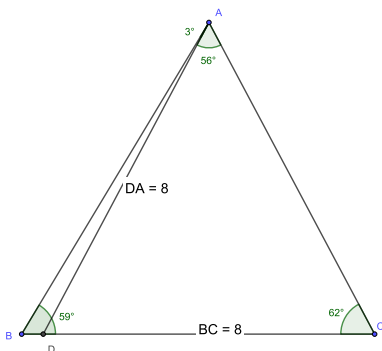# IOQM 2022 - 23
Explanations for queries received

There were queries on Q13, Q17, Q19 and Q22. There were no significant queries on other questions.

13. A triangle with the maximum angle for $\angle ABC = 59°$ is shown below.

17. We need the smallest positive integer N such that $f(f(f(N))) = 97$. Note that 389 is a prime and

$$f(f(f(389))) = f(f(388)) = f(194) = 97$$

Thus the answer is $\lfloor \sqrt{389} \rfloor = 19$.

19. The question asks for the number of values $x+2y+3z$ can take when $x+11y+111z = 1000$. Note that when $x + 11y + 111z = 1000$, we will have $x + 2y + 3z = n$ 1's in the string.

It is not difficult to see that under the condition $x+11y+111z = 1000$, $x+2y+3z$ takes 108 values. Hence the answer is $1 + 0 + 8 = 09$.

22. It is not difficult to show that for $n \geq 5$, F_n satisfies the recurrence

$$F_n = F_{n-1} + F_{n-3} + F_{n-4}$$

It is easy to see that $F_1 = 0, F_2 = 1, F_3 = 3$ and $F_4 = 4$. Using the recurrence, we compute the values of F_n to obtain

$$0, 1, 3, 4, 5, 9, 16, 25, 39, 64, 105$$

and hence the smallest value of n for which $F_n > 100$ is 11.

IOQM 2022 - 23 Final Answers

QNo	1	2	3	4	5	6	7	8	9	10	11	12
Answer	10	67	60	10	95	43	35	32	*	88	08	*
QNo	13	14	15	16	17	18	19	20	21	22	23	24
Answer	59	16	25	18	19	70	09	03	74	11	29	81

* - The questions 9 and 12 had errors in their statements and all students will be awarded marks for them.