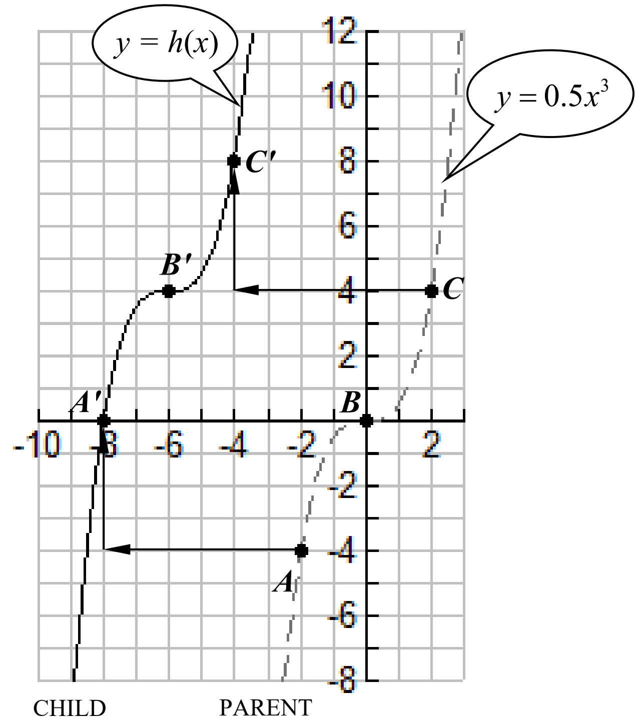
1. The graph of $y = 0.5x^3$ is shown (dashed), along with the graph of $h(x)$ on the set of axes below. The graph of $h(x)$ is a translation of $y = 0.5x^3$, which has been shifted both horizontally and vertically. Points ***A***, ***B***, and ***C*** on $y = 0.5x^3$ correspond to ***A′***, ***B′***, and ***C′*** on $h(x)$, respectively.

a. Describe in words the translation of $y = 0.5x^3$ to $h(x)$.
Example: a shift left or right <*some specified number of*> units and a shift up or down <*some specified number of*> units.



b. Write the equation of $h(x)$ as a function of x.

c. At what value does the graph of $h(x)$ cross the x-axis?
(This should be consistent with your formula in part **b**.)

d. At what value does the graph of $h(x)$ cross the y-axis?
(You can use your formula or a grapher. No work need be shown.)

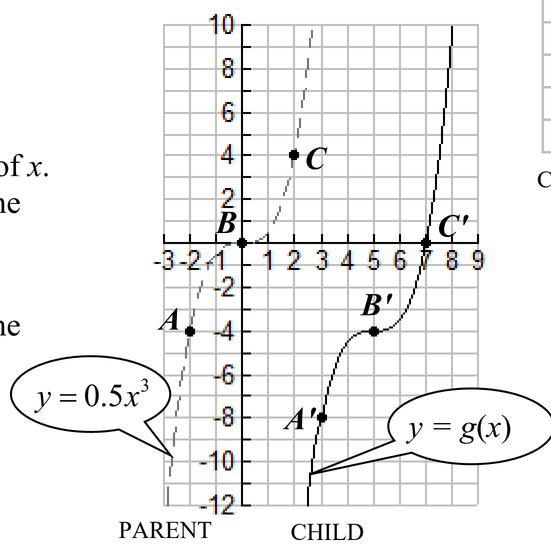
2. The graph of $y = 0.5x^3$ is shown (dashed), along with the graph of $g(x)$ on the set of axes below.

a. Describe in words the translation of $y = 0.5x^3$ to $g(x)$.

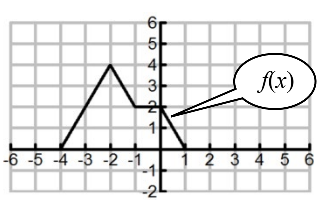
b. Write the equation of $g(x)$ as a function of x.

c. At what value does the graph of $g(x)$ cross the x-axis?

d. At what value does the graph of $g(x)$ cross the y-axis?

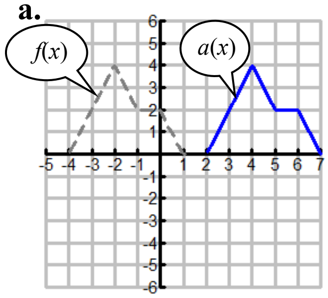


3. The graph of $y = f(x)$ is shown. The functions shown below are transformations of $f(x)$.

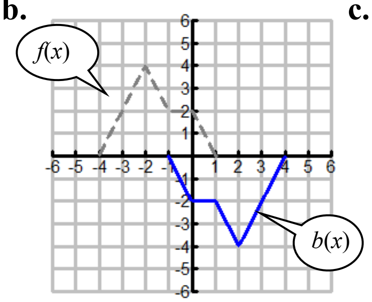


Describe each transformation and write a formula for each function in terms of $f(x)$.

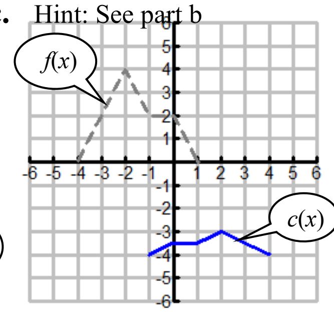
a.



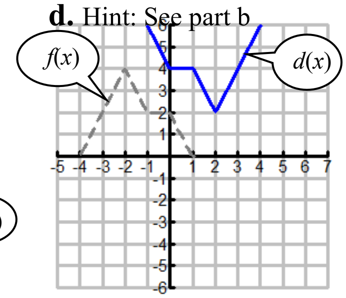
b.



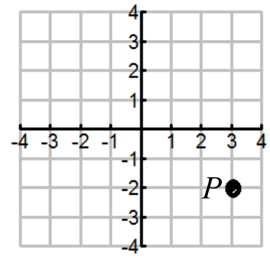
c. Hint: See part b



d. Hint: See part b



4. Suppose the point $P(3,-2)$ is a point on the graph of $y = f(x)$

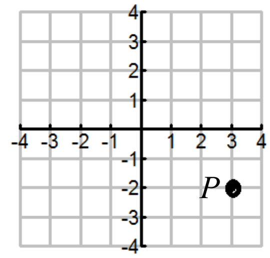


a. Suppose $f(x)$ is **even:**

i. Report the coordinates of another point Q, which corresponds to P. (_____ , _____)

ii. Plot the point Q on the grid provided.

b. Suppose $f(x)$ is **odd**:



i. Report the coordinates of another point Q, which corresponds to P. (_____ , _____)

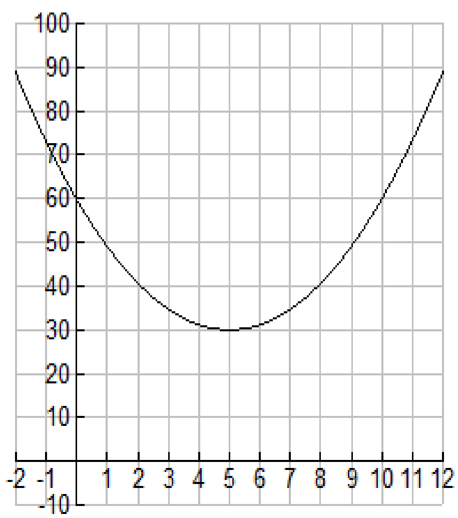
ii. Plot the point Q on the grid provided.

5. A ballet dancer jumps in the air. The height, $h(t)$, in feet, of the dancer at time, t in seconds since the start of the jump, is given by $h(t) = -16t^2 + 12t$.
No work need be shown. **Do not round off any calculations.**

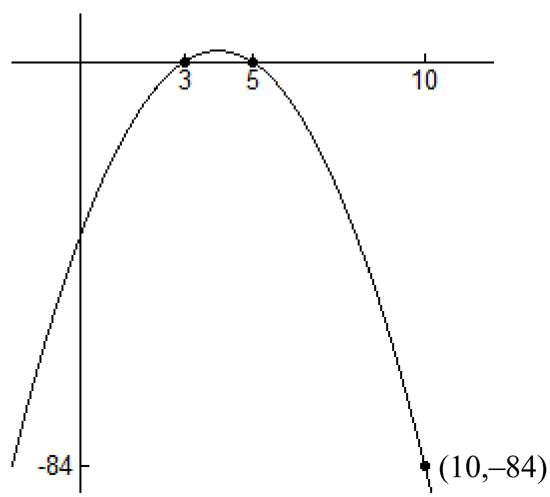
a. Write the function in *factored form*.
b. Report the zeros of the function.
c. Report the vertex of the function.
d. Write the equation of the axis of symmetry.
e. How much time in seconds is the dancer in the air?
f. What is the maximum height of the jump?
g. When does the maximum height of the jump occur?
h. Write the formula in *vertex form*.

6. Write formulas for the parabolas. You may use vertex form, factored form, or standard form, whichever is most efficient. **SHOW ALL WORK!**

a.



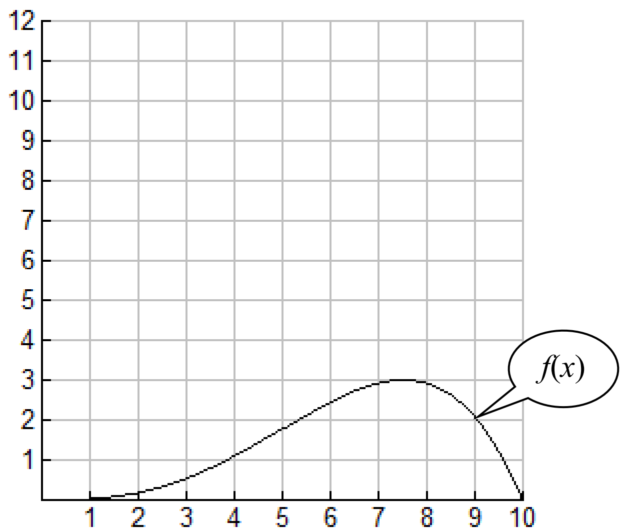
b.

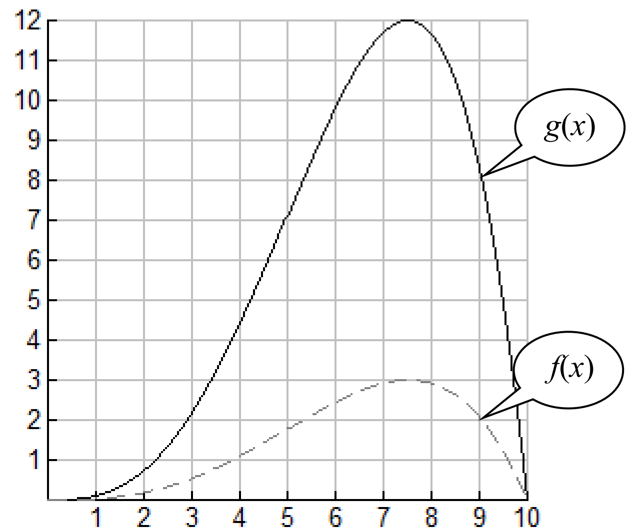


c.

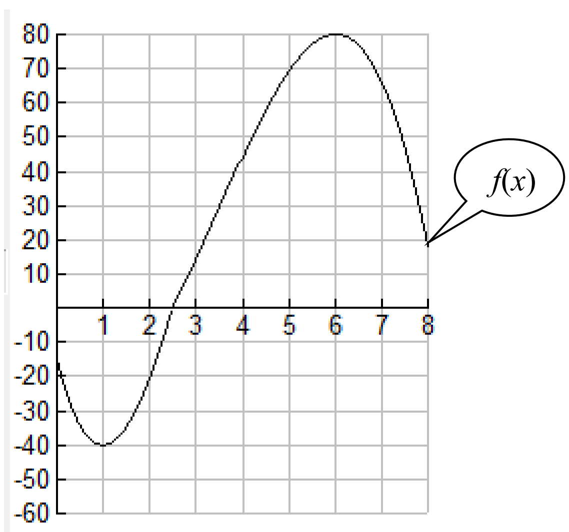
7. The graph of $y = f(x)$.is shown. Use the graph of $f(x)$ to write $g(x)$ as a transformation of $f(x)$. Find a formula for $g(x)$ in **terms of $f(x)$.**

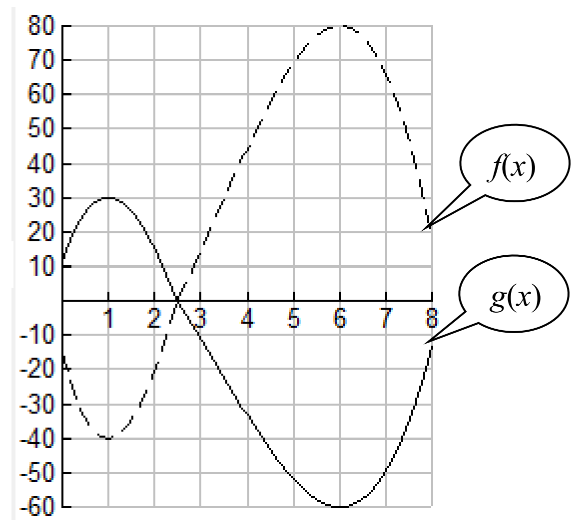
a.





b.





8. In the year 1900 the population P of a town was 200. The town grew by 23% every year. In the year 1900 the population Q of a town was 400 people but it grew by 200 people every year.

a. Write formulas for P and Q.

b. Find how many years it will take after 1900 for the population of Q to overtake the population of P. Report your solution to 2 decimal places.

9. Find the logarithm.

a. $\ln e^{5x-1}$ **b.** $\log 10^{7x}$ **c.** $\log_5 \sqrt{5}$

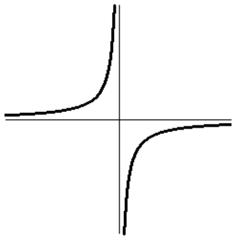
d. $\log_{\sqrt{5}} \sqrt{5}$ **e.** $\ln \dfrac{1}{\sqrt{e^{3x}}}$ **f.** $e^{\ln \sqrt{5x}}$

g. $\log_5\left(\sqrt[7]{5^x}\right)$ **h.** $\log_5\left(\dfrac{1}{25}\right)$ **i.** $\log 100^{11x}$

10. The graphs below are power functions of the form $y = k\,x^p$.

Determine the following information. Circle the appropriate bold face words.

a.

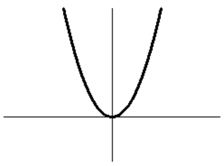


The leading coefficient, *k*, is **negative** / **positive**.

The power, *p,* is **even** (like ±2, ±4,…) / **odd** (like ±1, ±3,…) / **fractional.** (like $\pm\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5} \ldots$)

The symmetry of the graph is **even** / **odd** / **neither even nor odd** .

b.

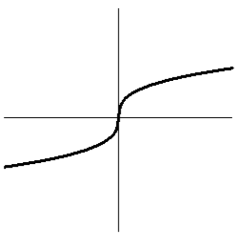


The leading coefficient, *k*, is **negative** / **positive**.

The power, *p,* is **even** (like ±2, ±4,…) / **odd** (like ±1, ±3,…) / **fractional.** (like $\pm\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5} \ldots$)

The symmetry of the graph is **even** / **odd** / **neither even nor odd** .

c.

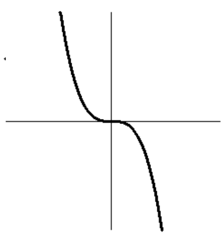


The leading coefficient, *k*, is **negative** / **positive**.

The power, *p,* is **even** (like ±2, ±4,…) / **odd** (like ±1, ±3,…) / **fractional.** (like $\pm\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5} \ldots$)

The symmetry of the graph is **even** / **odd** / **neither even nor odd** .

d.

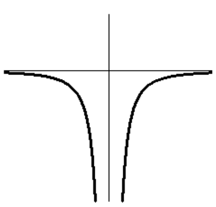


The leading coefficient, *k*, is **negative** / **positive**.

The power, *p,* is **even** (like ±2, ±4,…) / **odd** (like ±1, ±3,…) / **fractional.** (like $\pm\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5} \ldots$)

The symmetry of the graph is **even** / **odd** / **neither even nor odd** .

e.

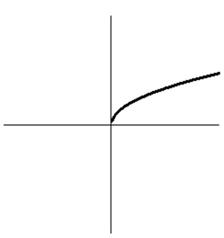


The leading coefficient, *k*, is **negative** / **positive**.

The power, *p,* is **even** (like ±2, ±4,…) / **odd** (like ±1, ±3,…) / **fractional.** (like $\pm\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5} \ldots$)

The symmetry of the graph is **even** / **odd** / **neither even nor odd** .

f.



The leading coefficient, *k*, is **negative** / **positive**.

The power, *p,* is **even** (like ±2, ±4,…) / **odd** (like ±1, ±3,…) / **fractional.** (like $\pm\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5} \ldots$)

The symmetry of the graph is **even** / **odd** / **neither even nor odd** .

11. Find the formula for the power function $y = kx^p$ given by each table. Show work.

a.

x	y
1	2
16	128

b.

x	y
81	900
625	1500

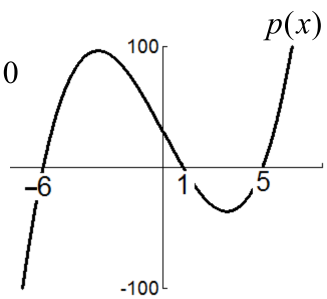
12. Consider the polynomial $f(x) = 80 + 70x - 30x^3 - 5x^7$.

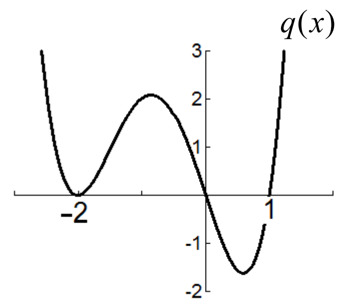
a. Report the leading term.
b. Report the leading coefficient.
c. Report the degree of $f(x)$.
d. Report the long run behavior of $f(x)$. Specify as  (Please circle one)

13. Consider the polynomial $g(x) = -20(x-50)^4(x+200)^2$.

a. Report the leading term.
b. Report the leading coefficient.
c. Report the degree of $f(x)$.
d. Report the long run behavior of $f(x)$. Specify as  (Please circle one)

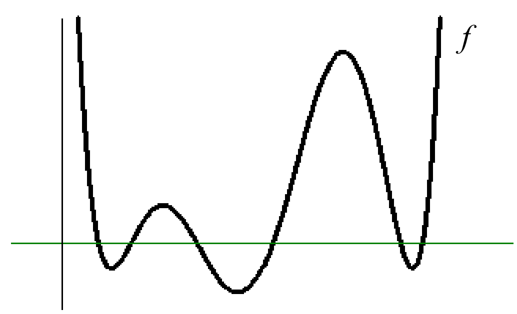
14. The graphs of the polynomials $p(x) = x^3 - 31x + 30$ and $q(x) = x^4 + 3x^3 - 4x$ show their zeros and their entire long run behavior. Write each polynomial in factored form as a **product of factors**.





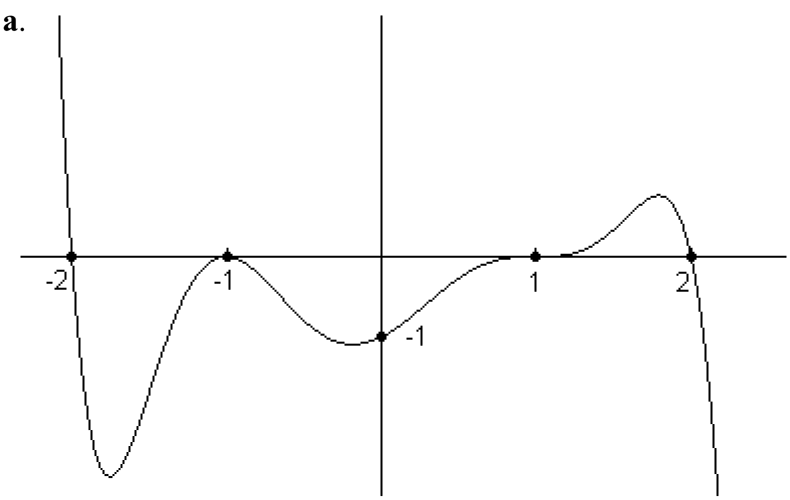
15. Suppose the polynomial f graphed in figure shows its entire long run behavior and has leading term ax^n, that is, $f(x) = ax^n$ + remaining terms of lower degree

a. Is a positive or negative?
b. Is n even or odd?
c. Write the minimum possible value of n. $n \geq$ ___

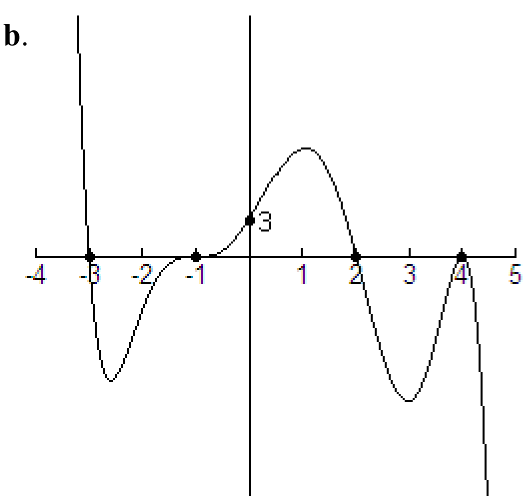


16. Write a possible formula for each polynomial function.

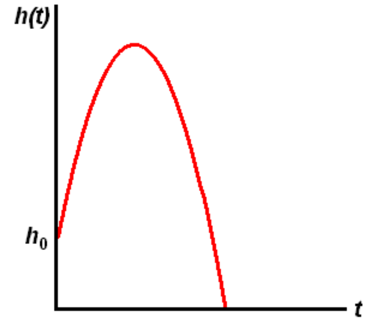
a.



b.



17. A model rocket is launched from the roof of a building with height h_0. Its height above ground (in meters) t seconds later is given by



$$h = f(t) = -5t^2 + 40t + 20$$

Answer the following.
All work may be done on the calculator. No work need be shown!
a. What is the value of h_0, the initial height of the rocket? Please report with correct units
b. When will the rocket hit the ground? Report accurate to two decimal places.
c. What is the **exact** maximum height of the rocket? Please report with correct units.
d. When will the rocket reach its maximum height? Please report with correct units.
e. What length of time will the rocket be 15 feet or higher? Report accurate to two decimal places.
f. Give the domain of the height of the rocket function (restricted according to the ***context of the problem situation***.)
g. Give the range of the height of the rocket function (restricted according to the ***context of the problem situation***.)

18. Simplify $100^{2\log x^5}$

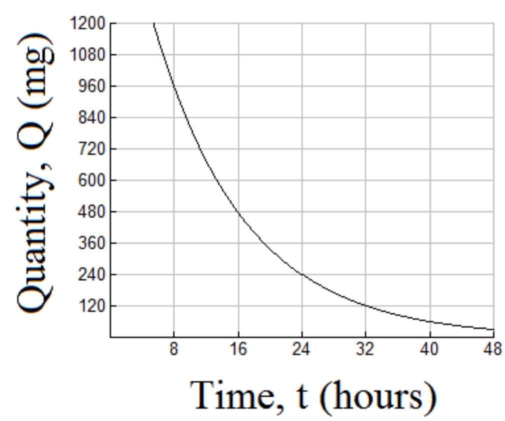
19. Simplify $\log\left(\frac{x^{20}}{y^2}\right)$ (SELECT ONE)

A. $\left(\frac{x}{y}\right)^{18}$ B. $\frac{\log x^{20}}{\log y^2}$ C. $18\log(x-y)$ D. $20x-2y$ E. $\frac{10x}{y}$ F. $\left(\frac{x}{y}\right)^{10}$

G. $10\log(x-y)$ H. $20\log x - 2\log y$ I. $18\log(10x-y)$ J. $\frac{18x}{y}$ K. None of these

20. A function Q gives the amount, in mg of drug in a patient's body.
The function Q decays exponentially.
Assume the pattern holds.
a. Complete the first entry in the table.
Complete the next row in the table.

t, hours	$f(t)$
0	
8	960
16	480
24	240
32	120



b. Report the half-life, in hours
__________ hours

c. Find a formula for this function $Q =$ ________________
d. What was the original amount of medication taken? __________ mg
e. Every hour the patient loses _______ % and keeps _______% of the drug. Report each to the nearest 0.1 percent.
f. Find, to the nearest 0.01 hour, the time it takes for the amount of drug to first fall below 1000 mg.
Show work. $t \approx$ ________ hours

21. Solve the equations.
Report both an exact solution (involving a logarithm) and an approximate solution to 3 decimal places.
a. $3e^{5x-10} = 60$ **b.** $7 \cdot 10^x + 10 = 70$ **c.** $26(0.5)^{x/7} + 40 = 48$

22. Solve the equations.
Report both an exact solution and an approximate solution to 3 decimal places.
a. $5\ln(3x) = 20$ **b.** $5\log x + 7 = 10$

23. The relationship of pH to the hydrogen ion concentration C is $\text{pH} = -\log C$.
If the pH is 2.15 what is the hydrogen ion concentration? Report to three decimal places.
A. 141.254 B. 0.332 C. 0.007 D. −141.254 E. −0.332 F. −0.007

24. Sales of an item increase by 50% every 9 years.
Assume sales $f(t)$ continue to grow exponentially, where t is in years.

a. If 100 items were sold at year $t = 0$,
complete the table to determine the number sold in year $t = 9$ and year $t = 18$.
Report **whole number** of values.

t	$f(t)$
0	100
9	
18	

b. At what effective percent rate does it increase **per year**? Round to the nearest **0.1** percent.

c. Write a formula for $f(t)$.

25. Sales of an item decrease by 98% every 6 years.
Assume sales $f(t)$ continue to decay exponentially, where t is in years.

a. If 100,000 items were sold at year $t = 0$,
complete the table to determine the number sold in year $t = 6$ and year $t = 12$.
Report **whole number** of values.

t	$f(t)$
0	100,000
6	
12	

b. At what effective percent rate does it decrease **per year**? Round to the nearest **0.1** percent.

c. Write a formula for $f(t)$.

26. If a function decays according to the formula $Q = 400(0.5)^{t/53}$
where t is in minutes.

a. Report the half-life, in minutes.

b. By what percent does it decay each minute?

27. A function increases at a rate of 17.76% per day.

a. Write a formula for the amount Q at day t, where Q_0 is the initial amount. Do not round any values.

$$Q = Q_0 \cdot (\_\_\_\_\_\_\_\_\_\_)^t$$

b. Find the doubling time.

i. Solve analytically and report your **exact** answer involving natural or common logarithms.

ii. Report an **approximate** answer of the doubling time accurate to days

c. Find the tripling time.

i. Solve analytically and report your **exact** answer involving natural or common logarithms.

ii. Report an **approximate** answer of the tripling time accurate to days