Welcome to the 2017 Individual Math Competition

Please do not open your test booklet until instructed to do so

Test Taking Information and Instructions:

Thank you for participating in the TechTest Jr./STEAM Expo Math competition. Here are a few reminders about the exam:

- You are not allowed to bring in any paper or pencils with you. Pencils and scratch paper will be provided. If you need additional paper or pencils, you may raise your hand to call a proctor for assistance.
- If you have any questions, you may also raise your hand for assistance. However, the proctors can only provide clarification. They cannot assist you in figuring out a question.
- Circle your answers **clearly** on the test sheet.
- You have an hour and 45 minutes to complete the exam. After completing it, you will need to turn in your exam, answer sheet, all scratch paper and pencil(s). At that point, you can move to the break area while the remaining participants complete their exams.
- All exams will be graded off-site and the winners will be announced on Saturday at the STEAM Expo awards ceremony at the Nevada County Fairgrounds.

This year's 7th/8th grade version of the exam consists of 20 questions (130 points total). The questions include math (Pre-Algebra, Algebra and Geometry) topics typically covered in your 7th and 8th grade classes and are based on the Common Core standards (CCSS).
Most questions are multiple-choice (the easier ones are worth fewer points than the more difficult ones), but a constructed response is required for the last six questions. Those six can be answered in the space provided. If more space is required, you may request a blank sheet of paper to use. The constructed response questions will be graded on the correctness of the answer as well as for the solution steps, so be sure to show your work. Calculators may be used, but phones or any other electronic devices are not allowed in the testing area.

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2017 STEAM Expo/TechTest Jr.
Math Problems (7ᵗʰ/8ᵗʰ Grade Version)

Questions 1 - 7 are worth 3 points each

1) **First Things First:** Solve for J: $J = (3 + 4(7 − 2)^2) * 5 − 3$
   a. -1497
   b. 206   **Note:** "*" means multiplication
   c. 1497
   d. 2012

2) **Close, but no Cigar**: During the 2016 election, you were asked by CNN to predict the voter turnout. Falling back on your vast political experience and statistical analysis skills, you did some quick calculations and assured CNN that 67% of the registered voters would turn out to cast their votes. As it turned out, only 55% turned out (probably the second biggest surprise of the election). What was the percent error in your prediction?
   a. -17.9%
   b. 12%
   c. 17.9%
   d. 21.8%
   e. 112%

3) **I Know I can! I Know I can!:** A train went up a hill and then down a hill. Its speed going down was 3.5 times the speed going up. On the way down the hill, a speed sensor clocked the train's speed at 4000 ft/min. Approximately how fast was it traveling up the hill?
   a. 4 mph
   b. 13 mph
   c. 19 mph
   d. 29 mph
   e. 45.5 mph

4) **Upon Closer Inspection:** TSA, the airport security organization at airports, claims that only ¼% of bags passing through their screening stations do not get screened properly. At that rate, if 4,800 bags go through a station in a day, how many bags would not get screened properly?
   a. 12
   b. 19
   c. 120
   d. 192
   e. 1,200

5) **Getting a Square (or Rectangular) Deal:** A rectangle's base is 3 feet longer than twice its height. The area is 54ft^2 and the perimeter is 33ft. What is the length of the rectangle's base?
   a. 4.5ft
   b. 9ft
   c. 12ft
   d. 18ft
   e. 21ft^2

6) **Absolute Fun:** Solve for Y: $Y = (|6 - 9| + 7) * (-|3 - 6|)$
   a. −63
   b. −30
   c. −12
   d. 12
   e. 30

7) **Food for Thought:** You can either pay $2.50 per energy bar or you can buy a club membership for $24 per year and get them for $1.90 each. How many would you have to buy for each deal to be the same cost?
   a. 9
   b. Between 21 and 22
   c. 36
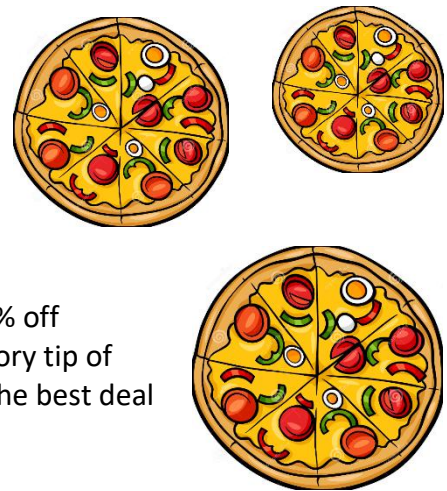   d. 40
   e. The club membership will always cost more

Questions 8 - 14 are worth 7 points each

8) **Getting a "Pizza" the Pie:** You are having a pizza party for you and 19 classmates. Alta Sierra Pizza has three sizes (diameters) of Combo pizzas: a 24" Giganto, a 20" Extra Large and a 15" Large. They are priced as follows:
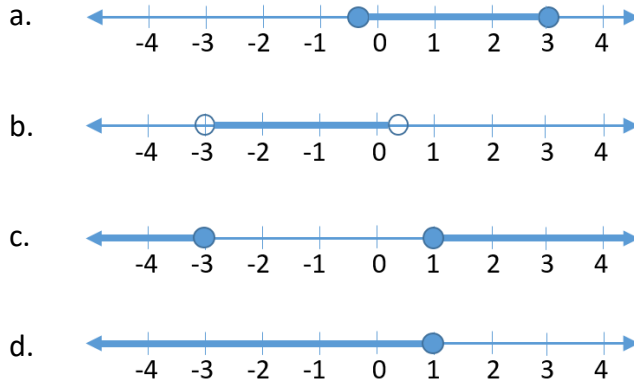   - Giganto: $22.60
   - Extra Large: $19.00
   - Large: $13.00

They are running a special and the Large pizzas are 25% off (discounted from the original $13.00 price). A mandatory tip of 20% is required for your party. Which of the pizzas is the best deal for you to get for your party?
   a. Giganto
   b. Extra Large
   c. Large
   d. All three are the same value

9) **All Things are not Created Equal:** Select the graph that corresponds to the following inequality:

$$\left| \frac{3x - 4}{-5} \right| \leq 1$$

a.

b.

c.

d.

10) **Flooding the Market:** Noah wanted to buy a small boat. He went to Ararat Motors and the target price he wanted to pay was $5,300, but he was willing to pay anything within $1700 of that amount. Which of the following describes the price (p) that he was willing to pay?
    a. $|5300 - p| \geq 1700$
    b. $|5300 + p| \geq 1700$
    c. $|1700 - p| < 5300$
    d. $|5300 - p| \leq 1700$
    e. $|5300 - 1700| < p$

11) **Probabilistically Speaking:** You have a password that has 5 characters. The first 3 are letters and the last two are numbers. Someone was watching over your shoulder when you typed it in and saw what you entered for the first and last character, effectively reducing the number of private/secure/unknown passwords. By how many combinations did that reduce the total?
    a. 36
    b. 260
    c. 6,760
    d. 703,040
    e. 1,750,840

12) **Road Trip!:** You're traveling through the state of Orthogonalville, where all roads are laid out in a grid pattern. You need to get from the town of Gridley to the town of Axes. You can either travel by car or by plane. By car, you would travel in the following directions for the following distances:

E: 100 miles
N: 75 miles
E: 90 miles
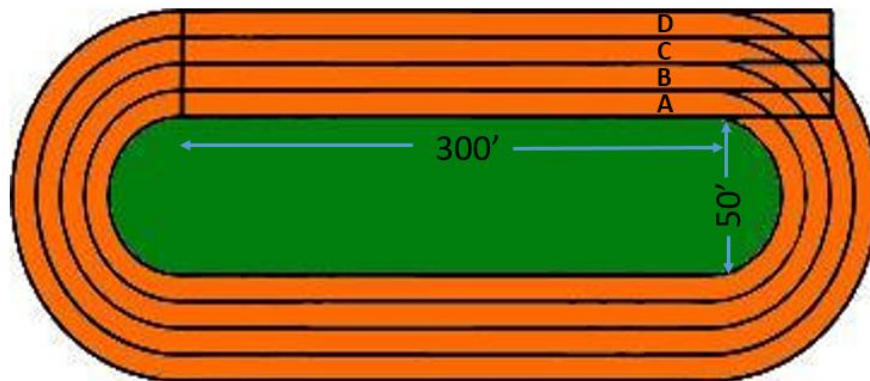N: 200 miles
E: 250 miles
S: 100 miles
W: 75 miles

By plane, you would go in a straight line from Gridley to Axes. Traveling by car costs $0.19 per mile. Traveling by plane (straight line from start to finish) costs 39 cents per mile, plus $35 for baggage. If you have a Frequent Flyer voucher (discount) worth $55, which method is cheaper?

a. Traveling by plane is at least $100 less than by car
b. Traveling by car is at least $100 less than by plane
c. Traveling by plane is between $0 and $50 less than by car
d. Traveling by car is between $0 and $50 less than by plane
e. The cost is exactly the same either way

13) **Paper Tiger:**

- Jorge needs some paper for his printer. Walking through Staples, he sees that a single package of deluxe printer paper is 1.5" tall and contains 500 sheets. It is on sale for $2.50.
- Jorge also sees a large box of the same paper on sale for $38. It has two stacks of paper in it, each stack being 11" tall.
- Which of the following is true:
    a. The single pack is a much better deal per piece (more than a 10% savings)
    b. The large box is a much better deal per piece (more than a 10% savings)
    c. The single pack is a slightly better deal per piece (less than a 10% savings)
    d. The large box is a slightly better deal per piece (less than a 10% savings)
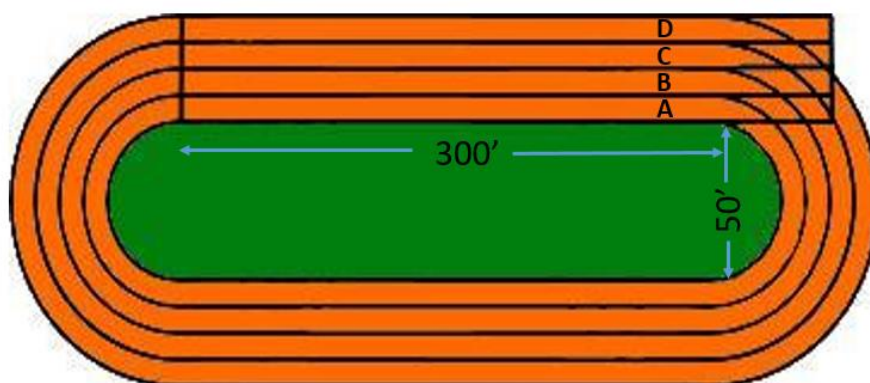   e. The two are the same price

14) **Staying on Track:** For a 3-lap race around the track below, how much of a head start will each lane need, relative to the one to the inside of it, in order to have the runners in all lanes go the same distance? The width of each lane is 3' and all runners must stay in their lane during the entire race. The distances are measured along the inside edge of each lane (see diagram below).

    a. 19'

    b. 28.5'

    c. 31.4'

    d. 57'

    e. The distance will vary from lane to lane

NOTE: For the following 6 problems, you must show your work in the space provided. If you need additional space, use a second piece of paper. Your score will be determined by the methodology used, the accuracy of your answer and the quality of the work shown. For maximum credit, be sure to clearly show your work in an organized manner.

15) **Lapping up the Paint:** The outdoor paint required to paint the synthetic track below costs $65 per gallon and each gallon covers $250ft^2$. Will it cost more to paint lane C than lane A and, if so, how much more? (Note: You can purchase a portion of a gallon of paint)

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16) **Fishing for a Loan:** Having a great idea for a new business, you applied for and were given an appearance on Shark Tank. You asked the panel for $350,000 to help pay for internet advertising and website development. You received the following offers:

- Kevin: A $350,000 loan for 3 years, at a 7.5% simple yearly interest rate
- Lori: A $230,000 loan for 3 years, at a 9% interest rate, compounded annually
- Mark: A $180,000 loan for 4 years, at an 8.9% simple yearly interest rate
- Daymond: A $385,000 loan for 2 years, at a 7.6% annual interest rate, compounded twice per year

Which loan would result in you paying <u>the least amount of interest</u> over the life of the loan?

17) **The Acid Test:** Sydney inherited her father's etching supply business. She has branched out and now has customers who want to purchase 5-gallon containers of a 45% sulfuric acid solution for etching glass. All that her father's business had was containers of a 60% sulfuric acid solution and a 10% sulfuric acid solution. How much of the 60% solution and how much of the 10% solution must she mix together to make 5 gallons of a 45% solution?

18) **Car Options:** You are shopping for a new Tesla and are trying to decide which options to purchase. Unfortunately, none of the option prices are listed individually. The dealer published the following options and the prices for selected combinations:

Options:
GPS Navigation
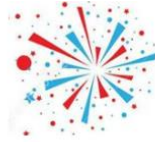Sirius XM Radio
Heated Seats
Extra Capacity Battery

Combination Prices:
GPS Navigation + Heated Seats = $1,400
Sirius XM Radio + Heated Seats = $1,650
GPS Navigation + Sirius XM Radio = $1,250
All options together = $3,350

Given the option pricing for the listed combinations, how much does each option cost?

19) **Wheeling and Dealing:** You inherited $45,000 and want to invest it. STEAM Expo stock is currently priced at $45 per share. You decide to purchase 250 shares of stock. There is a $25 transaction fee for making the purchase. Six months later, the stock is at $63 per share. You decide to sell half of your shares, now at the higher price. There is now a $35 transaction fee, plus $.15 per share bought or sold. After all is said and done. How much is your $45,000 inheritance now worth, in both cash and stock? Be sure to list the value of the remaining stock you have and the amount of cash you now have left.

20) **A Booming Success:**

You are watching a fireworks show and you time how long it takes for the sound to reach you after you see the explosion. There is a hill on the other side of where the fireworks are exploding which causes an additional echo. If the initial sound reaches you 1.5 seconds after the explosion and the echo reaches you 4.2 seconds after the explosion, how far away is the hill from where you are sitting? Assume that sound travels at 1100 feet per second.

Name: _____ **Test #:** _____

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- All exams will be graded off-site and the winners will be announced on Saturday at the STEAM Expo awards ceremony at the Nevada County Fairgrounds.

This year's 5th/6th grade version of the exam consists of 23 questions. The questions include math (Pre-Algebra and Algebra) topics typically covered in your 5th and 6th grade classes and are based on the Common Core standards (CCSS).
Most questions are multiple-choice (the easier ones are worth fewer points than the more difficult ones), but a constructed response is required for the last six questions. Those six can be answered in the space provided. If more space is required, you may request a blank sheet of paper to use. The constructed response questions will be graded on the correctness of the answer as well as for the solution steps, so be sure to show your work. Calculators may be used, but phones or any other electronic devices are not allowed in the testing area.

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2017 STEAM Expo/TechTest Jr.
Math Problems (5th/6th Grade Version)

Questions 1 - 8 are worth 4 points each

1) **Back to Basics:** Solve for J: $J = (3 + 4(7 - 2)^2) * 5 - 3$
   a. -1497
   b. 206   **Note:** "*" means multiplication
   c. 512
   d. 1497
   e. 2012

2) **The Shots Heard 'Round the World:** Cole is ambidextrous and in his last game he made 27 out of 42 free throws right-handed. He made 16 out of 23 left-handed. Which of the following is true:
   a. Cole shot a higher percentage left-handed
   b. Cole shot a higher percentage right-handed
   c. Cole shot the same percentage with each hand
   d. Cole would likely double his percentage if he shot with both hands

3) **As Time Goes By:** At your kindergarten reunion party, there were 72 people. Approximately 18% were left-handed. How many were right-handed?
   a. 13
   b. 18
   c. 54
   d. 59

4) **Absolute Fun:** Solve for Y: $Y = (|6 - 9| + 7) * (-|3 - 6|)$
   a. −63
   b. −30
   c. −12
   d. 12
   e. 30

5) **Water You Talking About?:** Your bathtub clogged up and you needed to drain it. There were 44 gallons of water in the tub and, unfortunately, all you had was a ¼ gallon container to use to scoop it out. How many full scoops would it take to get all 44 gallons out of the tub?
   a. 11
   b. 44
   c. 88
   d. 176
   e. 440

6) **Cooking up an Equation:** Flour Garden Bakery sold two dozen cookies for $1.50 each, five muffins for $2.95 each and 7 apple strudels for $3.25 each. Which equation represents this situation?
   a. (12 + 1.5) x (5 + 2.95) x (7 + 3.25)
   b. (2 x 1.5) + (5 x 2.95) + (7 x 3.25)
   c. (12 + 5 + 7) x (1.5 + 2.95 + 3.25)
   d. (12 x 1.5 x 2) + (5 x 2.95) + (7 x 3.25)

7) **Getting a Piece of the Pie:** You decided to go out for pizza to celebrate the end of your soccer season. Your finicky friends couldn't agree on the type of pizza to order, so you ordered one that was half pepperoni, but one-third of the pepperoni side also had pineapple. What fraction of the pizza had pepperoni *and* pineapple?
   a. 1/6
   b. 1/3
   c. 1/2
   d. 2/3
   e. 5/6

8) **Back to More Basics:** Evaluate the following:
   $10 + 5 \times (54 \div [(16 - 7) \div 3])$
   a. 15
   b. 20
   c. 30
   d. 100
   e. 540

Questions 9 - 16 are worth 6 points each

9) **A Banner Year for your Business:** You are going to hang a humongous banner on the side of a 15-story building. Each story of the building is 12 feet tall, except the first story which is 15 feet. You need two lengths of rope to stretch from the top of the building all the way to the ground. How many yards of rope will you need?
   a. 61
   b. 120
   c. 122
   d. 183
   e. 366

10) **Hanging Around:** Your class was asked to paint 180 ornaments to hang on the State Christmas tree in Sacramento. You found that your class can paint 5 ornaments in 23 minutes. At that rate, how long will it take to paint all 180 ornaments?
    a. 115 minutes
    b. 900 minutes
    c. 4,140 minutes
    d. 7.82 hours
    e. 13.8 hours

11) **Paper Tiger:**
    - Jorge needs some paper for his printer. Walking through Staples, he sees that a single package of deluxe printer paper is 1.5" tall and contains 500 sheets. It is on sale for $2.50.
    - Jorge also sees a large box containing 12 of the same single packages and it's selling for $30.
    - At the checkout stand, they have a door-buster deal: 30" of paper for $50
    - Which of the following is true:
        a. The single pack is a better deal
        b. The large box is a better deal
        c. The door-buster is a better deal
        d. All three are the same price per piece of paper

12) **Something is Fishy:** You were just pulling out of the marina in your new boat, fully equipped with the latest in sonar equipment. You were on your way to start your new project, which was to estimate the number of fish in the entire San Francisco Bay. After filling in your crew on what the project was, you started to focus on the details. Using a state-of-the-art sonar fish-finder, you were able to create a table (below) that listed how many of each type of fish were found per 1000 cubic feet of water. Knowing that the bay was approximately 51,000,000 cubic feet, and assuming that the fish densities were consistent throughout the entire bay, you used that to estimate the total number of each of the four fish listed in the table. Complete the table with the total amounts for each fish.
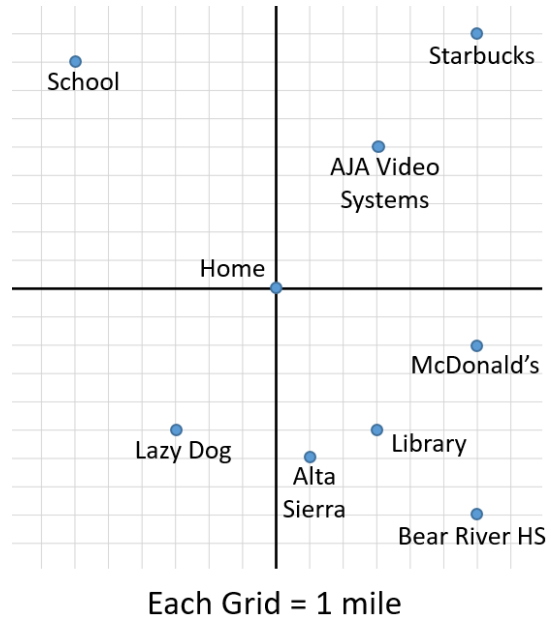
Fish	Number per 1,000 Cubic Feet	Total
Delta Smelt	250	
Pacific Herring	505	
Bay Halibut	198	
Calif Lizardfish	48	
Total		

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13) **Mapping out a Solution:** You leave your home in the morning and do the following:
- Travel -3 miles in the X direction
- Travel +2 miles in the Y direction
- You then reflect your position across the Y axis
- You then travel +3 in the Y direction
- Lastly, you reflect your position across the X axis

Where did you end up?
   a. AJA Video Systems
   b. Lazy Dog
   c. Back at home
   d. School
   e. Library

Each Grid = 1 mile

14) **Raking in the Cash:** Larry, Moe and Curly each got paid 1 penny for each leaf that they raked up. Larry raked 9,765,432 leaves. Moe raked up 8,999,234 leaves. Curly, who was a slacker, raked up less than the difference between what Larry and Moe raked. Which number could be Curly's total (select all that apply)?
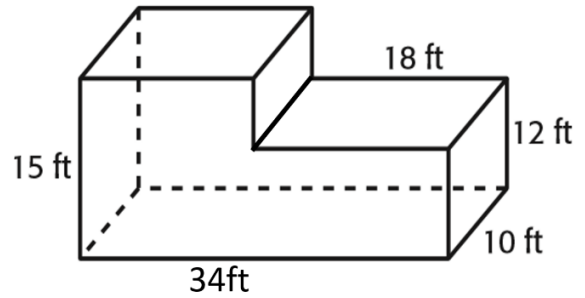   a. 1,999
   b. 766,198
   c. 1,000,001
   d. 1,999,234
   e. 18,764,666

15) **Pathway to College:** According to the Wall Street Journal, out of a total of $11 Billion in scholarships awarded each year, 13% were athletic scholarships and 87% were academic scholarships. If 350,000 students received scholarships, how many more received academic scholarships than athletic scholarships?
   a. 45,500
   b. 52,299
   c. 74,000
   d. 259,000
   e. 304,000

16) **Cranking up the Volume:** What is the volume of the composite shape to the right?
   a. 1892cf
   b. 4530cf
   c. 4560cf
   d. 5100cf
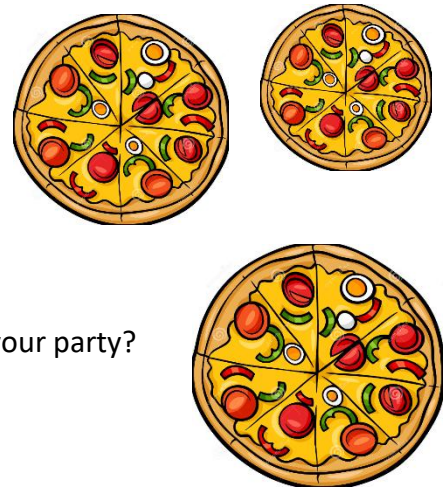   e. 6480cf

18 ft

12 ft

15 ft

10 ft

34ft

Question 17 is worth 8 points

17) **Getting a "Pizza" the Pie:** You are having a pizza party for you and 19 classmates. Alta Sierra Pizza has three sizes of pizzas: a 24" diameter Giganto, a 20" diameter Extra Large and a 15" diameter Large. They are priced as follows:
   - Giganto: $22.62
   - Extra Large: $15.71
   - Large: $8.84

Which of the pizzas is the best deal for you to get for your party?
   a. Giganto
   b. Extra Large
   c. Large
   d. All three are approximately the same value

NOTE: For the following 6 problems, you must show your work in the space provided. If you need additional space, use a second piece of paper. Your score will be determined by the methodology used, the accuracy of your answer and the quality of the work shown. For maximum credit, be sure to clearly show your work in an organized manner.

18) **Wheeling and Dealing:** You inherited $50,000 and want to invest it. STEAM Expo stock was selling for $40 per share. You decided to purchase 200 shares of stock. One year later, the stock was worth $80 per share. After you sold all 200 shares at the new price, how much is your inheritance now worth?

19) **Cooking up a Solution:** Your bakery had a very popular cookie and you kept selling out of it. You tried making twice as many, but then had some left over. You decided that the best solution was to make 1¾ batches. The original (single-batch) recipe is below. Determine how much of each ingredient would be required in the larger batch. List all responses in (reduced) fraction form. Be sure to show all work.

Single-Batch Recipe:
1 ½ cups of whole wheat flour
3 cups white flour
¾ cup oats
1 cup sugar
1.5 tsp salt
1.25 cups chocolate chips
1/3 stick of butter
3/8 cups of milk

1¾ Batch Recipe (fill in each amount):
Whole wheat flour:
White flour:
Oats:
Sugar:
Salt:
Chocolate chips:
Butter:
Milk:

20) **GREEN with Envy:** You are in the market for a new car. Being green, you are also concerned about environmental issues. In addition to looking at cost and mileage, you are also be considering the amount of Carbon Dioxide (CO_2) the car will add to the environment. You have narrowed your search down to a Honda Fit and a Honda Accord Hybrid. Manufacturing and transportation of the Fit results in 10 tons of CO_2, while the Hybrid results in 20 tons. The Fit gets 36 mpg and the Hybrid gets 48 mpg. A gallon of gas burned in a car produces 20lbs of CO_2. If you plan to drive 12,000 miles per year and keep the car for 5 years, which vehicle is the best environmental choice, based on CO_2 production, and what is its total CO_2 production for each car?

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21) **Road Trip:** Amtrak recently added a bus route that goes from Sacramento to Salt Lake City. The route begins in Sacramento, passes through Reno, continues through Winnemucca and then on to Salt Lake City. Taking I-80, it's 130 miles from Sacramento to Reno. It's 520 miles from Reno to Salt Lake City and 353 miles from Salt Lake City Winnemucca. How far is it from Sacramento to Winnemucca?

22) **Fishing for a Loan:** Having a great idea for a new business, you applied for and were given a spot on Shark Tank. You asked the panel for $350,000 to help pay for internet advertising and website development. You received the following offers:

- Kevin: A $350,000 loan for 1 year, with a 10% simple interest rate
- Lori: A $230,000 loan for 1 year, with a 12.6% simple interest rate
- Mark: A $150,000 loan for 1 year, with a 21% simple interest rate
- Daymond: A $385,000 loan for 1 year, with a 7.6% simple interest rate

Which loan would result in you paying back **the least amount of interest**, and how much interest would you pay?

23) **Pokémania:** Ivy Saur was getting ready for the upcoming Pokémon convention. She had been saving her allowance for 7 weeks. Each week, she earned $43.50 for babysitting and $47 for mowing lawns. She wanted to buy the following:

   - 5 Ivysaurs (her favorite) for $17.50 each
   - 3 Venusaurs for $26.25 each
   - 2 Charmanders for $15.75 each

With her allowance money in hand, she went to the convention. There was a $15 entrance fee to get in and she purchased all of the items above. Did she have enough money to purchase everything above and, if so, how much money did she have left?