

Please put away all papers and electronic devices except for a calculator. Show enough work that it is clear how you arrived at your answer. Put a box/circle around your final answer to each question, rounded to 4 decimal places unless otherwise specified. Good luck!

1. To deliver a package, a particular delivery service charges \$4.50 plus \$0.75 per ounce.

(a) (12 points) Find a formula for the total cost  $y$  of delivering a package in terms of the number of ounces  $x$  the package weighs.

x	y
0	4.50
1	5.25
2	6.00
3	6.75
⋮	⋮

← INITIAL VALUE = 4.50

) RATE OF CHANGE  $m = \frac{\Delta y}{\Delta x} = \frac{.75}{1} = .75$

$$y = 4.50 + .75x$$

(b) (8 points) How much does it cost to deliver a package that weighs 4.2 ounces?

SET  $x = 4.2$  AND SOLVE FOR  $y$ .

$$y = 4.50 + .75(4.2) = 4.50 + 3.15 = 7.65$$

$\$7.65$

(c) (8 points) What is the heaviest weight package you can afford to have delivered for \$15?

SET  $y = 15$  AND SOLVE FOR  $x$ .

$$15 = 4.50 + .75x$$

$$10.50 = .75x$$

$$x = \frac{10.50}{.75} = 14$$

14 ounces

2. State whether the growth/decay is linear or exponential and answer the question.

- (a) (12 points) The rent of an apartment increases by \$50 each year. If the rent for this apartment is \$2135 in 2012, find the monthly rent in 2022.

LINEAR

LET  $x = \#$  YEARS AFTER 2012  
 $y =$  RENT OF APT.

x	y
0	2135
1	2185
2	2235
3	2285
$\vdots$	$\vdots$
10	?

← INITIAL VALUE 2135  
 RATE OF CHANGE  $m = \frac{\Delta y}{\Delta x} = \frac{50}{1} = 50$

$$\therefore y = 2135 + 50x$$

SET  $x = 10$  (YEARS AFTER 2012)  
 AND SOLVE FOR  $y$ .

$$y = 2135 + 5(10) = \boxed{\$2635}$$

- (b) (12 points) The average concentration of carbon dioxide in the Earth's atmosphere is increasing by 0.55% each year. If the average concentration was 405.5 parts per million (ppm) in 2017, find the average concentration in 2050.

EXPONENTIAL

LET  $x = \#$  YEARS AFTER 2017  
 $y =$  AVE. CONC. OF  $CO_2$

x	y
0	405.5
1	407.73
2	409.97
3	412.23
$\vdots$	$\vdots$
32	?

← INITIAL VALUE 405.5  
 $\% \text{ CHANGE} = .0055$   
 i.e. MULTIPLY BY 1.0055

$$y = 405.5 (1.0055)^x$$

SET  $x = 33$  ;

$$y = 405.5 (1.0055)^{33} = \boxed{485.9587}$$

3. (12 points) The population size of a certain colony of bacteria is observed to double every 3 hours. If there are 260 bacteria in the colony at 10 am, find the number of bacteria in the colony at 6pm, rounded to the nearest integer.

Let  $x$  = # HOURS PAST 10 am  
 $y$  = POPULATION

$$y = A(2)^{x/T_2} \quad A = 260$$

$$T_2 = 3$$

$$y = 260(2)^{x/3}$$

SET  $x = 8$  :

$$y = 260(2)^{8/3} \approx \boxed{1651}$$

4. (12 points) The half-life of a drug in the human blood-stream is 16 hours. If 50 mg of the drug is injected into a patient, how much of the drug remains after 24 hours?

Let  $x$  = # HOURS AFTER INJECTION  
 $y$  = mg of DRUG IN BLOOD STREAM

$$y = A\left(\frac{1}{2}\right)^{x/T_{1/2}} \quad A = 50$$

$$T_{1/2} = 16$$

$$y = 50\left(\frac{1}{2}\right)^{x/16}$$

SET  $x = 24$  :

$$y = 50\left(\frac{1}{2}\right)^{24/16} \approx \boxed{17.6777 \text{ mg}}$$

5. (a) (12 points) Assume that  $y$  is a *linear* function of  $x$  and fill in the following table of values.

x	y	
0	100	} +5
1	105	
2	110	} +5
3	115	
4	120	} +5
5	125	

EVERY TIME  $x$  INCREASES BY THE SAME AMOUNT (1),

$y$  INCREASES BY THE SAME (ABSOLUTE) AMOUNT (5).

- (b) (12 points) Assume that  $y$  is an *exponential* function of  $x$  and fill in the following table of values.

x	y	
0	100	} $\times 1.05$
1	105	
2	110.25	} $\times 1.05$
3	115.7625	
4	121.550625	} $\times 1.05$
5	127.6281563	

EVERY TIME  $x$  INCREASES BY THE SAME AMOUNT (1),

$y$  INCREASES BY THE SAME RELATIVE CHANGE

( INCREASES BY 5% - MULTIPLIED BY 1.05 ).