

(A) Lesson Objectives:

- a. Invert exponential equations in modelling real world applications
- b. Use multiple representations to review inverse functions
- c. Use multiple representations to invert exponential functions
- d. Introduce logarithmic notation and connect to it exponential notation

(B) MEANING of Exponential Functions

- a. What does the mathematical statement $32 = 2^5$ REALLY mean? Explain it in words

- b. What does the mathematical statement $f(x) = 2^x$ REALLY mean? Explain it in words.

(C) Review of Inverses →

(D) 3-2-1

3 Thoughts/Ideas

2 Questions

1 Analogy

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(E) Opening Exploration → (A,T)

- a. Mr. S. recently completed a half ironman competition in Taiwan. (AAARRRGGGHHH!!!) As part of his training routine for the running part of the triathlon, he wants to understand the relationship between the distance he runs and the speed at which he runs.
- b. **PROBLEM:** He knows his top speed for distance running is 12 km/hr, so this represents the asymptote of an exponential function he uses to model the relationship between his distance (**independent variable**) and speed (**dependent variable**). The equation he uses is: $S(d) = 12 - 1.091(1.086)^d$.

Mapping Diagram

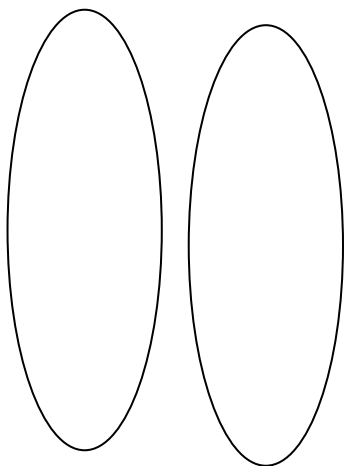
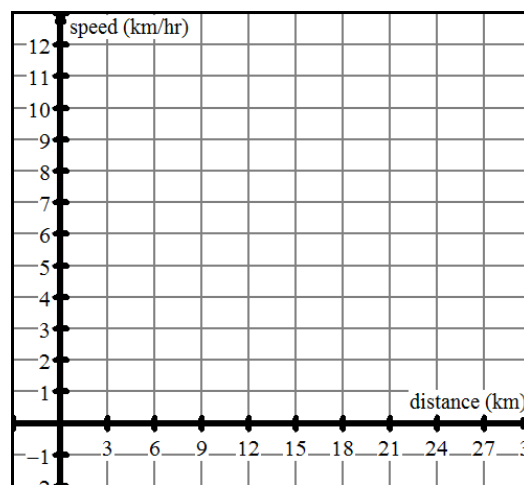


Table of Values

Distance (km)	Speed (km/hr)
0	
3	
6	
9	
12	
15	
18	
21	

Graph



- c. So I can ask a variety of questions about this scenario and this function:

- i. What is the domain and why?
- ii. What is the range and why?
- iii. What is the y-intercept and what does it mean?
- iv. What is the x-intercept and what does it mean?
- v. Evaluate $S(9)$ and interpret
- vi. Solve $S(d) = 9.06$ and interpret.
- vii. Solve $S(d) = 6$ and interpret.
- viii. Evaluate $S^{-1}(7.18)$ and interpret.
- ix. BONUS: How long does it take him to complete a 21K race?

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(E) Opening Exploration (CONTINUED) → (A,T)

- a. Mr. S. recently completed a half ironman competition in Taiwan. (AAARRRGGGHHHH!!!) As part of his training routine for the running part of the triathlon, he wants to understand the relationship between the distance he runs and the speed at which he runs. **NOW** → he wants to know HOW he can model a **NEW relationship** → i.e. $d(S)$ → what is the relationship between his speed (**independent variable**) and the distance he runs (**dependent variable**).

Mapping Diagram

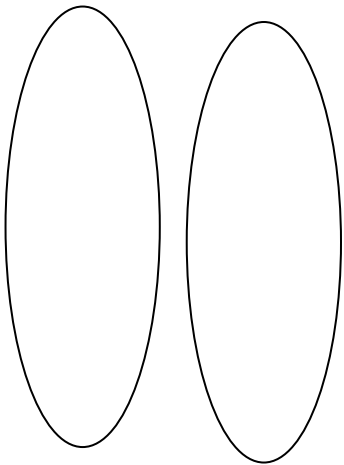
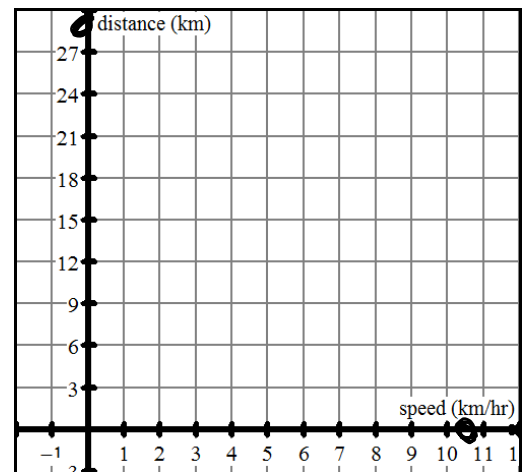


Table of Values

Speed (km/hr)	Distance (km)
	0
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Graph



- b. So I can ask a variety of questions about this scenario and this function:

- What is the domain and why?
- What is the range and why?
- What is the y-intercept and what does it mean?
- What is the x-intercept and what does it mean?
- Evaluate $d(10.21)$ and interpret.
- Solve $d(S) = 9$ and interpret.
- Solve $d(S) = 14$ and interpret.
- Evaluate $d^{-1}(12)$ and interpret.

BIG QUESTION: How do I determine an EQUATION for this relationship???

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(F) The Algebra of Inverting Functions (K)

In each equation, isolate "x" (make "x" the subject of the equation; solve for "x")				
$y = 2x - 1$	$y = \frac{1}{3}(x + 5)$	$y + 5 = -2(x + 1)$	$3x - 4y = 12$	CHALLENGE (T) $y = \frac{x - 2}{x + 5}$
KEY PROCESS EVERY TIME HAS BEEN:				

In each equation, isolate "x" (make "x" the subject of the equation; solve for "x")				
$y = x^2$	$y = 4x^3$	$y = -2(x + 1)^2$	$y = \frac{1}{2}x^5$	CHALLENGE (T) $y = 2x^2 - 4x + 8$
KEY PROCESS EVERY TIME HAS BEEN:				

(G)Algebraically Inverting Exponential Functions

- a. TOK Questions (simplified versions)

- b. Did Columbus INVENT North America?
- c. Did Columbus DISCOVER North America?
- d. Did Sir Isaac Newton INVENT gravity?
- e. Did Sir Isaac Newton DISCOVER gravity?
- f. Did Alexander Graham Bell INVENT the telephone?
- g. Did Alexander Graham Bell DISCOVER the telephone?
- h. Did mathematicians INVENT logarithms?
- i. Did mathematicians DISCOVER logarithms?

(H)Asd

(I)