FEMSSISA MATHEMATICS OLYMPIAD: Grade 8 - 12

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MATHEMATICS OLYMPIAD GRADE TWELVE

DATE: 5 AUGUST 2025

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

1. If the sum to n terms of the following arithmetic sequence is equal to 735 then find n?

   7; 13; 19; 25; ….

   (A) 14 (B) 15 (C) 16 (D) 17

2. Write down the period of f, if f = $\{(x;y): y = \sin 3x; x \in [-360^0; 360^0]\}$

   (A) 180^0 (B) 150^0 (C) 135^0 (D) 120^0

3. Determine the values of k for which the equation has 2 unequal real roots:

   x = $6 \pm \sqrt{-2k^2 + 5k + 3}$

   (A) $k > 3$ (B) $k \leq 3$ (C) $k < \frac{-1}{2}$ or $k > 3$ (D) $\frac{-1}{2} < k < 3$

4. Write down the amplitude of g if g = $\left\{(x;y): y = -\frac{1}{2}\cos x + 1; x \in [-360^0; 360^0]\right\}$

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

5. Rewrite h given by y = - $2x^2$ + 7x +2 in the form:

   y = $a(x-p)^2 + q$

   (A) y = $-2(x - \frac{7}{4})^2 - \frac{65}{8}$ (B) y = $-2(x - \frac{7}{4})^2 + \frac{65}{8}$

   (C) y = $-2(x + \frac{7}{4})^2 + \frac{65}{8}$ (D) y = $-2(x + \frac{7}{4})^2 + \frac{65}{8}$

6. Solve for x:

   $2x^3 + 3x^2 - 29x + 30 = 0$

   (A) $x = \frac{3}{2}; 2; -5$ (B) $x = \frac{-3}{2}; 2; -5$ (C) $x = \frac{3}{2}; -2; -5$ (D) $x = \frac{3}{2}; -2; 5$

7. The equation of the tangent to the curve y = $\frac{x^2-x-6}{x}$ at (1; -6) is…….

   (A) y=7x (B) y=7x-1 (C) y=7x-13 (D) y=7x-6

8. Determine: $\frac{dx}{dy}$ if $y = \frac{t}{x}$ and $t = y - 1$

   (A) 1 + $\frac{1}{x^2}$ (B) 1 - $\frac{1}{y^2}$ (C) 1 + $\frac{1}{y^2}$ (D) $\frac{1}{y^2}$

9. Solve for 'x':

   $\sqrt{3x+1} - \frac{12}{\sqrt{3x+1}} = 4$

   (A) $x = \frac{35}{3}$ (B) $x = \frac{-35}{3}$ (C) $x = \frac{35}{3}$ or $x = 1$ (D) $x = 1$

10. If $\sin\theta = \frac{-5}{13}$ and $\theta \in [0^o;270^o]$.

Then calculate:

$$\frac{1}{\tan(\theta-90^o)}$$

(A) $\frac{12}{13}$ (B) $\frac{-5}{12}$ (C)) $\frac{-12}{5}$ (D) $\frac{12}{5}$

11. Determine the coordinates of the point of inflection of:

$y = -x^3 + 6x^2 + 13x - 42$

(A) (3;2) (B) (-2;0) (C) (2;0) (D) (0;2)

12. Solve for x:

$$\frac{2}{3-2x} \leq 5$$

(A) $x \leq \frac{13}{10}$ (B) $x \leq \frac{13}{10} or\ x \geq \frac{3}{2}$ (C) $x > \frac{3}{2}$ (D) $x \leq \frac{13}{10} or\ x > \frac{3}{2}$

13. Write as a single ratio:

$$\frac{\cos 2x+\cos x+1}{\sin 2x+\sin x}$$

(A) $\frac{1}{\tan x}$ (B) $\frac{1}{2\cos x}$ (C) sin2 x (D) $\tan x$

14. A small factory can produce 600 bags per week and sell them at R400 each. For each decrease of R10 a bag, 20 more bags are sold. At what price must each bag be sold to maximise receipts?

(A) R370 (B) R360 (C) R350 (D) R340

15. Consider the series

$$\frac{2x-1}{2} + \frac{(x+3)(2x-1)}{4} + \frac{(x+3)^2(2x-1)}{8} \ldots\ldots$$

For what values of x does the series converge?

(A) $x < -1$ (B) $-5 < x < -1$ (C) $x > -5$ (D) $x < -5\ or\ x > -1$

16. The number y = 74x 73x72x71x…..x4 x 3 x 2 x 1 is divided by 5^n

Give the maximum value of n such that y is divisible by 5^n.

17. If $2^x = 18^a$ and $9^y = 18^a$ then write down a in terms of x and y.

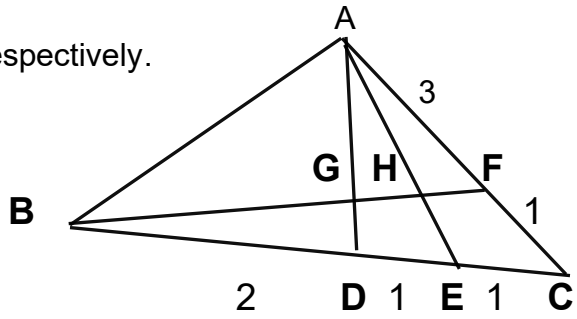
18. The 6 plastic digits 2; 3; 5; 7; 8 and 9 are used to construct 4 digit numbers.
What is the probability that a randomly selected 4 digit number is divisible by 11?

19. What is the maximum value of E if p is a real number?

$$E = \frac{-p^2-4p+12}{2}$$

20. ABC is a triangle. AD and AE divide BC in the ratio 2:1:1.
BF divides AC in the ratio 3:1.
BF intersects AD and AE at G and H respectively.

What is the ratio of BG:GH:HF?



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

TOTAL = 25