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

Subject Code: 02
Time Allowed: 3 Hours

Booklet Code: 110
Number of Items: 60

1. Let $f(x)=\frac{x+1}{x-1}$ and $g(x)=\sqrt{x+2}$ be two functions. Which one of the following is true about the combination values of f and g at $x=2$?

A. $(f.g)(2)=6$
B. $\left(\frac{f}{g}\right)(2)=\frac{2}{3}$
C. $(f+g)(2)=3$
D. $(f-g)(2)=-1$

2. Which one of the following defines an exponential function?

A. $f:\mathbb{R}\to(0,\infty)$ defined by $f(x)=b^x$, where $b>0$ and $b\neq 1$.
B. $f:\mathbb{R}\to(0,\infty)$ defined by $f(x)=x^b$, where $b>0$ and $b\neq 1$.
C. $f:(0,\infty)\to\mathbb{R}$ defined by $f(x)=b^x$, where $b>0$ and $b\neq 1$.
D. $f:(0,\infty)\to\mathbb{R}$ defined by $f(x)=x^b$, where $b>0$ and $b\neq 1$.

3. Let f be differentiable function at a number 'a' for a ∈ Domain f. In the expression $\frac{f(a+h)-f(a)}{h}$ for $h\neq 0$, as h gets closer and closer to zero from both directions, the expression becomes closer to $f'(a)$ which is equal to

A. The gradient of the normal line to the graph of f at a point (a, f(a)).
B. The gradient of the vertical line to the graph of f at a point (a, f(a)).
C. The gradient of the secant line to the graph of f at a point (a, f(a)).
D. The gradient of the tangent line to the graph of f at a point (a, f(a)).

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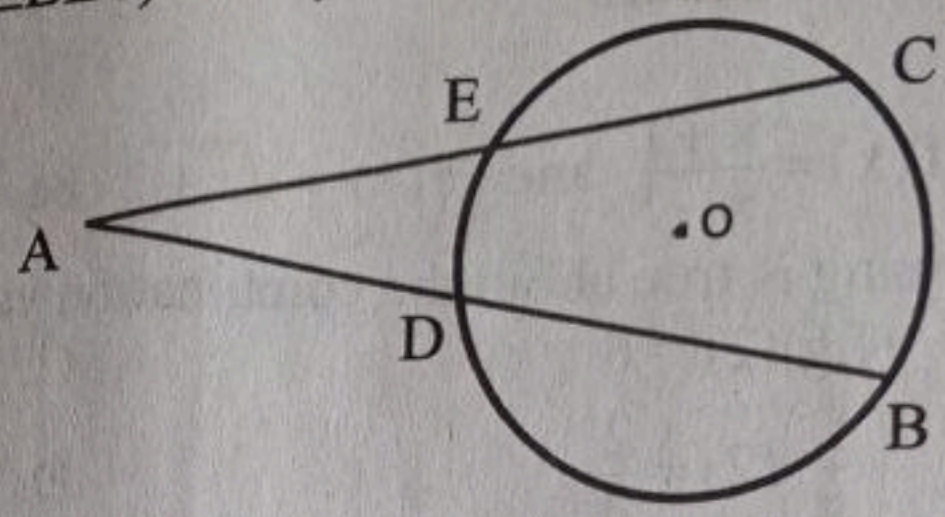
4. In the following figure, O is the center of the circle and the line segments $\overline{AB}$ and $\overline{AC}$ are intersecting the circle at D and E respectively. If $m(\angle ACD) = 30°$ and $m(\angle BEC) = 50°$, then which one of the following is equal to $m(\angle BAC)$?



A. 70°
B. 80°
C. 20°
D. 30°

5. Let p and q be propositions. Which one of the following propositions is a tautology?

A. $(p \Rightarrow \neg q) \Leftrightarrow (p \wedge q)$
B. $(\neg p \Rightarrow q) \Rightarrow (p \wedge q)$
C. $(p \wedge q) \Rightarrow (p \vee q)$
D. $(p \vee q) \Rightarrow (p \wedge q)$

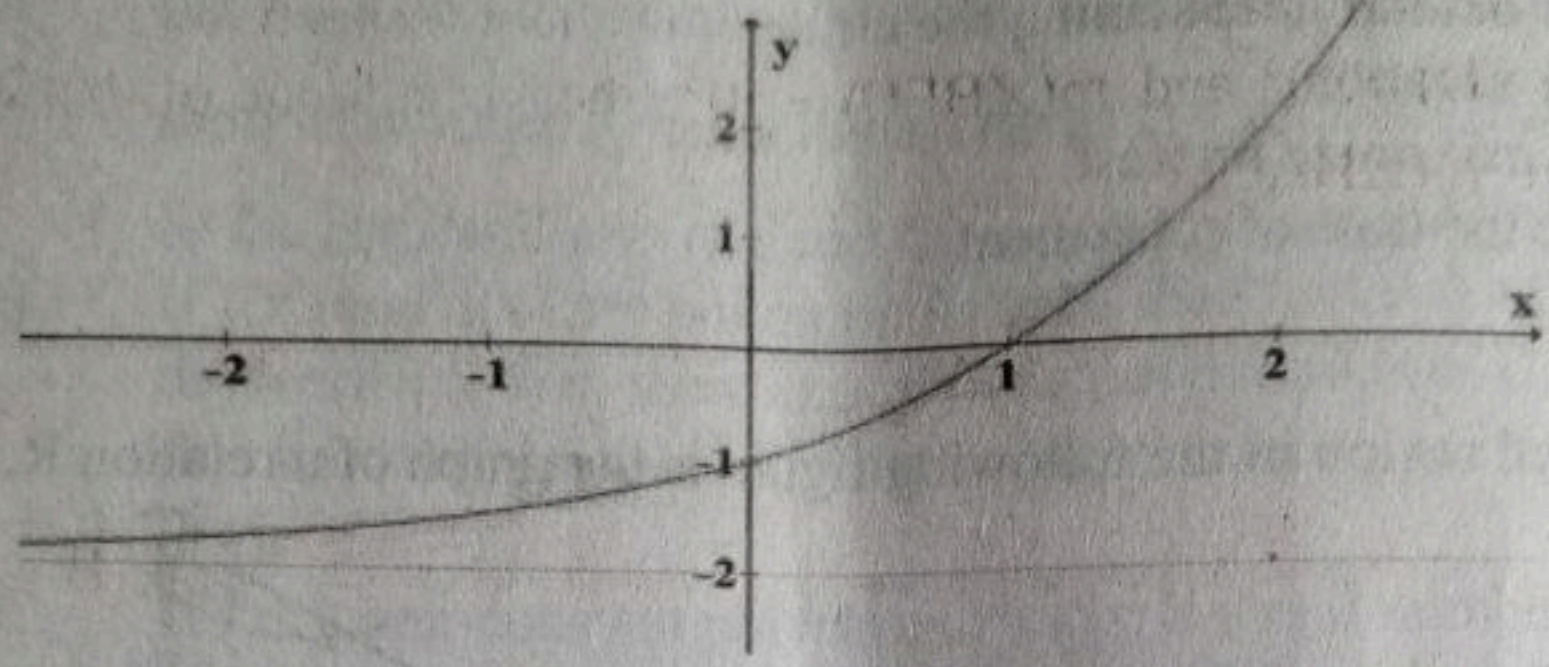
6. If 180 individuals can complete a job in 15 days by working 10 hours a day, how many individuals are needed to complete the job in 10 days if they work 12 hours a day?

A. 200
B. 144
C. 225
D. 220

7. If the measure of each interior angle of a regular polygon is 135°, then which one of the following is the number of lines of symmetry of the polygon?

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

8. Consider the following graph of a given exponential function f(x).



Which one of the following functions represents the graph shown above?

A. $f(x) = (2)^{x-2}$

B. $f(x) = \left(\frac{1}{2}\right)^{x-2}$

C. $f(x) = (2)^{x} - 2$

D. $f(x) = \left(\frac{1}{2}\right)^{x} - 2$

9. What is the perimeter of a regular hexagon of radius 6cm?

A. $18\sqrt{3}$ cm

B. 18 cm

C. 36 cm

D. $36\sqrt{3}$ cm

10. Which one of the following is a quantitative data?

A. Measuring the heights of each students in the given class.

B. Determining the tastes of foods in a restaurant.

C. Identifying the social status of individuals.

D. Checking the quality of a new product.

11. Which one of the following is true about the integral of a function f(x) with respect to a variable x?

A. $\int f'(x)dx$ is the set of all anti-derivatives of f.

B. $\int f'(x)dx$ is the set of all derivatives of f.

C. $\int f(x)dx$ is the set of all anti-derivatives of f.

D. $\int f(x)dx$ is the set of all derivatives of f.

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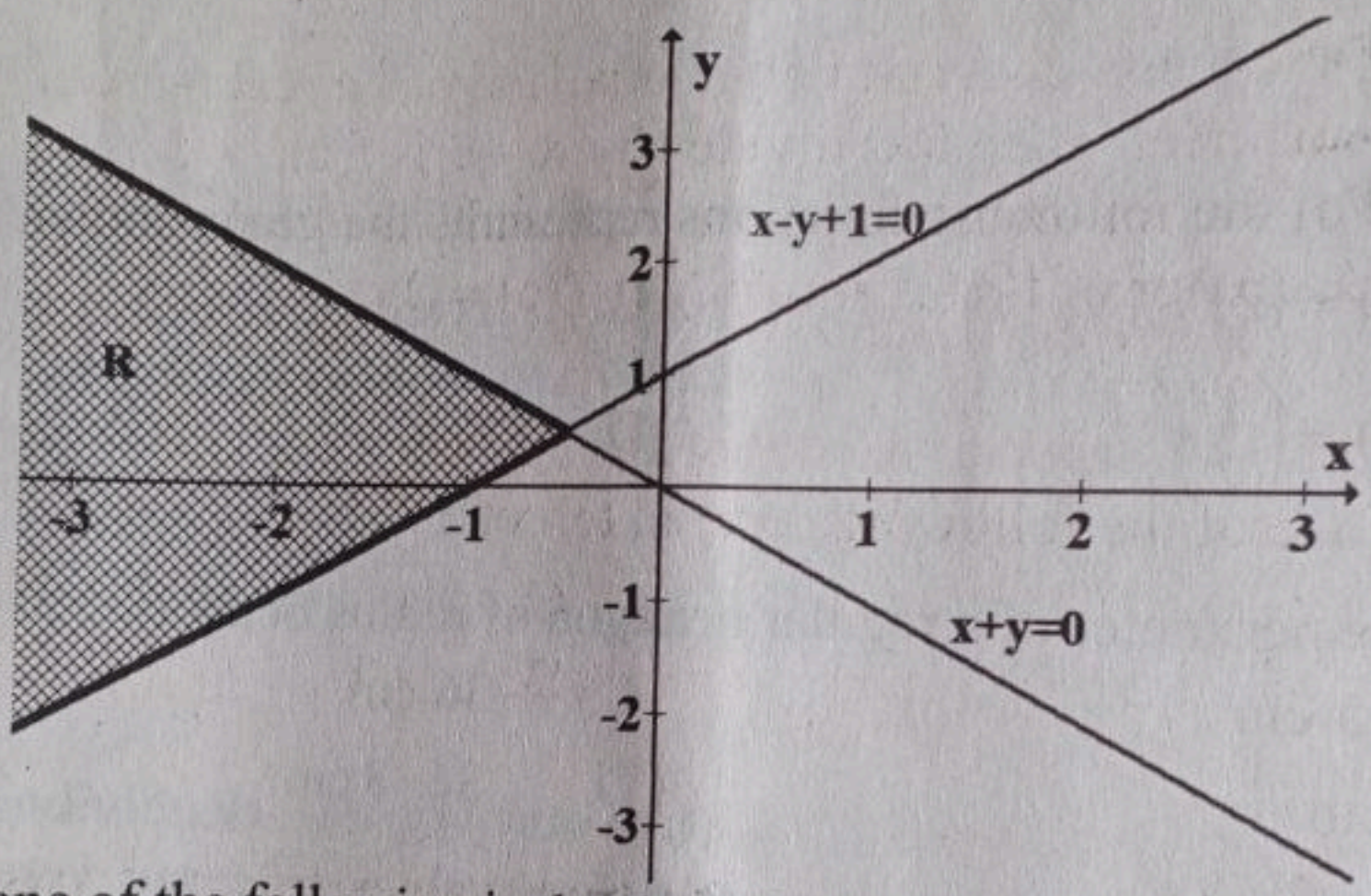
12. Which one of the following is **NOT** a valid reason for saving?
   A. For betting in football
   B. For vacation
   C. To maximize interest
   D. For the time of retirement

13. The shaded region in the following figure is the graph of a relation R.



Which one of the following is the domain and range of R respectively?

A. $(-\infty, -\frac{1}{2}]$ and $\mathbb{R}$

B. $\mathbb{R}$ and $(-\infty, -\frac{1}{2})$

C. $\mathbb{R}$ and $(-\infty, -\frac{1}{2}]$

D. $(-\infty, -\frac{1}{2})$ and $\mathbb{R}$

14. Which one of the following statements is the polynomial division theorem?

A. Let f is a non-constant polynomial with integer coefficients. If the rational number $\frac{c}{d}$ in its lowest terms is a root of f, then c is a factor of the constant term of f and d is a factor of the leading coefficient.

B. If f(x) and d(x) are polynomials such that $d(x) \neq 0$ and degree(d(x)) ≤ degree(f(x)), then there exist unique polynomials q(x) and r(x) such that $f(x) = d(x)q(x)+r(x)$, where $r(x) = 0$ or degree of r(x) < degree of d(x).

C. If f is a non-constant polynomial and c is a real number, then the remainder when f(x) divided by $x - c$ is f(c).

D. If f is a non-constant polynomial and c is a real number, then $x - c$ is a factor of f(x) if and only if $f(c) = 0$.

15. Which one of the following is equal to $\cot(1755°)$?

A. $\sqrt{3}$

B. $-\sqrt{3}$

C. 1

D. −1

16. Let p and q be proposition with truth values true and false respectively. Which one of the following statements is **NOT** correct?

A. $p \Rightarrow q$ is false.

B. $p \Leftrightarrow q$ is true.

C. $p \wedge q$ is false.

D. $p \vee q$ is true.

17 Which one of the following is equal to the sum $\sum_{n=1}^{5} 2n^2$?

A. 2+8+16+32+64

B. 2+4+8+16+32

C. 2+4+6+8+10

D. 2+8+18+32+50

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18. A company produces shirts of black and white colors from polyester and cotton. The company has 6000 units of polyester and 3000 units of cotton in its store. A black shirt requires 5 units of polyester and 4 units of cotton where as a white shirt requires 3 units of polyester and 3 units of cotton. If the factory gets a profit of Birr 120 from each black shirt and Birr 200 from each white shirt, what is the maximum profit of the company?

A. Birr 144,000
B. Birr 120,000
C. Birr 344,000
D. Birr 200,000

19. Let S, R and T be any three sets. Which one of the following is **NOT** true about the union of the sets?

A. $(S \cup R) \cup T = T \cup (R \cup S)$
B. $S \cup S = S$
C. $S \cup R = R \cup S$
D. $S \cup T = T$

20. Which one of the following is equal to the polynomial function $f(x) = x^2 + 4x + 4$?

A. $k(x) = (x-2)(x+2)$
B. $\ell(x) = (x^2 + 10x + 3) + (-6x + 1)$
C. $g(x) = \dfrac{x^4 + 4x^2 + 4}{x^2 + 2}$
D. $h(x) = (x^2 + 6x + 8) - (2x - 4)$

21. Which one of the following is true about the function $f(x) = \tan x$?

A. f is a periodic function with period $\frac{\pi}{2}$.

B. The graph of f intersects y-axis at $\left(\frac{\pi}{2}, 0\right)$.

C. The domain of f is $\mathbb{R} \setminus \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$.

D. The range of f is the set of real numbers, $\mathbb{R}$.

22. Which one of the following is an equation of the parabola with vertex V(0, 0) and focus F(2, 0)?

A. $x^2 = 8y$

B. $x^2 = \frac{1}{8}y$

C. $y^2 = 8x$

D. $y^2 = \frac{1}{8}x$

23. Which one of the following is equal to the sum $\sum_{k=1}^{7} 729(3^{1-k})$?

A. 1088

B. 1079

C. 1093

D. 1092

24. What is the maximum value of $z = 2x + 3y$ subjected to the constraints

$$\begin{cases} x + y \leq 6 \\ 2x - y \leq 6 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

A. 18

B. 22

C. 12

D. 14

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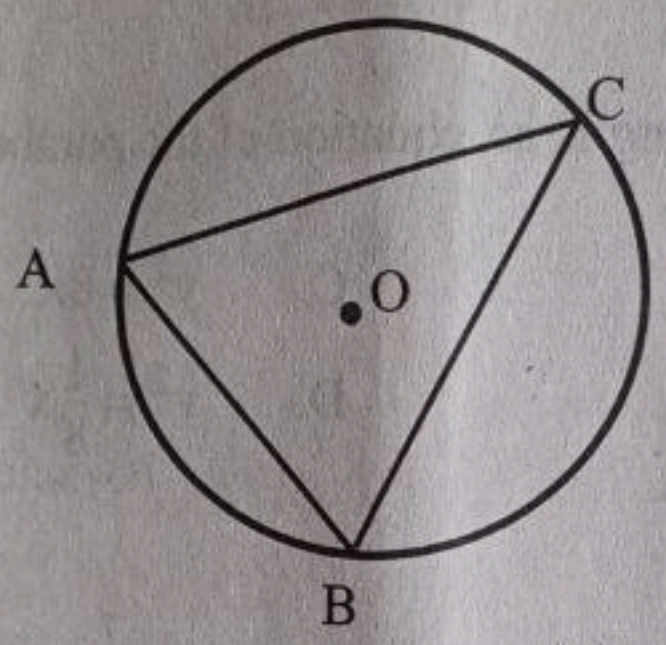
25. Which one of the following numbers is a common multiple of 324 and 1152?

A. 13824
B. 20736
C. 5184
D. 7776

26. Consider a circle with center O and the line segments $\overline{AB}$, $\overline{AC}$ and $\overline{BC}$ are chords of the circle as shown in the figure below. If $m(\angle ABC) = 60°$ and $m(\angle ACB) = 40°$, then what is $m(\angle BOC)$?



A. 120°
B. 160°
C. 100°
D. 80°

27. Which one of the following is the solution of the equation $(243)^{2x-3} = \frac{(81)^{-3x+2}}{3}$ in the set of real numbers?

A. 2
B. −2
C. −1
D. 1

28. What is the total surface area of a regular square pyramid with slant height 8cm and base area 25 cm^2?

A. 80 cm^2
B. 65 cm^2
C. 105 cm^2
D. 90 cm^2

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29. The following table presents the scores of Grade 11 students of a certain school in a Mathematics Examination.

Score	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Number of Students	10	9	15	12	10	4	2

What is the median of the data given in the above table?

A. 58.5
B. 60.5
C. 50.5
D. 55.5

30. What is the area of the region bounded by the graph of $f(x)=x^3$ and the x-axis on the interval $[-4, 2]$?

A. 120 Square units
B. 136 Square units
C. 60 Square units
D. 68 Square units

31. If $a=2-3\sqrt{5}$ and $b=3+2\sqrt{5}$, then which one of the following is true?

A. $ab=36$
B. $11a \div b=-36+13\sqrt{5}$
C. $a+b=5$
D. $a-b=-1-\sqrt{5}$

32. A sector of a circle of diameter 8cm is formed by a central angle of 45°. What is the area of the sector?

A. 8π cm^2
B. 2π cm^2
C. π cm^2
D. $(2\pi+8)$cm^2

33. Which one of the following intervals is the solution set of the inequality $\left|3-\frac{1}{2}x\right|<5$?

A. $(-16, 4)$
B. $(-4, 16)$
C. $(-8, 2)$
D. $(-2, 8)$

34. The altitude of a frustum of a regular square pyramid is 9 cm. What is the volume of the frustum if the side length of the upper base is 6 cm and the side length of the lower base is 10 cm?

A. $108\ cm^3$
B. $324\ cm^3$
C. $588\ cm^3$
D. $196\ cm^3$

35. Which one of the following numbers is the coefficient of x^6y^4 in the expansion of $(x+y)^{10}$?

A. 4860
B. 1260
C. 210
D. 240

36. Which one of the following is true about the Range and Interquartile Range of a given data?

A. Both are considering only the middle 50% of the data.
B. Both are measures of variation of the data.
C. Both are affected by extreme values in the data.
D. Both are measures of the variability of each item in the data.

37. Which one of the following is equal to the expression $\frac{(125)^{\frac{2}{3}}(81)^{-\frac{3}{4}}}{(27)^{-\frac{2}{3}}(625)^{\frac{3}{4}}}$?

A. $\frac{1}{15}$

B. 15

C. $\frac{3}{5}$

D. $\frac{5}{3}$

38. If the length of the sides of a triangle are 8cm, 6cm and 4 cm , then which one of the following is the area of the triangle?

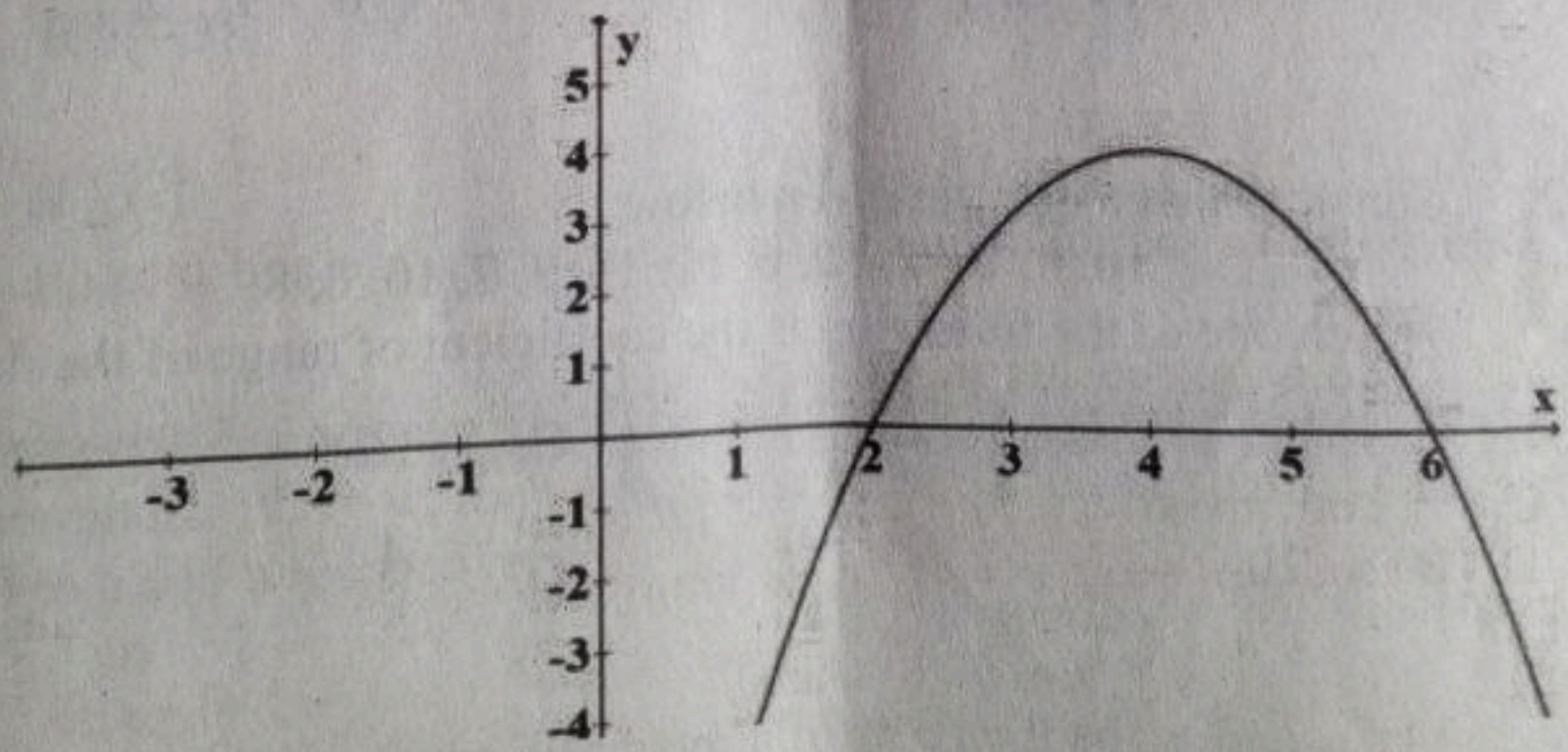
A. $3\sqrt{15}\,cm^2$

B. $1.5\sqrt{15}\,cm^2$

C. $24\,cm^2$

D. $12\,cm^2$

39. The following figure is the graph of a quadratic function $f(x)=ax^2+bx+c$ in the set of real numbers.



Which one of the following is the solution set of the inequality $f(x)\leq 0$?

A. $\{x : x\leq 0 \text{ and } x\geq -4\}$

B. $\{x : x\leq -4 \text{ or } x\geq 0\}$

C. $\{x : x\leq 2 \text{ or } x\geq 6\}$

D. $\{x : x\geq 2 \text{ and } x\leq 6\}$

40. Which one of the following is an onto function from $\mathbb{R}$ onto $\mathbb{R}$?

A. $f(x)=2x-3x^2$

B. $f(x)=5x^3+1$

C. $f(x)=|x-1|$

D. $f(x)=\sqrt{x^2+1}$

41. Let M be a matrix such that $M=\begin{pmatrix} 9 & 24 & 6 \\ -12 & 18 & 15 \\ 0 & 27 & 3 \end{pmatrix}$. Which one of the following matrices is equal to $\frac{2}{3}M$?

A. $\begin{pmatrix} 6 & 16 & 2 \\ -8 & 12 & 10 \\ 0 & 18 & 2 \end{pmatrix}$

B. $\begin{pmatrix} 6 & 16 & 4 \\ -8 & 12 & 10 \\ 0 & 18 & 2 \end{pmatrix}$

C. $\begin{pmatrix} 3 & 8 & 2 \\ -4 & 6 & 5 \\ 0 & 9 & 1 \end{pmatrix}$

D. $\begin{pmatrix} 6 & 8 & 4 \\ -8 & 6 & 10 \\ 0 & 9 & 2 \end{pmatrix}$

42. Consider that a data set given below:

10, 8, 10, 2, 12, 6, 12, 18, 3, 7, 10, 8, 8

Which one of the following is the coefficient of range of the data?

A. $\frac{5}{4}$

B. 20

C. 16

D. $\frac{4}{5}$

43. Let r_1 and r_2 be the roots of a quadratic equation $ax^2+bx+c=0$, such that $r_1+r_2=-2.5$ and $r_1r_2=1.5$, for a, b and c are real numbers and $a\neq 0$. Which one of the following can be the values of a, b and c respectively?

A. 1, 6 and 5

B. 2, 3 and 5

C. 1, 5, and 6

D. 2, 5 and 3

44. The following data gives the scores of 10 students in a Mathematics examination: 6, 10, 8, 5, 9, 8, 5, 10, 10, 9. Which one of the following is the standard deviation of the given data?

A. 3.6
B. $\sqrt{3.6}$
C. 5.8
D. $\sqrt{5.8}$

45. Which of the following pairs of lines with the given equations are parallel?

A. $\ell_1 : x - y + 3 = 0$ and $\ell_2 : -x + y - 9 = 0$
B. $\ell_1 : 4x - y = 2$ and $\ell_2 : -x + 4y - 3 = 0$
C. $\ell_1 : 2x + 3y = 5$ and $\ell_2 : 3x + 2y = 4$
D. $\ell_1 : x - 2y + 1 = 0$ and $\ell_2 : x + 2y - 1 = 0$

46. Which one of the following is the range of the function $f(x) = \frac{2x-1}{x+3}$?

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

47. Let $z = -a + 2i$ and $w = 5 - bi$ be two complex numbers, where a and b are real numbers. If $z = w$, then which one of the following pairs of numbers are equal to a and b respectively?

A. 5 and -2
B. -5 and -2
C. 5 and 2
D. -5 and 2

48. The following table presents the number of traffic accidents in a certain city per year for five consecutive years from 2019 to 2023.

Year	2019	2020	2021	2022	2023
Number of Accidents	3500	2750	2850	3500	3750

What is the average number of accidents per year for the given five years?

A. 3250
B. 3270
C. 3200
D. 3210

49. Which one of the following is the solution set of the equation $\left(\sqrt{16}\right)^{2x+1} = \left(\sqrt[3]{4096}\right)^{3x-5}$?

A. $\left\{\frac{9}{4}\right\}$
B. $\left\{\frac{9}{2}\right\}$
C. $\left\{\frac{11}{2}\right\}$
D. $\left\{\frac{11}{4}\right\}$

50. Which one of the following is a primary data?

A. The data obtained from a chart prepared by Ministry of Health regarding the spread of HIV/AIDS.
B. The data obtained by reading a journal regarding the opinion of the society about holidays.
C. The data obtained by measuring the weights of students in a certain school.
D. The data obtained from a document prepared by the MOE regarding the achievements of students in National Examination.

51. Which one of the following ordered pairs of numbers gives the coordinates of the point that divides a line segment with end points A(1, 1) and B(−6, 8) in the ratio of 3:4?

A. (2, −4)
B. (−2, −4)
C. (2, 4)
D. (−2, 4)

52. Which one of the following pairs of functions is an inverse of each other in their respective domains?

A. $f(x)=\sqrt{x+3}$ and $g(x)=x^2-9$
B. $f(x)=x^5$ and $g(x)=\frac{1}{x^5}$
C. $f(x)=x^3-1$ and $g(x)=\sqrt[3]{x+1}$
D. $f(x)=\frac{x+1}{x-1}$ and $g(x)=\frac{x-1}{x+1}$

53. Which one of the following numbers is the determinant of the matrix $M=\begin{pmatrix}1 & 2 & 3\\ 4 & 5 & 6\\ 7 & 8 & 10\end{pmatrix}$?

A. −3
B. 6
C. −6
D. 3

54. Which one of the following is a simple random sampling?

A. First the population is divided into homogenous groups and a sample is selected from each homogenous group.
B. First divide a city into ten groups and choose the secondary school principals from the randomly selected 3 groups.
C. Selecting five students from grade 12 students of the same school randomly.
D. Selecting a group randomly from groups formed by dividing the population into groups.

55. Let A and B be two sets that contain 15 and 17 elements respectively. If $A \cap B$ contains 10 elements, what is the number of elements in $A \cup B$?

A. 22
B. 12
C. 42
D. 32

56. Which one of the following is the position vector of the vector with initial point A (1, −1) and terminal point B (2, −3)?

A. $3i+4j$
B. $i-4j$
C. $3i-4j$.
D. $i-2j$

57. Let θ be an angle in standard position and P(−3, 4) be a point on the terminal side of θ. Which one of the following is true about the corresponding trigonometric functions?

A. $\cos\theta = \frac{-3}{5}$
B. $\sin\theta = \frac{-4}{5}$
C. $\sin\theta = \frac{3}{5}$
D. $\cos\theta = \frac{4}{5}$

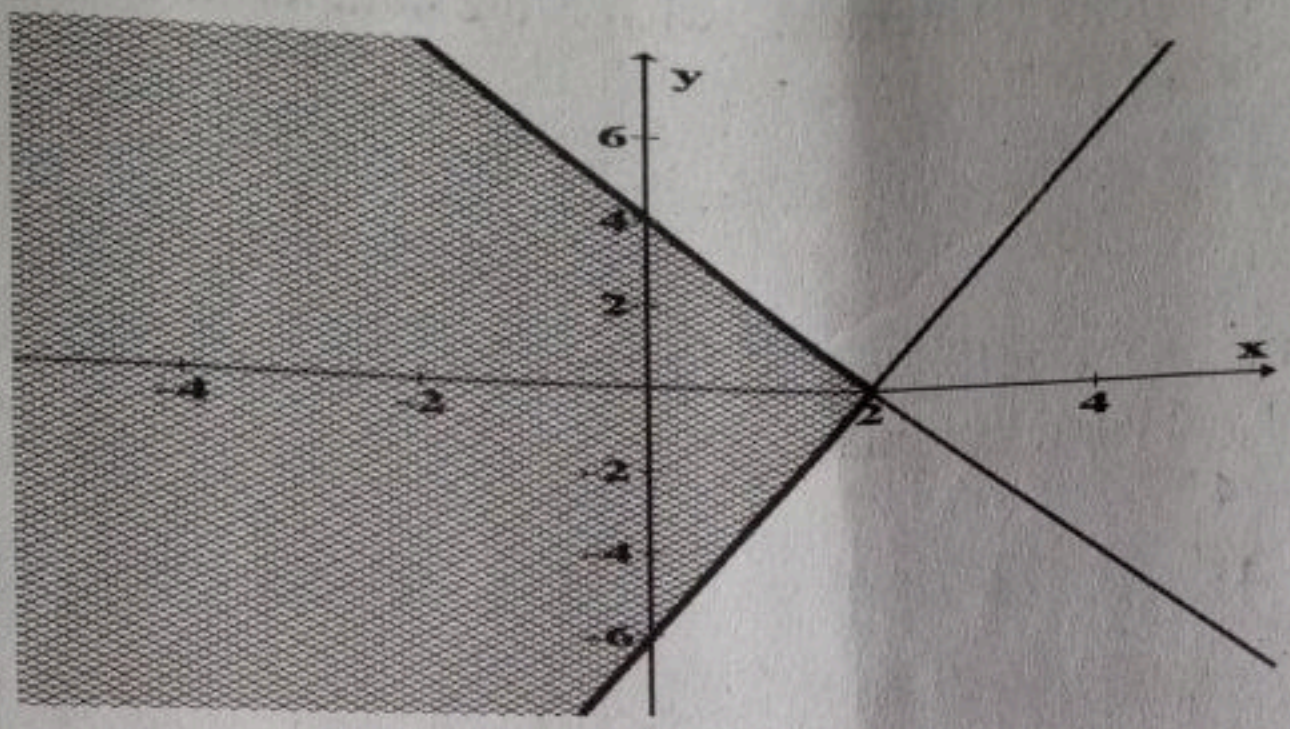
58. Which one of the following conic section is defined by "the set of points in a plane such that the sum of the distances from two given points is constant"?

A. Ellipse
B. Hyperbola
C. Parabola
D. Circle

59. If the fifth and the tenth terms of a geometric sequence are 640 and 20 respectively, then which of the following numbers are the first term and the common ratio of the given geometric sequence respectively?

A. 1024 and 2
B. 1024 and $\frac{1}{2}$
C. 10240 and 2
D. 10240 and $\frac{1}{2}$

60. Given that a graph of system of linear inequalities as shown below.



Which one of the following system of linear inequalities is represented by the shaded region in the graph?

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

B. $\begin{cases} 2x + y \geq 4 \\ 3x - y \leq 6 \end{cases}$

C. $\begin{cases} 2x + y \geq 4 \\ 3x - y \geq 6 \end{cases}$

D. $\begin{cases} 2x + y \leq 4 \\ 3x - y \geq 6 \end{cases}$

THE END