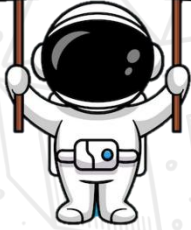




A TRADITION OF EXCELLENCE



INSTRUCTIONS

You are about to take Copernicus Exam.

Please read the followings carefully.

1. The exam has 25 multiple choice-questions. Each question weighs 4 points. The maximum score a student can get is 100. There is a penalty of one point for each incorrect answer. So only answer the questions you are sure of.
2. Start with the easier questions, you can always come back to the questions you leave.
3. The time allocated for the exam is 60 minutes. You will start when the invigilator tells you to start.
4. You are required to comply with the directions given by the head invigilator before the examination.
5. Those who are taking the exam with a mobile phone **MUST** make sure that during the examination no one calls.
6. If anything in the examination is unclear, you can contact the invigilator.
7. Where permitted you may use a translation dictionary.
8. Students must not give or receive assistance of any kind during the exam. Any cheating, any attempt to cheat, assisting others to cheat, participating therein, or engaging in such improper conduct is a serious violation and will generally result in disqualifying.

Remember that "Hard work beats talent when talent doesn't work hard"
We wish you the very best luck on the exam.



1. What is the value of $2020 \cdot 2024 - 2010 \cdot 2034$?

- A) 2022
- B) 1011
- C) 400
- D) 140

2. Calculate the value of

$$\frac{1}{3} + \frac{1}{15} + \frac{1}{35} + \frac{1}{63} + \frac{1}{99} + \frac{1}{143}$$

- A) $\frac{2011}{2022}$
- B) $\frac{1}{2}$
- C) $\frac{6}{13}$
- D) $\frac{11}{13}$

3. What is the remainder when 2022^{16} is divided by 17?

- A) 1
- B) 2
- C) 15
- D) 16

4. Calculate the value of

$$\frac{1}{\sqrt{4}+\sqrt{5}} + \frac{1}{\sqrt{5}+\sqrt{6}} + \frac{1}{\sqrt{6}+\sqrt{7}} + \frac{1}{\sqrt{7}+\sqrt{8}}$$

- A) $2(\sqrt{2}-1)$
- B) $\sqrt{8}-\sqrt{4}$
- C) $\sqrt{2}$
- D) 0

5. Find the value of $\frac{x}{x^2+y^2} - \frac{y(x-y)^2}{x^4-y^4} - \frac{1}{x+y}$.

- A) x
- B) $x+y$
- C) $x-y$
- D) 0

6. Calculate the value of $\sin 40^\circ + \sin 20^\circ - \sin 80^\circ$.

- A) 0
- B) $-\sin 20^\circ$
- C) 0.5
- D) $\sin 20^\circ$

7. Find x if $x + x^2 + x^3 = 258$.

- A) 3
- B) 6
- C) 9
- D) 12

8. Find n , if $n + \lfloor \sqrt{n} \rfloor + \lfloor \sqrt[3]{n} \rfloor = 2022$. Note: $\lfloor x \rfloor$ is the biggest natural number no more than x .

- A) 1964
- B) 1965
- C) 1966
- D) 1967

9. How many triplets of prime numbers are solutions of the equation below?

$$3p^4 - 5q^4 - 4r^2 = 26$$

- A) 0
- B) 1
- C) 2
- D) 3

10. Calculate the value of

$$\left(\frac{2a}{a+2} + \frac{2a}{6-3a} + \frac{8a}{a^2-4}\right) \cdot \frac{a-4}{a-2}$$

- A) a
- B) $a + 2$
- C) $\frac{a}{a+2}$
- D) $\frac{4a}{3(a-4)}$

11. Find the value of $a + b - c - d$, if

$$\begin{cases} a + b + c + d = 20 \\ ab + ac + ad + bc + bd + cd = 150 \end{cases}$$

- A) 0
- B) 10
- C) 12
- D) 16

12. If $m = 32!$, which statement is true?

- A) $m < 2^{70}$
- B) $2^{70} < m < 2^{100}$
- C) $2^{100} < m < 2^{130}$
- D) $2^{130} < m$

13. Real numbers a and b satisfy the equations $3^a = 81^{b+2}$ and $125^b = 5^{a-3}$. What is the value of ab ?

- A) -60
- B) -12
- C) 12
- D) 60

14. Students from Mrs. Hein's class are standing in a circle. They are evenly spaced and consecutively numbered starting with 1. The student with number 3 is standing directly across from the student with number 17. How many students are there in Ms. Hein's class?

- A) 28
- B) 29
- C) 30
- D) 31

15. Calculate the value of the expression below.

$$\left(\frac{5\sqrt{x} + \sqrt{y}}{\sqrt{x} - 5\sqrt{y}} + \frac{5\sqrt{x} - \sqrt{y}}{\sqrt{x} + 5\sqrt{y}}\right) \cdot \left(\frac{x\sqrt{y} - 25y\sqrt{y}}{x + y}\right)$$

- A) $x + y$
- B) $5xy$
- C) $10\sqrt{y}$
- D) $5(\sqrt{x} + \sqrt{y})$

16. What is $3a^b + 8a^{-3b}$, if $a^b = 2$?

- A) 5
- B) 7
- C) 8
- D) 24

17. Let $f(x, y) = x^3 + 3xy^2$. What is $f(20, 12) - f(12, 20)$?

- A) 2^6
- B) 2^7
- C) 2^8
- D) 2^9

18. The parallelogram $ABCD$ is such that $\angle B < 90^\circ$ and $AB < BC$. Points E and F are chosen on the circumscribed circle ω of triangle ABC so that the tangents to ω at these points pass through point D . If $\angle EDA = \angle FDC$, find angle $\angle ABC$.

- A) 30°
- B) 45°
- C) 60°
- D) 90°

19. Let $f(x) = 2 - x^2 - y^2$. What is $f(5, 2)$?

- A) -27
- B) -12
- C) -9
- D) 0

20. If x and y are real numbers satisfying $x^2y = 12$ and $xy^2 = 18$, find $x + y$.

- A) 3
- B) 4
- C) 5
- D) 6

21. The polynomial $x^4 - bx^2 - 1550x + d$ has 4 real roots. Find the sum of their cubes.

- A) 4450
- B) 4550
- C) 4650
- D) 4750

22. Find the only positive root of $x^4 + 4x^3 + 5x^2 = 3$.

- A) $\frac{\sqrt{5}-1}{2}$
- B) $\frac{\sqrt{5}}{2}$
- C) $\frac{\sqrt{5}+1}{2}$
- D) $\sqrt{5}$

23. Calculate the value of $(\cos 165^\circ - \cos 105^\circ)^2$.

- A) $\frac{1}{\sqrt{3}}$
- B) $\frac{1}{2}$
- C) $\frac{\sqrt{3}}{2}$
- D) 1

24. What number should replace the question mark?

3	8	4	9
2	4	3	6
6	7	8	2
4	2	1	?

- A) 6
- B) 8
- C) 9
- D) 4

25. 473982 is to 1419 as 329684 is to 1418.
Therefore, 751694 is to what?

- A) 1213
- B) 1319
- C) 1913
- D) 2115