A Little Bit of Everything

CPC Competition Team Tryouts

[DECLASSIFIED]

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1 Mental Math

Rules - Section 1

There are 25 questions and 5 minutes. Each question is worth 1 point.

1. You have 5 minutes to complete this test
2. No points are deducted for incorrect answers
3. You may only use a writing utensil (you may not use a calculator)
4. Scratch paper will be provided
5. Unless otherwise stated, you may give your answer as a simplified fraction or decimals. Answers left not simplified will be marked incorrect

It is unlikely you will finish. Don't get stuck.

Name: _____ **Date:** _____

1. $\binom{60}{2}$ _____
2. 20 permute 3 _____
3. $16802/? = 8$ give a decimal _____
4. $? * 12 + 3(? + 4) = 17$ _____
5. $120 * 42.5$ _____
6. $\frac{4}{112} * \frac{57}{10} * \frac{40}{3}$ _____
7. $7!$ _____
8. $\binom{15}{3}$ _____
9. $5.2 * 13 * 4$ _____
10. $48536/? = 12$ _____
11. $? * 17 - 6(? - 7) = 103$ _____
12. $75 * \frac{36}{5}$ _____
13. $18.6 * 200/5$ _____
14. $\binom{13}{3}$ _____
15. 47^2 _____
16. $90 * 52.4$ _____
17. $\frac{5}{100} * \frac{18}{4} * \frac{12}{9} * \frac{3}{7.25}$ _____
18. $19 * 702.5$ _____
19. $1 = 5(0.2? - 0.6?) - 2.15$ _____
20. $1282.15 - 48.0325 + 32000.00049$ _____
21. $0.3 * 0.4 * 0.5 * 1.8$ _____
22. $\frac{2?}{23.5} + 5 = 9$ _____
23. 61^2 _____
24. $20*? - 4532.418 = 5000$ _____
25. 2^{10} _____

2 Fermi

Rules - Section 2

There are 10 questions and 20 minutes. Each question is worth 2 points.

Your goal is to provide an estimate of what question asks for within 1 order of magnitude of the answer.

1. You have 20 minutes to complete this test
2. No points are deducted for incorrect answers
3. Answers within 1 order of magnitude will be marked correct
   $|log(\frac{\text{your answer}}{\text{true answer}})| \leq 1 \implies$ correct
4. Scratch paper will be provided
5. You may only use a writing utensil (you may not use a calculator)
6. Answers may be in scientific notation but must be simplified (ex. 15*700*3 is *not* an acceptable answer, but 31500 or $3.15 * 10^4$ are)

Example question: How many slices of pizza are eaten in the U.S. yearly?
You will be uncertain. Try to *estimate*

Name: _____ **Date:** _____

1. How many undergrad students are there in the US? _____
2. How much does the Great Pyramid of Giza weigh? (you may answer in any unit of measurement) _____
3. How many people were born in 2024 in Spain? _____
4. How many costco hotdogs would the all the boston marathon runners need to collectively consume to be calorie neutral on the day of the marathon? _____
5. How many pennies would fill (*not* fit in) the volume of a tesla model X frunk (front trunk)? _____
6. How many miles, relative to the center of earth, does the ISS travel yearly? _____
7. How many donuts did Krispy Kreme sell in 2022? _____
8. How many total points have been scored NBA history? _____
9. How many gallons of jet fuel are consumed yearly in the US? _____
10. If you had the same number of Fever Points as the last four numbers of your SSN, how many points would you have? _____
11. **Bonus:** Determine the next term in the sequence: 1 2 5 5 9 7 11 6 9 0 _____

3 Probability, Combinatorics, and POKER

Rules - Section 3

There are 35 questions and 30 minutes. Each question is worth 1 point.

1. You have 30 minutes to complete this test
2. No points are deducted for incorrect answers
3. You may only use a writing utensil (you may not use a calculator)
4. Scratch paper will be provided
5. Unless otherwise stated, you may give answers without simplifying (ex. $\binom{7}{2} * 5!$)
6. Percentages may be given in $X\%$ or $0.X$ format
7. You may assume any reference to a "deck" of cards is a standard 52-card deck with 13 denominations and 4 suits
8. You may assume any reference to a "die" or "dice" is a standard 6-faced die numbered 1 through 6 with each event occurring with uniformly probability
9. You may assume any reference to poker (or hands such as a full house) are to the Texas Hold'em style game

Use your time wisely.

Name: _____ **Date:** _____

1. On average, how many times must a 6-sided die be rolled until a 6 turns up?

   _____

2. How many combinations of 2 card hands can you make from a standard deck? (3d4h $\neq$ 3h4d)

   _____

3. How many combinations of pocket pairs exist?

   _____

4. How many combinations of straight flush exist?

   _____

5. How many combinations of full house exist?

   _____

6. What is the probability you are dealt pocket Aces?

   _____

7. What are your pot odds facing an effective shove of 120 into a pot of 220?

   _____

8. Your hand is 5s4s. The flop comes 3sAh7s. How many flush outs do you have that do not create a straight flush?

   _____

9. Your hand is JhJc. The board comes 9hJs8hKd. Your opponent holds Ks10s. How many outs does your opponent have?

   _____

10. Determine the next term in the sequence: 1.5 0.5 1 0 0 -1 -2 -3 -6 -7

    _____

11. How many combinations of 2 card hands can you make from a standard 52 card deck if suits aren't distinct? (3d4h $\equiv$ 3h4d)

    _____

12. Determine the next term in the sequence: 0 3 6 11 18 29

    _____

13. How many 12 letter passwords can you make using the lower-case alphabet if your password must contain exactly 4 vowels (a, e, i, o, u) and no two vowels may be adjacent?

    _____

14. How many unique paths can you travel to arrive on (10,5) in the coordinate plane if you begin on (0,0), you can only travel up and right, and you travel in integer increments?

_____

15. Determine the next term in the sequence: 2 3 4 6 9 14 22

_____

16. Determine the next term in the sequence: 1 2 4 7 11 16

_____

17. Determine the next term in the sequence: $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{7}$ $\frac{7}{22}$ $\frac{22}{155}$

_____

18. What is the probability the sum of two dice is less than 6?

_____

19. What is the expectation of a game in which you pay 2$ to play, win 8$ a third of the time, lose 2.5$ a sixth of the time, and lose 1$ the remaining times?

_____

20. Determine the next term in the sequence: 3 1.5 4.5 2.25 9 4.5 22.5

_____

21. What is the probability of drawing exactly 5 spades in 9 cards without replacement?

_____

22. What is the expected value of the sum of 12 dice rolls?

_____

23. You're going to walk home from work. Home is 7 blocks away. There are cross walks at every intersection. Catching a stop light at an intersection will add $30 - n$ seconds to your arrival time, where n is the number of blocks you have traveled. How many unique arrival times are possible?

_____

24. Your opponent shoves (all-in) pre-flop against you for $275 effective into a pot of $700. What are your pot odds?

_____

25. You are facing a 30bb bet into a pot of 60bb on the flop. At least how often should you be defending to make sure your opponent can't always make this bet profitably?

_____

26. Your cards are 2h10s and the board runs 7s3s2sAhKs. How many combinations can your opponent hold that beats your hand?

_____

27. Your cards are Jd7d. The board comes AkAhAdKdAs. Your opponent bets 20bb into a pot of 15bb. At least how often should you defend?

_____

28. How many 5 card combinations can you make using a standard deck given you have two pairs and three cards belonging to one suit?

_____

29. Phil ivey plays the WSOP main event 85% of the time. When phil ivey is playing, there is a 30% chance an amateur wins. Phil hellmuth plays the WSOP main event 60% of the time. When phil hellmuth is playing, there is a 65% chance an amateur wins. Phil ivey and phil hellmuth never play together, but one of them always plays. Given an amateur has won the WSOP main, what is the probability phil ivey was playing?

_____

30. There is initially $400 in the pot. Your opponent then bets $400 on the river. You believe your opponent has you beat at 65% of the time. Should you call (y/n)?

_____

31. What is the probability you are dealt suited connectors (cards of the same suit that are adjacent in number)?

_____

32. There are 9 poker chips of equal weight and one of different weight. Using a scale, what is the minimum number of weighings needed to determine the different chip?

_____

33. How many ways can 3 cards be displayed linearly such that they are all consecutive?

_____

34. How many ways can you distribute 120 poker chips to 5 players (poker chips are identical, players are distinct)?

_____

35. A player has $105 of $5, $10, and $30 chips. How many combinations of chips can they have?

_____

4 ANSWERS

4.1 Mental Math

4.2 Fermi

1. 20,300,000
2. 5,700,000 tons — 1.14e+10 lbs — 5170953018 kgs
3. 306,347
4. $25554 * \frac{100*26.2+2500}{580} = 225,580.14$
5. 524,355.30
6. 150,234,000
7. 1,600,000,000
8. 13,674,031
9. 23,910,000,000
10. Between 0001 - 9999
11. **Bonus:** 1

4.3 Probability, Combinatorics, and POKER

1. 6
2. $1326 = \binom{52}{2}$
3. $78 = 13 * \binom{4}{2}$
4. 40 (36 without royal)
5. $3744 = 13 * 4 * 12 * \binom{4}{2}$
6. $\frac{6}{1326}$
7. $\frac{120}{120*2+220}$
8. 8
9. 8
10. -14

11. 13^2 or 91
12. 46
13. $21^8 * \binom{5}{4} * 4! * \binom{13}{4}$
14. $\binom{15}{5} = 3003$
15. 35
16. 22
17. $\frac{155}{22*155+1}$
18. $\frac{10}{36}$
19. $-2 + \frac{8}{3} + \frac{-2.5}{6} + \frac{-1}{2}$ = -0.25
20. 11.25
21. $\frac{\binom{13}{5}\binom{39}{4}}{\binom{52}{9}} = 0.0287727$
22. $3.5 * 12 = 42$
23. 22
24. $\frac{275}{700+275*2}$
25. $\frac{2}{3}$
26. $3 * 44$
27. 100%
28. $\binom{13}{2}\binom{4}{2}(\binom{4}{2} - 1)(13 - 2)$ (Yes, cases with two draws to the third suited card are double counted, but they are half drawn to, so it should even out...)
29. $\frac{0.3*0.85}{0.3*0.85+0.6*0.65}$
30. Yes
31. 2/51
32. 3
33. $12 * 4^3$
34. $\binom{124}{4}$
35. 21