the tumor increased if its radius is doubled?

58. *Growth of a Cancerous Tumor* The surface area of a spherical cancer tumor is given by the function

$$S(r) = 4\pi r^2$$

where r is the radius of the tumor in centimeters. After extensive chemotherapy treatment, the surface area of the tumor is reduced by 75%. What is the radius of the tumor after treatment?

65. *Friend's Rule* Friend's rule, a method for calculating pediatric drug dosages, is based on a child's age. If a denotes the adult dosage (in milligrams) and if t is the age of the child (in years), then the child's dosage is given by

$$D(t) = \frac{2}{25}ta.$$

If the adult dose of a substance is 500 mg, how much should a 4-yr-old child receive?

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22. Find $f + g$, $f - g$, fg , and f/g , where

$$f(x) = \frac{1}{x^2 + 1}; g(x) = \frac{1}{x^2 - 1}.$$

29. Find the rules for the composite functions $f \circ g$ and $g \circ f$, where

$$f(x) = \frac{x}{x^2 + 1}; g(x) = \frac{1}{x}.$$

43. Find $f(a + h) - f(a)$ and simplify, if $f(x) = 3x + 4$.

52. *Overcrowding of Prisons* The 1980s saw a trend toward old-fashioned punitive deterrence as opposed to the more liberal penal policies and community-based corrections more popular in the 1960s and early 1970s. As a result, prisons became more crowded, and the gap between the number of people in prison and the prison capacity widened.

Based on figures from the U.S. Department of Justice, the number of prisoners (in thousands) in federal and state prisons is approximated by the function

$$N(t) = 3.5t^2 + 26.7t + 436.2(0 \leq t \leq 10)$$

where t is measured in years and $t = 0$ corresponds to 1983. The number of inmates for which prisons were designed is given by

$$C(t) = 24.3t + 365(0 \leq t \leq 10)$$

where $C(t)$ is measured in thousands and t has the same meaning as before.

- a. Find an expression that shows the gap between the number of prisoners and the number of inmates for which the prisons were designed at any time t .
- b. Find the gap at the beginning of 1983 and at the beginning of 1986.

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21. *Cowling's Rule* Cowling's rule is a method for calculating pediatric drug dosages. If a denotes the adult dosage (in milligrams) and t is the age of the child in years, then the child's dosage is given by

$$D(t) = \left(\frac{t+1}{24}\right)a.$$

If the adult dose of a substance is 500 mg, how much should a 4-yr-old child receive?

29. *Cricket Chirping and Temperature* Entomologists have discovered that a linear relationship exists between the number of chirps of crickets of a certain species and the air temperature. When the temperature is 70°F, the crickets chirp at a rate of 120 times per minute, and when the temperature is 80°F, they chirp at the rate of 160 times/minute.
- a. Find an equation giving the relationship between the air temperature T and the number of chirps per minute N of the crickets.
 - b. Find N as a function of T (the answer to (a) may give you this!) and use this formula to determine the rate at which the crickets chirp when the temperature is 102°F.