**Choose the letter of the answer to each problem. In all cases, NOTA means “none of these answers”.**

1. Our story begins under the pool of the Chiles gymnasium where Alex is crafting his best invention yet: a time machine. Why might he be creating this insightful contraption, you may ask? The answer is really quite silly… Alex would like to travel back in time to 1760 to explore one of the greatest periods of history: the Industrial Revolution. What is the prime factorization of 1760?

**A) B) C) D)**

**E) NOTA**

1. Before he leaves, Alex needs to decide who to bring along with him on this exciting journey. Given that he has 5 friends, how many different ways can Alex arrange his friends in a line?

**A) 120 B) 20 C) 14 D) 5 E) NOTA**

1. Alex is now ready to embark on his trip to explore the industrial revolution. The first stop: John Kay’s workshop. John Kay was an English inventor who created the Flying Shuttle, a tool that allowed a single weaver to weave much wider fabrics than before (12 inches!). Prior to the creation of the Flying Shuttle, fabrics could only have widths of 10 inches. By what percent is the width increased.

**A) 10 B) 20 C) 83 D) 120 E) NOTA**

1. While exploring John Kay’s workshop David gets hungry and decides to sneak off for food. He yearns for a traditional 18th century English meal. Luckily, John Kay’s workshop is located in England, and David spots a bangers and mash shop right away. Given that the shop is located 100 meters from John Kay’s workshop and David walks at a steady pace of 5 meters per second, how long, in milliseconds,will it take David to walk a round trip to the bangers and mash shop and back? (1 second = 1000 milliseconds)

**A) 20 B) 40 C) 80 D) 160 E) NOTA**

1. Back at John Kay’s workshop, Lindsay takes notice of what appears to be a prototype of some sort of invention. The prototype consists of two cubes stacked on top of each other. If one cube has a side length of 3 meters, and the other has a side length of 6 meters, what is the total volume, in cubic meters, of the cubic contraption?

**A) 243 B) 216 C) 200 D) 27 E) NOTA**

1. After exploring John Kay’s workshop, Alex and his friends decide to get back in the time machine and travel to meet another English inventor: James Hargreaves. Hargreaves was credited for the creation of the Spinning Jenny, a revolutionary tool that allowed workers to spin more wool at a given time. If a worker can spin 10 rounds of wool in 8 hours, how many rounds of wool can they spin in 12 hours?

**A) 10 B) 15 C) 20 D) 25 E) NOTA**

1. A Spinning Jenny consists of a metal frame, 8 wooden spindles, and 8 rovings. If Jason would like to build 2 Spinning Jennies, then how much would the total supplies needed cost? A metal frame costs $9.95, a wooden spindle costs $0.99, and a roving costs $1.99.

**A) $21.19 B) $28.99 C) $33.79 D) $67.58 E) NOTA**

1. Brighten is very interested in round things and takes great pride in his lucky hair. Immediately after arriving at Hargreaves’s workshop, Brighten takes notice of just how round the wheel on the Spinning Jenny is. It’s almost a perfect circle! In order to take a closer inspection, Brighten must solve a challenging math problem. Given the set of equations below, what is the positive abscissa?

**A) 0 B) 8 C) 12 D) 24 E) NOTA**

1. Legend has it that James Hargreaves was inspired by his 13 children to create the Spinning Jenny. Yasmine, his oldest daughter, is 3 times older than Cheyenne, his youngest daughter. His youngest son, Jack, is 2 years older than Cheyenne. How old is Yasmine now if the sum of Cheyenne and Jack’s ages in 6 years will equal her age in 6 years?

**A) 18 B) 21 C) 24 D) 27 E) NOTA**

1. After meeting James Hargreaves and viewing his Spinning Jenny, Hayden really needs to go to the restroom. If Hayden is at point (10,19) and the restroom is at point (12, 6), what is the slope of the path between Hayden and the restroom?

**A) 2 B) 6 C)**  **D)**  **E) NOTA**

1. While in the restroom, Hayden starts thinking about the Industrial Revolution (We’ve all done this before…). Where would society be without it? The answer is unclear, but what is the number of prime numbers less than 100? How many exactly are there?

**A) 21 B) 22 C) 23 D) 24 E) NOTA**

12. This week Watts put coal in his engine when it was half empty. Five days

later, Watts put coal again when the engine was about three fourths full. If Watts

bought 24 pounds of coal total, how many pounds of coal does the engine hold?

**A) 8 B) 12 C) 24 D) 32 E) NOTA**

13. Watt’s invented the steam engine which integrated a crankshaft and a gear. If there

are 4 different types of crankshafts and 2 different types of gears, how many

different steam engines can be created using 1 gear and 1 crankshaft?

**A) 2 B) 4 C) 6 D) 8 E) NOTA**

14. The steam engine would eventually lead to incredible improvements in almost all

industries, including the textile industry, across the world. It would also lead to

the development of locomotives and massive leaps forward in ship propulsion. If

there is a ship located at point (7, 8) and it must first fill up gas at x = 5 and later

travel to its final destination at point (12, 10), what is the minimum distance the ship

can travel?

**A) 5 B) 7 C) 25 D) 49 E) NOTA**

15. While playing with the steam engine, Bryan accidentally touches a “big stuff”, releasing an influx of gas into the sky. In an attempt to reduce the released gas’s effects on the environment, Bryan uses a spherical bag with a diameter of 6 to capture back the majority of the gas. What is the surface area of the spherical bag? Hint : surface area = 4πr2.

**A) B) C) D) E) NOTA**

16. It turns out Sihala was snooping around at the Chiles gymnasium, and he discovered Alex’s backup time machine. He and another group of friends also decide to travel back in time to experience the Industrial Revolution. Alex and Sihala’s groups decide to meet up by riding some trains. The two trains are 720 miles apart and they are heading directly toward each other. One train travels at 120 mph and the other travels at 180 mph. What is the total distance the slower train travels before the trains meet each other?

**A) 144 mi B) 288 mi C) 300 mi D) 432 mi E) NOTA**

17. The groups meet up at Robert Fulton’s workshop. Fulton was famous for the

steamboat which revolutionized transportation. However, they need help answering this

question in order to enter: How many ways can 10 be written as a sum of 1’s and 2’s

where different orderings count as different ways (i.e., is different

from )?

**A) 85 B) 89 C) 92 D) 95 E) NOTA**

18. Robert Fulton was busy building a boat, and he was doing some essential

calculations needed for finishing up his project. Help him with his calculations by

answering this question: The average of a set of 5 distinct positive even integers is 8.

What is the largest possible number that could be included in the set?

**A) 20 B) 22 C) 24 D) 26 E) NOTA**

19. Big Wes, being the hyper boy he is, got bored of the workshop really quickly. He

convinced the gang to leave with him and start their own business. But first, time for an

orange juice break. How much of a 70% orange juice drink must be mixed with 44

gallons of a 20% orange juice drink to obtain a mixture that is 50% orange juice?

**A) 44 B) 45 C) 65 D) 66 E) NOTA**

20. The Industrial Revolution introduced many new agricultural techniques. Filippo

decided to start a mushroom farm, and he needs to fence off a rectangular plot of land.

He has 60 meters of fencing material and the gang decides to build the farm with one of

the four boundaries being the factory building (assume the factory is longer than 60

meters). The other three sides will need to be fenced with fencing material. What is the

largest possible area of land, in , Filippo can fence off?

**A) 360 B) 400 C) 450 D) 480 E) NOTA**

21**.** Diseases such as cholera and typhoid were devastating diseases during the Industrial Revolution. Kayden wanted to simulate disease spread in an experiment. In his experiment, a disease has infected 2% of the population and a test is used to determine whether someone has the disease. If the test is accurate 98% of the time, what is the probability that a person testing positive for the disease actually has the disease?

**A) 0.05 B) 0.125 C) 0.375 D) 0.50 E) NOTA**

22. Kayden continues his experiments with diseases. A bacteria population increases

by 200% every hour. If the initial population was 80, what will it be after 3 hours?

**A) 480 B) 1600 C) 2160 D) 512,000 E) NOTA**

23. It has only been a couple of days and Big Wes’s business has already made big profits. So, Wes decides to read a book. After Wes opens the book, he notices that the product of the two page numbers on the facing pages is 650. What is the two sum of the two page numbers?

**A) -51 B) -50 C) 51 D) 52 E) NOTA**

24. Locomotives were also being developed that allowed people to travel more math

efficiently. Vera and Kaitlyn both want a free locomotive, and whoever answers this

question correctly gets the locomotive. Given , what is the

value of *a* that makes f(x) have only one distinct root?

**A) 3 B) 6 C) 9 D) 12 E) NOTA**

25. The Bessemer process was a refining procedure that allowed steel to be mass produced from pig iron. Jason uses this process when working at Big Wes’ factory, and he must meet a steel object quota monthly. Each day, he makes of the number of steel objects he has left to make. If he has one left to make on the 30th day, which day of the month did he have nine left to make?

**A) 20 B) 22 C) 26 D) 27 E) NOTA**

26. As a reward for doing such a good job, Big Wes decides to give Jason a pat on the back, but only if he can answer this question. Which property is this an example of :

(7 · 6) · 5 = (6 · 7) · 5 ?

**A) Associative B) Commutative C) Distributive**

**D) Inverse E) NOTA**

27. Fortunately, Jason got the last problem correct; however, Big Wes wants Jason to

prove his worth once more. Help Jason prove himself by answering another

question: What is the slope of a line perpendicular to 2x + 3y = 10 ?

**A)**  **B)**  **C)**  **D)**  **E) NOTA**

28. Filippo’s mushroom farm has been generating big profits. In the past three days, he

has made $275, $323, and $224. Let

. If a, b, c are all positive real numbers, then what is the value of

?

**A) 1644 B) 822 C) 411 D) 205.5 E) NOTA**

29. The gang has decided to finally end their time traveling journey. However, Cyrus accidentally locked the door to the time machine and set a random password. The square root of a number plus two is the same as the number. What is (are) the number(s)?

**A) 2, -1 B) 2 C) -1 D) 0 E) NOTA**

30. Well, that was quite the adventure. The gang visited numerous Industrial Revolution figures, learned about diseases, and even got locked out of their own time machine. Here is the final problem before we go: A Basketball player has successfully made 36 of his 48 free throws. Find the number of consecutive free throws the player needs to increase his success rate to 80%.

**A) 24 B) 12 C) 6 D) 0 E) NOTA**