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: 112
Number of Items: 60

1. Which one of the following is true about the Range and Interquartile Range of a given data?
   A. Both are measures of the variability of each item in the data.
   B. Both are measures of variation of the data.
   C. Both are affected by extreme values in the data.
   D. Both are considering only the middle 50% of the data.

2. Which one of the following numbers is the coefficient of x^6y^4 in the expansion of $(x+y)^{10}$?
   A. 240
   B. 1260
   C. 210
   D. 4860

3. 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. 196 cm^3
   B. 324 cm^3
   C. 588 cm^3
   D. 108 cm^3

4. Which one of the following intervals is the solution set of the inequality $\left|3-\frac{1}{2}x\right|<5$?
   A. $(-2,8)$
   B. $(-4,16)$
   C. $(-8,2)$
   D. $(-16,4)$

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

A. $(2\pi+8)\text{cm}^2$ C. πcm^2

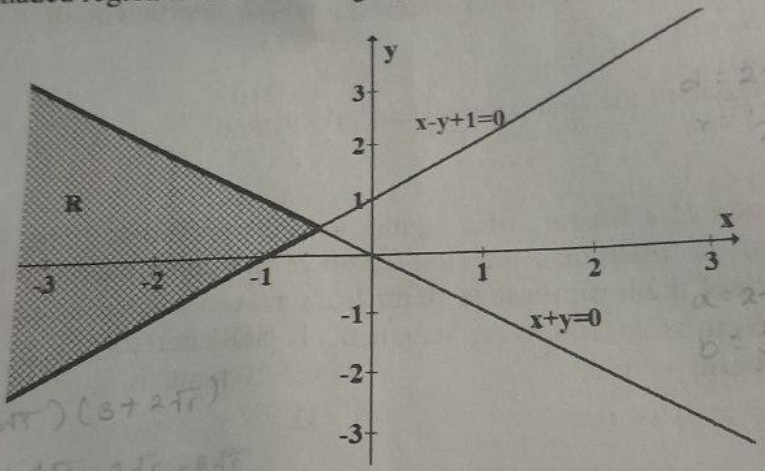
B. $2\pi\ \text{cm}^2$ D. $8\pi\ \text{cm}^2$

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

A. $a-b=-1-\sqrt{5}$ C. $a+b=5$

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

7. 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. $\left(-\infty,-\frac{1}{2}\right)$ and R C. R and $\left(-\infty,-\frac{1}{2}\right]$

B. R and $\left(-\infty,-\frac{1}{2}\right)$ D. $\left(-\infty,-\frac{1}{2}\right]$ and R

8. Which one of the following statements is the polynomial division theorem?
   A. 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 $f(c)=0$.
   B. If $f(x)$ and $d(x)$ are polynomials such that $d(x)\neq 0$ and degree$(d(x))\leq$ 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. 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.

9. Which one of the following is equal to $\cot(1755°)$?
   A. -1 C. 1
   B. $-\sqrt{3}$ D. $\sqrt{3}$

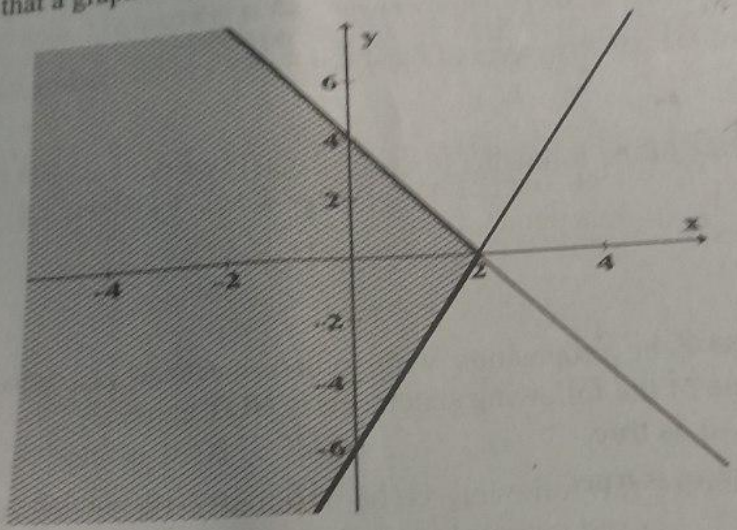
10. Let p and q be proposition with truth values true and false respectively. Which one of the following statements is **NOT** correct?
   A. $p\vee q$ is true. C. $p\wedge q$ is false.
   B. $p\Leftrightarrow q$ is true. D. $p\Rightarrow q$ is false.

11. Which one of the following is equal to the sum $\sum_{n=1}^{5}2n^2$?
   A. $2+8+18+32+50$ C. $2+4+6+8+10$
   B. $2+4+8+16+32$ D. $2+8+16+32+64$

12. 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 200,000
B. Birr 120,000
C. Birr 344,000
D. Birr 144,000

13. 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. $\begin{cases} 2x+y \le 4 \\ 3x-y \ge 6 \end{cases}$

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

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

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

14. 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. 10240 and $\frac{1}{2}$

B. 1024 and $\frac{1}{2}$

C. 10240 and 2

D. 1024 and 2

15. 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. Circle

B. Hyperbola

C. Parabola

D. Ellipse

16. 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. $\cos\theta = \frac{4}{5}$

B. $\sin\theta = \frac{-4}{5}$

C. $\sin\theta = \frac{3}{5}$

D. $\cos\theta = \frac{-3}{5}$

17. 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. $i-2j$

B. $i-4j$

C. $3i-4j$.

D. $3i+4j$

18. 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. 32

B. 12

C. 42

D. 22

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19. Which one of the following is a simple random sampling?
   A. Selecting a group randomly from groups formed by dividing the population into groups.
   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. First the population is divided into homogenous groups and a sample is selected from each homogenous group.

20. 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

21. Which one of the following pairs of functions is an inverse of each other in their respective domains?
   A. $f(x) = \frac{x+1}{x-1}$ and $g(x) = \frac{x-1}{x+1}$
   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. $f(x) = \sqrt{x+3}$ and $g(x) = x^2 - 9$

22. 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)

23. Which one of the following is a primary data?
A. The data obtained from a document prepared by the MOE regarding the achievements of students in National Examination.
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 chart prepared by Ministry of Health regarding the spread of HIV/AIDS.

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

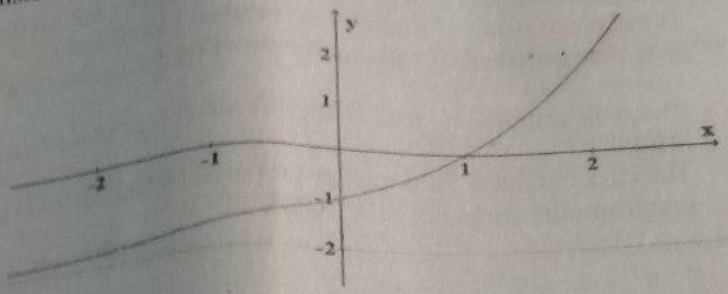
25. If the measure of each interior angle of a regular polygon is 135°, then which one of the following is the number of lines of symmetry of the polygon?
A. 8
B. 6
C. 9
D. 7

$(\sqrt{16})^{2x+1} = (\sqrt[3]{4096})^{3x-5}$

$(4)^{2x+1} =$

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



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

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

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

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

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

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

A. $36\sqrt{3}$ cm

B. 18 cm

C. 36 cm

D. $18\sqrt{3}$ cm

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

A. Checking the quality of a new product.

B. Determining the tastes of foods in a restaurant.

C. Identifying the social status of individuals.

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

29. 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 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 anti-derivatives of f.

30. Which one of the following is **NOT** a valid reason for saving?

A. For the time of retirement
B. For vacation
C. To maximize interest
D. For betting in football

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

$$\begin{cases} x + y \le 6 \\ 2x - y \le 6 \\ x \ge 0 \\ y \ge 0 \end{cases}?$$

A. 14
B. 22
C. 12
D. 18

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

A. 1092
B. 1079
C. 1093
D. 1088

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

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

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

C. $y^2 = 8x$

D. $x^2 = 8y$

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

A. The range of f is the set of real numbers, R.

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

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

A. $h(x) = (x^2 + 6x + 8) - (2x - 4)$

B. $\ell(x) = (x^2 + 10x + 3) + (-6x + 1)$

C. $g(x) = \frac{x^4 + 4x^2 + 4}{x^2 + 2}$

D. $k(x) = (x - 2)(x + 2)$

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

A. $S \cup T = T$

B. $S \cup S = S$

C. $S \cup R = R \cup S$

D. $(S \cup R) \cup T = T \cup (R \cup S)$

37. 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 $r_1 r_2 = 1.5$, 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. 2, 5 and 3
B. 2, 3 and 5
C. 1, 5, and 6
D. 1, 6 and 5

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

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

A. $\ell_1 : x - 2y + 1 = 0$ and $\ell_2 : x + 2y - 1 = 0$
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. $\ell_1 : x - y + 3 = 0$ and $\ell_2 : -x + y - 9 = 0$

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

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

41. 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

42. 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. 3210
B. 3270
C. 3200
D. 3250

43. 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. $\frac{4}{5}$
B. 20
C. 16
D. $\frac{5}{4}$

44. 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. $\begin{pmatrix} 6 & 8 & 4 \\ -8 & 6 & 10 \\ 0 & 9 & 2 \end{pmatrix}$
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. $\begin{pmatrix} 6 & 16 & 2 \\ -8 & 12 & 10 \\ 0 & 18 & 2 \end{pmatrix}$

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

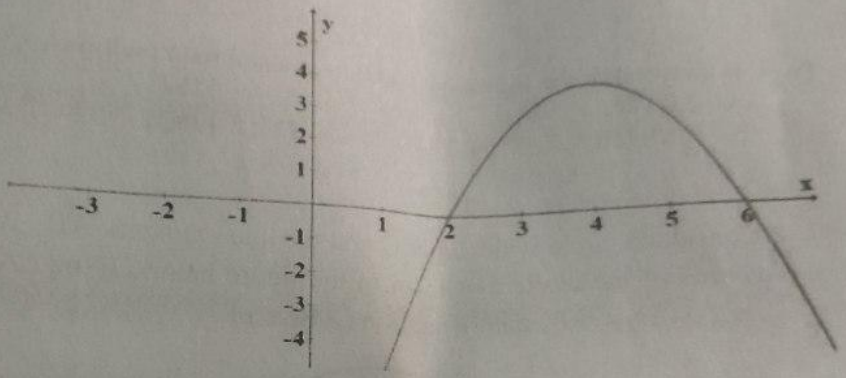
A. $f(x) = \sqrt{x^2 + 1}$

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

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

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

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

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

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

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

47. 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. $12\ cm^2$

B. $1.5\ 15\ cm^2$

C. $24\ cm^2$

D. $3\ 15\ cm^2$

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

B. 15

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

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

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

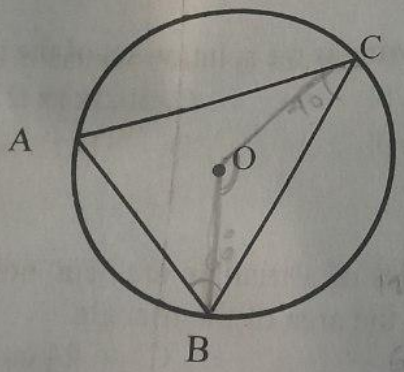
A. 7776

B. 20736

C. 5184

D. 13824

50. 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. 80°

B. 160°

C. 100°

D. 120°

51. 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. 1
B. −2
C. −1
D. 2

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

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

53. 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. 55.5
B. 60.5
C. 50.5
D. 58.5

54. 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. 68 Square units
B. 136 Square units
C. 60 Square units
D. 120 Square units

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55. 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. $(f-g)(2)=-1$

B. $\left(\frac{f}{g}\right)(2)=\frac{2}{3}$

C. $(f+g)(2)=3$

D. $(f.g)(2)=6$

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

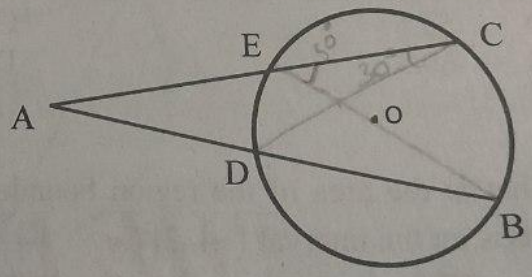
A. $f:(0,\infty)\rightarrow R$ defined by $f(x)=x^b$, where $b>0$ and $b\neq 1$.

B. $f:R\rightarrow(0,\infty)$ defined by $f(x)=x^b$, where $b>0$ and $b\neq 1$.

C. $f:(0,\infty)\rightarrow R$ defined by $f(x)=b^x$, where $b>0$ and $b\neq 1$.

D. $f:R\rightarrow(0,\infty)$ defined by $f(x)=b^x$, where $b>0$ and $b\neq 1$.

57. 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. 30°

B. 80°

C. 20°

D. 70°

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

A. $(p \vee q) \Rightarrow (p \wedge q)$

B. $(\neg p \Rightarrow q) \Rightarrow (p \wedge q)$

C. $(p \wedge q) \Rightarrow (p \vee q)$

D. $(p \Rightarrow \neg q) \Leftrightarrow (p \wedge q)$

59. Let f be differentiable function at a number 'a' for a $\in$ 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 tangent 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 normal line to the graph of f at a point (a, f(a)).

60. 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. 220

B. 144

C. 225

D. 200

THE END