FEMSSISA MATHEMATICS OLYMPIAD: Grade 8 - 12

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MATHEMATICS OLYMPIAD GRADE ELEVEN

DATE: 5 AUGUST 2024 – 8 AUGUST 2024

TIME: 90 MINUTES

INSTRUCTIONS:

1. This booklet has 15 multiple choice and 5 open ended questions.
2. Use the answer sheet provided.

   Circle the letter corresponding to your answer.
3. All working details must be done in the space provided.
4. Calculators are not permitted.
5. Diagrams are not necessarily drawn to scale.
6. The first 15 problems carry 1 mark each and the next 5 carry 2 marks each.
7. You have 90 minutes for the paper which works out to an average of 4.5 minutes per question.
8. Read the questions carefully before answering.
9. Visit the website: www.saolympiads.co.za.

ENJOY THE OLYMPIAD

Grade Eleven Mathematics Olympiad

1. For what real value of x is E undefined?

   E = $\frac{x}{x+3}$

   (A) x = 3 (B) x = -3 (C) x ≥ 3 (D) x ≤ − 3

2. Simplify:

   $\frac{x^2-2xy}{x^2+xy}$ x $\frac{x^2-y^2}{2x-4y}$

   (A) $\frac{x+y}{2}$ (B) $\frac{x-y}{-2}$ (C) $\frac{x+y}{-2}$ (D) $\frac{x-y}{2}$

3. Determine the distance AB if:

   A(-5; -4) and B(1; 4)

   (A) 8 (B) 10 (C) 13 (D) 15

4. Solve for x:

   3x - 4 ≥ 20 + 5x

   (A) $x \leq -12$ (B) $x \leq 12$ (C) $x \geq -12$ (D) $x \geq 12$

5. Without using a calculator evaluate:

   cos 150^0 x tan 210^0 x sin 240^0

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

6. Solve for x: $(x^2+3)^2 - 16(x^2+3) + 48 = 0$

   (A) $\pm 1\ only$ (B) $-1;\ -3\ only$ (C) $1;\ 3\ only$ (D) $\pm 1;\ \pm 3$

7. R60000 was divided equally among a certain number of persons. If 5 less people shared this amount, then each one would receive R1000 more. How many people are in the initial group?

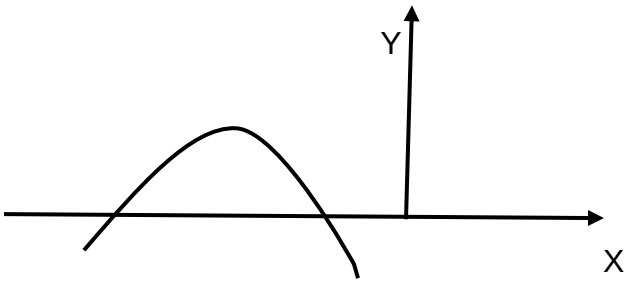
   (A) 15 (B) 20 (C) 25 (D) 30

8. Simplify to a single trigonometric ratio:

$$\frac{\cos x - \frac{1}{\cos x}}{\tan x}$$

(A) $\cos x$ (B) $\frac{1}{\sin x}$ (C) $-\sin x$ (D) $\frac{1}{\cos x}$

9. The graph A below is defined by $y = -2x^2 - 8x - 6$. The equation of the graph which is reflected about the X-axis and is translated 2 units vertically upwards is…



(A) $y = 2x^2 + 8x + 8$ (B) $y = 2x^2 + 8x$ (C) $y = 2x^2 - 8x$ (D) $y = x^2 + 8x + 9$

10. Determine the point of intersection of the asymptotes of $y = \frac{x-3}{x+1}$.

(A) (1;1) (B) (1;-1) (C) (-1;1) (D) (-2;1)

11. What is the 60th term of the series if the n-th term is $\frac{1}{an^2 + bn + c}$?

$\frac{1}{5} + \frac{1}{8} + \frac{1}{12} + \frac{1}{17} + \cdots ..$

(A) $\frac{1}{2020}$ (B) $\frac{1}{1893}$ (C) $\frac{1}{1880}$ (D) $\frac{1}{1820}$

12. For what values of k will the equation have real and unequal roots?
$x^2 + 2x + 2 = k(x+1)$

(A) $-2 < k < 2$ (B) $-2 \leq k \leq 2$ (C) $k \leq -2 \text{ or } k \geq 2$ (D) $k < -2 \text{ or } k > 2$

13. Did you know? 2! = 1 x 2; 3! = 1 x 2 x 3; 4! = 1 x 2 x 3 x 4 and so on…….

What is the smallest n for which $\frac{(6n+1)!}{(3n-1)!}$ will end in at least five 0's?

(A) 7 (B) 6 (C) 5 (D) 4

14. Solve for x:

$$\frac{2}{3-2x} \leq 1$$

(A) $x \leq \frac{1}{2} \text{ or } x > \frac{3}{2}$ (B) $x \leq \frac{-1}{2} \text{ or } x > \frac{3}{2}$ (C) $x > \frac{3}{2}$ (D) $x \leq \frac{1}{2} \text{ or } x \geq \frac{3}{2}$

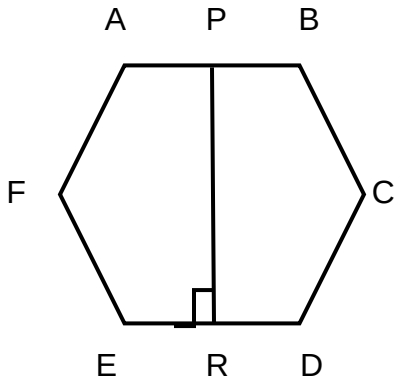
15. Consider:

7 9 11
13 15 17 19
21 23 25 27 29
……

Determine the middle term of the 23rd row.

(A) 615 (B) 625 (C) 635 (D) 645

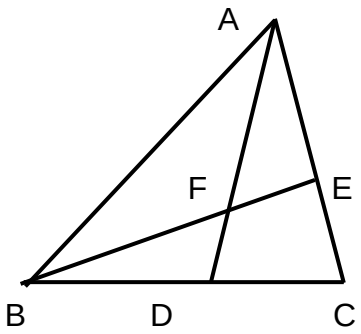
16. In the following regular hexagon PR = 36. Determine the length in units of AB.



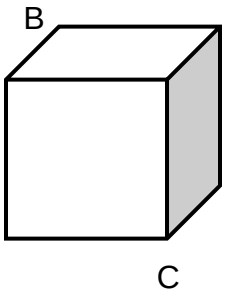
17. 8 litres of paint is made up of 20% blue and 80% white. How many litres of blue paint must be added to the 8 litres of paint to make the blue percentage, 50%?

18. Six plastic digits 2;3;4;6;7;9 is used make 5 digit odd numbers divisible by 11. What is the probability that a randomly selected 5 digit number is divisible by 11?

19. In the adjacent triangle, F divides AD in the ratio 4:1. E divides AC in the ratio 3:2. BE intersects AD at F. Determine the ratio of BD:DC.



20. If the shortest distance from B to C along the surface of the cube is $4\sqrt{5}$ cm then determine the volume of the cube in cm^3.



MARKS: 1-15: 15 X 1 = 15
16-20: 5 X 2 = 10
TOTAL = 25