SOUTHERN AFRICAN SENIOR MATHEMATICS OLYMPIAD
FEMSSISA

GRADE 11

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DATE: 28 AUGUST 2023 – 1 SEPTEMBER 2023

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 2023

1. What is the value(s) of x where $\sqrt{x-2} + x = 4$?

   (A) 3 or 6 (B) 6 (C) 3 (D) 4

2. Write down the following product.

   $$\left(1-\frac{1}{4}\right)\left(1-\frac{1}{5}\right)\left(1-\frac{1}{6}\right)\ldots.\left(1-\frac{1}{30}\right)$$

   (A) $\frac{1}{11}$ (B) $\frac{1}{10}$ (C) $\frac{1}{15}$ (D) $\frac{2}{3}$

3. If f(n+3) = 3n + 2 then determine f(n) in the form an + b.

   (A) 3n - 7 (B) 3n + 7 (C) 3n -5 (D) 3n + 5

4. Solve for x:

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

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

5. Solve for x: $(x^2+2)^2 - 17(x^2+2) + 66 = 0$

   (A) 2; 3 only (B) ±2 only (C) ±3 only (D) ±2; ±3

6. If $\cos\theta = 3\sin\theta$ then $9\tan^2\theta + 6\sin^2\theta + 6\cos^2\theta$ = …..

   (A) 6 (B) 7 (C) 8 (D) 9

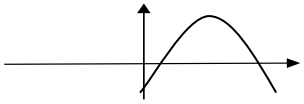
7. If $\frac{\sqrt{3}+1}{(\sqrt{3}-1)^2}$ $is\ written\ in\ the\ form\ a + b\sqrt{c}$ $then\ write\ the\ value\ of$ $\left(a + b + \sqrt{c}\right)$.

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

8. R48000 was divided equally among a certain number of persons. If 20 more shared this amount, then each one would receive R80 less. How many people are in the initial group?

(A) 140 (B) 120 (C) 100 (D) 80

9. The graph B alongside is defined by $y = -x^2 + 4x - 3$. The equation of the graph which is a reflection of B about the X-axis and is translated 3 units to the left is…



(A) $y = x^2 + 2x$ (B) $y = x^2 + 3x + 2$ (C) $y = x^2 - 2x$ (D) $y = x^2 + 4x - 5$

10. Points A(1; -4) ; B(3;8) are on $y = q + \frac{6}{x+p}$.

Write down the value of p x q if p and q are integers.

(A) -6 (B) 6 (C) -4 (D) 4

11. Evaluate: $11^2 - 13^2 + 15^2 - 17^2 + 19^2 \ldots\ldots + 67^2 - 69^2 + 71^2$

(A) 2800 (B) 2040 (C) 2641 (D) 2282

12. Determine the ordered pair (x;y) such that it satisfies both equations:

$4^{x-1} + 3^{y-1} = 7$ and $4^{x+1} - 3^{y-1} = 61$

(A) $(-2; 2)$ (B) $(2; 2)$ (C) $(2; -2)$ (D) (3;-3)

13. Simplify to a single trigonometric ratio:

$$\frac{1 + \cos\theta}{\sin\theta} x \frac{1}{\tan\theta}$$

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

14. A small factory can produce 500 chairs per week and sell them at R600 each. For each price increase of R50 per chair, 5 less chairs are sold. If there are 'x' increases then what is the value of x which maximises the receipts.

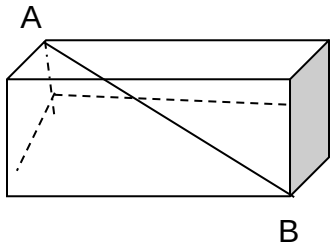
(A) 44 (B) 40 (C) 36 (D) 32

15. What is the probability that 4 digit numbers which are formed from the following numbers are even numbers if no digit is repeated?

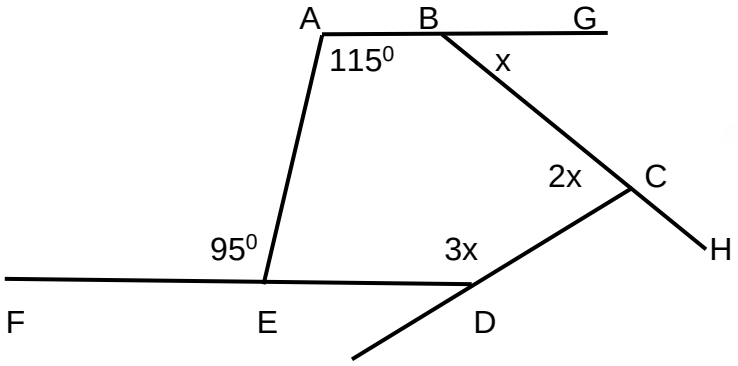
2; 5; 6; 8; 9

(A) $\frac{48}{120}$ (B) $\frac{60}{120}$ (C) $\frac{72}{120}$ (D) 72

16. The diagram represents a rectangular prism with a length which is twice the width and the height. The diagonal AB is equal to $8\sqrt{6} square\ units$. Determine the volume of the prism in cubic units.



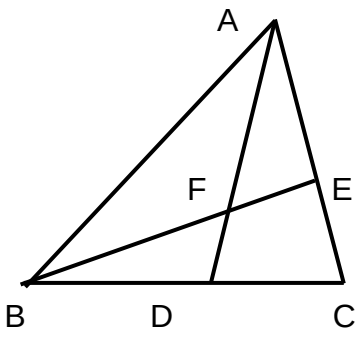
17. AB; BC; CD and DE of a pentagon are produced. $A\hat{E}F = 95^0$; $E\hat{A}B = 115^0$ $G\hat{B}C = x$; $B\hat{C}D = 2x$; $E\hat{D}C = 3x$ Determine the value of x.



18. 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 $\frac{(5n+1)!}{(2n-1)!}$ will end in at least four 0's?

19. In the adjacent triangle, F divides AD in the ratio 5:1. E divides AC in the ratio 3:1. BE intersects AD at F. Determine the ratio of BD:DC.



20. There are 4 indistinguishable red stones; 2 indistinguishable green stones and 2 indistinguishable blue stones. How many different arrangements are there?

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

TOTAL = 25