Unit 3 Assessment • Linear and Exponential Functions

1. For which linear function below does $f(-1) = 9$ and $f(3) = 1$?

(handwritten: Substitute -1 and 3 un for x — 3 un for x)

A. $f(x) = 3x + 6$
B. $f(x) = -2x + 7$ *(circled)*
C. $f(x) = -x + 6$
D. $f(x) = -9x$

2. Assume $f(x) = g(x)$. Which of the following functions may be used to represent the equation $3^{x+2} = 7x + 6$?

A. $f(x) = x + 2,\ g(x) = 7x + 6$
B. $f(x) = 3^{7x+6},\ g(x) = 7(3^{x+2}) + 6$
C. $f(x) = 3^{x+2},\ g(x) = 7x + 6$ *(circled)*
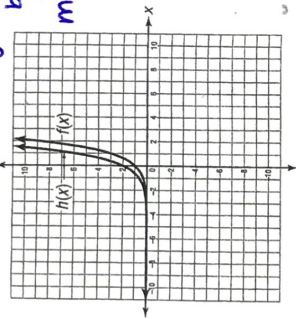D. $f(x) = 7^{x+2},\ g(x) = 3x + 6$

3. Which ordered pair represents a solution to the function graphed below?

(handwritten: has to fall on the line or graph)

A. (6, 0) *(circled)*
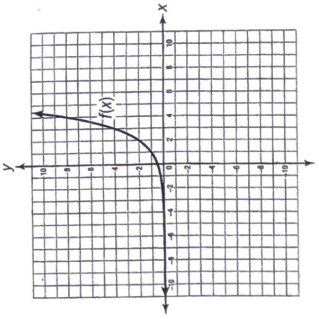B. (-2, 2)
C. (4, 1)
D. (2, -3)
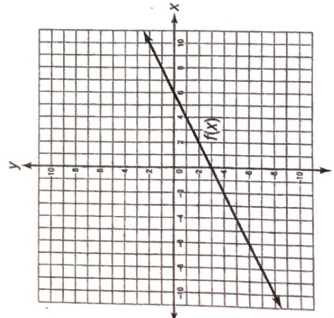
4. The graph of $f(x) = 3^x$ and its image, $h(x)$, are shown below.

(handwritten: This question most likely will not be on the milestone)

Which equation expresses the value of $h(x)$ in terms of $f(x)$?

A. $h(x) = f(x + 2)$
B. $h(x) = f(x + 1)$ *(circled)* *(handwritten: moved 1 left)*
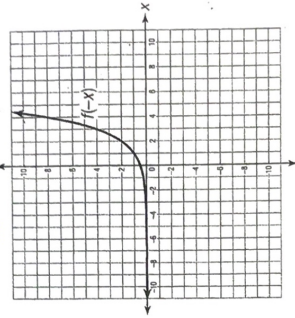C. $h(x) = 3f(x)$
D. $h(x) = 2f(x)$

5. Shu deposited her money in a savings account and checks the balance of the account each month. Her initial balance and the balances after the first four months are listed below.

$40, $44.10, $46.31, 48.62

What is the constant percent rate in this geometric series?

A. 2%
B. 5% *(circled)*
C. 10%
D. 20%

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6. The function $f(x) = 0.5 \cdot 2^x$ is graphed below.

Which graph below represents $f(-x)$?
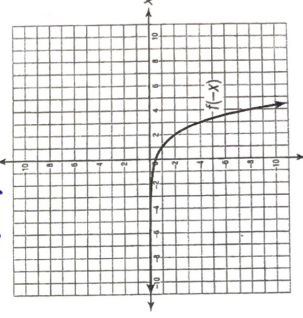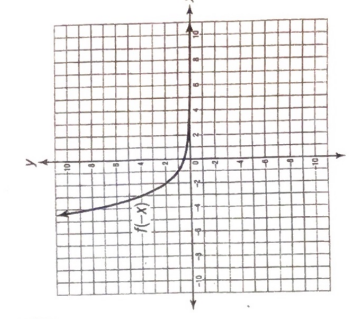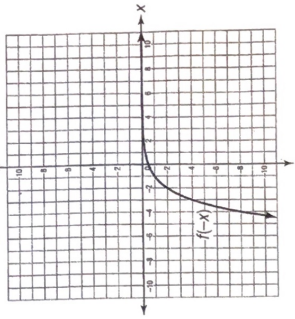
(handwritten on options: "the same" — crossed out; "-f(-x)" — crossed out; "-f(x)" — crossed out; D. circled)
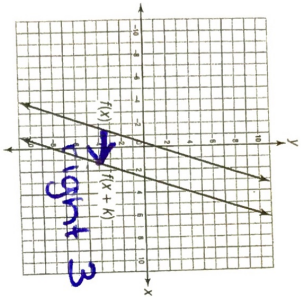
Go On ▶

7. A calculator screenshot of a function $f(x) = \frac{1}{4}x - 4$ is graphed below.
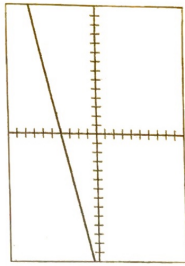
What change would be seen if $f(x) + 4$ were graphed?

A. The line shown on the calculator would shift to the right 4 units.

B. The line shown on the calculator would shift to the left 4 units.

C. The line shown on the calculator would shift up 4 units.

D. The line shown on the calculator would shift down 4 units.

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8. Didier went camping for summer vacation. It costs $5 to rent a tent, and the campsite costs $3 per night. He uses the equation $y = 3x + 5$ to figure out how much money he will spend. What do x and y represent?

A. x represents the cost of renting a tent, and y is the total cost of the camping trip.

B. x represents the number of nights at the campsite, and y represents the cost of renting a tent.

C. x represents the number of nights at the campsite, and y is the total cost of the camping trip.

D. x is the total cost of the camping trip, and y represents the cost per night at the campsite.

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9. In the graph below, the function $f(x) = 3x + 1$ has been transformed to the function $f(x + k)$.

right 3

What is the value of k in the transformation $f(x + k)$?

A. -7

B. -3 *Shouldn't be on milestone*

C. 3 $\circ f(x+k)$ moves left

D. 7 $\circ f(x-k)$ moves right

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10. The table below shows the values of a function.

x	f(x)
4	7
6	11
8	15
10	19

$+2 \big) \,\, 7$
$+2 \big) \,\, 11 \big) \, 4$
$+2 \big) \,\, 15 \big) \, 4$

$\frac{\Delta y}{\Delta x}$ $\frac{4}{2} = 2$

Which best describes the function, based on the average rates of change?

A. The function is linear because the average rates of change are all the same, 2.

B. The function is exponential because each average rate of change is 2 times the previous rate of change.

C. The function is linear because the average rates of change are all the same, 4.

D. The function is exponential because each average rate of change is 4 times the previous rate of change.

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11. The census bureau tracked the population in the city of Weston over four years. The table below shows the populations measured during that time.

Year	Population
2006	36,000
2007	39,600
2008	43,560
2009	47,916

Does the population growth show linear growth, exponential growth, or neither?

A. Since the population is increasing by the same percentage each year, the function is exponential.

B. Since the population is increasing by the same percentage each year, the function is linear.

C. Since the rate of increase is constant, the function is linear.

D. Since the rate of increase is not constant, the function is exponential. *not the best answer*

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12. The function $f(x)$ is transformed to $\frac{1}{3}f(x)$. Which represents the type of transformation performed?

A. leftward shift

B. rightward shift

C. vertical stretch

D. vertical shrink

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13. What is the value of the function $f(x) = 3^x - 2$ when $x = 3$?

$3^3 - 2$
$27 - 2$

A. 7

B. 9

C. 25

D. 27

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14. The table below represents ordered pairs of a relation.

x	y
-2	2
-1	1
0	0
1	1
-2	5

x values cannot repeat

Which change could be made so that the relation becomes a function?

A. Replace $(-1, 1)$ with $(1, 4)$.

B. Replace $(-1, 1)$ with $(-3, 6)$.

C. Replace $(-2, 5)$ with $(3, 8)$.

D. Replace $(-2, 2)$ with $(-2, 3)$.

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15. A function table is shown below.

x	f(x)
1	2
2	4
3	8
4	16
5	32

Which is the best interpretation of the average rate of change of the function shown?

A. As x increases by 1, f(x) increases by 2; therefore, f(x) is a linear function.

B. As x increases by 1, f(x) increases by 2; therefore, f(x) is an exponential function.

C. As x increases by 1, f(x) increases by a power of 2; therefore, f(x) is a linear function.

D. As x increases by 1, f(x) increases by a power of 2; therefore, f(x) is an exponential function.

Unit 3

16. The properties of two linear functions need to be compared. The function $f(x)$ has a slope of 2 and crosses the y-axis at the point (0, 4). The function $g(x)$ is represented in the function table below.

| input x	output g(x)
−7	−2
−5	−1
−3	0
−1	1
1	2

Which represents the intervals in which the outputs of the functions are negative?

A. $f(x)$ is negative when $x < 4$; ✗
 $g(x)$ is negative when $x < 1$. ✗

B. $f(x)$ is negative when $x < -2$; ✗
 $g(x)$ is negative when $x < -3$.

C. $f(x)$ is negative when $x < -2$;
 $g(x)$ is negative when $x < 1$. ✗

D. $f(x)$ is negative when $x < -4$;
 $g(x)$ is negative when $x < -3$.

Handwritten:
$f(x) = 2x + 4$

Ⓑ $f(-2) = 2(-2) + 4 = 0$
so anything less than −2 would have a negative y-value

17. The function $f(x) = 0.25 \cdot 4^x$ and its reflection over the x-axis are graphed below.
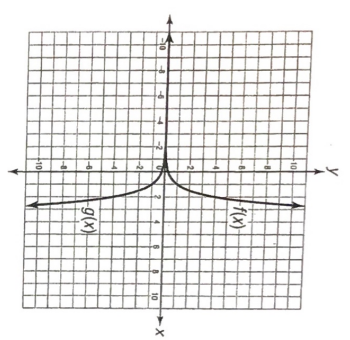
Which algebraic function best describes the transformation shown?

A. $g(x) = f(-x)$

B. $g(x) = -f(-x)$

C. $g(x) = -f(x)$ ⓒ

D. $g(x) = f(x - 1)$

18. Julian is planning a birthday party and wants to make sure that he has enough sandwiches for all of his guests. He wants to have 1 sandwich per invited guest and 5 extra sandwiches to put aside for lunch next week. He uses the function $g(x) = x + 5$. Which is the best interpretation of the function that Julian used?

A. If x represents the number of invited guests, $g(x)$ represents the number of sandwiches needed so that each guest gets 1 sandwich and there are 5 left over. Ⓐ

B. If x represents the number of invited guests, $g(x)$ represents the number of sandwiches needed so that each guest gets 5 sandwiches and there is 1 left over.

C. If x represents the total number of sandwiches, $g(x)$ represents the number of guests who would be able to eat sandwiches.

D. If x represents the total number of sandwiches, $g(x)$ represents the number of sandwiches that would be left over at the end of the party.

19. The function table below shows the air temperature in degrees Celsius over the course of 10 days.

Day	Temperature (°C)
1	23
2	25
3	27
4	26
5	24
6	28
7	30
8	32
9	29
10	28

During which intervals is the function increasing and decreasing?

A. increasing from day 1 to day 8; decreasing from day 8 to day 10

B. increasing from day 1 to day 3; decreasing from day 3 to day 10

C. increasing from day 1 to day 3, day 5 to day 8; decreasing from day 3 to day 5, day 8 to day 10 ⓒ

D. increasing from day 3 to day 5, day 8 to day 10; decreasing from day 1 to day 3, day 5 to day 8

20. The rates of change of two functions are being compared. One function, f(x), is represented by the equation $f(x) = 4x + 2$, while the other function, g(x), is represented in the function table below.

x	g(x)
-1	-2
1	4
2	7
5	16

$f(x) = 4$
$g(x) = 3$

Which statement is true?

- **A.** The rate of change for f(x) is greater than the rate of change for g(x). *(circled)*
- **B.** The rate of change for g(x) is greater than the rate of change for f(x).
- **C.** The rates of change for f(x) and g(x) are equal.
- **D.** The rates of change cannot be compared because f(x) is a linear function and g(x) is an exponential function.

21. A company made $20,000 in revenue in one year. The president of the company determined that the company's revenue needs to increase by 10% each year for it to be successful. If t represents the number of years that have passed and R(x) represents the yearly revenue goal, which expression could the company president use to determine the revenue goal for any year?

- **A.** $R(x) = 0.10r^{20,000}$
- **B.** $R(x) = 20,000 \cdot 1.10^t$ *(circled)*
- **C.** $R(x) = 1.10 \cdot 20,000^t$
- **D.** $R(x) = 20,000^{1.10t}$

22. Val is measuring water temperatures in her science class. Water is in liquid form above 32°F. After measuring each temperature in degrees Fahrenheit, she subtracts 32 and then multiplies by $\frac{5}{9}$ to find the temperature in degrees Celsius. If all the water she is using is in liquid form, what is the practical domain of the function that she is using to convert from degrees Fahrenheit to degrees Celsius?

- **A.** all real numbers
- **B.** $x > 0$ *(circled)*
- **C.** $x < 0$
- **D.** $x > 32$

23. Doris decided to start a stamp collection. She hopes to triple the total number of stamps that she has in her collection each year. If she has 3 stamps when she starts her collection, which sequence represents the number of stamps she wants to have in her collection each year?

- **A.** 3, 9, 27, 54, 108, ...
- **B.** 3, 9, 15, 21, 27, ...
- **C.** 3, 6, 9, 12, 15, ...
- **D.** 3, 9, 27, 81, 243, ... *(circled)*

24. An arithmetic sequence is shown below.

$$\frac{1}{4}, \frac{3}{4}, 1\frac{1}{4}, 1\frac{3}{4}, 2\frac{1}{4}, 2\frac{3}{4}, \ldots$$

What is the common difference of the arithmetic sequence?

- **A.** $\frac{1}{4}$
- **B.** $\frac{1}{3}$
- **C.** $\frac{1}{2}$ *(circled)*
- **D.** $\frac{3}{4}$

25. A geometric sequence is shown in the table below, where a_n represents the nth term of the sequence.

	Value
a_1	1
a_2	4
a_3	16
a_4	64
a_5	256

What is the recursive formula of the geometric sequence?

- **A.** $a_{n+1} = a_n^2$
- **B.** $a_{n+1} = a_n + 3$
- **C.** $a_{n+1} = 2a_n$
- **D.** $a_{n+1} = 4a_n$ *(circled)*

Shouldn't be on milestone

26. The functions f(x) and g(x) have key features that may be compared. The function f(x) is represented in the function table below, while $g(x) = -5x + 17$.

x	f(x)
-6	0
-3	4
0	8
3	12

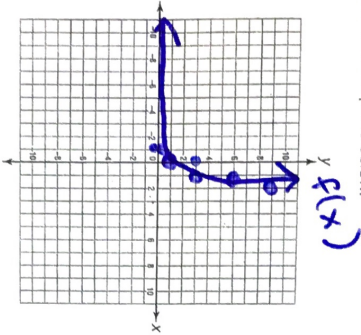What are the domains and ranges of f(x) and g(x)?

f(x) and g(x) → linear so both are all real #'s for domain & range

Go On ▶

Unit 3

27. The function $f(x)$ is represented by the equation $f(x) = 3^x$, while a subset of a function $g(x)$ is represented in the function table below.

x	g(x)
-1	0
0	3
1	6
2	9
3	12

A. Graph $f(x)$ and $g(x)$ on the coordinate plane below.

$f(x) = 3^x$

x	y
-1	1/3
0	1
1	3
2	9

B. Compare the rates of change of $f(x)$ and $g(x)$, and discuss the significance of the two graphs intersecting in the first quadrant.

$f(x)$: 3
$g(x)$: 1.5 → doubled rate of change
→ both show exponential growth

Go On ▶

28. An arithmetic sequence is shown below.

12, 17, 22, 27, 32, 37, ...

$a_n = a_1 + d(n-1)$

A. What is the explicit formula for a_n, the nth term of the sequence?

$a_1 = 12 \quad d = 5$
$a_n = 12 + 5(n-1)$
$a_n = 12 + 5n - 5$
$a_n = (12-5) + 5n \rightarrow a_n = 7 + 5n$

B. Why can an arithmetic sequence be written as a function in this way? Use a generalized arithmetic sequence and the concept of rate of change in your explanation.

As the x value increases at a constant rate, so does the y-value (the common difference or rate of change)

29. Pia paid for a year of college using a combination of one government loan and one bank loan. For both loans, the amount Pia will have to pay depends on the number of years before she pays it back. The amount she owes to the government can be modeled by the function $g(t) = 10,000 + 10,000(0.025)(t)$. The amount she owes to the bank can be modeled by the function $b(t) = 4,000 + 4,000(0.07)(t)$. For both functions, t is the number of years before she repays the loan.

Combine functions g and b to build a new function, c, which will show the total amount Pia must repay in t years. Use g(t) and b(t) in your answer.

$g(t) = 10,000 + 250t$
$b(t) = 4,000 + 280t$
$g(t) + b(t) = 14,000 + 530t$

Go On ▶

30. A continuous function is represented by a subset in the function table below.

x	f(x)
0	1
1	5
2	25
3	125
4	625

A. Is f(x) a linear function or an exponential function?

exponential

B. Use the values in the table to show the relationship between consecutive values of f(x) when x increases by 1.

$$f(x) = 5^x$$

C. From your study of this particular function, make a generalization about this type of function's (identified in part A) values across equal intervals.

they grow at a geometric (multiplying) rate

STOP