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EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE (EAES)
ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)
MATHEMATICS, Hamlie, 2016 E.C / July, 2024 G.C

Booklet Code: 096
Number of Items: 60

Subject Code: 02
Time Allowed: 3 Hours

1. In the set of natural numbers, which one of the following defines a composite number?
   A. A number that has only two distinct factors.
   B. A number that is divisible by numbers from 2 to 9.
   C. A number that has two or more different factors.
   D. A number that has three or more different divisors.

2. Which of the following is true about rationalizing the denominator?
   A. Only denominators can be multiplied by an irrational number.
   B. Only numerators can be rationalized when there is a radical.
   C. It is a method of changing the denominator in to a rational number.
   D. It is a technique of multiplying a given number by an irrational expression.

3. When dividing 142 by 13 and expressed the result by applying the division algorithm, we get?
   A. $142 = 10(13) + 12$
   B. $142 = 11(13) - 1$
   C. $142 = 11(13) + 1$
   D. $142 = 10(14) + 2$

4. The solution set of the system $\begin{cases} 2x - y = 5 \\ 3y + 15 = 6x \end{cases}$ is:
   A. ϕ
   B. $\{(t, 2t - 15): t \in R\}$
   C. $\{(t, 2t - 5): t \in R\}$
   D. $\{(0,-5), (1,-3), (2,-2), \ldots\}$

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5. If the product of the roots of the equation $4x^2-2kx+k-1=0$ is $-\frac{3}{2}$, whi of the following is the sum of the roots of the equation?

A. $-\frac{2}{5}$
B. $-\frac{5}{2}$
C. $\frac{2}{5}$
D. $\frac{5}{2}$

6. Which of the following can better be regarded as a universal set to app set operations on the sets A = {-1, 1, 2, 3, ..., 20} and B = {0, 3, $\frac{10}{3}$,

A. The set of natural numbers.
B. The set of integer numbers.
C. The set of irrational numbers.
D. The set of rational numbers.

7. Given sets A = {-1, {0}, {-1, 0}} and B = {{-1}, -1, 0}, which of the following is the relative complement of A with respect to B?

A. {{-1}, 0}
B. {{0}, {-1, 0}}
C. {{0}, {-1}}
D. {{-1, 0}}

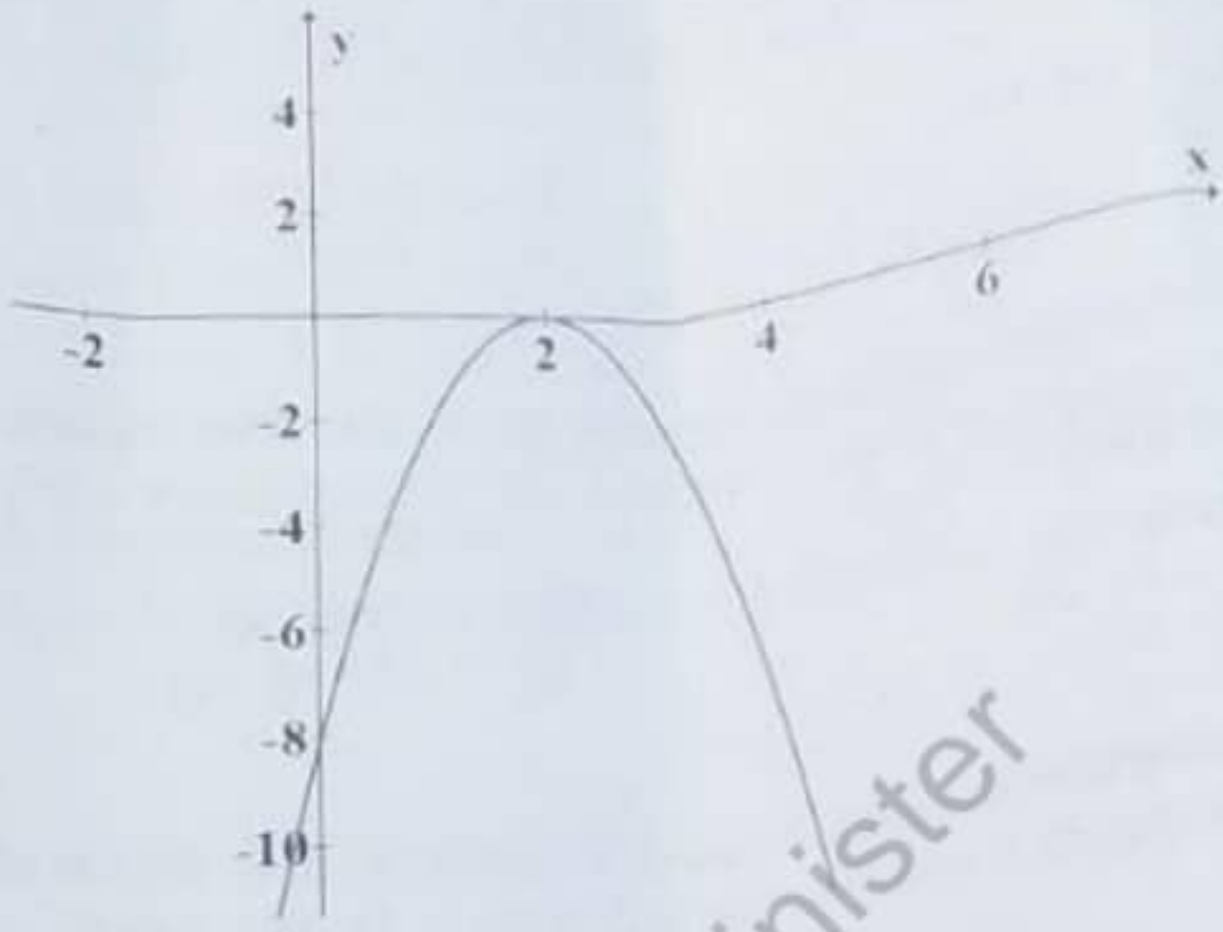
8. Let A = {-2, -1, 0, 1}, B= {1, 5} and R = {(-1, 5), (0, 5), (1, 0)}. T which of the following is true?

A. Domain of R is {-1, 0, 1, -2}.
B. Range of R is {1, 0, 5}.
C. R is a relation from A into B.
D. R is a relation of 3 elements.

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9. Let f be a function whose graph is the given below.



Which one of the following is equal to $h(x)$?

A. $-2x^2 + 4x - 8$
B. $2x^2 - 8x + 8$
C. $8x - 2x^2 - 8$
D. $8x - 2x^2 + 8$

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10. Which one of the following refers to the definition of similar plane figures?
A. Figures whose corresponding angles have the same ratio.
B. Figures where one is an enlargement of the other.
C. Figures whose ratios of length of corresponding sides are different.
D. Figures that have different shapes but might have same size.

11. In ΔABC $m(< B) = 90^\circ$, with $m(< A) = 30^\circ$ and $BC = 11$cm, then what is t

length of $\overline{AC}$?

A. 22 cm
B. $\frac{22\sqrt{3}}{3}$ cm
C. $11\sqrt{3}$ cm
D. $\frac{11\sqrt{3}}{3}$ cm

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12. Given a circle of diameter 16 cm, a chord of the circle is 6 cm far from the center of the circle. Which of the following is the length of the chord?

A. $2\sqrt{7}$ cm
B. 8 cm
C. $4\sqrt{7}$ cm
D. 16 cm

13. Which of the following is the approximate surface area of the bases of a regular pentagonal prism of radius 6 cm? (Given values: $\sin 72^\circ \approx 0.3$, $\cos 72^\circ \approx 0.95$)

A. 54 sq. cm
B. 85.5 sq. cm
C. 27 sq. cm
D. 27.5 sq. cm

14. Let $\bar{x}$ denote the arithmetic mean of a numerical data. If each observation is multiplied by 0.5, which of the following is the new mean?

A. $\bar{x}$
B. $\frac{1}{2}\bar{x}$
C. $2\bar{x}$
D. $\bar{x} - 0.5$

15. A regular triangular pyramid labeled 1, 2 and 3, is thrown twice and what comes down on a flat surface is observed. What is the probability that the sum of the numbers faced down from this experiment less than 5?

A. $\frac{1}{3}$
B. $\frac{2}{3}$
C. $\frac{4}{9}$
D. $\frac{5}{9}$

16. Given vectors $\vec{u}$ having initial point (-1, 0) and terminal point (2, 3) and $\vec{v}$ with initial point (5, -2) and terminal point (2, 3), then $\vec{v} - \vec{u}$ is equal to:

A. (-6, 3)
B. (2, -6)
C. (0, -2)
D. (-6, 2)

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17. Which one of the following is the definition of a polynomial function?

A. A function f defined by $f(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x^1 + a_0$ where n is non -negative integer, $a_n \neq 0$ and $a_n, a_{n-1}, \ldots, a_0 \in R$.

B. A function f defined by $f(x) = a_n x^n + a_{n+1}x^{n+1} + a_{n+2}x^{n+2} + \ldots$ where n is positive integer, $a_n \neq 0$ and $a_n, a_{n+1}, \ldots, \in R$.

C. A function f defined by $f(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x^1 + a_0$ where n is an integer, $a_n \neq 0$ and $a_n, a_{n-1}, \ldots, a_0 \in R$.

D. A function f defined by $f(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x^1 + a_0$ where n is a rational number, $a_n \neq 0$ and $a_n, a_{n-1}, \ldots, a_0 \in R$.

18. When $f(x) = 4x^3 + kx - 1$ is divided by $x - 2$ the remainder is 3, what is the value of k?

A. 14
B. 7
C. $\frac{7}{2}$
D. 9

19. What is the solution set of the equation $\log_4(x+1) - 2\log_4 x = 0.5$?

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

20. Which of the following is the characteristic of $\log(20 + \frac{1}{5})$?

A. -1
B. 1
C. 2.02
D. 0.2

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21. Which one of the following is the solution set of the equation $\left(\frac{1}{25}\right)^x + 5(0.04)^x = 30$?

A. $\{5\}$
B. $\left\{\frac{1}{5}\right\}$
C. $\left\{-\frac{1}{2}\right\}$
D. $\left\{\frac{1}{2}\right\}$

22. Given the set $A = \{x \in R: x \notin (\pi, \infty)\}$ which of the following sets is equal to A?

A. $(-\infty, \pi]$
B. $(-\pi, \pi]$
C. $(-\infty, \infty)$
D. $[\pi, \infty)$

23. Which one of the following is the solution set of $(2x - 1)^2 + 2 \leq 6x^2 - 3x$?

A. $[-1.5, 1]$
B. $[1.5, \infty)$
C. $(-\infty, 1.5) \cup [1, \infty)$
D. $(-\infty, -1.5] \cup [1, \infty)$

24. The line $y = x$ is intersected by the horizontal line $y = a$ at point P and $y = b$ at point Q for $a \neq b$. Which of the following gives the distance from Q to P?

A. $2|a - b|$
B. $\sqrt{2}|b - a|$
C. $\sqrt{2}(b - a)$
D. $2\sqrt{|a - b|}$

25. Let $P\left(-\frac{1}{2}, 3\right)$ and $Q(4, -5)$ are points on the line $y = kx + b$. Which of the following is the value of k?

A. $-\frac{7}{16}$
B. $-\frac{9}{19}$
C. $-\frac{16}{7}$
D. $-\frac{16}{9}$

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26. Which of the following is true about a trigonometric value of angles?

A. $\sin(270^\circ) = 0$
B. $\cos(-180^\circ) = -1$
C. $\tan(-90^\circ) = 0$
D. $\tan(540^\circ) = -1$

27. For $0^\circ \leq \theta \leq 90^\circ$, which of the following relationship describes the co-function of angle θ?

A. $\cos\theta$ is equal to secant of its complementary angle.
B. $\csc\theta$ is equal to sine of its supplementary angle.
C. $\cot\theta$ is equal to tangent of its complementary angle.
D. $\sec\theta$ is equal to sine of its supplementary angle.

28. For $0^\circ \leq \theta \leq 90^\circ$, which of the following identity is correct?

A. $\csc^2(90^\circ - \theta) = 1 + \tan^2\theta$
B. $\cot^2(90^\circ - \theta) = 1 + \csc^2\theta$
C. $\sec^2\theta + \tan^2\theta = 1$
D. $\cot^2\theta + \csc^2\theta = 1$

29. Let ABCD be a Rhombus and E be the mid-point of the shortest diagonal $\overline{AC}$. Then which of the following is **NOT** true?

A. ΔABC is isosceles.
B. $\overline{AC}$ is perpendicular to $\overline{BD}$.
C. ΔBEC is a right triangle.
D. $\angle DAB$ is an acute angle.

30. A person would like to fence all sides of a regular hexagonal polygonal park of radius 12 meter. What is the length of a fencing material needed in meter?

A. $72\sqrt{3}$
B. 72
C. $36\sqrt{3}$
D. 36

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31. Given a right circular cylinder of base radius 5 cm and lateral surface area 150π sq. cm, which of the following is the volume of the cylinder in cubic centimeters?

A. 375π
B. 350π
C. 315.5π
D. 200π

32. A spherical container of diameter 3 meters is filled with water. What is the amount of the water in the container in cubic meters?

A. $\frac{27}{4}\pi$
B. $\frac{27}{2}\pi$
C. $\frac{9}{2}\pi$
D. $\frac{9}{4}\pi$

33. The domain and the range respectively of the function f defined by $f(x) = 1 + |2x - 4|$ are:

A. $[2, \infty)$ and $[1, \infty)$
B. R and $[2, \infty)$
C. $[2, \infty)$ and R
D. R and $[1, \infty)$

34. Which of the following is the inverse of $f(x) = \sqrt{x-3}$?

A. $f^{-1}(x) = x^2 + 3, x \geq 0$
B. $f^{-1}(x) = x^2 + 3, x \geq 3$
C. $f^{-1}(x) = \sqrt{x+3}, -\infty < x < \infty$
D. $f^{-1}(x) = \frac{1}{\sqrt{x-3}}, x \neq 3$

35. Which of the following is the simplified form of $\left[x - \frac{x+3}{x-1}\right] \div \frac{x-3}{x^2-2x+1}$?

A. $\frac{x^2-2x+3}{x-1}, x \neq 3$
B. $\frac{-1+x}{x-3}, x \neq 1$
C. $x^2 - 1, x \neq 1, 3$
D. $x^2 - 2x + 1, x \neq 1, 3$

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40. A data on scores of 32 students is listed as follows.

52	48	65	70	50	42	40	61
76	35	55	58	67	60	55	45
60	45	32	66	76	58	75	63
50	75	44	46	78	74	61	52

If the data is to be grouped in 6 classes, what has to be the class interval (w)?

A. 6
B. 7
C. 8
D. 9

41. Five English books, 3 of which identical and 3 different Mathematics books are to be arranged in a row. If one particular Mathematics book is to be placed, first, in how many ways can this be done?

A. 240
B. 840
C. 5040
D. 6720

42. Let identical balls labeled 1 to 10 are placed in a box. If a ball is drawn at random, what is the probability that the ball is labeled neither odd nor a multiple of 3?

A. $\frac{3}{10}$
B. $\frac{1}{2}$
C. $\frac{3}{5}$
D. $\frac{2}{5}$

. Let A be a 3x3 matrix and k be a real number. Which of the following is true?

A. If $B = kA$, then $\det(B) = 3k\det(A)$.
B. If $B = A^T$, then $\det(-B) = \det(A)$.
C. If B is obtained by interchanging two rows of A, then $\det(B) = \det(A)$.
D. If B is obtained by multiplying one column of A by k, then $\det(B) = k\det(A)$.

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44. Given the linear system, $\begin{cases} a_1x + b_1y + c_1z = 3 \\ a_2x + b_2y + c_2z = -1 \\ a_3x + b_3y + c_3z = 2 \end{cases}$ such that the determinant of the coefficient matrix is $\frac{1}{3}$. Which of the following is the value of y?

A. $\frac{1}{3}\begin{vmatrix} a_1 & b_1 & c_1 \\ 3 & -1 & 2 \\ a_3 & b_3 & c_3 \end{vmatrix}$

B. $\frac{1}{3}\begin{vmatrix} a_1 & 3 & c_1 \\ a_2 & -1 & c_2 \\ a_3 & 2 & c_3 \end{vmatrix}$

C. $-3\begin{vmatrix} a_1 & b_1 & c_1 \\ 3 & 1 & -2 \\ a_3 & b_3 & c_3 \end{vmatrix}$

D. $-3\begin{vmatrix} a_1 & 3 & c_1 \\ a_2 & 1 & c_2 \\ a_3 & -2 & c_3 \end{vmatrix}$

45. If $w = i - \frac{3+i}{5}$, then which of the following is equal to the modulus of w?

A. $\frac{3}{5}\sqrt{5}$

B. 1

C. $\frac{1}{5}\sqrt{10}$

D. $1 + \frac{1}{5}\sqrt{10}$

46. Few terms of a sequence are given as follows: $-2, 0, 4, 10, \ldots$. Which of the following can be a fifth term?

A. 14
B. 16
C. 18
D. 20

47. For the arithmetic sequence with $A_3 = 5$ and $A_5 = 10$, which of the following is the sum of the first 20 terms?

A. 475
B. 495
C. 570
D. 950

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48. Suppose a and b are real numbers such that $a \neq 0$ and $b > 0$. If $\sum_{n=1}^{\infty} b\left(\frac{a}{b}\right)^n$ converge, which of the following is true?

A. $|a| = b$
B. $|a| > b$
C. $a \geq b$
D. $|a| < b$

49. An enterprise found out its profit by the formula $f(t) = t^2 - t + 100$, t in days. Which of the following is the average rate of change of its profit on $0 \leq t \leq 2$?

A. $\frac{f(0)-f(2)}{2}$
B. $\frac{f(2)-f(1)}{2}$
C. $\frac{f(2)-f(t)}{t-2}$
D. $\frac{1}{2}(f(2)-f(0))$

50. For the purpose of road management, flow of vehicles needs to be regulated. On the average it was observed that the speed of vehicles in km/hr follow the formula $f(x) = 10\left(x + \frac{50}{2x+1}\right)$, x is the speed in km/hr. Which of the following is the minimum speed in km/hr of a vehicle in the situation?

A. 45
B. 95
C. 105
D. 115

51. Which of the following gives the definition of integration for a function?

A. It is a process of reversing the derivative of the function.
B. It is the derivative of a function at a point.
C. It is the rate of change of a function.
D. It is the derivative of a function on the given interval.

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52. Which of the following is the mean deviation about the mean of the data given below?

15 12 10 13 9 12 11 15 14 9

A. 1.4
B. 1.5
C. 1.8
D. 2.0

53. Given the following grouped data

x	8 – 12	13 - 17	18 - 22	23 –27	28 –32
f	3	4	5	6	2

Which of the following is the standard deviation of the data?

A. 6
B. 6.5
C. $\sqrt{37}$
D. $\sqrt{37.5}$

. Given two sets of data A and B with ranges 15 and 15 respectively, coefficient of range (CR) of A is 0.2 and CR of B is 0.21. Then which of the following is true?

A. The dispersion of A is slightly greater than that of B.
B. The dispersion of B is slightly greater than of A.
C. Data A has the same dispersion as B even if CR varies.
D. No enough information to compare dispersion roughly.

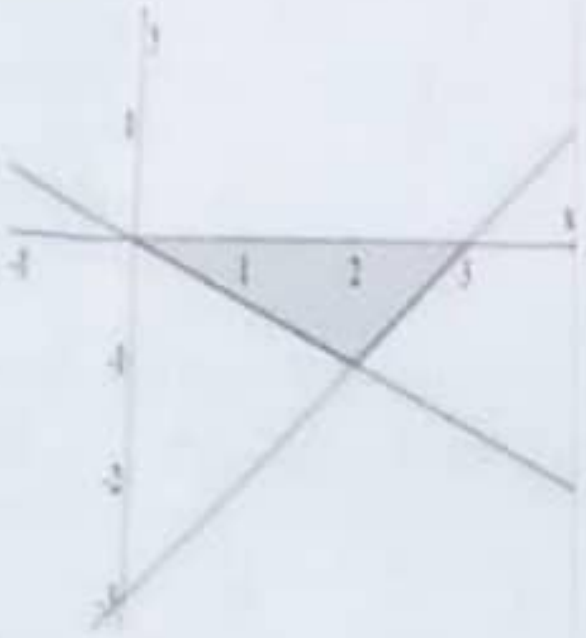
In a homogeneous population where there is a categorical difference, items are selected randomly in each category. Which of the following describes the sampling method stated above?

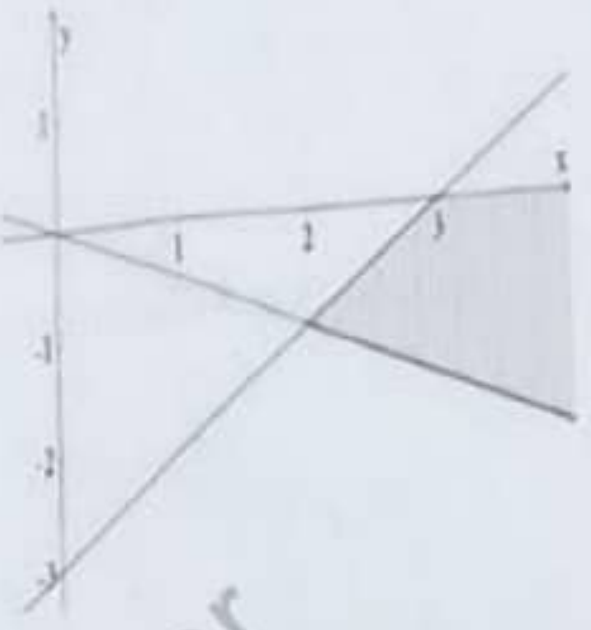
A. Simple random sampling
B. Systematic sampling
C. Stratified sampling
D. Cluster sampling

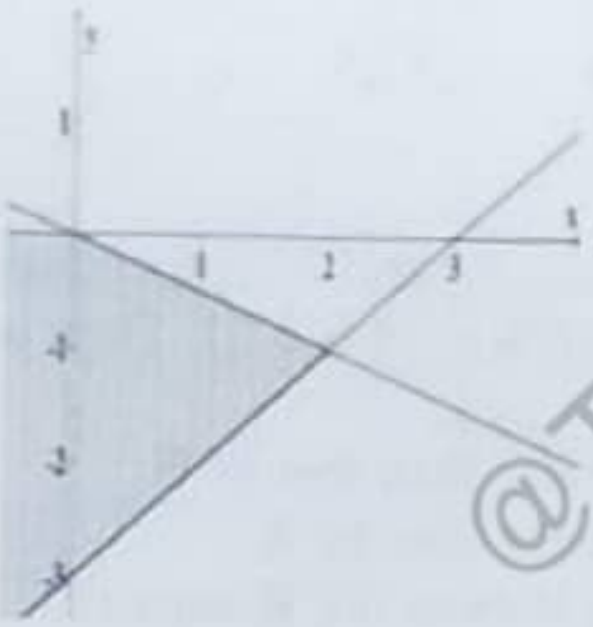
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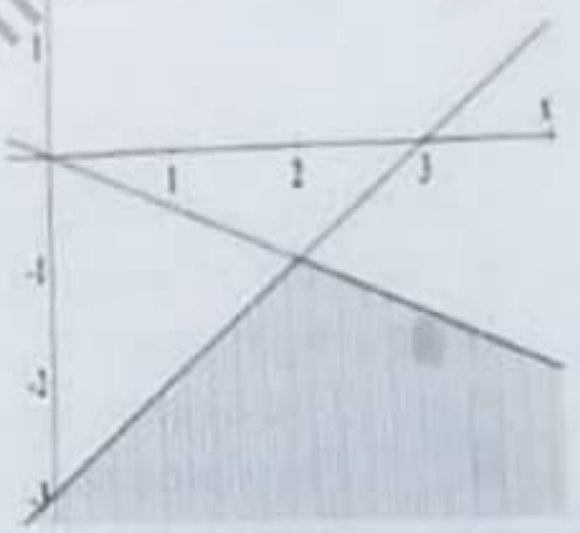
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56. Which of the following shaded region represents the graph of the system of inequalities $2y + x \geq 0$, $x - y \leq 3$, $y \leq 0$?

A. 

C. 

B. 

D. 

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Which one of the following is the minimum value of the following linear programming problem?

Minimize: $Z = 3x + y$

Subject to: $y \geq -x + 4$, $y \geq 5x - 20$, $x \geq 1$, $y \leq 5$

A. 12
B. 8
C. 4
D. 6

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8. An agent planned to transport fertilizers in barrels and sacks from a port using two types of cars designated by A and B. Each car A can transport 30 barrels and 50 sacks charging Birr 8,000 for a trip, and each car B can transport 45 barrels and 80 sacks charging Birr 12,000. If there are at least 400 barrels and at most 1500 sacks to be transported from the port, which of the following is a constraint of the linear programming problem to minimize the cost of transportation given by $z = 8{,}000x + 12{,}000y$?

A. $\begin{cases} 6x+9y \geq 80 \\ 5x+8y \leq 150 \\ x \geq 0, y \geq 0 \end{cases}$

B. $\begin{cases} 6x+9y \leq 80 \\ 5x+8y \geq 150 \\ x \geq 0, y \geq 0 \end{cases}$

C. $\begin{cases} 3x+5y \leq 40 \\ 9x+16y \leq 30 \\ x \geq 0, y \geq 0 \end{cases}$

D. $\begin{cases} 3x+5y \geq 40 \\ 9x+16y \leq 30 \\ x \geq 0, y \geq 0 \end{cases}$

9. A college graduate plans to deposit Birr 2000 each year starting from the first day of the year into a saving account that pays 8% interest compounded annually. How much will he/she has just after the first day of the third year?

A. Birr 4492.2
B. Birr 6332.8
C. Birr 6492.8
D. Birr 7012.2

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In order to safeguard the property of a lessor, rent tax on income per year is set as per the following rate.

Taxable income in Birr	Tax Rate in percentage
0 to 7200	Exempted
7201 to 19800	10
19801 to 38400	15
38401to 63,000	20

In 2015 E.C, if a building was rented for 8 months at Birr 4,500 per month, what was the amount of rental tax paid at the end of the year?

A. Birr 3390
B. Birr 3690
C. Birr 3960
D. Birr 4390

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THE END

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