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በ ኢትዮ_ Students የ ቴሌግራም ቻናል ላይ ነው



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Number of Items: 65 Time Allowed:

DIRECTIONS: For each of the following problems, choose the best answer from the given alternatives and carefully **blacken** the letter of your best choice on the separate answer sheet provided.

1. If a function f is differentiable at a, then what is the value of $\lim_{x \to a} f(x)$?

   (A) $f(a)$ (B) $f'(a)$ (C) $f'(a) - f(a)$ (D) 0

2. Which one of the following is a convergent sequence?

   (A) $\left\{\frac{1+2^n}{3^n}\right\}$ (B) $\left\{\frac{1}{n}+\sin(n)\right\}$ (C) $\left\{\frac{1-3^n}{2^n}\right\}$ (D) $\left\{\frac{(-1)^n}{2}\right\}$

3. What is the value of $\sum_{n=2}^{20}\left(\frac{1}{n-1}-\frac{1}{n}\right)$?

   (A) $\frac{17}{20}$ (B) $\frac{23}{20}$ (C) $\frac{21}{20}$ (D) $\frac{19}{20}$

4. Let A and B be two events. Suppose that the probability that neither event occurs is $3/8$. What is the probability that at least one of the events occur?

   (A) $1/8$ (B) $5/8$ (C) $1/4$ (D) $3/4$

5. If the truth value of $(p \wedge \neg p) \Leftrightarrow [(q \vee \neg q) \Rightarrow r]$ is True, then which one of the following must be True?

(A) q (B) p (C) $\neg q$ (D) $\neg r$

6. What is the maximum value of the function $f(x) = x^4 - 2x^2$ on $[-2, 1]$?

(A) 8 (B) 12 (C) 24 (D) 40

7. What are the greatest lower bound and least upper bound of the sequence $\left\{(-1)^n\left(1+\frac{1}{n}\right)\right\}$, respectively?

(A) -2 and 2 (B) $-\frac{3}{2}$ and 2 (C) -2 and $\frac{3}{2}$ (D) -2 and $-\frac{3}{2}$

8. Which one of the following is an equation of the circle whose endpoints of a diameter are $(0,-2)$ and $(2,2)$?

(A) $x^2 + y^2 = 4$
(B) $x^2 + y^2 - 2y - 4 = 0$
(C) $(x-1)^2 + y^2 = 4$
(D) $x^2 + y^2 - 2x - 4 = 0$

9. What is the equation of the line that passes through $(1, 1)$ and is parallel to the line $3y - x = 1$?

(A) $x - 3y + 2 = 0$
(B) $x + 3y = 4$
(C) $3y - x + 2 = 0$
(D) $3x - y = 2$

10. Which one of the following is true about signum, absolute value and greatest integer functions?

(A) $sgn(x) = \pm|x|$, for all $x \in \mathbb{R}$.
(B) $sgn(x) \leq \lfloor x \rfloor$, for all $x \leq 0$.
(C) $|x| = x\,sgn(x)$, for all $x \in \mathbb{R}$.
(D) $sgn(x) \leq \lfloor x \rfloor$, for all $x \geq 0$.

11. What is the area of the triangle (in sq. units) formed by the lines joining the vertex of the parabola $x^2 = -36y$ to the end points of the latus rectum?

(A) 126
(B) 261
(C) 216
(D) 162

12. What is the partial fraction decomposition of $\frac{x^2+x+1}{(x+2)(x^2+1)}$?

(A) $\frac{3}{5(x+2)}+\frac{2x+1}{5(x^2+1)}$

(B) $\frac{5}{3(x+2)}+\frac{2x+1}{3(x^2+1)}$

(C) $\frac{2}{5(x+2)}+\frac{3x+1}{5(x^2+1)}$

(D) $\frac{2}{3(x+2)}+\frac{2x+1}{3(x^2+1)}$

13. What is the area of the region enclosed by the graph of $y^2=x+1$ and $y^2=-x+1$?

(A) $\frac{3}{8}$ sq. units (B) $\frac{4}{3}$ sq. units (C) $\frac{8}{3}$ sq. units (D) $\frac{3}{4}$ sq. units

14. What is the value of $\int_1^2 \frac{x+4}{x(x+2)}dx$?

(A) 2 (B) $\ell n\,3$ (C) $\ell n\,2$ (D) $\ell n4-\ell n\,3$

15. What is the slope of the tangent line to the graph of $f(x)=3e^x+\sin x+2$ at $(0,5)$?

(A) 2 (B) 3 (C) 5 (D) 4

16. The population of a certain city is increasing at a rate of 3% per year. If the population was 100,000 in 2010 E.C., then what will be the population in 2020 E.C?

(Given: $(1.03)^9 = 1.30$, $(1.03)^{10} = 1.34$, $(1.3)^9 = 10.60$, $(1.3)^{10} = 13.78$)

(A) 134,000
(B) 130,000
(C) 1,060,000
(D) 1,378,000

17. If $z=-3+4i$ and $w=1+2i$, then what is the value of $\frac{2z}{w}+\overline{w}$?

(A) $2+3i$ (B) $3+5i$ (C) $3+2i$ (D) $3-2i$

18. A salesman sold items x_1, x_2, and x_3, with different rates of commissions as shown in the table below.

Months	Sales of units			Total Commission (in Birr)
	x_1	x_2	x_3	
February	90	100	20	800
March	130	50	40	900
April	60	100	30	850

What are the rates of commission on items x_1, x_2 and x_3, respectively.

(A) 4, 2 and 11
(B) 2, 4 and 11
(C) 4, 11 and 2
(D) 11, 2 and 4

19. If A is a square matrix of order 3 and $\det(A) = 5$, then what is the value of $\det(A.\text{adj}(A))$?

(A) 3 (B) 5 (C) 125 (D) 25

20. If $f'(x) = e^{x-1} + 3x^2 - \frac{1}{x}$ and $f(1) = 5$, what is $f(x)$?

(A) $f(x) = e^{x-1} + 3x^2 + \frac{1}{x^2} + 2$
(B) $f(x) = e^{x-1} - x^3 + lnx + 5$
(C) $f(x) = e^{x-1} + 3x^2 - \frac{1}{x} + 5$
(D) $f(x) = e^{x-1} + x^3 - lnx + 3$

21. Suppose the following are the premises of an argument.

He is healthy and he is not angry.
He is angry or his plan fails.
His plan does not fail if he does not travel abroad.

Given that the premises are true, which one of the following can be a conclusion that makes the argument valid?

(A) His plan fails and he is angry.
(B) His plan does not fail.
(C) He travels abroad.
(D) His plan fails and he does not travel abroad.

22. A man running a race-course noted that the sum of the distance from the two flag posts from him is always 10 meters and the distance between the flag posts is 8 meters. What is the equation of the path traced by the man?
(Take flag posts to be on the x-axis with origin at their midpoint)

(A) $\frac{x^2}{9}+\frac{y^2}{25}=1$
(C) $\frac{x^2}{100}+\frac{y^2}{64}=1$
(B) $\frac{x^2}{25}+\frac{y^2}{9}=1$
(D) $\frac{x^2}{64}+\frac{y^2}{100}=1$

23. What is the value of $\int_1^9 \frac{e^{\sqrt{x}}}{\sqrt{x}}\,dx$?

(A) e^3 - e
(C) $e(e^2-\frac{1}{3})$
(B) $\frac{e^3}{3}$ - e
(D) $2(e^3$ - e)

24. What is the value of $\int x\sqrt{1-x^2}\,dx$?

(A) $\frac{-1}{3}(1-x^2)^{3/2}$ + C
(C) $(1-x^2)^{3/2}$ + C
(B) $-2x\sqrt{1-x^2}$ + C
(D) $\frac{1}{2}\sqrt{1-x^2}$ + C

25. Which one of the following is **NOT** true about the function $f(x)=3x^4-4x^3$?

(A) $(0,0)$ is point of inflection of f.
(B) 0 and 1 are critical numbers of f.
(C) f is concave upward on $(0,\frac{2}{3})$ and concave downward on $(-\infty,0)$ and on $(\frac{2}{3},\infty)$
(D) f is decreasing on $(-\infty,1)$ and increasing on $(1,\infty)$.

26. What is the value of $\lim_{x\to 0}\frac{1}{x^2}\sin^2\left(\frac{x}{2}\right)$?

(A) $^1/_2$
(B) $^1/_4$
(C) 2
(D) 4

27. If $f(x)=\frac{|x|}{x}$ and $g(x)=\frac{x+2}{x^3-4x}$, then what is the value of $\lim_{x\to -2}(f(x)+g(x))$?

(A) $\frac{-9}{8}$ (B) ∞ (C) $\frac{9}{8}$ (D) $\frac{-7}{8}$

28. Let $z=\left(\frac{1-i}{1+i}\right)^{18}$. Then what is the value of z?

(A) -1 (B) i (C) –i (D) 1 - i

29. Let A be a 3×3 invertible matrix and B be any 3×3 matrix. If $|A| = a$ and, $|B| = b$, then which one of the following is **NOT** true?

(A) $|A^TA|=a^2$

(B) $|kA|=k^3|A|$, for any $k\in\mathbb{R}$

(C) $|A^{-1}B|=ab$

(D) If $b=0$, then B is not invertible.

30. The time needed to type a sample of 8 business letters in an office is 7, 8, 6, 8, 9, 7, 5, 6 minutes. What are the mean ($\bar{X}$) and the standard deviation (s) of the data in minute?

(A) $\bar{X}=7, s=\sqrt{1.5}$ (C) $\bar{X}=8, s=\sqrt{2}$

(B) $\bar{X}=7, s=\sqrt{2}$ (D) $\bar{X}=8, s=\sqrt{1.5}$

31. A private college has 1000 students. 60 % of these students are males. 45% of these students pay their payment by credit card including 175 females. What is the probability that the student is a male or a credit card user?

(A) 0.675 (C) 0.325

(B) 0.225 (D) 0.775

32. Which one of the following is true about the graph of $f(x)=\frac{2x^3+2x^2+3x}{x^2+x}$?

(A) The vertical asymptote of the graph is only $x=-1$ and its oblique asymptote is $y=2x$.

(B) The graph has y-intercept at (0, 3).

(C) The graph has at least one x-intercept.

(D) The vertical asymptotes of the graph are at $x=0$ and $x=-1$ but it has no horizontal asymptote.

33. Let $f(x)=\frac{3x+1}{x-2}$. Then what is the range of $f(x)$?

(A) $\mathbb{R}\setminus\{2\}$ (C) $\mathbb{R}\setminus\{3\}$

(B) $\mathbb{R}$ (D) $\mathbb{R}\setminus\{-1/3\}$

34. What is the value of $\int \frac{1}{x}\left(\ell n\, x+x^2e^{-x}\right)dx$?

(A) $\frac{1}{2}x^2\ell nx-(x+1)e^{-x}+C$ (C) $\frac{1}{2}x^2\ell nx+(2-x)e^{-x}+C$

(B) $\frac{1}{2}\ell n^2x-(x+1)e^{-x}+C$ (D) $\frac{1}{2}\ell n^2x+(2-x)e^{-x}+C$

35. If $f(x)=\frac{1}{3}x^3+cx^2+ax+5$ has a local minimum value at $x=1$, then which one of the following is true about the possible values of a and c?

(A) $a=3,\ c=-2$ (C) $a=-2c-1,\ c<-1$

(B) $a=-2c-1,\ c$ any real number. (D) $a=-2c-1, c>-1$

36. Let $\{a_n\}$ be a sequence with $a_1=a$, $a_2=f(a_1)=f(a)$, $a_3=f(a_2)=f(f(a))$, $\cdots$, $a_{n+1}=f(a_n)$, where f is a continuous function. If $\lim_{n\to\infty}a_n=5$, what is $f(5)$?

(A) 5 (B) 5^n (C) 5^{n+1} (D) 1

37. If the sum of the first three consecutive terms of an arithmetic progression $\{A_n\}$, with $A_n > 0$ for all n, is 9 and the sum of their squares is 35, then what is the sum S_n of the first n terms?

(A) n^2+1 (B) n^2-1 (C) n^2 (D) $2n^2+1$

38. Let A be a 3×3 matrix and $|A| = -2$. Then what is the value of $|\text{adj}(A)|$?

(A) -8 (B) -2 (C) $-1/2$ (D) 4

39. Let $A=\{1,2,3,4,5,6,7\}$, $B=\{7,8,9\}$ and $C=\{8,9,10\}$. If one of the numbers is deleted randomly from each of these sets, what is the probability that all the three deleted numbers are even **or** all are multiples of 3?

(A) $\frac{4}{5}$ (B) $\frac{2}{21}$ (C) $\frac{1}{9}$ (D) $\frac{8}{63}$

40. The age distribution of students in a certain class is given below:

Age	10-14	15-19	20-24	25-29
No. of students	2	10	6	7

What is the modal value of the distribution?

(A) 17.83 (B) 17.38 (C) 18.37 (D) 18.73

41. If $f(x) = k\ln x + e^{\sin x}$ and $f''(\pi) = -1$, then what is the value of k?

(A) $2\pi^2$ (B) π^2 (C) π (D) 2π

42. Let $f(x) = x - x^2$ and $g(x) = \frac{1}{x}$. Then what is $g\left(f\left(\frac{1}{x}\right)\right)$ equals to

(A) $x - x^2$ (B) $\frac{x^2}{x-1}$ (C) $\frac{1}{x^2-x}$ (D) $\frac{x-1}{x^2}$

BOOKLET CODE: 26 **SUBJECT CODE: 02**

43. A cylindrical tank whose inner diameter is 2 m contains 4π m^3 oil. If the oil is discharged from the tank at the rate of $\frac{2\pi}{3}$ m^3/min, then how long (in min) does it take for the tank to be empty?

(A) $\frac{4}{3}$ (B) 4 (C) 12 (D) 6

44. What are the values of a and b so that the function $f(x)=\begin{cases} x+1, & x<1 \\ ax+b, & 1\le x<2 \\ 3x, & x\ge 2 \end{cases}$ is continuous everywhere?

(A) $a=4, b=-2$ (B) $a=-4, b=-2$ (C) $a=4, b=2$ (D) $a=-4, b=2$

45. Let $U=\mathbb{N}$ (the set of natural numbers) be the universe. Which one of the following proposition is true?

(A) $(\exists x)(x+x=x)$
(B) $(\forall x)(\exists y)(y<x)$
(C) $(\forall x)(\exists y)(x\div y=y\div x)$
(D) $(\forall x)(\exists y)(x-y=x)$

46. What is the maximum possible area of a rectangle in square units with diagonal of length 16 units?

(A) 48 (B) 128 (C) 64 (D) 256

47. Let $f(x)=\ln(x\sqrt{x})$. Then what is $f'(x)$ equal to?

(A) $2x/3$ (B) $\sqrt{x}/2$ (C) $2/x\sqrt{x}$ (D) $3/2x$

48. Which one of the following is equal to $\frac{d}{dx}\log_2\sqrt{6x}$?

(A) $\frac{1}{2x\,\ell n(2)}$ (B) $\frac{3}{2x\,\ell n(2)}$ (C) $\frac{3x}{2\,\ell n(2)}$ (D) $\frac{1}{6x\,\ell n(2)}$

49. What is the sum of the series $\sum_{n=1}^{\infty} 3^n 4^{-n}$?

(A) ∞ (B) 3/16 (C) 3 (D) 4

50. If $z=(1+\sqrt{3}i)(1+i)$, then which one of the following is the polar representation of z?

(A) $z=4\left(\cos(105^\circ)+i\sin(105^\circ)\right)$ (C) $z=2\sqrt{2}\left(\cos(15^\circ)+i\sin(15^\circ)\right)$

(B) $z=2\sqrt{2}\left(\cos(105^\circ)+i\sin(105^\circ)\right)$ (D) $z=4\left(\cos(75^\circ)+i\sin(75^\circ)\right)$

51. The variance of 20 observations is 5. If each observation is multiplied by 2, then what is the variance of the resulting observations?

(A) 5 (B) 10 (C) 20 (D) 40

52. What is the value of $\lim_{n\to\infty}\sum_{k=1}^{n}\frac{2}{n}\left[\left(\frac{2k}{n}\right)^3+5\left(\frac{2k}{n}\right)\right]$?

(A) 4 (B) 14 (C) 10 (D) 18

53. Let $A(a,2,5)$, for $a>0$, be a point on the sphere $x^2+y^2+z^2-6z=0$ and C be the center of the sphere. If $P(k,2,4)$ is a point in space such that $\vec{PA}$ is perpendicular to $\vec{CA}$, what is the cosine of the angle between $\vec{PA}$ and $\vec{PC}$?

(A) $\frac{5}{\sqrt{35}}$ (B) $\frac{7}{\sqrt{35}}$ (C) $\frac{7}{\sqrt{70}}$ (D) $\frac{5}{\sqrt{70}}$

54. What is the period (p) and the range of $f(x)=5\sin\left(\frac{1}{3}x+2\right)+3$?

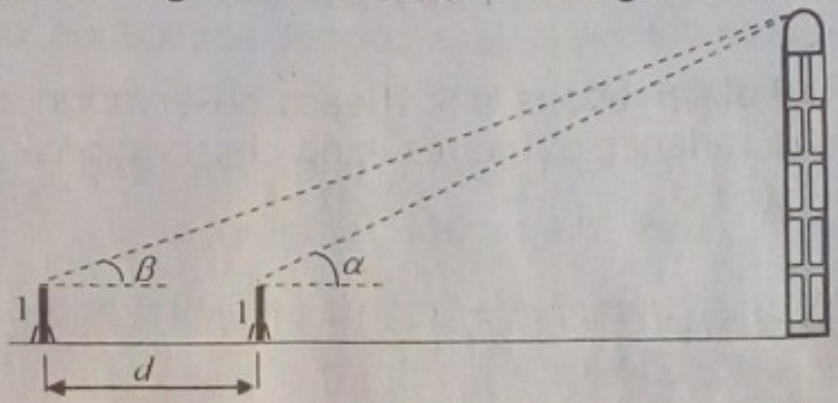
(A) $p=6\pi$, range = [−2, 8] (C) $p=6\pi$, range = [−5, 5]

(B) $p=\frac{2\pi}{3}$, range = [−5, 5] (D) $p=\frac{2\pi}{3}$, range = [−2, 8]

55. Let l be the line given by the vector equation $(x, y) = (-2, 1) + \lambda(1, 1)$, $\lambda \in \mathbb{R}$. Which one of the following is the equation of the image of l after being translated by the vector $\mathbf{u} = (2, -1)$ followed by a rotation through $45°$ about the origin?

(A) $y = \sqrt{2}x$ (B) $y = \sqrt{2}$ (C) $x = 0$ (D) $y = -2\sqrt{2}x$

56. In order to measure the height of a tower, suppose a surveyor takes two sightings from a transit 1meter high which are positioned d meters apart on the same ground level as in the figure below.



If the first measured angle of elevation is α and the second is β (see, the figure), then what is the height of the tower (in meter) in terms of α, β and d?

(A) $\dfrac{\tan\alpha \tan\beta}{(\tan\alpha - \tan\beta)d} + 1$

(B) $\left(\dfrac{\tan\alpha \tan\beta}{\tan\alpha - \tan\beta}\right)d + 1$

(C) $\left(\dfrac{\tan\alpha - \tan\beta}{\tan\alpha \tan\beta}\right)d + 1$

(D) $\left(\dfrac{\tan\alpha \tan\beta}{\tan\alpha + \tan\beta}\right)d + 1$

57. If the dot products of a vector $\vec{A}$ with the vectors $i - j + k$, $2i + j - 3k$ and $i + j + k$ are 4, 0 and 2, respectively, what is $\vec{A}$?

(A) $\vec{A} = (2, 1, 1)$ (B) $\vec{A} = (-2, 1, -1)$ (C) $\vec{A} = (-2, -1, 1)$ (D) $\vec{A} = (2, -1, 1)$

58. What is the image of the circle $x^2 + y^2 - 4x - 6y + 12 = 0$ when it is reflected with respect to the line $y = -x$?

(A) $(x+3)^2 + (y+2)^2 = 1$

(B) $(x-2)^2 + (y-3)^2 = 1$

(C) $(x+2)^2 + (y+3)^2 = 1$

(D) $(x-3)^2 + (y-2)^2 = 1$

59. Let P=(1,α,α) and Q=(α-1,1,1) be two points in space and the distance between P and Q is 3. Then what is the value(s) of α? (M)

(A) $\alpha = -1, \alpha = 9$

(B) $\alpha = 1, \alpha = -9$

(C) $\alpha = 3, \alpha = {}^{-1}/_{3}$

(D) $\alpha = -3, \alpha = {}^{1}/_{3}$

60. If the image of the line $2x-3y=7$ under a translation is $2x-3y=0$, which one of the following is a translation vector of the translation line?

(A) $u=(2,-1)$ (B) $u=(-2,1)$ (C) $u=(-1,2)$ (D) $u=(1,-2)$

61. Let $P(n)$ be an open proposition on the set of natural numbers ($\mathbb{N}$). Which one of the following is a correct application of the principle of mathematical induction?

(A) If $P(1)$ is true for $n=1$; and if both $P(n)$ and $P(n+1)$ are true for certain $n\in\mathbb{N}$, then $P(n)$ is true for all $n\in\mathbb{N}$.

(B) If $P(10)$ is true; and if $P(n)$ is true implies that $P(n+1)$ is true, then $P(n)$ is true for all $n\in\mathbb{N}$.

(C) If $P(1)$ is true; and $P(n) \Rightarrow P(n+1)$ is true for any $n\in\mathbb{N}$, then $P(n)$ is true for all $n\in\mathbb{N}$.

(D) If $P(10)$ is true; and assuming $P(n)$ is true for any $n>10$ if it follows that $P(n+1)$ is true, then $P(n)$ is true for all $n\geq 10$.

62. If, in ΔABC, $AB=3, BC=4$ and $m(<B)=60^\circ$, then what are the length of AC and the cosine of $<A$, respectively?

(A) $\sqrt{13}$ and $\frac{1}{\sqrt{13}}$

(B) $\sqrt{13}$ and $\frac{-1}{\sqrt{13}}$

(C) $\sqrt{13}$ and $\frac{6}{5\sqrt{13}}$

(D) $\sqrt{13}$ and $\frac{-6}{5\sqrt{13}}$

63. What is the standard equation of the line passing through the point $(2, 3)$ and parallel to the line given by $\begin{cases} x = 1 + 2\lambda \\ y = -2 - \lambda \end{cases}, \lambda \in \mathbb{R}$?

(A) $\frac{x-2}{-1} = \frac{y-3}{2}$

(B) $\frac{x-1}{2} = \frac{y-3}{-2}$

(C) $\frac{x-2}{2} = \frac{y-3}{-1}$

(D) $\frac{x-1}{1} = \frac{y-3}{-2}$

64. Consider the following assertion:
$p + 2^n$ is an odd number for any prime p and any $n \in \mathbb{N}$.
Which one of the following is correct about a prove or disprove of the assertion?

(A) The assertion can be proved by direct method; because p is odd and $2^n = 2(2^{n-1})$ is even imply that $p + 2^n$ is odd since the sum of odd and even is odd.

(B) There is a counter example that disproves the assertion.

(C) The assertion can be proved by the indirect method; because if $n \notin \mathbb{N}$, then $2^n \notin \mathbb{N}$ and hence $p + 2^n$ is not odd.

(D) The assertion can be disproved by the method of contradiction.

65. If θ is a fourth quadrant angle and $\sec\theta = \sqrt{2}$ then what is $\csc\theta$ equals to?

(A) $-1/\sqrt{2}$ (B) $-\sqrt{2}$ (C) $1/\sqrt{2}$ (D) $\sqrt{2}$

THE END

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