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# Mathematics, 2017 EC, social science, entrance exam, round 1

Grade 12 · Mathematics · 2017 E.C.

**Time allowed:** 120 minutes | **Questions:** 59 | **Total marks:** 59

Name _____ Grade _____ ID No. _____ Date _____

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**1.** Let $f(x)$ be a polynomial of degree at least 1, $g(x)$ be a non-zero polynomial and $c \in \mathbb{R}$. Which of the following states the Factor Theorem? (1)

**A.** $f(c) = 0$ if and only if $x - c$ is a factor of $f(x)$.

**B.** For distinct real numbers $a$ and $b$, if $f(a)f(b) < 0$, then $f(x)$ has at least one zero between $a$ and $b$.

**C.** There exist polynomials $q(x)$ and $r(x)$ such that $f(x) = g(x)q(x) + r(x)$.

**D.** If $f(x)$ is divided by $x - c$, then the remainder is $f(c)$.

**2.** Let $A = \{1, 2\}$ and $B = \{1, 3\}$ be sets. Then which one of the following Cartesian products is correct? (1)

**A.** $B \times A = \{(1,1), (3,1), (1,2), (3,2), (2,3)\}$.

**B.** $B \times B = \{(1,1), (1,3), (3,3), (2,3)\}$.

**C.** $A \times B = \{(1,1), (1,3), (2,1), (2,3), (3,2)\}$.

**D.** $A \times A = \{(1,1), (2,2), (2,1), (1,2)\}$.

**3.** Consider the matrix $\begin{pmatrix} 2 & -3 & 1 \\ 0 & -1 & \pi \\ 3 & 1 & 4 \end{pmatrix}$. What is the cofactor of entry $\pi$? (1)

**A.** $7$

**B.** $-11$

**C.** $-11\pi$

**D.** $-7\pi$

**4.** When converting the recurring decimal $0.\overline{25}$ into a fraction using convergent geometric series, then what are the first term and the common ratio respectively? (1)

**A.** $0.25$ and $0.01$

**B.** $25$ and $0.01$

**C.** $0.25$ and $0.1$

**D.** $2.5$ and $0.1$

**5.** What are the maximum and minimum values respectively of $z = 3x + y$ subject to constraints (1)

$$\begin{cases} 3x + 2y \leq 20 \\ 2x - y \geq 4 \\ x \geq 0, y \geq 0 \end{cases} ?$$

**A.** $20$ and $6$

**B.** $40$ and $6$

**C.** $16$ and $6$

**D.** $18$ and $8$

**6.** What is the domain of the function $f(x) = \sqrt{3 - x^2}$? (1)

**A.** $[\sqrt{3}, \infty)$

**B.** $[-\sqrt{3}, \sqrt{3}]$

**C.** $[-3, 3]$

**D.** $(-\infty, \sqrt{3}] \cup [\sqrt{3}, \infty)$

**7.** If $x = 0.00471$, then which of the following gives the mantissa of $\log x$? (1)

**A.** $-3$

**B.** $3$

**C.** $\log 4.71$

**D.** $\log 0.471$

**8.** Dibabe was hired in an elementary school with a monthly salary of Birr 30,000. The agreement was to raise her salary every year by Birr 3,000. What is the total amount of money that Dibabe will earn at the end of the 8th year in Birr? (1)

**A.** 2,964,000
**B.** 3,888,000
**C.** 2,976,000
**D.** 324,000

**9.** For what value of $x$ is the matrix $\begin{pmatrix} 1 & 0 & 1 \\ 2x+1 & 3 & 0 \\ 1 & -1 & x \end{pmatrix}$ invertible? (1)

**A.** $\{x \in \mathbb{R} : x \neq -1\}$
**B.** $\{x \in \mathbb{R} : x \neq 4\}$
**C.** $\{x \in \mathbb{R} : x \neq 0\}$
**D.** $\{x \in \mathbb{R} : x \neq 3\}$

**10.** What is the surface area (in $cm^2$) of leather material required to make a spherical shape ball of radius 25cm? (1)

**A.** $625\pi$
**B.** $2500\pi$
**C.** $100\pi$
**D.** $1250\ sphere$

**11.** Mr. Bekele finances two investments, $I_1$ and $I_2$. The profits of $I_1$ and $I_2$ are 8% and 10%, respectively. The total investment is Birr one million with at least Birr 50,000 in $I_1$ and at most Birr 300,000 in $I_2$. Which of the following is the Mathematical representation of the problem if Mr. Bekele wishes to maximize his profit? (Let $x$ and $y$ be the amount of money invested on $I_1$ and $I_2$ in Birr, respectively) (1)

**A.** $\begin{cases} \text{Maximize } z = 0.08x + 0.1y \\ \text{s.t. } x + y \geq 1,000,000 \\ x \leq 50,000 \\ y \geq 300,000 \\ x, y \geq 0 \end{cases}$

**B.** $\begin{cases} \text{Maximize } z = 0.08x + 0.1y \\ \text{s.t. } x + y \geq 1,000,000 \\ x \geq 50,000 \\ y \leq 300,000 \\ x, y \geq 0 \end{cases}$

**C.** $\begin{cases} \text{Maximize } z = 0.08x + 0.1y \\ \text{s.t. } x + y \leq 1,000,000 \\ x \leq 50,000 \\ y \geq 300,000 \\ x, y \geq 0 \end{cases}$

**D.** $\begin{cases} \text{Maximize } z = 0.08x + 0.1y \\ \text{s.t. } x + y \leq 1,000,000 \\ x \geq 50,000 \\ y \leq 300,000 \\ x, y \geq 0 \end{cases}$

**12.** What is the result when $3\sqrt{2} - 7\sqrt{6}$ is subtracted from $2\sqrt{2} + 4\sqrt{3}$? (1)

**A.** $\sqrt{2} + (4 - 7\sqrt{2})\sqrt{3}$
**B.** $-\sqrt{2} + 11\sqrt{2}\sqrt{3}$
**C.** $-\sqrt{2} + (4 + 7\sqrt{2})\sqrt{3}$
**D.** $\sqrt{2} - \sqrt{3}(7\sqrt{2} + 4)$

**13.** Which one of the following is qualitative data? (1)

**A.** The time Derartu took to win Atlanta Olympic.
**B.** Age of President Trump.
**C.** The volume of oil in a container.
**D.** The type of Coffee produced in Keffa.

**14.** Consider the functions $f(x) = 5^x$ and $g(x) = \log_5 x$. Which of the following is correct about the relations of domains and ranges of $f$ and $g$? (1)

**A.** $\text{Domain}(f) = \text{Range}(g)$
**B.** $\text{Domain}(f) \subseteq \text{Domain}(g)$
**C.** $\text{Domain}(f) = \text{Domain}(g)$
**D.** $\text{Range}(f) = \text{Range}(g)$

**15.** In the figure shown below, $\overline{AC} = \overline{DE}$, $\angle BAC = \angle DEF$, $\angle ACB = \angle FDE$ and $\overline{AC} \equiv \overline{DE}$ Then which one of the following is true? (1)

**A.** $\triangle ABC \equiv \triangle FED$
**B.** $\triangle ABC \equiv \triangle EFD$
**C.** $\triangle ABC \equiv \triangle DEF$
**D.** $\triangle ABC \equiv \triangle DFE$

**16.** Let $f$ be a function and let $c$ be an element of domain of $f$ at which the gradient of $f$ is zero. Which one of the following statements is true about $f'(c)$? (1)

**A.** $f'(c) = 0$
**B.** $f'(c) \neq 0$
**C.** $f'(c) > 0$
**D.** $f'(c)$

**17.** What is the solution set of the equation $|2x - 3| - 1 = 0$? (1)

**A.** $\left[\frac{3}{2}, \infty\right)$
**B.** $\{2\}$
**C.** $\{1, 2\}$
**D.** $\{\}$

**18.** An equilateral triangle is inscribed in a circle with radius $\sqrt{3}$ cm. Then what is the perimeter (in cm) of the triangle? (1)

**A.** $\frac{9}{2}$
**B.** $\frac{9\sqrt{3}}{8}$
**C.** $9$
**D.** $3\sqrt{3}$

**19.** Which of the following statements defines frustum of a pyramid? (1)

**A.** It is part of a pyramid excluded the base of the pyramid and horizontal cross-section made by the plane slant to the base.
**B.** It is part of a pyramid included between the base of the pyramid and a horizontal cross-section made by the plane parallel to the base.
**C.** It is part of a cone included between the base of the cone and a plane parallel to the base.
**D.** It is a surface in space all points of which are equidistant from a point.

**20.** If $\mathbf{u} = (1, -1)$ and $\mathbf{v} = (2, -4)$ are vectors, then $\mathbf{u} - \mathbf{v}$ is equal to: (1)

**A.** $(-1, 3)$
**B.** $(-3, 5)$
**C.** $(3, -5)$
**D.** $(1, -3)$

**21.** The gradient of a function $f(x) = \frac{1}{x^2}$ at $x = a, a \neq 0$ is equal to: (1)

**A.** $-\frac{2}{a^4}$
**B.** $-\frac{2}{a^3}$
**C.** $\frac{2}{a^2}$
**D.** $\frac{2}{a^3}$

**22.** Which of the following is NOT a valid reason for a person to save money? (1)

**A.** To buy shares from private banks
**B.** To give loan to other people and collect profit
**C.** For down payment of a house
**D.** To support life after retirement

**23.** Consider the following data. 12, 21, 16, 15, 10, 11, 12, 18, 9, 10, 13, 14, 15, 13, 19 Which one of the following is true? (1)

**A.** $Q_3 = 16$
**B.** $Q_2 = 13.5$
**C.** $Q_1 = 4$
**D.** $Q_1 = 12$

**24.** A line $\ell_1$ in the $x, y$-plane has equation $x - y + 3 = 0$. A second line $\ell_2$ which is perpendicular to $\ell_1$ contains the point $(2, 3)$. Which one of the following gives equation of $\ell_2$? (1)

**A.** $3y + 2x + 3 = 0$
**B.** $y - x + 5 = 0$
**C.** $y + x - 5 = 0$
**D.** $y - x - 3 = 0$

**25.** When the Division Algorithm is applied to the fraction $\frac{283}{20}$, then which one of the following is the corresponding representation? (1)

**A.** $283 = 10 \times 20 + 83$
**B.** $283 = 1 \times 283 + 0$
**C.** $283 = 7 \times 20 + 143$
**D.** $283 = 14 \times 20 + 3$

**26.** Consider the data 7, 12, 21, x, 14. What is the value of $x$ if its range is 23? (1)

**A.** 30
**B.** 33.5
**C.** 2
**D.** 23

**27.** The following is raw data of 15 students in a test: 9, 6, 6, 10, 6, 10, 9, 7, 7, 5, 9, 7, 10, 7, 7 Which one of the following is frequency distribution of the given data? (1)

**A.**

| $v$ | 5 | 6 | 7 | 9 | 10 |
|---|---|---|---|---|---|
| $f$ | 5 | 4 | 3 | 2 | 1 |

**B.**

| $v$ | 5 | 6 | 7 | 9 | 10 |
|---|---|---|---|---|---|
| $f$ | 1 | 3 | 5 | 3 | 3 |

**C.**

| $v$ | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|
| $f$ | 1 | 3 | 5 | 1 | 3 | 2 |

**D.**

| $v$ | 1 | 3 | 5 | 3 | 3 |
|---|---|---|---|---|---|
| $f$ | 5 | 6 | 7 | 9 | 10 |

**28.** Let $R_1(x) = \frac{x^3 - 9x}{x^2 - 2}, x \neq \pm\sqrt{2}$, and $R_2(x) = \frac{x^2 + 3x}{x - \sqrt{2}}, x \neq \sqrt{2}$ be rational functions. Then what is the simplified form of $\frac{R_1(x)}{R_2(x)}$? (1)

**A.** $1$
**B.** $x - 3$
**C.** $\frac{x - \sqrt{2}}{x + 3}, x \neq -3, 0$
**D.** $\frac{x - 3}{x + \sqrt{2}}, x \neq \pm\sqrt{2}, 0$

**29.** Which one of the following is a scalar quantity? (1)

**A.** Displacement of an object to change its position.
**B.** The average velocity of airplane to travel.
**C.** Force applied on an object to change its place.
**D.** The total time taken to complete surgery.

**30.** Let $a > 0$ and $a \neq 1$. Then which one of the following is NOT true about the graphs of exponential functions $f(x) = a^x$ and $g(x) = \left(\frac{1}{a}\right)^x$? (1)

**A.** They intersect each other at $(0, 1)$.
**B.** They are increasing function.
**C.** They have the same domain.
**D.** They have the same range.

**31.** A spherical fuel container with radius 3m is filled with fuel. What is the amount (in $m^3$) of fuel in the container? (1)

**A.** $\frac{12}{3}\pi$
**B.** $9\pi$
**C.** $36\pi$
**D.** $18\pi$

**32.** A circle with radius 3 cm increases its radius at a rate of 0.2 cm/sec. What is the area of the circle at the $5^{\text{th}}$ second? (1)

**A.** $9.64\pi$ $cm^2$
**B.** $4\pi$ $cm^2$
**C.** $16\pi$ $cm^2$
**D.** $9\pi$ $cm^2$

**33.** A school has 6,000 students. The ratio of female students to the total number of students is 2:3. Which one of the following is true about the students in the school? (1)

**A.** The number of female students is twice the number of male students.

**B.** The ratio of male students to female students is 1:3.

**C.** The number of male students is greater than that of female students.

**D.** About 33% of the students in the school are female.

**34.** Let $S$ be a set given by $\{x \in \mathbb{N} : 1 < x \leq 100\}$. Then which one of the following statement is true? (1)

**A.** $S$ is equal to $\{2, 3, 4, \ldots, 99, 100\}$.

**B.** $S$ is equivalent to $\{1, 2, 3, \ldots, 100\}$.

**C.** $S$ is equal to $\{2, 3, 4, \ldots, 99\}$.

**D.** $S$ is equivalent to $\{101, 102, \ldots, 198\}$.

**35.** What is the inverse of the matrix $\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$? (1)

**A.** $\begin{pmatrix} 2 & -1 \\ 0 & 3 \end{pmatrix}$

**B.** $\frac{-1}{6}\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$

**C.** $\begin{pmatrix} -\frac{1}{2} & \frac{1}{6} \\ 0 & \frac{1}{3} \end{pmatrix}$

**D.** $\begin{pmatrix} -2 & 0 \\ 1 & 3 \end{pmatrix}$

**36.** Which one of the following is equal to $\sum_{k=1}^{4}(2k-1)$? (1)

**A.** 20

**B.** 30

**C.** 16

**D.** 32

**37.** Given the polynomial function $p(x) = 5x^2 - x^3 - \sqrt{2}$. Then what are the degree, leading coefficient and constant term of the polynomial function $p(x)$ respectively? (1)

**A.** $3, 5, -\sqrt{2}$

**B.** $3, -1, -\sqrt{2}$

**C.** $2, 5, -\sqrt{2}$

**D.** $3, 1, \sqrt{2}$

**38.** Let $S$ be a set given by $\{x \in \mathbb{N} : 1 < x \leq 100\}$. Then which one of the following statement is true? (1)

**A.** $S$ is equal to $\{2, 3, 4, \ldots, 99, 100\}$.

**B.** $S$ is equivalent to $\{1, 2, 3, \ldots, 100\}$.

**C.** $S$ is equal to $\{2, 3, 4, \ldots, 99\}$.

**D.** $S$ is equivalent to $\{101, 102, \ldots, 198\}$.

**39.** What is the inverse of the matrix $\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$? (1)

**A.** $\begin{pmatrix} 2 & -1 \\ 0 & 3 \end{pmatrix}$

**B.** $\frac{-1}{6}\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$

**C.** $\begin{pmatrix} -\frac{1}{2} & \frac{1}{6} \\ 0 & \frac{1}{3} \end{pmatrix}$

**D.** $\begin{pmatrix} -2 & 0 \\ 1 & 3 \end{pmatrix}$

**40.** Which one of the following is equal to $\sum_{k=1}^{4}(2k-1)$? (1)

**A.** 20

**B.** 30

**C.** 16

**D.** 32

**41.** Given the polynomial function $p(x) = 5x^2 - x^3 - \sqrt{2}$. Then what are the degree, leading coefficient and constant term of the polynomial function $p(x)$ respectively? (1)

**A.** $3, 5, -\sqrt{2}$

**B.** $3, -1, -\sqrt{2}$

**C.** $2, 5, -\sqrt{2}$

**D.** $3, 1, \sqrt{2}$

**42.** A person, whose height is 2 m, is standing away from a 16 m tall building. The angle of depression from the top of the building to the head of the person is $30^\circ$. How far is the person from the building in meters? (1)

**A.** $14\sqrt{3}$

**B.** $\frac{16}{\sqrt{3}}$

**C.** $16\sqrt{3}$

**D.** $\frac{14}{\sqrt{3}}$

**43.** If a sampling interval is calculated by dividing the size of the population by the size of the sample, then which probability sampling technique is used? (1)

**A.** Stratified Sampling

**B.** Systematic Sampling

**C.** Simple Random Sampling

**D.** Cluster Sampling

**44.** Which one of the following systems of equations possesses no solution? (1)

**A.** $\begin{cases} -x+3y=-2 \\ -2x+6y=-4 \end{cases}$

**B.** $\begin{cases} -2x+y=2 \\ 4x-2y=4 \end{cases}$

**C.** $\begin{cases} x-3y=0 \\ 2x+y=-7 \end{cases}$

**D.** $\begin{cases} x+y=\sqrt{2} \\ -x+y=\pi \end{cases}$

**45.** Let $A(-1,2)$ and $B(0,5)$ be initial and terminal points of vector $\overrightarrow{AB}$. What is the position vector of $\overrightarrow{AB}$? (1)

**A.** $-i+7j$

**B.** $5j$

**C.** $-i-3j$

**D.** $i+3j$

**46.** The system of linear equations $\begin{cases} x+z=0 \\ 2x+y=1 \\ x+2y+z=0 \end{cases}$ in matrix form is equal to: (1)

**A.** $\begin{pmatrix} 1 & 1 & 0 \\ 2 & 1 & 0 \\ 1 & 2 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

**B.** $\begin{pmatrix} 1 & 0 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

**C.** $\begin{pmatrix} 1 & 0 & 1 \\ 2 & 1 & 0 \\ 1 & 2 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

**D.** $\begin{pmatrix} 1 & 1 & 1 \\ 2 & 1 & 0 \\ 1 & 2 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

**47.** Which one of the following is NOT true about the coefficient of variation? (1)

**A.** It is used to evaluate the variation of a data.

**B.** It is the ratio of standard deviation to the mean.

**C.** It is a measure of relative dispersion that is based on standard deviation.

**D.** It is a relative measure used to measure the degree of consistency.

**48.** Which of the following describe combination of objects? (1)

**A.** The number of ways of arrangement of n objects in a specific order using r objects at a time.

**B.** The number of ways of arranging the seat of n people in a circle.

**C.** The number of ways of choosing r objects from n objects disregarding the order of selection.

**D.** The number of ways of arranging n objects taking n at a time considering the order of the objects.

**49.** Which one of the following is true about measures of dispersion? (1)

**A.** It gives representative of the whole data.

**B.** It locates the central value of the data.

**C.** It measures the scatter of the data.

**D.** It gives the middle value of the data.

**50.** The solution set of $\sqrt[3]{64^{x-1}} = \left(\frac{1}{16}\right)^{2x+3}$ is equal to: (1)

**A.** $\left\{-\frac{1}{2}\right\}$
**B.** $\left\{\frac{1}{3}\right\}$
**C.** $\{-1\}$
**D.** $\{1\}$

**51.** In how many ways can the name for vertices of a triangle be given in different order by using letters A, B, C, D, E? (1)

**A.** 20
**B.** 120
**C.** 10
**D.** 60

**52.** If $\sin(-53^\circ) = \beta$, then which one of the following is correct? (1)

**A.** $\sin(37^\circ) = \beta$
**B.** $\sin(127^\circ) = \beta$
**C.** $\sin(-37^\circ) = \beta$
**D.** $\sin(307^\circ) = \beta$

**53.** What is the solution set of the inequality $1 - \frac{3}{x} \leq \frac{4}{x^2}$? (1)

**A.** $[-1, 0) \cup (0, 4]$
**B.** $[-1, 4]$
**C.** $(-\infty, -1) \cup (4, \infty)$
**D.** $(-\infty, -1] \cup [4, \infty)$

**54.** The slope of a line passing through $P(1, -1)$ and $Q(0, 1)$ is equal to: (1)

**A.** 2
**B.** -1
**C.** 3
**D.** -2

**55.** Given the function $f(x) = 2\,\mathrm{sgn}\,x + 1$. Then what are the domain and the range of $f(x)$ respectively? (1)

**A.** $\mathbb{R}$ and $\{-3, 1, 3\}$
**B.** $\mathbb{R}$ and $\{-3, -1, 3\}$
**C.** $\mathbb{R}$ and $\{-2, 0, 2\}$
**D.** $\mathbb{R}$ and $\{-1, 1, 3\}$

**56.** What is the rationalizing factor of the number $\frac{5\sqrt{3}}{\sqrt{3}-\sqrt{2}}$? (1)

**A.** $\frac{1}{\sqrt{3}+\sqrt{2}}$
**B.** $\frac{\sqrt{3}}{\sqrt{3}+\sqrt{2}}$
**C.** $\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$
**D.** $\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

**57.** An entrance examination for a certain job was given to 35 applicants and their results are summarized in the table below. Results Number of applicants 41-50 3 51-60 14 61-70 10 71-80 5 81-90 2 91-100 1 Then which one of the following is NOT true? (1)

**A.** The upper class limit of the second class is 60.
**B.** The class midpoint of the second class is 55.
**C.** 61-70 is the class interval of the third class.
**D.** The lower class limit of the fifth class is 81.

**58.** What is the equation of the tangent line to the graph of $f(x) = 2x^3 - 3x^2 + 1$ at $x = 2$? (1)

**A.** $y = 120x - 235$
**B.** $y = 6x - 7$
**C.** $y = 2x + 5$
**D.** $y = 12x - 19$

**59.** An entrance examination for a certain job was given to 35 applicants and their results are summarized in the table below. Results Number of applicants 41-50 3 51-60 14 61-70 10 71-80 5 81-90 2 91-100 1 Then which one of the following is NOT true? (1)

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END OF THE EXAMINATION

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