



2017
quark
SHIFTING PARADIGMS



qSAT

(Quark Scholastic Aptitude Test)
(For Level 2: Students of Class 11th and 12th)

Time: 2 Hours

Maximum Marks = 200

Read all the Instructions carefully.

Instructions:

A. General

- This booklet is your question paper and it has **11 pages**
- A blank page is provided at the end for your rough work (don't use any additional sheet for rough work).
- Use of blank papers, slide rules, calculators or any electronic gadget in any form is not allowed.
- **The answer sheet is separately provided.** Make sure you fill in your details on the answer sheet.

B. Question Paper Format

- The Question paper contains **25 questions divided into 10 sections.**
- All section contains different number of questions.

C. Marking Scheme

- The marking scheme of each section is different.
- Adjacent to the section name the marking scheme for that section is mentioned.
(Format: No. of Questions x marks per Question = Total marks of that section, negative marks for each question)

All the Best!!!

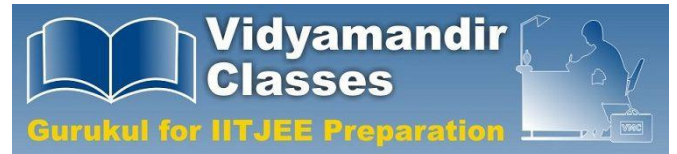


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SECTION 1: WARM UP

(5x 6 =30; -3 for incorrect)

Q.1. There is a cube of side 1cm length. What are the maximum number of faces of the cube you can see directly? (no mirror, only you and the cube)

Q.2. Given the following series-

1, 2, 2, 1, 1, 2, 1, 2, 2, 1, 2, 2, 1, 1, 2, 1, v, w, x, y, z ...

Find the value of $2vw + xy - z + xz$?

Q.3. Given the following series-

4, 6, 8, 9, 10, 12, x, y, z.

Find the value of $2y - x - z$?

Q.4. You have 100 kgs tomatoes, which are 99 percent water by weight. You let them dehydrate until they are 98 percent water. The weight of the remaining tomatoes is x, then find the sum of prime factors of x.

Q.5. If we try to find out numerals in place of the following letters to make the following true, then we get two unique solution sets. The sum of values of all the letters in both the solutions is S. Then find the value of $[S/10]$ where $[x]$ is the greatest integer less than or equal to x.

TWO
+ THREE
SEVEN

TWELVE



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SECTION 2: SHERLOCK IS BACK

(1 x 6 = 6; - 3 for incorrect)

Once again, after so many years of wait, when everyone had thought Sherlock had a great Reichenbach Fall, he is back now but is trapped in a maze. This time, Moriarty has been quite careful in the designing of the maze. Moriarty knows that Sherlock is a grandmaster at chess, so instead he modifies the game of chess and makes it 3 dimensional. Now suppose the king is allowed to move to a square which has one side adjacent with its current position. It can also go inside the volume of the cube. If each face of the cube has 8 faces, in how many ways the king can go from one corner of the cube to the diagonally opposite end? If the answer of this question is x , then find the number of prime factors in the sum of digits of x .

SECTION 3: FINANCIAL CRISIS

(1 x 7 = 7; -4 for incorrect)

Its New Year time and Sherlock is still solving crimes but this is a pretty easy one. Moriarty is out of town for vacations so his men are not doing a good job and work is becoming too easy for Sherlock. So, Sherlock has also decided to go for a vacation and left his assistant Watson to solve the problems. Moriarty's men have sent him 12 coins and a weighing scale. One of the coins is not of the same weight as all the others. Your job is to find out the minimum number of weighing required to find out the coin which has the different weight.



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SECTION 4: STILL TRAPPED

(1 x 8 = 8, -4 for incorrect)

Though the mastermind Moriarty had modified the game of chess, he was still in doubt whether or not he will be successful or not because after all, Sherlock was a grandmaster at chess. So Moriarty decided to design another puzzle. In order to solve a mystery crime, Sherlock worked out that Moriarty was fond of counting figures. Hence help Sherlock count the number of triangles in the following figure. If the number of triangles are x , then find the sum of the digits of x .





SECTION 5: CIRCULAR CIRCUMFERENCE

(3 x 8 = 24; -5 for incorrect)

Sherlock, Watson and his team are sitting on a round table and discussing the possible strategies to eradicate Moriarty forever. But Moriarty as we all know, doesn't keep quiet for long. He has trapped Sherlock again and asked him to solve the following puzzle. Moriarty's men have given each of Sherlock's team members a switch and a light is placed on the top of everyone. Each switch if pressed once, will toggle the light of three persons, the one who pressed it and the two adjacent ones. Initially all lights are switched off. Help Sherlock solve the following-

Q.1) If there are 1000 members in Sherlock's team, then find the minimum number of times Sherlock's team has to press the switch to turn on all the lights. If the answer is x , then find the sum of digits of the number of factors of x (including x).

Q.2) If there are 3000 members in Sherlock's team, then find the minimum number of times Sherlock's team has to press the switch to turn on all the lights. If the answer is x , then find the sum of digits in the sum of all factors of x (including x).

Q.3) Now define a function f such that $f(x) =$ Minimum number of presses required to turn on all the lights if there are x people in the team. Now if

$$\sum(i) = x \quad (i=5 \text{ to } i=20)$$

Then find the value of $[x/20]$ where $[x]$ denotes the greatest integer smaller than or equal to x .



SECTION 6: LET THE MATHNESS BEGIN

(5 x 10 = 50; -5 for incorrect)

Sherlock has been very easily solving all the questions upto now, (yeah, that's why you're here, pun intended). Moriarty now wants Sherlock to solve some easy math problems to continue his further investigation. He has kept 4 hostages and each question will free each one of them. Help Sherlock save lives of all the hostages.

Q.1) Moriarty likes decimal expansion of fractions. So, help him find the 49th digit after the decimal point in the decimal expansion of $1/9801$.

Q.2) There is a rectangle with area $A = 24$ square units. One set of opposite corners is folded at an angle of 45 degrees in the same plane. The other set of corners is at their original place and the resultant parallelogram has area $A' = 15$ square units. If the perimeter of the original rectangle is x then the sum of digits of x is?

Q.3) A mystic circle is a circle in which numbers are written from 1-32 in such a way that the sum of any two adjacent numbers is a perfect square. If the number of times squares 4, 9, 16....49 appear are a_1, a_2, a_3, a_4, a_5 and a_6 respectively. Then if the value of $\sum_{i=1}^6 ia_i$ is x , then find the value of $x-143$.

Q.4) Given the equation:

$$\left(1 + \frac{1}{x}\right)^{x+1} = \left(1 + \frac{1}{1999}\right)^{1999}$$

If the sum of all real x that satisfy the above equation is S , then find the number of trailing zeroes in the value of $[S/5]$ where $[x]$ is the greatest integer less than or equal to x .

Q.5) The number of positive integral values of n such that

$$n^3 + 2n^2 + 9n + 8$$

$$n \leq 100$$

Is a perfect cube are?



SECTION 7: ARE YOU SHERLOCKED?

(2 x 8 =16; -4 for incorrect)

Mr. Brain Drain is an old client of Sherlock. As his name suggests, his brain has been completely drained by Moriarty. He was an excellent puzzle solver and people used to consult him for solving problems. Then a tragic incident took place to which everyone was oblivious. Hence, he still receives puzzles. Help Mr. Brain Drain solve the following-

Q.1) If $1+2+3 = 100513$; $2+3+4 = 201325$; $3+4+5 = 342541$, then if the value of $4+5+6$ is a 6 digit number ABCDEF, then find the value of $A+B+C-D-E-F$.

Q.2) We define a modulo function and say $a \equiv b \pmod m$ if $a-b$ divides m . Now given the following properties, your task is to find the smallest number n which obeys this properties-

$n \equiv 1 \pmod 2, \quad n \equiv 2 \pmod 3, \quad n \equiv 3 \pmod 4, \quad n \equiv 4 \pmod 5, \quad n \equiv 5 \pmod 6, \quad n \equiv 6 \pmod 7$

$n \equiv 7 \pmod 8, \quad n \equiv 8 \pmod 9, \quad n \equiv 9 \pmod 10$

If ' $n-19$ ' is a perfect square of a two digit number, then find the sum of digits of the two digit number.

Q.3) Sherlock likes to solve rubix cubes. But here comes a beautiful variation. There is a cube which is painted red on one face and blue on the opposite face. The other faces are not coloured. Now this cube is cut into 343 small pieces. Then if the number of pieces which have no paint on them is x , then find the sum of digits of x .

Q.4) 1
 1 1
 2 1 1
 1 2 1 1
 1 1 1 2 2
 ??????????????

If the sum of values of the missing numbers is a two digit number AB, then find the value of $2*A + B$.



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Q.5) There are two eggs. Your task is to find out their strength. You are placed in a 100 storey building, and you can drop the eggs from any floor to check if they break or not. Both the eggs have the same strength. If the minimum number of ways in which you can drop the eggs to find out that from which floor it breaks is a two digit number AB, then find the value of $2*B + A$.



SECTION 8: THE FINAL PROBLEM

(3 x 15 = 45; -7 for incorrect)

To everyone's surprise, Jim Moriarty, the mastermind who trapped Sherlock in New York is back. He exclaims, "Miss me? Did you miss me?" Sherlock is stunned and cannot believe what is happening around. However, Moriarty has come up with a case which adds to the surprise element of Sherlock as he is in a state of shock. Help Sherlock solve the final problem.

PS: Smoking is injurious to health.

There are 5 houses labelled from 101-105 (in order) painted 5 different colors from 1 to 5. Persons that reside in the house are of different nationality labelled from 6-10. The 5 people like different chocolates labelled from 11-15 and smoke a different brand of cigar labelled from 16-20. All of the 5 have a taste of different type of ice cream which are labelled from 21-25. No two people have similar tastes in anything.

Person with nationality 6 lives in a house with color 1.

Person with nationality 7 likes ice cream 21.

Person with nationality 8 like chocolate 11.

The house with color 2 is located on the left side of the house with color 3.

The person who owns the house with color 2 likes chocolate 12.

The person who smokes 16 likes ice cream 22.

The person who owns house with color 4 smokes 17.

The person residing at the center loves chocolate 13.

The man with nationality 9 resides in house number 101.

The person who smokes 18 has the neighbor who loves ice cream 23

Person who likes ice cream 24 lives next to the person who smokes 17.

The owner who smokes 19 likes chocolate 14.

The person with nationality 10 smokes 20.

Man with nationality 9 lives next to the house with color 5.

Person who smokes 18 lives next to the person liking chocolate 15.

Q.1) If the sum of values of (color, nationality, chocolate and cigar) of the person who likes ice cream 25 is x , then find the number of prime factors of x .

Q.2) If the sum of values of (nationality, chocolate, cigar and ice cream) of the person who resides in the house with color 5 is x , then find the value of sum of digits of x .

Q.3) If the sum of values of (color, nationality, cigar and ice cream) of the person who chocolate 15 is x , then find the value of $(x-5)/8$.

Rough Work



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