Name: ________________________

F.IF.B.4: Evaluating Exponential Expressions

1 Five thousand dollars is invested at an interest rate of 3.5% compounded quarterly. No money is deposited or withdrawn from the account. Using the formula below, determine, to the *nearest cent*, how much this investment will be worth in 18 years.

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A = amount

P = principal

r = interest rate

n = number of times the interest rate compounded annually

t = time in years

2 Robert is buying a car that costs $22,000. After a down payment of $4000, he borrows the remainder from a bank, a six year loan at 6.24% annual interest rate. The following formula can be used to calculate his monthly loan payment.

$$R = \frac{(P)(i)}{1 - (1 + i)^{-t}}$$

R = monthly payment
P = loan amount
i = monthly interest rate
t = time, in months

Robert's monthly payment will be
1) $298.31
2) $300.36
3) $307.35
4) $367.10

3 The George family would like to borrow $45,000 to purchase a new boat. They qualified for a loan with an annual interest rate of 6.75%. The monthly loan payment can be found using the formula below.

$$M = \frac{P\left(\frac{r}{12}\right)\left(1 + \frac{r}{12}\right)^n}{\left(1 + \frac{r}{12}\right)^n - 1}$$

M = monthly payment
P = amount borrowed
r = annual interest rate
n = number of monthly payments

What is the monthly payment if they would like to pay off the loan in five years?
1) $262.99
2) $252.13
3) $915.24
4) $885.76

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4 Monthly mortgage payments can be found using the formula below, where M is the monthly payment, P is the amount borrowed, r is the annual interest rate, and n is the total number of monthly payments.

$$M = \frac{P\left(\frac{r}{12}\right)\left(1+\frac{r}{12}\right)^n}{\left(1+\frac{r}{12}\right)^n - 1}$$

If Adam takes out a 15-year mortgage, borrowing \$240,000 at an annual interest rate of 4.5%, his monthly payment will be

1) \$1379.09
2) \$1604.80
3) \$1835.98
4) \$9011.94

5 The Wells family is looking to purchase a home in a suburb of Rochester with a 30-year mortgage that has an annual interest rate of 3.6%. The house the family wants to purchase is \$152,500 and they will make a \$15,250 down payment and borrow the remainder. Use the formula below to determine their monthly payment, to the *nearest dollar*.

$$M = \frac{P\left(\frac{r}{12}\right)\left(1+\frac{r}{12}\right)^n}{\left(1+\frac{r}{12}\right)^n - 1}$$

M = monthly payment
P = amount borrowed
r = annual interest rate
n = total number of monthly payments

6 Using the formula below, determine the monthly payment on a 5-year car loan with a monthly percentage rate of 0.625% for a car with an original cost of \$21,000 and a \$1000 down payment, to the *nearest cent*.

$$P_n = PMT\left(\frac{1-(1+i)^{-n}}{i}\right)$$

P_n = present amount borrowed
n = number of monthly pay periods
PMT = monthly payment
i = interest rate per month

The affordable monthly payment is \$300 for the same time period. Determine an appropriate down payment, to the *nearest dollar*.

7 Jim is looking to buy a vacation home for \$172,600 near his favorite southern beach. The formula to compute a mortgage payment, M, is $M = P \bullet \frac{r(1+r)^N}{(1+r)^N - 1}$ where P is the principal amount of the loan, r is the monthly interest rate, and N is the number of monthly payments. Jim's bank offers a monthly interest rate of 0.305% for a 15-year mortgage. With no down payment, determine Jim's mortgage payment, rounded to the *nearest dollar*. Algebraically determine and state the down payment, rounded to the *nearest dollar*, that Jim needs to make in order for his mortgage payment to be \$1100.

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8 The temperature, F, in degrees Fahrenheit, after t hours of a roast put into an oven is given by the equation $F = 325 - 185e^{-0.4t}$. What was the temperature of the roast when it was put into the oven?

1) 325
2) 200
3) 185
4) 140

9 The formula to determine continuously compounded interest is $A = Pe^{rt}$, where A is the amount of money in the account, P is the initial investment, r is the interest rate, and t is the time, in years. Which equation could be used to determine the value of an account with an $18,000 initial investment, at an interest rate of 1.25% for 24 months?

1) $A = 18{,}000e^{1.25 \bullet 2}$
2) $A = 18{,}000e^{1.25 \bullet 24}$
3) $A = 18{,}000e^{0.0125 \bullet 2}$
4) $A = 18{,}000e^{0.0125 \bullet 24}$

10 The amount of money in an account can be determined by the formula $A = Pe^{rt}$, where P is the initial investment, r is the annual interest rate, and t is the number of years the money was invested. What is the value of a $5000 investment after 18 years, if it was invested at 4% interest compounded continuously?

1) $9367.30
2) $9869.39
3) $10,129.08
4) $10,272.17

11 The formula for continuously compounded interest is $A = Pe^{rt}$, where A is the amount of money in the account, P is the initial investment, r is the interest rate, and t is the time in years. Using the formula, determine, to the *nearest dollar*, the amount in the account after 8 years if $750 is invested at an annual rate of 3%.

12 Matt places $1,200 in an investment account earning an annual rate of 6.5%, compounded continuously. Using the formula $V = Pe^{rt}$, where V is the value of the account in t years, P is the principal initially invested, e is the base of a natural logarithm, and r is the rate of interest, determine the amount of money, to the *nearest cent*, that Matt will have in the account after 10 years.

13 Emma's parents deposited $5000 into a bank account during her freshman year. The account pays 5% interest compounded continuously using the formula $A = Pe^{rt}$, where A is the total amount accrued, P is the principal, r is the annual interest rate, and t is time, in years. Determine, to the *nearest dollar*, the amount in the account 4 years later.

14 The number of bacteria that grow in a petri dish is approximated by the function $G(t) = 500e^{0.216t}$, where t is time, in minutes. Use this model to approximate, to the *nearest integer*, the number of bacteria present after one half-hour.

F.IF.B.4: Evaluating Exponential Expressions
Answer Section

1 ANS:

$$A = 5000\left(1+\frac{.035}{4}\right)^{4\cdot 18} \approx 9362.36$$

REF: 061629a2

2 ANS: 2

$$i = \frac{6.24\%}{12} = .52\% \quad R = \frac{(18000)(.52\%)}{1-(1+.52\%)^{-12\cdot 6}} \approx 300.36$$

REF: 012420aii

3 ANS: 4

$$M = \frac{45000\left(\frac{6.75\%}{12}\right)\left(1+\frac{6.75\%}{12}\right)^{5\times 12}}{\left(1+\frac{6.75\%}{12}\right)^{5\times 12}-1} \approx 885.76$$

REF: 082316aii

4 ANS: 3

$$M = \frac{240000\left(\frac{4.5\%}{12}\right)\left(1+\frac{4.5\%}{12}\right)^{15\times 12}}{\left(1+\frac{4.5\%}{12}\right)^{15\times 12}-1} \approx 1835.98$$

REF: 062209aii

5 ANS:

$$M = \frac{(152500-15250)\left(\frac{.036}{12}\right)\left(1+\frac{.036}{12}\right)^{360}}{\left(1+\frac{.036}{12}\right)^{360}-1} \approx 624$$

REF: 061831aii

6 ANS:

$$20000 = PMT\left(\frac{1-(1+.00625)^{-60}}{0.00625}\right) \quad 21000 - x = 300\left(\frac{1-(1+.00625)^{-60}}{0.00625}\right)$$

$$PMT \approx 400.76 \qquad\qquad x \approx 6028$$

REF: 011736aii

7 ANS:

$$M = 172600 \bullet \frac{0.00305(1+0.00305)^{12 \cdot 15}}{(1+0.00305)^{12 \cdot 15} - 1} \approx 1247$$

$$\begin{aligned} 1100 &= (172600 - x) \bullet \frac{0.00305(1+0.00305)^{12 \cdot 15}}{(1+0.00305)^{12 \cdot 15} - 1} \\ 1100 &\approx (172600 - x) \bullet (0.007228) \\ 152193 &\approx 172600 - x \\ 20407 &\approx x \end{aligned}$$

REF: 061734aii

8 ANS: 4

$F = 325 - 185e^{-0.4(0)} = 325 - 185 = 140$

REF: 012415aii

9 ANS: 3 REF: 061416a2

10 ANS: 4

$A = 5000e^{(.04)(18)} \approx 10272.17$

REF: 011607a2

11 ANS:

$A = 750e^{(0.03)(8)} \approx 953$

REF: 061229a2

12 ANS:

2,298.65

REF: fall0932a2

13 ANS:

$A = 5000e^{0.05 \cdot 4} \approx 6107$

REF: 081629a2

14 ANS:

$G(30) = 500e^{0.216(30)} \approx 325,985$

REF: 011728a2