

- $$\left(\frac{2x^{\frac{3}{4}}}{y^{\frac{1}{3}}}\right)^3 \cdot \left(\frac{y^4}{x^{\frac{-1}{2}}}\right) = Px^k y^w$$
. Find the value of  $(k + w + P)$ . Write your answer as a reduced improper fraction.
- The average rate of change of a function  $f(x)$  between  $x = a$  and  $x = b$  is given by  $A = \frac{f(b) - f(a)}{b - a}$ . Let  $f(x) = \frac{2}{x + 1}$ . *ANS* should be an improper fraction of the form  $\frac{k}{w}$ . Find the average rate of change  $A$  for this function between  $a = w$  and  $b = k$ . Write your answer as a reduced fraction.
- Let  $ANS = k$  and  $f(x) = \sec(kx)$ . The graph of  $f(x)$  has vertical asymptotes of the form  $x = w\pi$ ,  $x$  in radian measure. Find the least positive value of  $w$ .
- The function  $f(x) = ax^3 + bx^2 + cx + d$  has integral coefficients and the graph of  $f(x) = ax^3 + bx^2 + cx + d$  contains points  $(-2, -37)$ ,  $(-1, -11)$ ,  $(0, -5)$ , and  $(2, 19)$ . Find the **exact** value of  $f(ANS)$ .

ANSWERS

- $\frac{55}{4}$  (Must be this reduced improper fraction.)
- $-\frac{1}{140}$  or  $\frac{-1}{140}$  or  $\frac{1}{-140}$  (Must be this reduced common fraction.)
- 70
- 1024235

1. Solve for  $x$  if  $\frac{x}{x - \left(\frac{x+1}{2}\right)} = 4$
2. (Function composition notation:  $f \circ g(x) = f(g(x))$ .) Find the absolute value of the difference between  $f \circ g(ANS)$  and  $g \circ f(ANS)$  when  $f(x) = x^2 + 3$  and  $g(x) = 4x - 1$ .
3. Two ships leave an island traveling at the same speed. One travels on a bearing of  $42^\circ 30'$  and the other on a bearing of  $52^\circ 12'$ . How far apart will the two ships be when they are  $ANS$  miles from the island? Answer to the nearest hundredth of a mile.
4. One type of annuity investment involves an initial investment deposited at a guaranteed annual rate (APR) and left over a long period of time. Let  $ANS\%$  be the APR interest rate that is compounded monthly. How long will it take for the account to double in value? Answer as the total number of months rounded to the nearest whole month.

ANSWERS

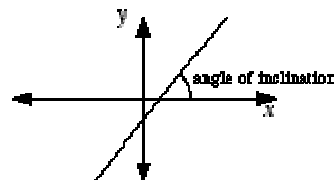
1. 2
2. 25
3. 4.23 (Must be this decimal, statute miles optional.)
4. 197 (Months optional.)

1. A pot contains 6 liters of brine at a concentration of 120 g/L. How much of the water should be boiled off to increase the concentration to 200 g/L? Write your answer as a reduced improper fraction.
2.  $P$  is jointly proportional to  $x$  and  $y$  and inversely proportional to  $z$ .  $P = 25$  when  $x = 2$ ,  $y = 3$ , and  $z = 12$ . Find  $P$  when the  $x$  and  $y$  values are doubled and  $z = ANS$ .
3. A 12.002-inch diameter saw blade has 16 cutting teeth per inch along the circumference of the blade. If the blade is rotating at  $ANS$  revolutions per minute, how many teeth cross the cutting surface per second? Answer rounded to the nearest whole tooth.
4. A pilot is approaching an airport on a straight line path with a runway. He spots a marker at the furthest end of a runway at an angle of depression of  $30^\circ$ . He also measures the angle of depression to a marker at the nearest end of the runway as an angle of depression of  $32^\circ$ . If the horizontal runway is  $ANS$  feet long, what is the vertical distance to ground of the plane? Write your answer rounded to the nearest foot. (Presume linear distances, neglecting the curvature of the Earth.)

ANSWERS

1.  $\frac{12}{5}$  (Must be this reduced improper fraction, L or liters optional.)
2. 500
3. 5027 (Teeth optional.)
4. 38165 (Feet optional.)

1. In this problem,  $i = \sqrt{-1}$ .  $\frac{7+3i}{4i}$  can be simplified to a complex number of the form  $k + wi$ . Find the sum  $(k + w)$ .
2. For all real numbers  $x$ ,  $f(x+1) = (ANS)f(x) + 1$  and  $f(0) = 6$ . Find the value of  $f(5)$ .
3. Let  $k = ANS$ .  $f(x) = 3\sin x + k\cos x$  with  $x$  measured in degrees. Find the least positive angle such that  $f(x) = 0$ . Round your answer to the nearest degree.
4. The angle of inclination for a line is the angle  $\alpha$ ,  $0^\circ \leq \alpha < 180^\circ$ , measured counterclockwise from the part of the  $x$ -axis in the positive direction from the line. Let  $ANS$  be the angle of inclination, in degrees, for a line that passes through the point  $(5, 4)$ . This line crosses the  $x$ -axis at  $(k, 0)$ . Find the value of  $k$  as a decimal rounded to the nearest hundredth of a unit.



ANSWERS

1. -1
2. -5
3. 59 (Degrees optional.)
4. 2.60 (Must be this decimal, last "0" is significant, no ordered pair.)

1. A father is 4 times as old as his daughter. In six years, he will be 3 times as old as she is then. How old will the daughter be in six years? (Assume all ages are whole numbers of years.)
2. How many integral solutions exist such that  $3|x-7|+6 \leq ANS$  ?
3.  $ANS = x^2 + 2xy + y^2$ . Find the exact distance between the two branches of the graph of this relation.
4. (Notation:  $f(x) = \text{Arc tan } x$  represents the inverse tangent function.) Let  $k = ANS$ . Find the value of  $\cos(2\text{Arc tan } k)$ . Write your answer as a reduced common fraction.

ANSWERS

1. 18 (Years optional)
2. 9
3.  $3\sqrt{2}$  (Must be this exact radical.)
4.  $-\frac{17}{19}$  or  $\frac{-17}{19}$  or  $\frac{17}{-19}$  (Must be a reduced common fraction.)