

SAMPLE QUESTIONS - MATHEMATICS, CATEGORY 5

1. A large rectangle is partitioned into four rectangles by two segments parallel to its sides. The areas of three of the resulting rectangles are shown. What is the area of the fourth rectangle?

6	14
?	35

- (A) 10 (B) 15 (C) 20 (D) 21 (E) 25

2. Find $\frac{\sin 30^\circ}{\sin 10^\circ} - \frac{\cos 30^\circ}{\cos 10^\circ}$

- A) 0 B) 1 C) 2 D) 3 E) 4

3. Find $\log 20 + 2\log 2 - 3\log 2 =$

- (A) -2 (B) -1 (C) 0 (D) 1 (E) 2

4. Solve $\lim_{x \rightarrow 0} \left(\frac{\tan^2 3x}{25x^2} \right)$

A) $\frac{3}{25}$

B) $\frac{6}{25}$

(C) $\frac{9}{25}$

(D) 6

(E) 9

5. Simplify the operation $(1 \cdot 1!) + (2 \cdot 2!) + (3 \cdot 3!) + \dots + (n \cdot n!)$

A) $(n-1)! + 1$ **B) $(n+1)! - 1$** (C) $n! + 1$ (D) $n! - 1$ (E) $(n-1)!$

6. A rectangle, whose sides are of different integral length in cm, has its perimeter and area equal in value. Find the area of all these possible rectangles, in cm^2 .

(A) 10cm^2

(B) 12cm^2

(C) 16cm^2

(D) **18cm^2**

(E) 20cm^2

7. If $\log_2(15!) = x$, then find $\log_2(16!) = ?$

A) $2x$

B) $6x$

C) x

D) $x + 1$

E)

$x + 4$

8. $2220 \cdot 2210 - 2214 \cdot 2216 = ?$

- (A) - 104 (B) - 24 (C) 104 (D) 620 (E) 2412

9. If $\sqrt[3]{x + \sqrt[3]{x + \sqrt[3]{x + \dots}}} = 2$, then find x.

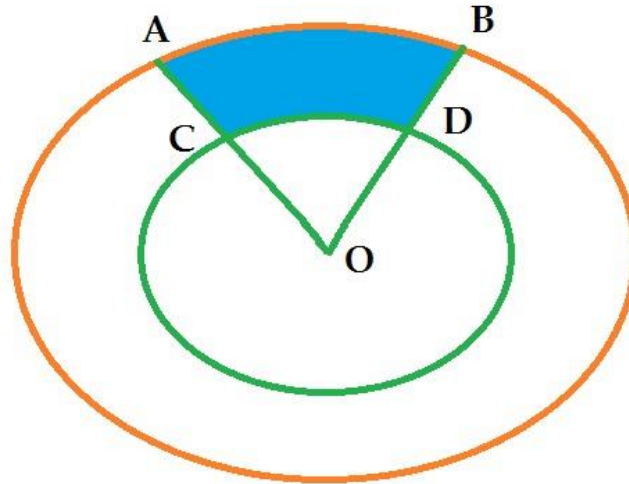
- (A) 8 (B) 6 (C) 4 (D) 3 (E) 2

10. In the equations below, the functions of \blacksquare , \odot and Δ are given. Accordingly, which of the following numbers does the question mark stand for in the fourth equation?

$$\begin{aligned}
 I. a \odot b &= 2 \cdot a \blacksquare b \\
 II. a \blacksquare b &= b \Delta 2 \cdot a \\
 III. a \Delta b &= 2 \cdot a + 2 \cdot b \\
 IV. (2 \odot 2) \blacksquare 2 &=?
 \end{aligned}$$

- (A) 72 (B) 74 (C) 76 (D) 82 (E) 84

11. If $|AO|=2$, $|CO|=1$, $|AO|=|BO|$, $|CO|=|DO|$, $m(\angle AOB)=60^\circ$, then find the area of shaded region.



- (A) $2 - \pi$ (B) $\frac{\pi}{2}$ (C) $8 - 4\pi$ (D) $\frac{3\pi}{10}$ (E) $\frac{2\pi}{5}$

12. If $A = \begin{bmatrix} 6 & 3 \\ 0 & 6 \end{bmatrix}$, $C = \begin{bmatrix} 2 & 1 \\ 0 & 8 \end{bmatrix}$ and $A \cdot B = C$, find $B = ?$

- (A) $\begin{bmatrix} \frac{1}{3} & -\frac{1}{2} \\ 0 & -\frac{4}{3} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{3} & \frac{1}{2} \\ 0 & \frac{4}{3} \end{bmatrix}$ (C) $\begin{bmatrix} -\frac{1}{3} & \frac{1}{2} \\ 0 & \frac{4}{3} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{3} & -\frac{1}{2} \\ 0 & \frac{4}{3} \end{bmatrix}$ (E) $\begin{bmatrix} -\frac{1}{3} & \frac{1}{2} \\ 0 & -\frac{4}{3} \end{bmatrix}$

13. Find $A \cdot B$, if $\frac{4x+3}{2x^2+3x-2} = \frac{A}{2x-1} + \frac{B}{x+2}$

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

14. Solve $\int \frac{3x^2}{(x^3+1)^5} dx = ?$

(A) $\frac{-1}{4(x^3+1)^4} + c$ (B) $\frac{1}{x^2+4} + c$ (C) $\frac{x}{x^2+4} + c$

(D) $\frac{1}{2(x^3+1)^2} + c$ (E) $\frac{-1}{(x^3+1)^3} + c$

15. Solve $\frac{3+6+9+12+\dots+75}{4+8+12+16+\dots+100} = ?$

(A) $\frac{4}{3}$ (B) 1 (C) $\frac{3}{4}$ (D) $\frac{1}{2}$ (E) $\frac{1}{3}$

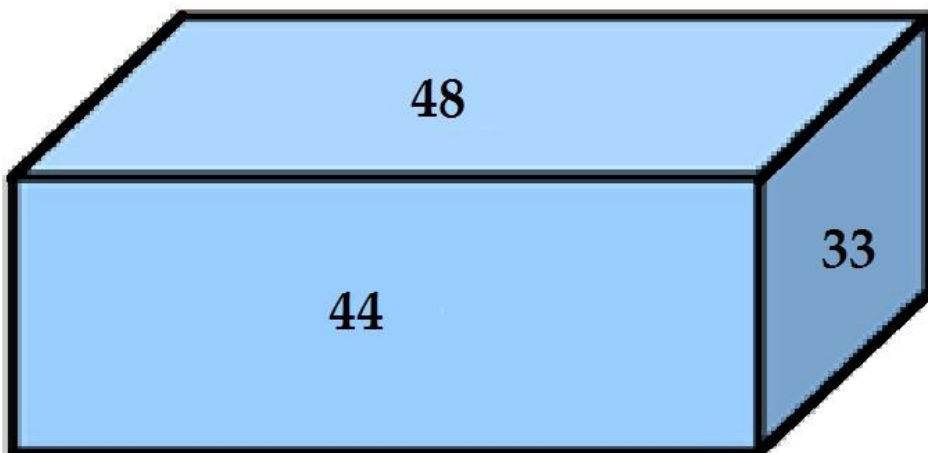
16. Replace the asterisks with digits so that the multiplication below is correct:

The product is

$$\begin{array}{r}
 * * * * * \\
 \times * * * 1 \\
 \hline
 3 3 3 3 7 \\
 * * * * * \\
 * * * * * \\
 + * * * * * \\
 \hline
 * * * * 2 0 0 9 *
 \end{array}$$

- (A) 128720097 (B) 182720097 (C) 187220097
 (D) 172720097 (E) 123720097

17. The areas of 3 sides of a block are 44 cm², 33 cm², and 48 cm². The volume of the block is ... cm³.



- (A) $164cm^2$ (B) $204cm^2$ (C) $248cm^2$ (D) $264cm^2$ (E) $300cm^2$

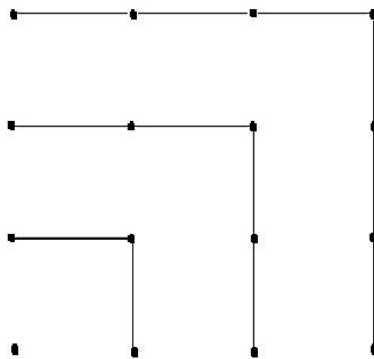
18. Write the expression $\frac{a^3-8b^3}{a^2-4b^2} : \frac{a^3+4ab^2+2ba^2}{a^3+2ba^2}$ in the simplest form.

- (A) $2a$ (B) a (C) $-a$ (D) $-2a$ (E) 1

19. If $\frac{1}{x+y} + \frac{1}{x-y} = \frac{3}{4}$ and $\frac{1}{x+y} - \frac{1}{x-y} = \frac{1}{4}$, then find $x^2 - y^2 = ?$

- (A) 48 (B) 32 (C) 20 (D) 15 (E) 8

20. Using next picture, we can observe that $1+3+5+7 = 4 \times 4$. What is the value of $1 + 3 + 5 + 7 + \dots + 33 + 35 = ?$



- A) 10 x 10 B) 12 x 12 C) 13 x 13 D) 21 x 21 E) 18 x 18

21. The number series I and II are related to each other. Accordingly, which of the following number series represents a similar relation to the number series III?

I – 98 99 101 104 108

II – 53 52 50 47 43

III – 27 29 33 39 47

IV - ? ? ? ? ?

A) 86 70 62 58 56

B) 78 79 83 92 108

C) 56 57 61 70 88

D) 88 85 81 72 56

E) 44 42 38 32 24

22. Simplify $\frac{(x-y)^3(x^2+2xy+y^2)}{(x^2-y^2)^2}$

- A) $x - y$ B) $y - x$ C) $x + y$ D) $(x^2 - y^2)$ E) $(x^2 + y^2)$

23. How does $f(x) = 9^x$ change over the interval from $x = 8$ to $x = 9$?

A) $f(x)$ increases by 9

B) $f(x)$ increases 90 times

C) $f(x)$ increases by a factor of 9

D) $f(x)$ increases by 9%

E) $f(x)$ decreases 9 times

24. If the number of bacteria in a colony triples every 46 minutes and there is currently a population of 200 bacteria, what will the population be 92 minutes from now?

A) 900 bacteria

B) 1200 bacteria

C) 1500 bacteria

D) 1800 bacteria

E) 2100 bacteria

25. If $f(x) = 2 + \log_3(\log_2(x - 1))$, then find the value of $f^{-1}(3) = ?$

A) 5

B) 9

C) 13

D) 17

E) 26