Instructor: **Grøndahl**

Name: Key

MATH 173
Unit Exam 1

Show All Work
Justify All Conclusions
No Graphing Calculators Allowed

You Got This

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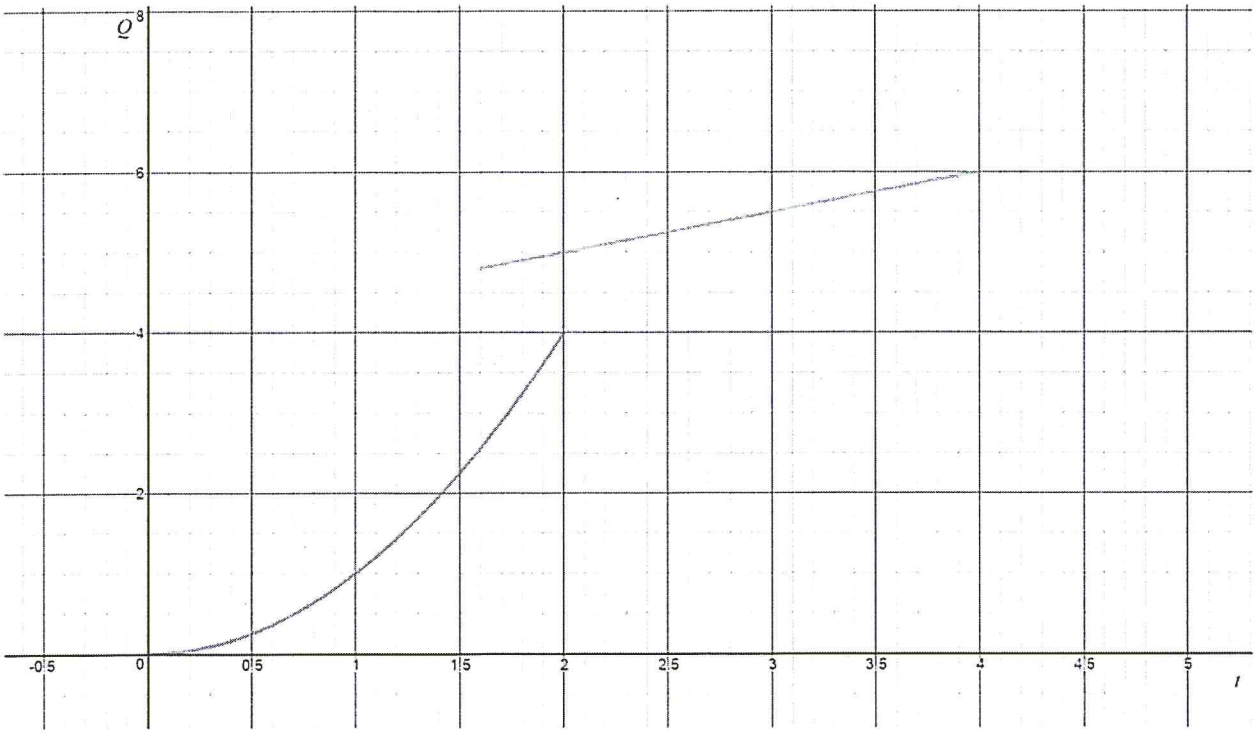
1) The graph below shows the relationship between the quantities Q and t



a) Explain why the graph below does not represent Q as a function of t

ON THE INTERVAL $[1.6, 2]$ EACH INPUT t HAS MORE THAN 1 OUTPUT Q

b) Give the concavity of the graph on the intervals $t \in [0,1]$ and $t \in [3,4]$

ON $[0,1]$ THE CURVE IS CONCAVE UP

ON $[3,4]$ THERE IS NO CONCAVITY

2) Does the equation $a^2 + b^2 = 4$ represent b as a function of a ? Explain why or why not.

NO IT DOES NOT.

WHEN $a = 1$

$$1 + b^2 = 4$$
$$b^2 = 3$$
$$b = \pm\sqrt{3}$$

THERE ARE TWO OUTPUTS INSTEAD OF ONE.

THIS HAPPENS FOR ALL $-2 < a < 2$

3) The table below shows the number of female senators, S , at the beginning of the first session of each Congress, c . Is S a function of c ? Explain why or why not.

c	98	100	102	104	106	108	110	112	113
S	2	2	2	8	9	14	16	17	20

YES EVERY INPUT C HAS ONLY 1 OUTPUT S

4) A cell phone company offers three different "pay as you go" plans.
   - Plan A charges \$0.25 per minute
   - Plan B charges \$0.99 per day plus \$0.10 per minute
   - Plan C charges a fixed rate of \$1.99 per day

Let P_A, P_B, and P_C represent the daily charges using plans A, B, and C respectively. Let m be the number of minutes per day spent on the phone.

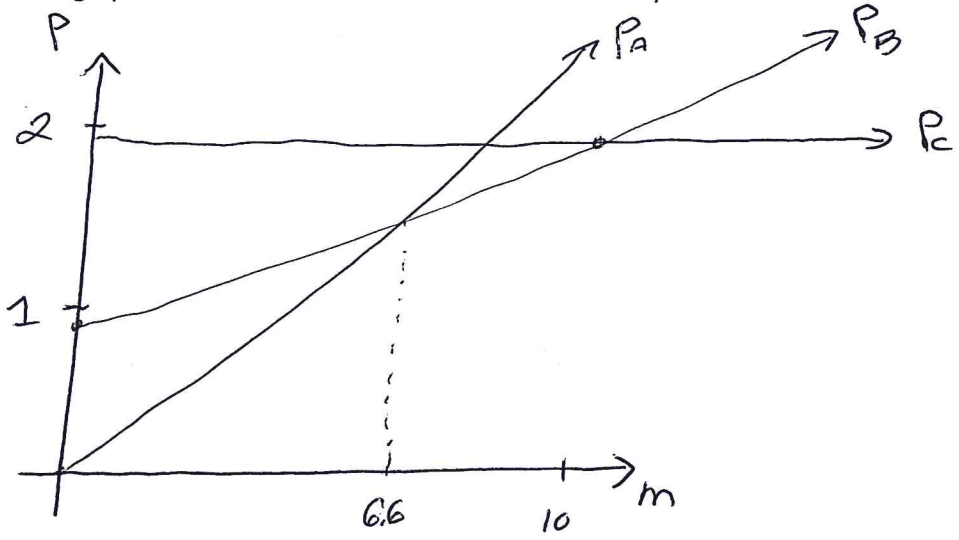
a) Find formulas for P_A, P_B, and P_C .

$P_A = 0.25m$

$P_B = 0.99 + 0.10m$

$P_C = 1.99$

b) Sketch the graphs of all three functions on one coordinate system.



c) For which values of m is Plan B the cheapest?

$0.25m = 0.99 + 0.10m$

$0.15m = 0.99$

$m = 6.6$

$0.99 + 0.10m = 1.99$

$0.10m = 1$

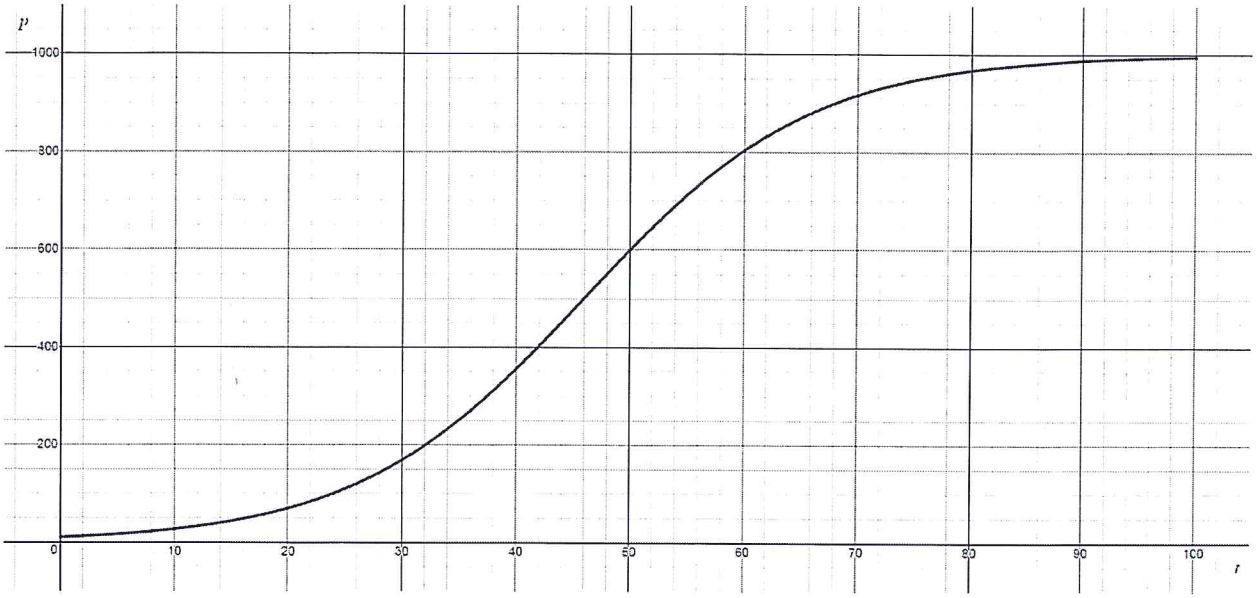
$m = 10$

$6.6 < m < 10$

5) What can be said about the rate of change of a linear function?

IT IS CONSTANT

6) The graph below shows the population, p , of a bacteria after t , minutes. The initial population was 10.



a) How can we tell that this function is invertible?

IT PASSES THE HORIZONTAL LINE TEST

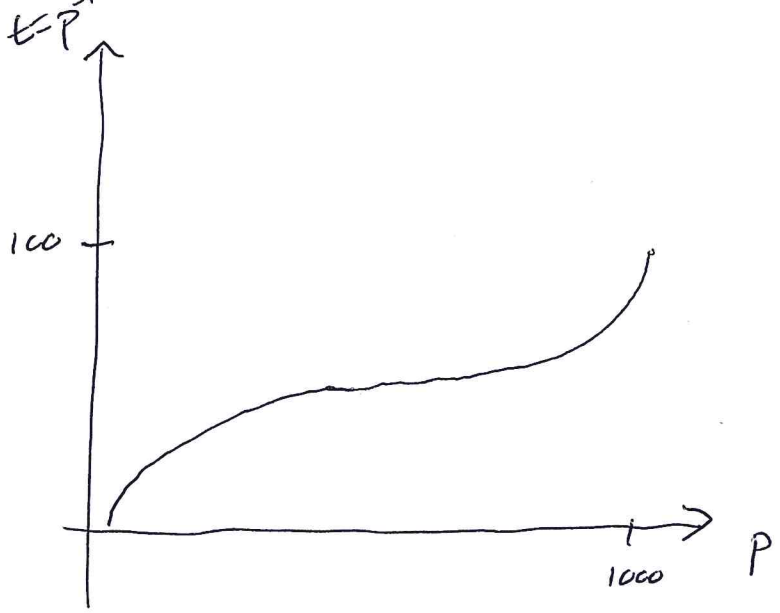
EACH OUTPUT VALUE MAPS FROM ONLY 1 INPUT VALUE.

b) Give the domain and range of p^{-1}

DOMAIN: $[10, 1000)$

RANGE: $[0, 100]$

c) Sketch the graph of p^{-1} , with p on the horizontal axis and $t = p^{-1}$ on the vertical axis.



7) Given the function $f(x)=|2x-4|$

a) Express $f(x)$ as a piecewise defined function

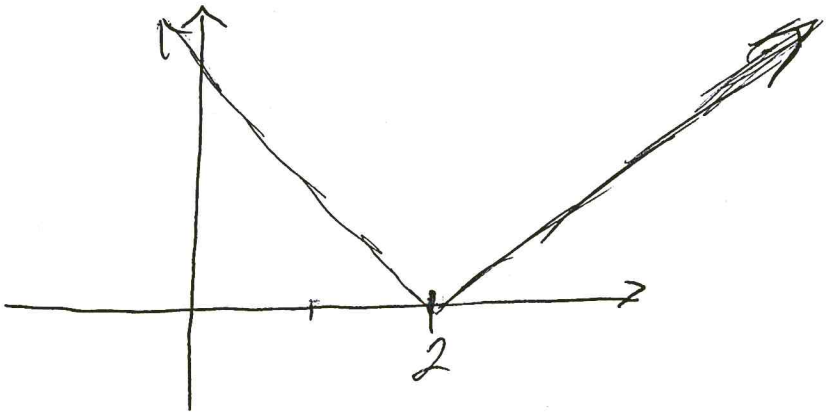
$2x-4 \geq 0$

$2x \geq 4$

$x \geq 2$

$$f(x) = \begin{cases} 2x-4 & , \ x \geq 2 \\ -(2x-4) & , \ x < 2 \end{cases}$$

b) Sketch the graph



c) Give the domain and range of f

Domain: $x \in \mathbb{R}$

Range: $f(x) \geq 0$

8) Starting with the quadratic function: $q(x) = x^2 + 8x - 1$

a) Complete the square to put $q(x)$ in vertex form.

$q(x) = x^2 + 8x + 16 - 1 - 16$

$q(x) = (x+4)^2 - 17$

b) Describe the function in terms of transformations of $f(x) = x^2$

$q(x)$ IS $f(x)$ SHIFTED LEFT 4 UNITS AND DOWN 17 UNITS

c) Now solve for the zeros or x-intercepts of q .

$(x+4)^2 - 17 = 0$

$(x+4)^2 = 17$

$x+4 = \pm\sqrt{17}$

$x = -4 \pm \sqrt{17}$

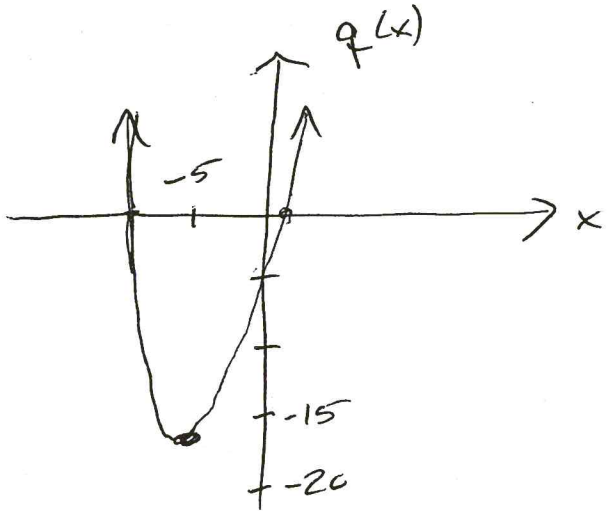
d) Now write $q(x)$ in factored form.

$q(x) = (x - (-4+\sqrt{17}))(x - (-4-\sqrt{17}))$

$= (x+4-\sqrt{17})(x+4+\sqrt{17})$

(Continued)

e) Sketch the graph of this quadratic function.



f) Give the domain and range of this function.

Domain: $x \in \mathbb{R}$

Range: $q(x) \geq -17$