NOTA stands for "none of these above." Good luck and have fun!

1. We are playing a game of tag in a long hallway. The hallway has LED strips on either side of the hallway. If zero or one lights are lit, I can move to an unlit wall and sneak towards you. If both lights are lit, my position is revealed and you will begin to run. The left LED strip cycles every 34 seconds – 1 second on, 33 seconds off. The right LED strip cycles every 51 seconds – 1 second on, 50 seconds off. I noticed that both lights just turned off. How long, in seconds, do I have to sneak to you before you see me again?

   A. 17 B. 34 C. 51 D. 102 E. NOTA

2. A velociraptor chasing after you! You first notice it when it is 100 meters behind you, and you start running. Unfortunately for you, whatever speed you run at, the velociraptor runs 10 meters per second faster. How many seconds do you have before your inevitable combat against the velociraptor?

   A. 1 B. 10 C. 90 D. 1000 E. NOTA

3. My cow is tied to the corner of my barn. His rope is exactly 60 meters in length. The dimensions of my rectangular barn are 50 meters by 100 meters. Assuming the cow is incapable of digging or jumping, how large of an area, in square meters, can the cow roam?

   A. 2700 B. 2700 π C. 2725 D. 2725 π E. NOTA

4. You have your back to an infinitely long, infinitely high wall and are trying to shout as loudly as you can. Assume for the purposes of this question that sound waves cannot travel through solid objects, the earth is flat, and you have no height. Your shouts travel for half a kilometer before becoming inaudible. What is the volume of space, in cubic kilometers, for which your shouts are audible?

   A. $\frac{\pi}{24}$ B. $\frac{\pi}{16}$ C. $\frac{\pi}{6}$ D. $\frac{\pi}{4}$ E. NOTA

5. You have a circle inscribed in an equilateral triangle. Since you lack measuring tools, you call the side length of the triangle S. In terms of S, what is the area of the inscribed circle?

   A. πS^2 B. $\frac{\pi S^2}{4}$ C. $\frac{\pi S^2}{8}$ D. $\frac{\pi S^2}{12}$ E. NOTA

6. I am hungry for chicken nuggets. The boxes available contain either 5 or 7 nuggets, causing me to hunger for knowledge. What is the largest integral number of nuggets that I cannot obtain solely through buying boxes of 5 and 7 nuggets?

A. 1 B. 13 C. 23 D. No maximum E. NOTA

7. You spot a plane passing nearby. Through your quick calculations, you determine that the horizontal distance between you and the plane is 2 kilometers. You also know that this is a commercial passenger plane, which cruises at an altitude of 10,000 meters. How far, in kilometers, is the plane away from you?

A. 8 B. $2\sqrt{26}$ C. 8000 D. 9998 E. NOTA

8. I, too, see the plane passing overhead. I, too, know that the passenger plane is at an altitude of 10,000 meters. My rangefinder tells me that the plane is 20 kilometers away from me. What is the angle of elevation, in degrees, from me to the plane?

A. 0° B. 30° C. 60° D. 90° E. NOTA

9. You have a case of nervous jitters. I have a blue pill and a red pill. The blue pill has a 30% chance of curing you, while the red pill has a 100% chance of curing you. I blindfold you and give you a pill. You are happy because you are cured. What is the probability that you took the red pill?

A. $\frac{1}{2}$ B. $\frac{8}{13}$ C. $\frac{10}{13}$ D. 1 E. NOTA

10. My preferred drink is a 2% sugar solution. I currently have 15 grams of a 1% sugar solution. How many grams of pure sugar would I need to add in order to have a 2% sugar solution?

A. 0 B. $\frac{15}{98}$ C. $\frac{15}{196}$ D. 15 E. NOTA

11. The decibel scale measures the energy of sound waves using a base-10 logarithmic scale and is computed as $D = 10\log_{10}\frac{I}{I_0}$, where D is the decibel measure, I_0 is the standard threshold of hearing, and I is the energy of the sound. Human yells are generally 90 decibels. Suppose my car horn produces a sound of 110 decibels and your yell is a typical human one. What is the ratio of my car horn's sound energy to the sound energy of your yell?

A. $\frac{11}{9}$ B. 20 C. 100 D. 200 E. NOTA

12. I am the proud owner of a pool. The drain on this pool can drain 2 liters per second, while a hose fills the pool at a rate of 1.5 liters of fluid per second. The pool starts with 200 liters of water with the drain open and the hose turned on. How long, in seconds, does it take to fully drain?

A. 100 B. 200 C. 300 D. 800 E. NOTA

13. I am laying concrete over a hole deep in the forest. The hole is of the shape $|x| + |y| = 4$, and I fill it with 64 cubic units of concrete. How deep, in units, is the layer of concrete?

A. 1 B. 1.5 C. 2 D. 2.5 E. NOTA

14. My virus population starts at 23 and declines continuously, halving every day. How long in days before my population reaches 9?

A. $\log_2\frac{23}{9}$ B. $\log_{\frac{1}{2}}\frac{23}{9}$ C. $\log_{\frac{1}{2}}23$ D. 2 E. NOTA

15. I develop a machine. The basic structure of the machine consists of two circles of radii 2 and 6, with their centers 8 units apart. However, I need a band to wrap around these circles. What is the length of the shortest band that will wrap around both circles?

A. 8 B. 16
C. $\frac{8\pi}{3} + 8\sqrt{3}$ D. $\frac{28\pi}{3} + 8\sqrt{3}$ E. NOTA

16. Frank's test average in Mr. Lu's math class is an 87. He has taken 3 tests so far, and has one test left to salvage his grade to an A (90.0). Assuming all tests are weighted the same and grades do not round, what is the minimum integer score Frank needs to get an A in Mr. Lu's class?

A. 98 B. 99 C. 100 D. Impossible (he needs to score over 100) E. NOTA

17. Heath Ledger has a non-standard 54 card deck, which is comprised of a standard 52-card deck and two Jokers. He draws two cards without replacement – what is the probability that he draws both Jokers?

A. 0 B. $\frac{1}{2862}$ C. $\frac{1}{1431}$ D. $\frac{2}{1431}$ E. NOTA

18. Knowing that January 1st, 2020, fell on a Wednesday, what day of the week was July 28th, 2020?

A. Tuesday B. Wednesday C. Thursday D. Friday E. NOTA

19. Frank's tunnel, in the shape of a parabolic arch, follows the equation $y = -x^2 + 6x - 7$ for $y > 0$. Unfortunately, a major flood has filled the tunnel with water up to the latus rectum of the tunnel. He wants to send in a drone to inspect the damage, but the drone cannot touch the water. How tall is the tallest drone with width 1 unit that will fit through the flooded tunnel?

A. 1/4 B. 1/2 C. 1 D. no drone will fit E. NOTA

20. Humans are indistinguishable; cats are distinguishable. How many ways can three humans and two cats sit at a circular table?

A. 4 B. 5 C. 24 D. 120 E. NOTA

21. At Eastside High School, seniors can choose between psychology, anatomy, computer science, and math. If you know that there are 4 seniors taking all four classes, 17 seniors taking exactly three classes, 24 seniors taking exactly two classes, and 35 seniors taking only one class, how many seniors are there? Assume seniors cannot take zero classes.

A. 4 B. 24 C. 35 D. 80 E. NOTA

22. Compound interest is one of the most powerful forces in the world. If Frank deposits £568 into a savings account accruing 2% interest every year, compounded yearly, how much money, rounded to the nearest cent, will be in his account at the end of two years?

A. 0 (He gets robbed) B. £580.96 C. £585.47 D. £590.95 E. NOTA

23. Frank has a large cube with volume 12649337 cubic meters. What is its side lengths in meters? (Trusts me, the answer is an integer.)

A. 223 B. 227 C. 233 D. 237 E. NOTA

24. What is the value of the sum $1^2 + 2^2 + 3^2 + \ldots + 15^2$?

A. 120 B. 1240 C. 7200 D. 14400 E. NOTA

25. Frank is learning to pick locks. His favourite tool for the occasion is a modified paper clip, bent into the shape of a parabola. His tool takes the on shape of $4 - x^2$ for $-2 \leq x \leq 2$. What is the area bounded by his tool and the x-axis?

A. $\frac{2}{3}$ B. $\frac{8}{3}$ C. $\frac{32}{3}$ D. $\frac{64}{3}$ E. NOTA

26. Frank calls up his friend Slick Rick and makes a request of him. He will flip a fair coin five times. What is the probability that he flips 3 or more heads?

A. $\frac{1}{32}$ B. $\frac{1}{8}$ C. $\frac{1}{2}$ D. 1 E. NOTA

27. A ball rebounds to one-third of its previous height every time it bounces. Frank drops the ball from a height of 10 meters. In total, what distance does the ball travel?

A. 10 B. 15 C. 17 D. 20 E. NOTA

28. Eric and Erick play a game with a fair six-sided die. They take turns rolling the die, starting with Eric. On each player's turn, he rolls the die until a number that has never been rolled before is rolled. If that number is a 6, the player wins. Otherwise, the other player starts his turn. What is the probability Erick wins the game?

A. $\frac{1}{6}$ B. $\frac{1}{2}$ C. $\frac{2821}{7776}$ D. 1 E. NOTA

29. I need a new pen to prevent my horses from running off. I have also realised that I have a very long wall I can utilize to build my pen. I use the wall as one side of my rectangular pen and only have 20 meters of fencing, what is the largest area, in square meters, my pen can cover?

A. 20 B. 50 C. 100 D. 400 E. NOTA

30. You have done well to reach this far – but this question will surely break you. I hand you a slip of paper – on it reads the equation $x^2 = 4$. Solve for x.

A. -4568762 B. 2 C. 1567 D. 68357 E. NOTA