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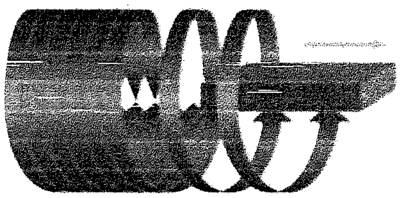
Name Teacher Version Date ___________ Block _________

Analogic – State of the art in Security Technology (Day 1)

Objectives	SWBAT identify linear relationships between numerous functions by creating two-way tables and graphing linear equations in quadrant I. Students will also be able to find the solutions of a system of linear equations algebraically.
Math Standards	**Expressions and Equations** - 8.EE **8. Analyze and solve linear equations and pairs of simultaneous linear equations.** **a.** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. **b.** Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. **c.** Solve real-world and mathematical problems leading to two linear equations in two variables. **Functions** – 8.F **Define, evaluate and compare functions** • **2.** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change*. **Use functions to model relationships between quantities.** • **4.** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, *y)* values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
Math Practices	**MP.1 - Make sense of problems and persevere in solving them.** Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search

	for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches. **MP.4 - Model with mathematics.** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
Do Now (10 Minutes)	***Directions:*** *Read the following information about the manufacturing company* **Analogic.** *Highlight important facts about the company and the type of security products the produce* For decades our customers have manufactured products that have advanced the practice of medicine and saved lives. They repeatedly turn to Analogic to foresee market trends before the rest of the industry does. As a result, our customers are often a step or two ahead of their nearest competitor. Our engineering and manufacturing expertise are unmatched, and our products are used extensively around the world in medical imaging, ultrasound, and airport security. **Security Solutions** **Computed Tomography for Airport Security** Computed tomography (CT), the same technology used in the diagnosis of human disease and injury, is an effective tool in the detection of explosives and other threats in airport checked and checkpoint baggage. When CT was first introduced to the healthcare industry it was deemed revolutionary in its ability to facilitate a comprehensive internal assessment of the human body. The devastation of Pan Am flight 103 in 1988 over Lockerbie, Scotland, committed governments to deploying Explosives Detection Systems (EDSs) that would reduce the risk of a recurrence of this type of incident. In the United States, scientists at Federal Aviation Administration (FAA) laboratories began analyzing and investigating candidate technologies that could rapidly and reliably detect explosives in baggage with a low false-alarm rate. Because of its 3-D high-resolution imaging capability, computed tomography was the clear choice.

3-D Continuous-Flow CT Technology Makes the Difference



The helical/spiral CT scan speed is synchronized with the conveyor belt speed for complete bag coverage and no gaps in the 3-D image data coverage.

The eXaminer and Cobra systems, with 3-D Continuous-Flow CT technology, are the most advanced systems available to detect explosives and threats in checked baggage and in carry-on items at aviation security checkpoints. With a very high level of accuracy and a low false-alarm rate, these systems scan bags by applying helical/spiral CT at speeds precisely synchronized to the speed of the baggage conveyor belt. These systems move bags and passengers through the screening process to the plane at the highest possible rates currently available. One rapid pass through the gantry provides complete 3-D image data for an entire bag and its contents to determine the presence of explosives or other prohibited items.

TSA-Certified Checked-Baggage EDS Systems

Greater Certainty in an Uncertain World

The need for vigilance in air travel is now more important then ever. And keeping air travelers and their baggage moving quickly and safely in the face of evolving threats is an ongoing challenge for airports and the TSA.

Analogic is a leading OEM supplier of advanced aviation explosive detection equipment for checked-baggage applications. Working with our sales, installation, and service partner, L-3 Communications, we offer complete solutions to meet ever-changing air carrier checked-baggage screening needs.

The eXaminer®* Family of Explosives Detection Systems (EDSs)

The eXaminer SX, The eXaminer 3DX, The eXaminer XLB

These can detect a multitude of threats in a variety of airport configurations. All our checked-baggage EDSs use advanced CT technology to provide enhanced, real-time, high-resolution 3-D images of the entire contents of a bag or parcel.

The eXaminer SX	The T. F. Green Airport in Providence Rhode Island is one of the smaller airports here in New England. The Explosives Detection System they use is the eXaminer SX. This system is compact and low cost for small and medium-sized airports.

- This scanner scans up to 360 bags per hour using in-line configurations and up to 300 in standalone configurations

Equations: The number of bags scanned per hour can be represented using the following equations.

(In-line Configurations) $y = 360x$
(Standalone Configurations) $y = 300x$

a. Complete the two-way table provided using the provided linear equations. You must show all your work and all computations.

x (# of hours)	**0**	**1**	**2**	**3**	**4**	**5**
y (In-line)	0	360	720	1080	1440	1800
y (Standalone)	0	300	600	900	1200	1500

In-Line Config.

$y = 360(0)$ ✓ 0 $y = 360(1)$ ✓ 360 $y = 360(2)$ ✓ 720

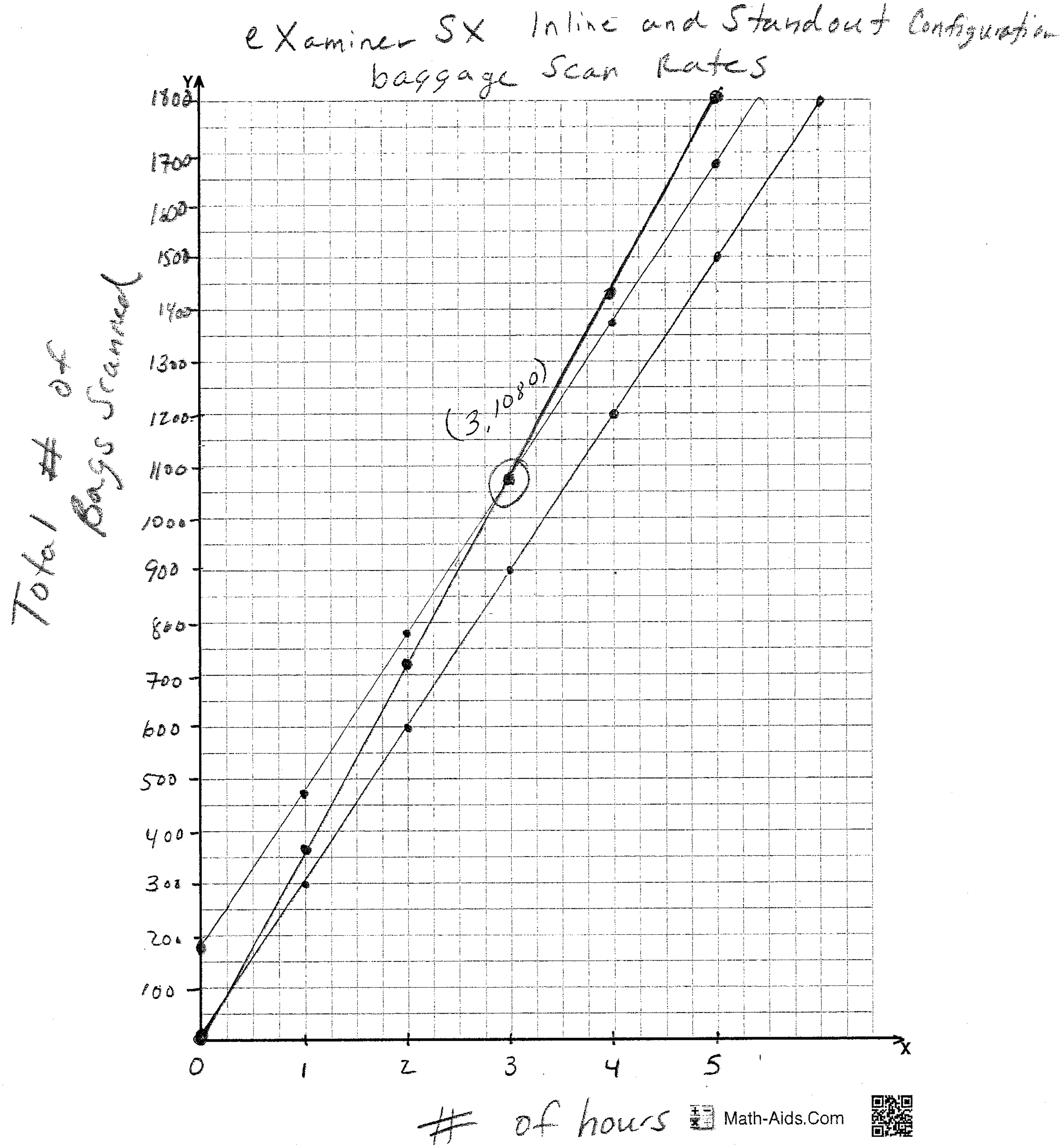
$y = 360(3)$ ✓ 1080 $y = 360(4)$ ✓ 1440 $y = 360(5)$ ✓ 1800

Standalone config

$y = 300(0)$ ✓ 0 $y = 300(1)$ ✓ 300 $y = 300(2)$ ✓ 600

$y = 300(3)$ ✓ 900 $y = 300(4)$ ✓ 1200 $y = 300(5)$ ✓ 1500

b. Graph the table on the coordinate plane in Quadrant I. Be sure to label the x and y axis and provide a title for the graph.



c. Write a linear equation for the **Standalone Configuration** scanner if it already had scanned 180 bags before the first hour.

$y = 300x + 180$

d. Complete the two-table with your new equations for the **Standalone configuration.**

x (# of hours)	0	1	2	3	4	5
y (In-line)	0	360	720	1080	1440	1800
y (Standalone)	180	480	780	1080	1380	1680

$y = 300(0) + 180$ → $0 + 180$ → 180

$y = 300(1) + 180$ → $300 + 180$ → 480

$y = 300(2) + 180$ → $600 + 180$ → 780

$y = 300(3) + 180$ → $900 + 180$ → 1080

$y = 300(4) + 180$ → $1200 + 180$ → 1380

$y = 300(5) + 180$ → $1500 + 180$ → 1680

e. At what hour did both scanners scan the same amount of bags?

at hour 3 they both scanned 1,080 bags

f. Graph the new points on the same coordinate plane in Quadrant I. At what point does the new line intersect with the **In-Line Configuration?**

(3, 1080)

Analogic – State of the art in Security Technology (Day 2)

The eXaminer 3DX and eXaminer 3DX-ES	Logan Airport is a bigger Airport and needs to use faster and more proficient Explosives Detection System. They use two types of scanners, the eXaminer 3DX and an upgraded version, the eXaminer 3DX-ES.

The eXaminer 3DX:

- This scanner scans up to 550 bags per hour in in-line configurations and up to 330 bags per hour in standalone configurations.

a. Write two linear equations to represent the total number of bags scanned after x amount of hours using in-line configurations and standalone configurations.

In-line Configurations: $y = 550x$

Standalone Configurations: $y = 330x$

b. Using the two equations, complete the two-way input/output table provided. Make sure to show all your work and computations.

x (# of hours)	0	1	2	3	4	5
y (In-line)	0	550	1100	1650	2200	2750
y (Standalone)	0	330	660	990	1320	1650

InLine: $y = 550(0)$ → 0; $y = 550(1)$ → 550; $y = 550(2)$ → 1100

$y = 550(3)$ → 1650; $y = 550(4)$ → 2200; $y = 550(5)$ → 2750

Standalone: $y = 330(0)$ → 0; $y = 330(1)$ → 330; $y = 330(2)$ → 660

$y = 330(3)$ → 990; $y = 330(4)$ → 1320; $y = 330(5)$ → 1650

The eXaminer 3DX-ES:

- This scanner scans up to 730 bags per hour in in-line configurations and up to **440** bags per hour in standalone configurations.

c. Write two linear equations to represent the total number of bags scanned after x amount of hours using in-line configurations and standalone configurations.

In-line Configurations: $y = 730x$

Standalone Configurations: $y = 440x$

d. Using the two equations, complete the two-way input/output table provided. Make sure to show all your work and computations.

x (# of hours)	**0**	**1**	**2**	**3**	**4**	**5**
y (In-line)	0	730	1460	2190	2920	3650
y (Standalone)	0	440	880	1320	1760	2200

Inline: $y = 730(0)$ → 0 $y = 730(1)$ → 730 $y = 730(2)$ → 1460

$y = 730(3)$ → 2190 $y = 730(4)$ → 2920 $y = 730(5)$ → 2200

Standalone: $y = 440(0)$ → 0 $y = 440(1)$ → 440 $y = 440(2)$ → 880

$y = 440(3)$ → 1320 $y = 440(4)$ → 1760 $y = 440(5)$ → 2200

	c. Overnight, Logan Airport only has the eXminer 3DX-ES running on a **standalone configuration** due to the low number of outgoing flights. After one hour of scanning bags the number of outgoing flights increase and the eXaminer 3DX is turned on using an **In-line configuration.** **What is the new equation for the first scanner after running for one hour?** $y = 440x + 440$ d. How many hours will it take from the time the second scanner (eXaminer 3DX) was turned on to scan the same amount of bags as the first scanner (eXaminer 3DX-ES)? Solve the system **algebraically.** $440x + 440 = 550x$ $-440x \quad -440x$ $\frac{440}{110} = \frac{110x}{110}$ $x = 4$ It will take 4 hour to scan the same # of bags
The eXaminer XLB	Los Angeles International Airport (LAX) is one of the most used airports in the country. To expedite luggage scans they use the fastest and most accurate Explosive Detection System avalible, the eXaminer XLB This next-generation EDS designed for ultra-high-speed applications in large, heavy-traffic airports. • The **eXminer XLB** scans up to 1,200 bags per hour in continuous-flow mode. The table below represents the number of bags scanner per hour.

x (# of hours)	**0**	**1**	**2**	**3**	**4**	**5**
y (In-line)	0	1200	2400	3600	4800	6000

a. By using the table, identify the slope and y- intercept and write the appropriate equation representing this data. Use $\frac{y2-y1}{x2-x1}$ to find the slope.

$(0, 1)$ $(1, 1200)$ $\frac{1200-0}{1-0} = \frac{1200}{1} = 1200$

Slope: 1200 **y-intercept:** 0 **Equation:** $y = 1200x$