

Preparation Notes

Please review and customize this deck to prepare it for use. Some notes:

- These professional learning (PL) materials (slide deck and accompanying handout) are being offered in editable forms so that you may make adjustments to better support the specific work happening in your school or district.
- These PL materials are designed to easily accommodate remote delivery:
 - A [Jamboard template](#) is provided to facilitate discussion of student work; the facilitator will need to make a copy of this and be ready to share the link with participants as noted in the deck.
 - Text that can be readily pasted (marked with “—”) into a video call’s chat feature is included when participants need to reference the handout.
 - There are placeholders for handout links to be shared with participants in the notes field of selected slides; the facilitator will need to add a link to the handout where indicated by “[insert link].”

M102 Overview

**XQ Badge Project PL Series Baseline
Session**

Month DD, YYYY

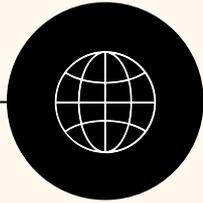


Welcome!

Joining Question:

- Please share your name, role, and where you're joining from.
- What is something that made you laugh recently?

Outcomes and Agenda



Participants will be able to:

- Explain the content and practice expectations for the M102 badge
- Analyze tasks through the lenses of (1) content and practice expectations and (2) learning principles
- Analyze student work for evidence of learning

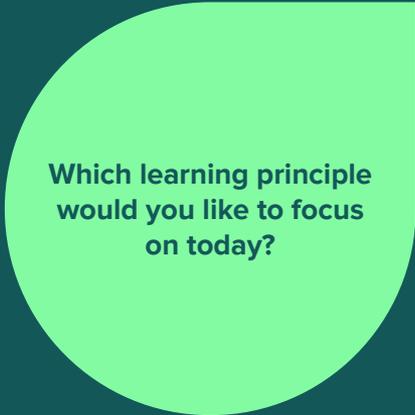


Agenda:

- Exploring the Content
- Task 1: Expectations and Learning Principles
- Task 1: Student Work
- Task 2: Expectations and Learning Principles
- Task 2: Student Work
- Closing

Learning Principles

1. Engage with cognitively demanding tasks in heterogeneous settings.
2. Engage in social activities.
3. Build conceptual understanding through reasoning.
4. Have agency in their learning.
5. View mathematics as a human endeavor across centuries.
6. See mathematics as relevant.
7. Employ technology as a tool for problem-solving and understanding.



**Which learning principle
would you like to focus
on today?**

01

Exploring the Content

What comes to mind?
What knowledge and skills
should students learn to
earn this badge?



**Come off mute
or put your
thoughts in the
chat!**

What's the Story of these Standards?

Selected Common Core Standards for Mathematics High School – Algebra

Create equations that describe numbers or relationships

1. Create equations and inequalities in one variable and use them to solve problems.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

Solve linear equations in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Solve systems of equations

6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

**How would you synthesize these?
What are the key takeaways
for students?**

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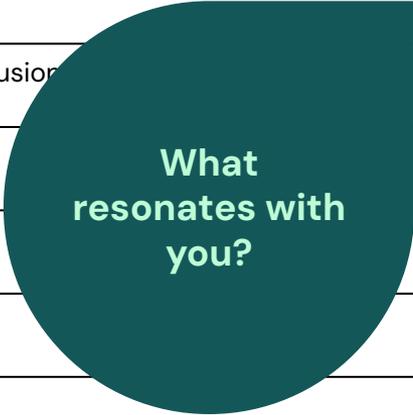
Share your thinking!

M102 Content and Practice Expectations (CPE)

102.a	Engage in the modeling cycle.
102.b	Interpret linear functions and equations that arise in applications in terms of the context.
102.c	Analyze linear functions using different representations.
102.d	Build linear functions that model relationships between two quantities.
102.e	Analyze and solve linear equations and pairs of simultaneous linear equations to draw conclusions.
102.f	Interpret expressions for linear functions in terms of the situation they model.
102.g	Solve linear equations and inequalities in one variable.
102.h	Create equations that describe linear relationships.
102.i	Understand the relevance of modeling with linear functions.
102.j	Use a linear function model to determine values of interest in a real-world problem.

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**What
resonates with
you?**

M102 Content and Practice Expectations and Indicators

Content and Practice Expectations	Indicators Choose an artifact where you...
102.a: Engage in the modeling cycle (performance assessment).	i. engage with the full modeling cycle (problem, formulate, compute, interpret, validate, revise as necessary, report).
102.b: Interpret linear functions and equations that arise in applications in terms of the context.	i. select two different data points that illustrate something interesting or important about the context you are modeling and describe what these points tell you about the topic.
	ii. use a model to compute output values and then interpret the values in the context of the problem.
	iii. describe the domain of the linear function, including anything noticed about values that are not part of the domain given the context.
	iv. describe the contextual meaning of the rate of change for a linear model.



What new
insights do you
have?

Let's Investigate

Choose at least one task to explore:

- Kimi and Jordan
- Sandia Aerial Tram

Which content and practice expectations are evident in each one?

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- Kimi and Jordan
- Sandia Aerial Tram

Which content and practice expectations are evident in each one?

**Come off mute
or put your
thoughts in the
chat! What did
you find?**

What's the Same?

What's Different?

1. How do these content and practice expectations align to ways you've taught this topic before?
2. How are they different?

**Come off mute
or put your
thoughts in the
chat!**

Inequity Is our Reality

“And by 2018, problems with the pipeline through math courses and tests were persisting. Despite the implementation of new state standards and tests, just 31 percent of students were meeting or exceeding standards in math, compared with 56 percent in English.” (Daro & Asturias, 2019)

Source:

<https://justequations.org/resource/branching-out-designing-high-school-math-pathways-for-equity>

We Must Lead the Movement

How can this approach give space for what math can be?

Is math...?

- About getting one right answer, the teacher's way
- Irrelevant
- About doing procedures
- Independent work
- Something my teacher made up
- Formulaic

Or could math be...?

- About using multiple strategies flexibly
- Connected to the real-world in ways that make sense
- About understanding and applying
- Collaborative work
- Lived across continents and centuries
- Novel, challenging problems

02

Task 1: Expectations and Learning Principles

Let's Do Some Math!

Part 1

Lauren records her taxi fare displayed on the computer screen at different points of time during a taxi ride:

Distance, d , in miles	Fare, f , in dollars
3	8.25
5	12.75
11	26.26

Do the task as a student would. Jot down any reflections that you have as you do the math!

How would you describe the relationship between these two quantities?

Content and Practice Expectations

Part 1

Lauren records her taxi fare displayed on the computer screen at different points of time during a taxi ride:

Distance, d , in miles	Fare, f , in dollars
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5	12.75
11	26.26

Choose 1–2 Content and Practice Expectations that student work could give evidence of.

How would you describe the relationship between these two quantities?

Content and Practice Expectations

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Lauren records her taxi fare displayed on the computer screen at different points of time during a taxi ride:

Distance, d , in miles	Fare, f , in dollars
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102.d: Build linear functions that model relationships between two quantities.

How would you describe the relationship between these two quantities?

Learning Principles

In M102 Modeling with Linear Functions and Equations, students will employ the following learning principles:

- Engage with cognitively demanding tasks in heterogeneous settings (LP 1).
- Engage in social activities (LP 2).
- Build conceptual understanding through reasoning (LP 3).
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- Employ technology as a tool for problem-solving and understanding (LP 7).

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- Employ technology as a tool for problem-solving and understanding (LP 7).

Which of these principles does this task lend itself to? Which ones can the task be easily adapted to accommodate?

Learning Principles

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**Share what
you came up
with!**

03

Task 1: Student Work

Round 1: What do you notice?

- **Jot down:** One thing you notice about each piece of student work.

Lauren records her taxi fare displayed on the computer screen at different points of time during her taxi ride.

Distance, d , in miles	Fare, f , in dollars
3	8.25
5	12.75
11	26.25

$m = \frac{y}{x}$
 $\frac{4.5}{2} = \frac{9}{4}$
 $\frac{13.5}{6} = \frac{9}{4}$

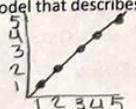


How would you describe the relationship between the two quantities?
 I would describe them that they are the same q will be the amount of money and 4 would be the miles.

Part 2

Identify **two** quantities that have a relationship that you'd like to track and believe is linear in nature.

y . Cookies
 x . Friends

- What quantities are you tracking?
Cookies and Friends
- What about the relationship between these two quantities lead you to believe it will be linear?
Because the more cookies you make you would be able to invite more friends.
- Develop a model that describes the relationship between the two quantities.

 A graph because it's easier to tell the quantities.
- What surprised you about the relationship you just modeled?
Something that surprised me was that it's easy to tell the difference between them.

Round 1: What do you notice?

- **Jot down:** One thing you notice about each piece of student work.

Come off mute
and share what
you saw!

Lauren records her taxi fare displayed on the computer screen at different points of time during her taxi ride.

Distance, d , in miles	Fare, f , in dollars
3	8.25
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11	26.25

$m = \frac{y}{x}$
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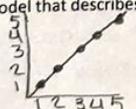


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Criteria for Success

Conference and Provide Revision Support	Accept with Revision	Accept
<p>The student's artifact shows an emerging understanding of the expectations of the indicator(s). After conferencing and additional instruction/learning, the student may provide a revised or different artifact as evidence of the indicator(s).</p>	<p>The student's artifact is approaching a full understanding of the expectations of the indicator(s). The artifact may contain execution errors that should be corrected in revision. The student may revise the selected artifact or submit a different artifact.</p>	<p>The student's artifact demonstrates evidence that they have met the expectations of the indicator(s).</p>

What resonates with you? What questions surface for you?

Humanizing Assessment

When a student stands up to present their academic work, we have an incredible opportunity to listen deeply, uncover the students strengths and struggles, reimagine our curriculum and pedagogy, and move with an antiracist and student-centered lens. (Safir and Dugan, 2021, p. 135)

Source: Safir, Shane, and Jamila Dugan. Street Data: A Next-Generation Model for Equity, Pedagogy, and School Transformation. Corwin, 2021.

Round 2: What evidence of learning is there?

102.d: Build linear functions that model relationships between two quantities.

Let's examine some work together:

Conference and Provide Revision Support

The student's artifact shows evidence of an emerging understanding of the expectations of the indicator(s). After conferencing and additional instruction/learning, the student may provide a revised or different artifact as evidence of the indicator(s).

Accept with Revision

The student's artifact shows evidence of approaching a full understanding of the expectations of the indicator(s). The artifact may contain execution errors that should be corrected in revision. The student may revise the selected artifact or submit a different artifact.

Accept

The student's artifact demonstrates evidence that they have met the expectations of the indicator(s).

Examining Student Work

The image shows a digital workspace interface for reviewing student work. At the top, there are three tabs: "Conference and Provide Revision Support", "Accept with Revision", and "Accept". On the left side, there is a vertical toolbar with several icons: a pencil, an eraser, a mouse cursor, a document icon (highlighted with a red circle and a red arrow), a photo icon, a circle icon, a text box icon, and a scissors icon. In the center of the workspace, there is a large red callout bubble with the text "Put your thoughts on the Jamboard!". In the bottom right corner, there is a red circular badge with the text "Work Sample 1".

Example #1

- What quantities are you tracking?

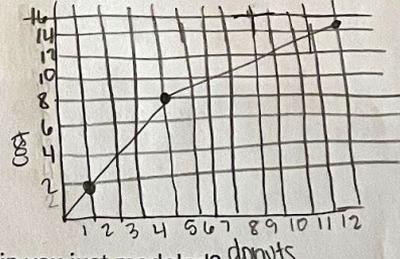
The total cost of donuts and the amount of donuts.

- What about the relationship between these two quantities leads you to believe it will be linear?

There could be the same amount of money for the same amount of donuts.

- Develop a model that describes the relationship between the two quantities.

cost	donut
2	1
8	4
15	8
24	12



- What surprised you about the relationship you just modeled?

I was surprised about how it was supposed to be non-proportional and linear.

Let's compare notes.

Example #2

- What quantities are you tracking?

hours and dollars

- What about the relationship between these two quantities leads you to believe it will be linear?

how many hours
you work, how much
money you get.

- Develop a model that describes the relationship between the two quantities.

h	M
0	0
1	10
2	20
3	30
4	40

- What surprised you about the relationship you just modeled?

-how much money you
can get in just a couple
of hours

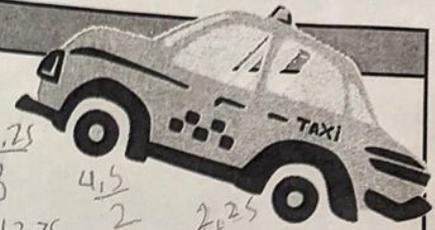
Let's compare
notes.

Example #3



Julien records her taxi fare displayed on the computer screen at different points of time during her taxi ride.

Distance, d in miles	Fare, f in dollars
3	8.25
5	12.75
11	26.25



$$\begin{array}{r} 12.75 - 8.25 \\ \hline 4.5 \\ \times 2 \\ \hline 9.0 \\ \hline 26.25 - 12.75 \\ \hline 13.5 \\ \div 6 \\ \hline 2.25 \end{array}$$

How would you describe the relationship between the two quantities?

linear because it constantly increases by 2.25

Part 2

Identify two quantities that have a relationship that you'd like to track and believe is linear in nature.

- What quantities are you tracking?
speed, time
- What about the relationship between these two quantities lead you to believe it will be linear?
the higher speed you are going the less time it will take to get to a place
- Develop a model that describes the relationship between the two quantities.
 $t = \text{time}$
 $s = \text{speed}$
 $T = S \cdot t$
- What surprised you about the relationship you just modeled?
That they are equal to each other

Three Key Components of the Math Badging System

- Content and Practice Expectations
- Learning Principles
- Criteria for Success

Which one excites you the most?

What one will have the greatest impact on students?

What questions surface for you?



**Come off
mute or share in
the chat!**

04

Task 2: Expectations and Learning Principles

Let's Do Some Math!

Share a table that outlines median monthly rent by state, like the one below.

Ask: "What do you notice? What do you wonder?"

State	Annual Mean Wage (All Occupations)	Median Monthly Rent	Value of a Dollar
Alabama	\$46,840	\$998	\$1.16
Alaska	\$61,760	\$1,748	\$0.95
Arizona	\$53,400	\$1,356	\$1.04
Arkansas	\$44,780	\$953	\$1.17
California	\$65,740	\$2,518	\$0.87
Colorado	\$60,840	\$1,927	\$0.98
Connecticut	\$65,450	\$1,803	\$0.94
Delaware	\$56,700	\$1,435	\$1.01
Florida	\$50,020	\$1,590	\$0.99
Georgia	\$51,940	\$1,262	\$1.08
Hawaii	\$58,190	\$2,481	\$0.85

(Source: [The Average Cost of Living by State and Why Ignoring It Could Sink Your Business](#))

Your job is to explore how different income structures impact saving for an emergency fund. Consider the following situation.

Do the task as a student would. Jot down any reflections that you have as you do the math!

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102.j: Use a linear function model to determine values of interest in a real-world problem.

Learning Principles

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**Share what
you came up
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05

Task 2: Student Work Examination

Round 1: What do you notice?

Jot down

- One thing you notice about each piece of student work.

Part 3

Consider Paula and Irfan's income structures, living expenses, and their wish to have emergency fund savings. Use features of your graphing software to explore the following:

a. (1.1) Under what conditions will Irfan be able to save \$12,000?

It would take Irfan a little over $16\frac{1}{2}$ (16.67) months for Irfan to save \$12,000

b. (1.1) Explore the legal requirements for working overtime. Resource: [Overtime Pay](#)

After working 40 hrs in a week you are entitled to be paid 1.5 times your normal pay rate.

c. (4.1) How many additional hours a week (overtime) will Irfan need to work if he gets paid at a rate of time and a half? Or double his regular rate?

$$17 \cdot 1.5 = 25.5/\text{hr}$$

$$255 + 17 \cdot 20 = 975$$

$$12,000 / 975 = 12.31$$

$$10 \text{ hrs} = 255$$

If Irfan works 10 hrs OT every week he can save \$12,000 4 months faster in only $12\frac{1}{3}$ (12.31) months

d. (8.2) Share about the differences you notice between the two workers.

Paula deposits more money than Irfan every month. • Paula's hourly salary is \$8 more than Irfan's.
Paula starts with some money in her savings while Irfan does not.

Round 1: What do you notice?

Jot down

- One thing you notice about each piece of student work.

Come off mute and share what you saw!

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Paula starts with some money in her savings while Irfan does not.

Round 2: What evidence of learning is there?

**102.j: Use a linear
function model to
determine values of
interest in a real-world
problem.**

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Example #1

2) Part 1

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Let's compare notes.

What do you notice about this table?

- The highest mean wage is \$65,740 in CA
- The highest median monthly rent is \$2,518 in CA
- The highest value of a dollar is \$1.17 in AR
- Dollar less than a dollar in AL, CA, CO, CT, FL, HI

What do you wonder about this table?

- Why is a dollar less than a dollar if it's a dollar?
- What are the gas prices?
- What are the taxes?

Part 2

Your job is to explore how different income structures impact saving for an emergency fund. Consider the following situations:

Paula works as an electrician and makes about \$52,000 a year. Her living expenses are about \$2,000 a month. She has saved \$12,000, which she estimates is enough for 6 months of expenses in case of emergency.

$x = \text{# of months}$ $y = \text{money in bank}$
 $y = 2,333x + 12,000$

a. (7.2) Write an equation that represents how much Paula has after x months.

b. (6.3) Graph this equation using Desmos.com or geogebra.org.

c. (7.1) Describe what the graph looks like.

The graph is linear and goes up at a constant slope of 2,333. The graph has a y-intercept of 12,000.

d. (1.2) Why does it make sense that the graph looks like that?

The same amount is deposited each month. It should be a constant slope because she works the same amount & she saved there.

Irfan works as a machine assembler for \$17 an hour and has about the same cost of living as Paula. He works full-time, which is 40 hours a week. He would like to save for 6 months of expenses.

$x = \text{months}$ $y = \text{money in bank}$
 $y = 720x$

e. (7.2) Write an equation that represents how much Irfan has after x months.

f. (6.3) Graph this equation using Desmos.com or geogebra.org.

g. (7.1) Describe what the graph looks like.

The graph is linear and goes up at a constant slope of 720; graph has a y-intercept of 0.

h. (1.2) Why does it make sense that the graph looks like that?

The same amount of \$720 is deposited every month. It should be a constant slope. The graph being 0 makes sense as he starts with no savings.

Part 3

Consider Paula and Irfan's income structures, living expenses, and their wish to have emergency fund savings. Use features of your graphing software to explore the following:

a. (1.1) Under what conditions will Irfan be able to save \$12,000?

It would take Irfan a little over 16 1/2 (16.67) months for Irfan to save \$12,000

b. (1.1) Explore the legal requirements for working overtime. Resource: [Overtime Pay](#)

After working 40 hrs in a week you are entitled to be paid 1.5 times your normal pay rate.

c. (4.1) How many additional hours a week (overtime) will Irfan need to work if he gets paid at a rate of time and a half? Or double his regular rate?

$$17 \cdot 1.5 = 25.5/\text{hr} \quad 25.5 \cdot 40 = 995 \quad 12,000/995 = 12.13$$

$$10 \text{ hrs} = 255$$

If Irfan works 10 hrs OT every week he can save \$12,000 in 4 months

d. (8.2) Share about the differences you notice between the two workers.

Paula deposits more money than Irfan every month. Paula's hourly salary is \$8 more than Irfan's. Paula starts with \$12,000 in her savings while Irfan does not.

Example #2

What do you notice? What do you wonder?

State	Annual Mean Wage (All Occupations)	Median Monthly Rent	Value of a Dollar
Alabama	\$46,840	\$998	\$1.16
Alaska	\$61,760	\$1,748	\$0.95
Arizona	\$53,400	\$1,356	\$1.04
Arkansas	\$44,780	\$953	\$1.17
California	\$65,740	\$2,518	\$0.87
Colorado	\$60,840	\$1,927	\$0.98
Connecticut	\$69,000	\$2,000	\$0.94
Delaware	\$60,000	\$1,800	\$1.01
Florida	\$50,000	\$1,500	\$0.99
Georgia	\$50,000	\$1,500	\$1.08
Hawaii	\$50,000	\$1,500	\$0.85

What do you notice?

- All the values for a dollar are different
- It is not linear
- It only shows some of the states

What do you wonder?

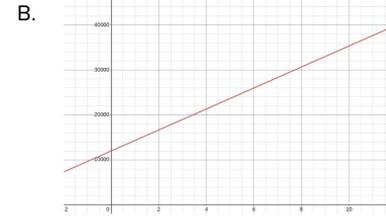
- Why is the cost of living different everywhere?
- Why does the value of a dollar change every time?

Let's compare notes.

(Source: [The Economist](#), "How to Sink Your Business")

Paula

A. $f(x) = 12000 - 2000x + 4333.33x$

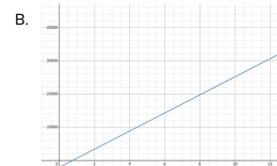


C. A linear line that increases.

D. Because she makes more money than she spends on expenses.

Irfan

A. $f(x) = 2720x - 2000$



C. A linear function that increases, but not as quickly as Paula's.

D. He also makes more money than he spends on expenses, but he makes less money than Paula.

Example #3

What do you notice AND wonder?

That the value of a dollar is not in fact, a dollar.

California has the most expensive median of monthly rent

When was this chart created?

Your job is to explore how different income structures impact saving for an emergency fund. Consider the following situation.

Paula works as an electrician and makes about \$52,000 a year. Her living expenses are about \$2,000 a month. She has saved \$12,000, which she estimates is enough for 6 months of expenses in case of an emergency.

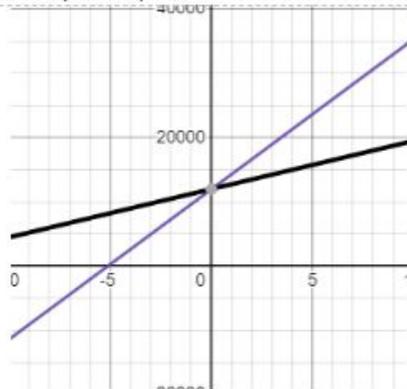
A. Write an equation that represents how much Paula has after x months.

$$52,000/12 = 4333 \text{ monthly}$$

$$4,333 - 2,000 = 2,333 \text{ can be put into fund}$$

$$2,333 * x = 12,000$$

B. Graph this equation.



xw

Let's compare notes.

title of presentation

C. Describe what the graph looks like.

Purple is Paula's. It stayed straight for a little bit then eventually went slanted.

D. Why does it make sense that the graph looks like that?

Because it's linear and searching for a specific point as well as a decimal but also increases every month therefore becomes slanted.

Irfan works as a machine assembler for \$17 an hour and has about the same cost of living as Paula. He works full-time (40 hours a week). He would like to save for 6 months of expenses.

A. Write an equation that represents how much Irfan has after x months.

17

2000

40 hours

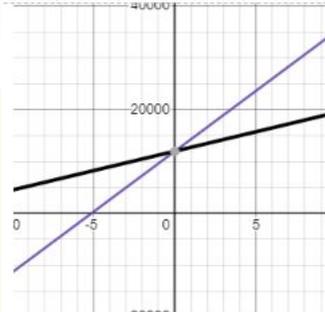
$$17 * 40 = 680$$

$$680 * 4 = 2720$$

750 put aside monthly

$$750 * x = 120000$$

B. Graph this equation.



C. Describe what the graph looks like.

his is black and it stayed straight for a little bit then eventually went slanted.

D. Why does it make sense that the graph looks like that?

It's perfectly linear and it was looking for an exact point in which it got at 16. WE can indicate that this will take 16 months for him to save up \$12000 but if he decides to keep saving up, it'll get growing

Consider Paula and Irfan's income structures, living expenses and their wish to have emergency fund savings. Use features of your graphing software to explore the following:

A. Under what conditions will Irfan be able to save \$12,000?

If he works 40 hours every week, no breaks for the \$17 an hour, for 16 months, He'll get exactly 12,000 in savings after his monthly living expenses.

Let's Hear Some Reflections

What kinds of support will students need to demonstrate evidence of learning?

Has your thinking changed at all on how to implement this task? If so, how?

**Come off
mute or share in
the chat!**

06

Closing

What Are Your Takeaways?

Choose one question to respond to:

1. Which content and practice expectation are you most excited about? Why?
2. Which learning principle are you most excited about connecting to M102 content? Why?
3. What impact do you think using a portfolio system will have on your students? Why?