Name_____ Date_____ Period_____

Fitting Exponential Models to Data

In this assignment, you will be using the exponential equation. There are two ways it can be written.

$y = a \bullet b^x$	$y = a \bullet (1 + r)^x$
Where a = starting value and b = the rate of change	Where a = starting value and r = % increase or decrease

1.) Every musical note has an associated frequency measured in hertz (Hz), or vibrations per second. The table shows the approximate frequencies of the notes in the octave from middle C up to the next C on a piano. (In this scale, E# is the same as F and B# is the same as C.)

Piano Notes

Note name	Note above middle C	Frequency (Hz)
Middle C	0	262
C#	1	277
D	2	294
D#	3	311
E	4	330
F	5	349
F#	6	370
G	7	392
G#	8	415
A	9	440
A#	10	466
B	11	494
C above middle C	12	523

The arrangement of strings in a piano shows an exponential-like curve.

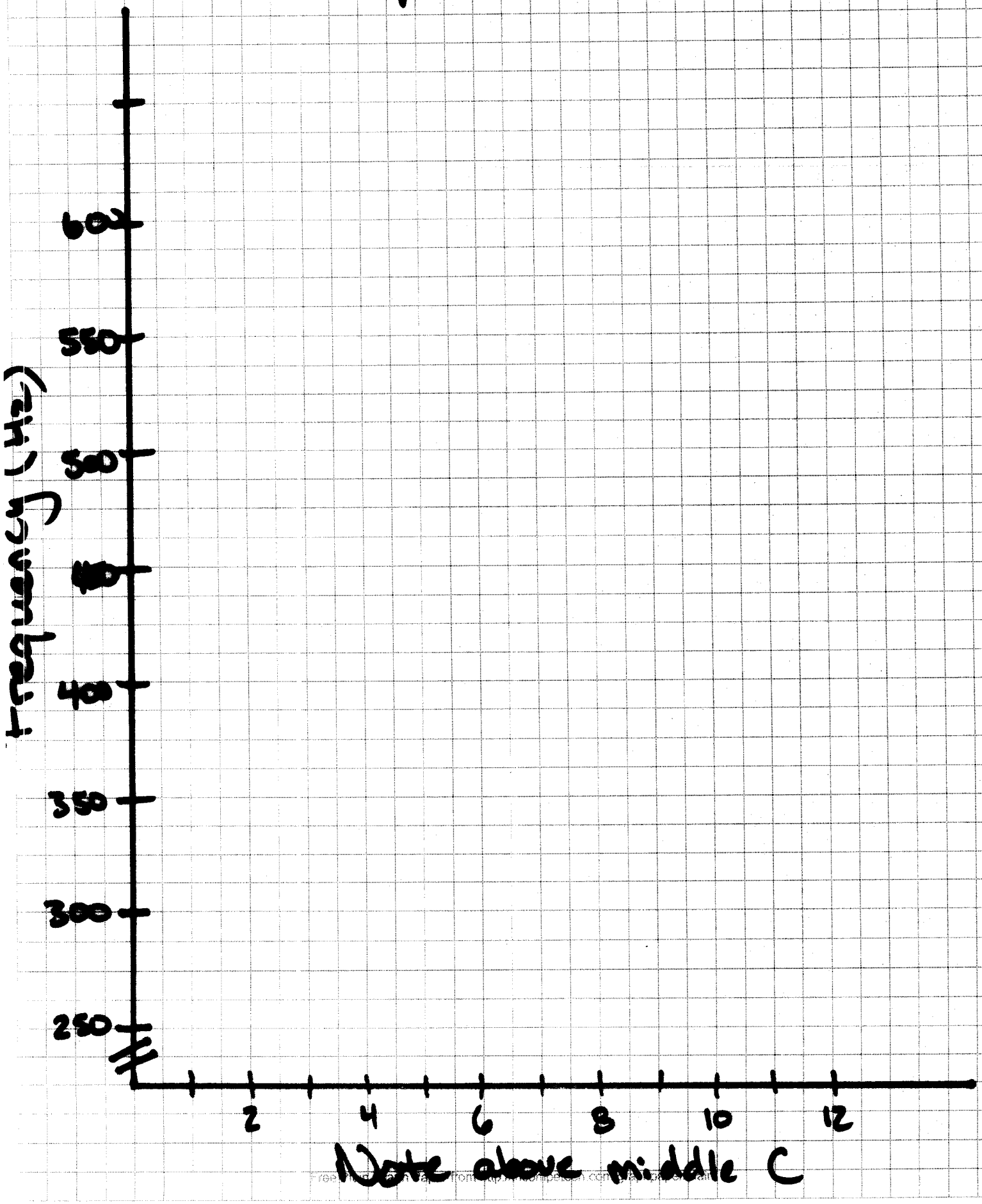
a.) Using the graph paper in this packet to plot the data for the frequencies of the piano notes.

b.) Use your calculator to write an equation, in the form of y = a , in the form of $\mathbf{y = a \cdot b^x}$, that fits the data.

c.) Use the equation to find the frequency of the note two octaves above middle C (note 24).

d.) Find the note with a frequency of 600 Hz. In other words, what will the x value be when the y value reaches 600?

Frequencies of Piano Notes



2.) Between 1960 and 1990, the population of a town increased at a rate of 0.34% per year. The population, P, in year t is given by $\mathbf{P = 2000(1.0034)^t}$ where t = 0 corresponds to 1980. Find the population of the town in 1980, 1985, 1990, and 1995.

Year	t	P
1980	0	
1985	5	
1990	10	
1995	15	

3.) Rewrite each value as either 1 + r or 1 – r. Then state the rate of increase or decrease as a percent.
Example.) 1.15 Answer → 1 + 0.15; rate of increase: 15%

a.) 1.08 b.) 0.76 c.) .0998 d.) 2.5

4.) Use the equation $\mathbf{y = 47(1-0.12)^x}$ to answer each question.

a.) Does this equation model an increasing or decreasing pattern?

b.) What is the rate of increase or decrease?

c.) What is the y-value when x is 13?

d.) What happens to the y-values as the x-values get very large?

5.) Mya placed a cup of hot water in a freezer. Then she recorded the temperature of the water each minute.

Water Temperature

Time (x)	0	1	2	3	4	5	6	7	8	9	10
Temperature° (y)	47	45	43	41.5	40	38.5	37	35.5	34	33	31.5

a.) Find the initial (starting) value.

b.) Find the rate of change.

c.) Write an equation in $\mathbf{y = a(1-r)^x}$ form.

d.) Use your equation to predict how long it will take for the water temperature to drop below 5°C.

6.) Write an equation to model the growth of an initial deposit of $250 in a savings account that pays 4.25% annual interest. Let B represent the balance in the account and let t represent the number of years the money has been in the account.

7.) Use the properties of exponents to rewrite each expression with only positive exponents.

a. $4x^3 \cdot (3x^5)^3$

b. $\frac{60x^8y^4}{15x^3y}$

c. $3^2 \cdot 2^3$

d. $\frac{(8x^3)^2}{(4x^2)^3}$

e. $x^{-3}y^4$

f. $(2x)^{-3}$

g. $2x^{-3}$

h. $\frac{2x^{-4}}{(3y^2)^{-3}}$