

Mathematics, 2018 EC, social science, entrance exam, round 1

Grade 12 · Mathematics · 2018 E.C.

MARKING KEY: CONFIDENTIAL

Time allowed: 120 minutes

Questions: 40

Total marks: 40

Sit this paper online with instant scoring, free on Temari.et.

temari.et/exam-prep/papers/grade-12-mathematics-2018-social

1. What is the solution set of $\sqrt{5^{x^2}} = 25^x$? (1)

- A. $\emptyset$ B. 0
C. $\sqrt{2}$ D. $\checkmark$ 0, 4

Answer: DEquating exponents of base 5 gives $x^2/2 = 2x$, which simplifies to $x^2 - 4x = 0$, giving solutions $x = 0$ and $x = 4$.

2. In an experiment of rolling a die, what is the probability of getting 1 or 5? (1)

- A. $\frac{1}{6}$ B. $\checkmark$ $\frac{1}{3}$
C. $\frac{2}{3}$ D. $\frac{1}{4}$

Answer: BThe outcomes for rolling a 1 or a 5 are {1, 5}, and since there are 6 total possible outcomes, the probability is $2/6 = 1/3$.

3. Which one of the following pairs of lines are perpendicular to each other? (1)

- A. $l_1 : y = 2x - 1$ and $l_2 : y = \frac{1}{2}x + 1$ B. $l_1 : y = 1$ and $l_2 : y = -2$
C. $l_1 : y = 3x + 1$ and $l_2 : y = -3x + 4$ D. $\checkmark$ $l_1 : x = 3$ and $l_2 : y = 1$

Answer: DA vertical line ($x = 3$) and a horizontal line ($y = 1$) are perpendicular to each other because they intersect at a 90-degree angle.

4. Suppose that a person has 4 jackets and 5 trousers. In how many different ways can the person dress? (1)

- A. $\checkmark$ 20 B. 16
C. 9 D. 25

Answer: ABy the fundamental counting principle, the number of ways to choose one jacket and one pair of trousers is $4 * 5 = 20$.

5. Consider the following grouped data as shown in the table below. Which one of the following is the variance of the above data? Value Frequency 1-5 4 6-10 5 11-15 6 16-20 5 (1)

- A. 60 B. 29.5
C. 59 D. $\checkmark$ 28.5

Answer: DThe midpoints of the classes are 3, 8, 13, and 18 with mean 11, and using the population variance formula gives $570 / 20 = 28.5$.

6. Which of the following statements defines a prime number? (1)
- A. It is a natural number that is a product of two distinct numbers.
 - B. It is a natural number that has more than two factors.
 - C. It is a natural number that is a factor of all numbers.
 - D. ✓ It is a natural number that has exactly two distinct factors.

Answer: D

A prime number is defined as a natural number greater than 1 that has exactly two distinct factors: 1 and itself.

- [illegible]

Answer: A

The total area of the metal sheet is $12\text{ m} \times 18\text{ m} = 216\text{ m}^2$, and dividing this into 6 congruent pieces gives an area of $216 / 6 = 36\text{ m}^2$ per piece.

8. What is the solution set of the inequality $|3 - 2x| - 5 \geq 2$? (1)
- A. $\{x: x \geq -2 \text{ or } x \leq 5\}$ B. $\{x: -2 < x < 5\}$
- C. $\{x: -2 \leq x \leq 5\}$ D. **$\checkmark \{x: x \leq -2 \text{ or } x \geq 5\}$**

Answer: D

Solving $|3 - 2x| \geq 7$ yields two cases: $3 - 2x \geq 7$, which simplifies to $x \leq -2$, and $3 - 2x \leq -7$, which simplifies to $x \geq 5$. Combining these gives the solution set $\{x : x \leq -2 \text{ or } x \geq 5\}$.

- 9.** What are the domain and range of the function $f(x) = x + |x|$ respectively? (1)
- A. $\mathbb{R}$ and $[2, \infty)$ B. $\mathbb{R}$ and $\mathbb{R}$
- C. ✓ $\mathbb{R}$ and $[0, \infty)$ D. $[0, \infty)$ and $\mathbb{R}$

Answer: C

The domain of $f(x) = x + |x|$ is the set of all real numbers, and its range is $[0, \infty)$ since $f(x) = 2x$ for $x \geq 0$ and $f(x) = 0$ for $x < 0$.

10. Given below the ages of 40 people taken to form five football teams in a certain sport field. Ages 10-18 18-26 26-34 34-42 42-50 No. of Peoples 10 4 8 12 6 What is the class midpoint of the third class?
- A. 34.5 B. 26
C. 30.5 D. ✓ 30

Answer: D

The third class is 26-34, and its class midpoint is calculated by taking the average of its limits: $(26 + 34) / 2 = 30$.

11. Let a function, $f(x) = \begin{cases} 2x^2 - 4, & \text{if } x \geq 1 \\ x^3 - 4x + 1, & \text{if } x < 1 \end{cases}$. Then what is the equation of the tangent line to the graph of f , at $x = -2$? (1)
- A. $y = -4x + 14$
- B. $y = -8x - 12$
- C. $y = 8x + 17$
- D. $y = 4x - 2$

Answer: C

For $x = -2 < 1$, we use $f(x) = x^3 - 4x + 1$, where $f(-2) = 1$ and $f'(-2) = 8$, yielding the tangent line equation $y - 1 = 8(x + 2)$, or $y = 8x + 17$.

12. Let A and B be two sets such that $A = \{1, 4, 9\}$ and $B = \{n \in \mathbb{N} : 3 < n \leq 5\}$. Which of the following sets represents $A \times B$? (1)

- A. $\{(4, 1), (5, 1), (5, 4), (5, 5), (4, 9), (5, 9)\}$ B. $\{(1, 4), (1, 5), (4, 4), (4, 5), (9, 4), (9, 5)\}$
 C. $\{(1, 4), (1, 5), (4, 5), (5, 5), (9, 4), (9, 5)\}$ D. $\{(4, 1), (5, 1), (4, 4), (5, 4), (9, 4), (9, 5)\}$

Answer: B

The set $B = \{n \in \mathbb{N} : 3 < n \leq 5\}$ consists of the natural numbers 4 and 5, so $B = \{4, 5\}$. The Cartesian product $A \times B$ consists of all ordered pairs (a, b) where $a \in A$ and $b \in B$, resulting in $\{(1, 4), (1, 5), (4, 4), (4, 5), (9, 4), (9, 5)\}$.

13. Let $p(x) = 4x^3 - x^2 + ax + b$ be a polynomial function such that a and b are constants. If $p(x)$ is divided by $x + 1$ and $x - 2$ the remainders are 0 and 36 respectively, then what are the values of a and b respectively? (1)

- A. 0 and 5 B. -2 and 3
 C. -3 and 4 D. $\checkmark$ 1 and 6

Answer: D

Using the Remainder Theorem, $p(-1) = 0$ implies $b - a = 5$ and $p(2) = 36$ implies $2a + b = 8$, which solves to $a = 1$ and $b = 6$.

14. If $\cos \theta = -\frac{5}{13}$ and θ is an angle in the second quadrant, then what is the value of $\cot \theta$? (1)

- A. $\frac{12}{13}$ B. $\checkmark -\frac{5}{12}$
 C. $-\frac{12}{13}$ D. $\frac{5}{12}$

Answer: B

In the second quadrant, $\sin \theta = \sqrt{1 - \cos^2 \theta} = 12/13$, so $\cot \theta = \cos \theta / \sin \theta = (-5/13) / (12/13) = -5/12$.

15. Let a matrix $A = \begin{pmatrix} 1 & -3 & 2 \\ -3 & 3 & -1 \\ 2 & -1 & 0 \end{pmatrix}$. Then what is the inverse of A ? (1)

- A. $\checkmark \begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{pmatrix}$ B. $\begin{pmatrix} -1 & 2 & 4 \\ 3 & -3 & 1 \\ -2 & 1 & 0 \end{pmatrix}$
 C. $\begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} \\ \frac{1}{2} & \frac{1}{4} & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{5} & \frac{1}{6} \end{pmatrix}$ D. $\begin{pmatrix} 1 & -\frac{1}{3} & \frac{1}{2} \\ -\frac{1}{3} & \frac{1}{3} & -1 \\ \frac{1}{2} & -1 & 0 \end{pmatrix}$

Answer: A

Multiplying matrix A by the matrix in option A yields the identity matrix, confirming it is the correct inverse matrix.

16. In an arithmetic sequence, the 4th and 8th terms are 0 and 12 respectively. What is the sum of the first thirteen terms of the sequence? (1)

- A. 234 B. 18
 C. $\checkmark$ 117 D. 27

Answer: C

Since $a_4 = a_1 + 3d = 0$ and $a_8 = a_1 + 7d = 12$, we find $d = 3$ and $a_1 = -9$, so the sum of the first 13 terms is $S_{13} = (13/2) * (2(-9) + 12(3)) = 117$.

17. A line is passing through the points $(-2, 5)$ and $(3, -5)$. What is the gradient of the line? (1)
- A. 0
B. $-\frac{1}{2}$
C. ✓ -2
D. $\frac{2}{3}$

Answer: C

The gradient is calculated using the formula $m = (y_2 - y_1) / (x_2 - x_1) = (-5 - 5) / (3 - (-2)) = -2$.

18. Let $p(x)$ and $q(x)$ be polynomials with $q(x) \neq 0$. Which one of the following defines a rational expression? (1)
- A. $\sqrt{\frac{p(x)}{q(x)}}$
B. ✓ $\frac{p(x)}{q(x)}$
C. $\frac{p(x)}{\sqrt{q(x)}}$
D. $\frac{\sqrt{p(x)}}{q(x)}$

Answer: B

A rational expression is defined as the quotient of two polynomials, $p(x)/q(x)$, where the denominator $q(x)$ is not equal to zero.

19. Consider the following data: 6, 11, 4, 15, 26, 11, 4, 10, 2, 9. Which of the following is true about the mode of the given data? (1)
- A. Multimodal
B. Unimodal
C. No mode
D. ✓ Bimodal

Answer: D

The values 4 and 11 both appear with the highest frequency of 2, meaning the data has two modes and is therefore bimodal.

20. Given the data: 10, 4, 2, 8, 2, 4. What is the standard deviation of the given data? (1)
- A. $\sqrt{3}$
B. ✓ 3
C. 5
D. $2\sqrt{5}$

Answer: B

The mean of the data is 5, and the population standard deviation is $\sqrt{((10-5)^2 + 2(4-5)^2 + 2(2-5)^2 + (8-5)^2) / 6} = \sqrt{54 / 6} = 3$.

21. Consider the following system of linear equations.
$$\begin{cases} x - y = 2 \\ 3x + y = 4 \\ 2x - 2y = 3 \end{cases}$$
 Then which one of the following matrices is (1)

the reduced form of the augmented matrix into triangular matrix?

- A. $\begin{pmatrix} 1 & -1 & 2 \\ 0 & -2 & -2 \\ 0 & 0 & -1 \end{pmatrix}$
B. $\begin{pmatrix} -1 & 0 & 0 \\ -2 & 4 & 0 \\ 1 & -1 & 2 \end{pmatrix}$
C. $\begin{pmatrix} -1 & 0 & 0 \\ -2 & -2 & 0 \\ 1 & -1 & 2 \end{pmatrix}$
D. ✓ $\begin{pmatrix} 1 & -1 & 2 \\ 0 & 4 & -2 \\ 0 & 0 & -1 \end{pmatrix}$

Answer: D

Performing row operations $R_2 \leftarrow R_2 - 3R_1$ and $R_3 \leftarrow R_3 - 2R_1$ on the augmented matrix transforms it into the upper triangular form shown in option D.

22. Let MD refers to the mean deviation from the mean and $\bar{x}$ denotes the mean of a data set. Which of the following formula represents the coefficient of Mean deviation (CMD) from the mean of the data? (1)

- A. $CMD = \frac{MD + \bar{x}}{MD - \bar{x}}$ B. $CMD = \frac{\bar{x}}{MD}$
C. $CMD = \frac{MD - \bar{x}}{MD + \bar{x}}$ D. ✓ $CMD = \frac{MD}{\bar{x}}$

Answer: D

The coefficient of mean deviation (CMD) is a relative measure of dispersion, defined as the ratio of the mean deviation (MD) to the mean ($\bar{x}$), which is represented by $CMD = \frac{MD}{\bar{x}}$.

23. Which one of the following statements is NOT true about regular polygon? (1)

- A. A circle can be circumscribed about the regular polygon.
B. It has n lines of symmetries.
C. ✓ **Its apothem is equal to the side of the polygon.**
D. A circle can be inscribed in the regular polygon.

Answer: C

For any regular polygon, a circle can be both inscribed (inradius is the apothem) and circumscribed (circumradius). The apothem is equal to the side length only for very specific cases (which do not exist for regular polygons), so statement C is false.

24. Let $a > 0$ and $a \neq 1$. Consider $f(x) = a^x$ and $g(x) = \log_a x$. Then which one of the following statements is true about their domains and ranges? (1)

- A. ✓ **The domain of $f(x)$ is equal to the range of $g(x)$.**
B. The domain of $f(x)$ is equal to the domain of $g(x)$.
C. The domain of $f(x)$ is a subset of the domain of $g(x)$.
D. The range of $f(x)$ is equal to the range of $g(x)$.

Answer: A

The exponential function $f(x) = a^x$ has domain $\mathbb{R}$ and range $(0, \infty)$, while the logarithmic function $g(x) = \log_a x$ has domain $(0, \infty)$ and range $\mathbb{R}$. Thus, the domain of $f(x)$ is equal to the range of $g(x)$.

25. What is the solution set of $\log_2 x + \log_2(x + 3) = 2$? (1)

- A. ✓ $\{1\}$ B. $\{2\}$
C. $\{-4, 1\}$ D. $\{4\}$

Answer: A

Using the properties of logarithms, $\log_2(x(x + 3)) = 2 \implies x^2 + 3x = 4 \implies x^2 + 3x - 4 = 0$, which gives $x = 1$ or $x = -4$. Since the domain of $\log_2 x$ requires $x > 0$, the only valid solution is $x = 1$.

26. If $A = \begin{pmatrix} 3 & 1 & 1 \\ 2 & -1 & 1 \\ 0 & 1 & 3 \end{pmatrix}$, then what is the value of $\det(A)$? (1)

- A. -4 B. ✓ **-16**
C. 14 D. 2

Answer: B

Evaluating the determinant along the first row gives $\det(A) = 3(-3 - 1) - 1(6 - 0) + 1(2 - 0) = -12 - 6 + 2 = -16$.

27. Consider the rhombus ABCD as shown in the figure below, where AC = 6 units and BD = 8 units. Then which one of the following statements is true about the above rhombus? (1)
- A. $m(\angle DAB) = m(\angle OBA) + m(\angle ODA)$
- B. The side of the rhombus is 10 units.
- C. ✓ **The perimeter of the rhombus is 20 units.**
- D. $m(\angle OAB) = m(\angle OBA)$

Answer: C

The diagonals of a rhombus bisect each other at right angles, dividing the rhombus into four right-angled triangles with legs of length 3 and 4. The hypotenuse (side of the rhombus) is $\sqrt{3^2 + 4^2} = 5$ units, so the perimeter is $4 \times 5 = 20$ units.

28. What is the fraction form of the decimal 0.343434...? (1)
- A. $\frac{17}{50}$
- B. ✓ $\frac{34}{99}$
- C. $\frac{5}{9}$
- D. $\frac{34}{90}$

Answer: B

Let $x = 0.\overline{34}$. Then $100x = 34.\overline{34}$, and subtracting the first equation from the second yields $99x = 34$, which gives $x = \frac{34}{99}$.

29. Let $P(a, b)$ be a point, other than the origin $(0, 0)$, on the terminal side of an angle θ in standard position. Then what is the value of $\cos \theta$? (1)
- A. ✓ $\frac{a}{\sqrt{a^2 + b^2}}$
- B. $\frac{b}{a^2 + b^2}$
- C. $\frac{b}{\sqrt{a^2 + b^2}}$
- D. $\frac{a}{a^2 + b^2}$

Answer: A

By definition of trigonometric functions in standard position, $\cos \theta = \frac{x}{r}$, where $r = \sqrt{x^2 + y^2}$. For the point $P(a, b)$, we have $x = a$ and $y = b$, so $\cos \theta = \frac{a}{\sqrt{a^2 + b^2}}$.

30. Which one of the following is a skew symmetric matrix? (1)
- A. $\begin{pmatrix} 0 & -2 & 3 \\ 2 & 0 & 4 \\ -3 & 4 & 0 \end{pmatrix}$
- B. $\begin{pmatrix} -1 & 0 & 0 \\ 2 & 2 & 0 \\ 1 & -3 & 1 \end{pmatrix}$
- C. ✓ $\begin{pmatrix} 0 & -2 & 1 \\ 2 & 0 & -3 \\ -1 & 3 & 0 \end{pmatrix}$
- D. $\begin{pmatrix} 1 & -5 & 4 \\ -5 & 2 & 0 \\ 4 & 0 & 3 \end{pmatrix}$

Answer: C

A matrix M is skew-symmetric if $M^T = -M$, which requires all main diagonal entries to be zero and $m_{ij} = -m_{ji}$ for all $i \neq j$. Matrix C satisfies these conditions perfectly.

31. In a bank, there are 10 customers waiting for service. In how many different ways can an officer choose six customers in all, if three older customers are given priority? (1)
- A. 120
- B. ✓ **35**
- C. 72
- D. 210

Answer: B

Since three older customers must be chosen first, the officer only needs to select the remaining $6 - 3 = 3$ customers from the remaining $10 - 3 = 7$ customers. The number of ways to do this is $\binom{7}{3} = \frac{7 \times 6 \times 5}{3 \times 2 \times 1} = 35$.

32. Given below the amount of time (in minutes) spent on running each day by a group of 16 students. Time spent on running 1-4 5-8 9-12 13-16 17-20 No. of students 3 2 4 4 3 What is the coefficient of quartile deviation of the given data? (1)

A. ✓ $\frac{9}{22}$
C. 9

B. $\frac{9}{2}$
D. 11

Answer: A

With $N = 16$, the first quartile position is $16/4 = 4$ (in class 5-8), giving $Q_1 = 4.5 + \frac{4-3}{2} \times 4 = 6.5$. The third quartile position is 12 (in class 13-16), giving $Q_3 = 12.5 + \frac{12-9}{4} \times 4 = 15.5$. The coefficient of quartile deviation is $\frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{15.5 - 6.5}{15.5 + 6.5} = \frac{9}{22}$.

33. A mobile seller sells Samsung(S) and Motorola(M) mobile phones. The seller has Birr 10,000,000 to invest and has a storage space of at most 600 mobile phones. Samsung costs Birr 18,000 and Motorola costs Birr 16,000. The shop owner can make a profit of Birr 1,500 from the sale of Samsung and Birr 1,200 from the sale of Motorola. Which one of the following represents the linear objective function and constraints of the profit? (let S and M be the numbers of Samsung and Motorola mobile respectively) (1)

A. $Z = 1,200S + 1,500M$

B. $Z = 1,500S + 1,200M$

subject to: $\begin{cases} 16,000S + 18,000M \leq 10,000,000 \\ S + M \leq 600 \\ S, M \geq 0 \end{cases}$

subject to: $\begin{cases} 18,000S + 16,000M \leq 10,000,000 \\ S + M \leq 600 \\ S, M \geq 0 \end{cases}$

C. $Z = 1,200S + 1,500M$

D. $Z = 1,500S + 1,200M$

subject to: $\begin{cases} 18,000S + 16,000M \leq 10,000,000 \\ S + M \geq 600 \\ S, M \geq 0 \end{cases}$

subject to: $\begin{cases} 18,000S + 16,000M \geq 10,000,000 \\ S + M \leq 600 \\ S, M \geq 0 \end{cases}$

Answer: B

The profit objective is $Z = 1500S + 1200M$ to be maximized. The investment limit of 10,000,000 Birr gives $18000S + 16000M \leq 10000000$, and the storage limit gives $S + M \leq 600$, representing the constraints perfectly in option B.

34. The two consecutive sides of a parallelogram are 3 m and 4 m long and the angle between them is 30° . Then what is the area of the parallelogram? (1)

A. 7.5 m^2
C. ✓ 6 m^2

B. 12 m^2
D. 24 m^2

Answer: C

The area of a parallelogram with adjacent sides a, b and included angle θ is given by $\text{Area} = ab \sin \theta = 3 \times 4 \times \sin(30^\circ) = 12 \times 0.5 = 6 \text{ m}^2$.

35. What is the solution set of the quadratic inequality $3x^2 - 3x - 6 < 0$? (1)

A. $(-3, 6)$
C. ✓ $(-1, 2)$

B. $(-\infty, -1) \cup (2, \infty)$
D. $(-\infty, -3) \cup (6, \infty)$

Answer: C

Dividing the inequality $3x^2 - 3x - 6 < 0$ by 3 gives $x^2 - x - 2 < 0$. Factoring the quadratic expression yields $(x - 2)(x + 1) < 0$, which is satisfied when x lies strictly between the roots -1 and 2 , giving the interval $(-1, 2)$.

36. There are three red, four yellow and three green balls in a bag. If two balls are picked randomly from the bag at a time, what is the probability of getting at least one green ball? (1)
- A. $\frac{1}{3}$ B. $\frac{7}{15}$
C. $\checkmark \frac{8}{15}$ D. $\frac{7}{45}$

Answer: C

The total number of ways to pick 2 balls out of 10 is $\binom{10}{2} = 45$. The number of ways to pick 2 non-green balls (from the 7 red/yellow balls) is $\binom{7}{2} = 21$. Thus, the probability of at least one green ball is $1 - \frac{21}{45} = \frac{24}{45} = \frac{8}{15}$.

37. A shop sale a shoe at a price of Birr 1225 with a 30% discount notice. How much was the original price of the shoe in Birr? (1)
- A. 1432.50 B. $\checkmark$ 1750
C. 3675 D. 1592.50

Answer: B

A 30% discount means the sale price of 1225 Birr is 70% of the original price. Therefore, the original price is $1225/0.70 = 1750$ Birr.

38. Two six face dice are thrown at a time. What is the probability of getting the sum of the outcome is a prime number? (1)
- A. $\checkmark \frac{5}{12}$ B. $\frac{5}{8}$
C. $\frac{7}{12}$ D. $\frac{2}{3}$

Answer: A

The prime sums possible from rolling two dice are 2, 3, 5, 7, and 11. The corresponding number of favorable outcomes are 1, 2, 4, 6, and 2, which sum to 15 out of 36 total outcomes, giving a probability of $\frac{15}{36} = \frac{5}{12}$.

39. A person is given the colors blue, red and green and asked to paint six houses in a row. The rules are: R1: No two neighboring houses can have the same color. R2: The second and the last houses must have same color. R3: The third and fifth houses cannot have the same color. Then which houses will always have the same color? (1)
- A. The second and the fifth B. The first and the fourth
C. The first and the sixth D. $\checkmark$ The fourth and the sixth

Answer: D

Let H_2 and H_6 have color c_1 . Since H_3 and H_5 cannot have color c_1 (by R1) and cannot share a color (by R3), one must have color c_2 and the other c_3 . Thus, H_4 is adjacent to a c_2 house and a c_3 house, meaning it must have color c_1 . Therefore, H_4 and H_6 always share the same color.

40. In a household, there are three mothers, six daughters and four granddaughters living together. What is the smallest possible number of females in the house? (1)
- A. 13 B. 12
C. $\checkmark$ 7 D. 9

Answer: C

We can construct a tree with 7 females: 1 grandmother (A), 2 daughters of A (B, C), and 4 daughters of B and C (D, E, F, G). Here, A, B, C are mothers (3), B, C, D, E, F, G are daughters (6), and D, E, F, G are granddaughters (4). Thus, the minimum number of females is 7.

END OF THE MARKING KEY

Sit this paper online at temari.et/exam-prep/papers/grade-12-mathematics-2018-social.

More exam papers are at temari.et/exam-prep/papers.

Generated on Tikimt 2, 2019 E.C. (October 12, 2026 G.C.) · Temari.et