



Name: \_\_\_\_\_

Time allowed: 3:00

Roll No. \_\_\_ Section: \_\_\_\_\_

Subject: MATHS (For Natural Science)

2012 E.C Model Exam

Grade 12

II

**INSTRUCTION- CHOOSE THE CORRECT ANSWER AND WRITE THE LETTER OF YOUR CHOICE ON THE SEPARATE ANSWER SHEET .**

1. If  $C(n, r-1) = 36$ ,  $C(n, r) = 84$  and  $C(n, r+1) = 126$ , then  $n+r =$   
(A) 11 (B) 12  
(C) 13 (D) 14 (E) None of these
2. The total number of ways in which six '+' and four '-' signs can be arranged in a line such that no two '-' signs occur together is  
(A) 32 (B) 34  
(C) 35 (D) 37 (E) none of these
3. A private college has 1000 students 60 % of these students are males, 45% of these students pay their by credit card including 175 females .What is the probability that the student is a male or a credit card user?  
(A) 0.675 (B) 0.775  
(C) 0.225 (D) 0.325 (E) none of these
4. If 6 boys and 6 girls sit in a row randomly the probability that boys and girls sit alternatively is  
(A)  $1/231$  (B)  $1/462$   
(C)  $1/154$  (D)  $1/132$  (E) none of these
5. Let  $Z \neq 0$  be a complex number. If the number  $\frac{Z-1}{Z+1}$  is purely imaginary, then  
(A)  $|Z|=1$  (B)  $|Z|>1$  (C)  $|Z|<1$  (D)  $|Z|=-1$  (E) None of these
6. If  $Z$  is a complex number such that  $Z + \frac{1}{Z} = 1$  then  $Z^{99} + \frac{1}{Z^{99}}$  is

- (A) -2      (B) -1      (C) 2      (D) 1      (E) none of these

7.  $\frac{(\cos\theta + i\sin\theta)^4}{(\sin\theta + i\cos\theta)^5}$  is equal to

- (A)  $\cos\theta - i\sin\theta$     (B)  $\cos9\theta - i\sin9\theta$     (C)  $\sin\theta - i\cos\theta$     (D)  $\sin9\theta - i\cos9\theta$

8. A sales man sold items  $x_1$ ,  $x_2$  and  $x_3$  with different rates of commissions as shown in the table

| Months   | Sales of units |       |       | Total commission<br>(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  $x_1$ ,  $x_2$  and  $x_3$  respectively.

- (A) 11, 2 and 4      (B) 4, 11 and 2      (C) 4, 2 and 11      (D) 2, 4 and 11      (E) none
9. If A is non-singular square matrix of order n, then  $|\text{adj } A|$  is equal to

- (A)  $|A|^{n-1}$     (B)  $|A|^n$       (C)  $|A|^{n-2}$       (D)  $|A|$     (E) none of these

10. For any 2x2 matrix A, if  $A[\text{adj.}A] = \begin{pmatrix} 10 & 0 \\ 0 & 10 \end{pmatrix}$  then,  $|A|$  equals

- (A) 0      (B) 10      (C) 20      (D) 100      (E) none of these

11. Let  $A = \begin{pmatrix} 1 & \sin\theta & 1 \\ -\sin\theta & 1 & \sin\theta \\ -1 & -\sin\theta & 1 \end{pmatrix}$  then the minimum value of  $\det(A)$  is

- (A) 4      (B) 3      (C) 2      (D) 5      (E) none of these

12. If  $A = (a_{ij})$ , with  $A^{-1} = \begin{pmatrix} 1 & 3 & 2 \\ 1 & 1 & 3 \\ 0 & 4 & 5 \end{pmatrix}$  the cofactor of  $a_{23}$  is

- (A) -3/14      (B) -2/7  
(C) 2/7      (D) -3/7      (E) none of these

13. If the vertex and the focus of a parabola are (-1,1) and (2,3) respectively, then the equation of the directrix is

- (A)  $3x+2y-25=0$       (B)  $3x+2y+14=0$   
(C)  $2x-3y+10=0$       (D)  $3x+2y-14=0$     (E) none of these

14. If the foci of the ellipse  $\frac{x^2}{16} + \frac{y^2}{b^2} = 1$  and the hyperbola  $\frac{x^2}{144} - \frac{y^2}{81} = 1/25$ , coincide then the value of  $b^2$  is

- (A) 1                      (B) 5                      (C) 7                      (D) 9                      (E) none of these

15. If  $\frac{x^2}{(a^2-6a+5)} + \frac{y^2}{(a^2-3a-4)} = 1$  represent the equation of an ellipse, what is the value of  $a$ ?

- (A)  $(-\infty, -1) \cup (5, \infty)$                       (B)  $(-\infty, 1) \cup (5, \infty)$   
 (C)  $(-\infty, -1) \cup (4, \infty)$                       (D)  $(-\infty, 1) \cup (4, \infty)$   
 (E) None of these

16. Which of the following is not necessarily true?

- (A) If  $A+B = \pi/4$  then  $(\tan A + 1)(\tan B + 1) = 2$                       (B)  $\frac{1-\tan^2 15}{1+\tan^2 15} = \sqrt{3}/2$   
 (C)  $\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B$                       (D)  $\sin 75 + \cos 75 = \sqrt{3/2}$   
 (E) None of these

17. From the top of a  $h$  meter high cliff, the angles of depression of the top and the bottom of a tower are observed to be  $30^\circ$  and  $60^\circ$  respectively, the height of the tower is

- (A)  $\frac{h}{3}$  Meter                      (B)  $\frac{2h}{3}$  Meter  
 (C)  $\frac{h}{\sqrt{3}}$  Meter                      (D)  $\frac{2h}{\sqrt{3}}$  Meter                      (E) none of these

18. For any two vectors  $\vec{a}$  and  $\vec{b}$

- (A)  $|\vec{a} \cdot \vec{b}| > |\vec{a}| |\vec{b}|$   
 (B)  $|\vec{a} \cdot \vec{b}| \leq |\vec{a}| |\vec{b}|$   
 (C)  $|\vec{a} \cdot \vec{b}| < |\vec{a}| |\vec{b}|$   
 (D)  $|\vec{a} \cdot \vec{b}| \geq |\vec{a}| |\vec{b}|$                       (E) none of these

19. Which of the following is true?

- (A)  $|k\vec{a}| = k|\vec{a}|$ , for real number  $k$   
 (B) In the  $xy$ - plane, the vector  $a\vec{i} - b\vec{j}$  is perpendicular to the line  $ax + by + c = 0$   
 (C) If  $|\vec{a}| = |\vec{b}|$ , then  $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b})$  is positive  
 (D) The range of  $f(x) = 5\sin(\frac{1}{3}x + 2) + 3$  is  $[-5, 5]$   
 (E) None of these

20. What is the standard equation of the line passing through the point  $(2, 3)$  and parallel to the

line given by  $\begin{cases} x = 1 + 2t \\ y = -2 - t \end{cases}$ ,  $t \in R$ ?

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

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

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

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

(E) None of these

21. Which one of the following is NOT correct?

(A) If  $p \Rightarrow (q \vee r)$  is False, then  $\neg r \wedge q$  is *False*.

(B)  $[\neg(p \vee q) \Rightarrow p] \Leftrightarrow \neg(\neg p \wedge \neg q)$  is a tautology

(C) If  $p$  is True, then  $\neg p \Rightarrow (r \vee s)$  is True.

(D) If  $\neg p \Rightarrow q$  is True, then  $(q \Rightarrow \neg p) \vee (\neg p \wedge \neg q)$  is True

22. Which one of the following statements has a truth value True?

(A)  $(\forall x)(\exists y)(y^2 + 4x = 0), x, y \in \mathbb{R}$

(B)  $(\forall x) \left( \sqrt{\text{sgn}(x^2) + \text{sgn}(x^3)} > 0 \right), x \in \mathbb{R}$

(C)  $(\exists x)(\forall y)(|x| \leq y), x, y \in \mathbb{N}$

(D)  $(\forall x)(\exists y)(x + y = y); x, y \in \mathbb{R}$

23. Which one of the following is NOT true?

(A)  $(\forall x)(\exists y)(x^2 + y < 0)$ ; where  $x, y \in \mathbb{R}$

(B)  $(\exists x)(\forall y)(x \leq y^2 - 1)$ ; where  $x, y \in \mathbb{R}$

(C)  $(\exists x)(\forall y)(y^2 - x^2 = 1)$ ; where  $x, y \in \mathbb{R}$

(D)  $(\forall x)(\exists y)(x \div y = y \div x)$ ; where  $x, y \in \mathbb{N}$

24. Which one of the following is NOT correct?

(A) “It is not true that his mother is an Ethiopian or his father is an American” is equivalent to “His mother is not an Ethiopian and his father is not an American”

(B) “It is not true that he studies physics but not mathematics” is equivalent to “If he does not study physics, then he studies mathematics.”

(C) The negation of “Aster speaks Spanish or French, but not German” is “Aster speaks German but neither Spanish nor French”

(D) “It never rains when it is cold” is equivalent to “If it rains, then it is cold”

25. Which one of the following represents the equation of the ellipse, with major axis along the  $x$  - axis and passing through  $(4, 3)$  and  $(-1, 4)$ ?

(A)  $15x^2 + 7y^2 = 247$

(C)  $16x^2 + 9y^2 = 144$

(B)  $7x^2 + 15y^2 = 247$

(D)  $16x^2 + y^2 = 265$

26. What is the eccentricity of the hyperbola with foci  $(0, \pm 12)$ , and the length of the latus rectum 36?

(A) 2

(B) 3

(D) 4

(E) 6

27. The solution set of  $x^3 - 2x - 4 = 0$  on the set of complex numbers is given by:

(A)  $\{-1, 2, -i\}$

(B)  $\{2, -1 + i, -1 - i\}$

(C)  $\{2, -i, i\}$

(D)  $\{-2, -i, i\}$

28. Which one of the following is NOT true about the distribution given below?

| Age     | Number of Students |
|---------|--------------------|
| 10 – 19 | 3                  |
| 20 – 29 | 5                  |
| 30 – 39 | 14                 |
| 40 – 49 | 7                  |

(A) The first quartile is 28

(B) The median is 34.14

(C) The mode is 35.13

(D) The variance is 30

29. Which one of the following is NOT true?

(A) If the determinant of a  $3 \times 3$  matrix is 12, then the determinant of the matrix formed by replacing each element by its co-factor is 144.

(B)  $AB = AC$  implies  $B = C$  for any three matrices of same order.

(C) If  $A$  is a square matrix of order 3 and  $|A| = 7$ , then  $|adj A| = 49$

(D)  $\begin{bmatrix} 0 & -2c & -2b \\ b & c+a & b \\ c & c & a+b \end{bmatrix} = 4abc$

30. What is the solution set of the system  $\begin{cases} x + y + 2z = 1 \\ x + 2y + z = 1 \\ 3x + 4y + 5z = 3 \end{cases}$

(A)  $\{(1, 0, 0)\}$

(C)  $\{(1 - 3k, k, k) | k \in \mathbb{R}\}$

(B)  $\{(k + 1, -k, 0) | k \in \mathbb{R}\}$

(D)  $\emptyset$

31. Let  $A$  and  $B$  be two events such that  $P(A) = 0.6$ ,  $P(B) = 0.2$ , and  $P(A \setminus B) = 0.5$ , then  $P(A' \setminus B')$  is equal to:

- (A)  $\frac{1}{5}$  (B)  $\frac{7}{10}$  (C)  $\frac{4}{5}$  (D)  $\frac{3}{8}$

32.  $A, B$  and  $C$  work independently on a problem. If the respective probabilities that they will solve it are  $\frac{1}{2}$ ,  $\frac{1}{3}$  and  $\frac{2}{5}$ , then what is the probability that the problem will be solved?

- (A)  $\frac{1}{5}$  (B)  $\frac{3}{5}$  (C)  $\frac{2}{3}$  (D)  $\frac{4}{5}$

33. In how many ways can 5 children be arranged in a row such that 2 boys,  $x$  and  $y$ , are always together?

- (A) 120 (B) 72 (C) 48 (D) 24

34. From the digits 0, 1, 3, 5 and 7, four – digit a number which is greater than 5000 is formed. What is the probability that the number formed is divisible by 5, if digits are allowed to repeat?

- (A)  $\frac{5}{8}$  (B)  $\frac{3}{5}$  (C)  $\frac{2}{5}$  (D)  $\frac{1}{2}$

35. A student appears for an entrance exam. *Section – A* of the paper is Math having 5 questions

and *Section – B* is General Science having 7 questions. The student is required to answer 8 questions in all. He should attempt at least 3 questions from *maths* and the same from GS

In how many ways can the student do so?

- (A) 720 (B) 680 (C) 540 (D) 42

36. Consider two events  $A$  and  $B$  such that  $p(A \cap B) = 0.12$ ,  $p(A \cup B) = 0.65$  and  $p(A / B) = \frac{12}{37}$

Then  $p(B / A) =$  \_\_\_\_\_

- (A) 0.50 (B) 0.80 (C) 0.30 (D) 0.55

37. Let  $A$  and  $B$  be  $2 \times 2$  matrices. Then which of the following is always true?

- (A)  $A(B - C) = 0 \Rightarrow B = C$  (C)  $(A^T B)^T = AB^T$   
(B)  $|A| = |B| \Rightarrow AB = I_2$  (D)  $|AB| \neq 0 \Rightarrow A$  is invertible

38. Let  $M = \begin{bmatrix} 4 & 3 & -9 \\ 0 & -2 & 15 \\ 12 & 9 & -5 \end{bmatrix}$ . Find a matrix  $N$  such that  $2M + 3N$  is a scalar matrix whose non-zero element is 2.

- (A)  $\begin{bmatrix} -2 & -2 & 6 \\ 0 & 2 & -10 \\ -8 & -6 & 4 \end{bmatrix}$  (B)  $\begin{bmatrix} 2 & 0 & 8 \\ 2 & -2 & 6 \\ -6 & 10 & -4 \end{bmatrix}$  (C)  $\begin{bmatrix} 2 & 0 & 4 \\ 0 & -2 & 2 \\ 8 & 6 & -4 \end{bmatrix}$  (D) None of these

39. What is the solution set of the determinant equation  $\begin{vmatrix} 1 & 2x & 1 \\ 3 & 1 & 0 \\ 2x & 5 & 2x \end{vmatrix} = 3$

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

40. What must be the value of  $t$  so that the system has a unique solution?

$$\begin{cases} x - y + z = 1 \\ -x + 5y - 4z = 1 \\ 2x + 2y + z = t \end{cases} \quad \text{(A) } t = 1 \quad \text{(B) } t \neq 4 \quad \text{(C) } t \neq 0 \quad \text{(D) } t \in \mathbb{R}$$

41. Suppose that  $A$  and  $B$  are  $3 \times 3$  matrices such that  $AB = 2I_3$ . If  $|B| = 6$ , what is  $|A^T|$ ?

- (A)  $\frac{1}{3}$  (B)  $\frac{4}{3}$  (C) 12 (D) 48

42. If  $A = \begin{bmatrix} 2 & 7 \\ 1 & 3 \end{bmatrix}$  and  $B^{-1} = \begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix}$ , then  $(AB)^{-1}$  is equal to :

- (A)  $\begin{bmatrix} -2 & 5 \\ 2 & -4 \end{bmatrix}$  (B)  $\begin{bmatrix} 4 & -3 \\ 4 & -5 \end{bmatrix}$  (C)  $\begin{bmatrix} -3 & 11 \\ 1 & -3 \end{bmatrix}$  (D)  $\begin{bmatrix} 4 & 0 \\ 0 & 2 \end{bmatrix}$

43. The solution set of the system given below, for  $t \in \mathbb{R}$  is:

$$\begin{cases} x + y + 2z = 1 \\ x + 2y + z = 2 \\ -2x - 2y - 4z = -2 \end{cases} \quad \begin{matrix} \text{(A) } \{(3t, t + 1, t)\} \\ \text{(B) } \{(3t, t - 1, t)\} \end{matrix} \quad \begin{matrix} \text{(C) } \{(-3t, t + 1, t)\} \\ \text{(D) } \{(-3t, t - 1, t)\} \end{matrix}$$

44.  $A$  &  $I$  are square matrices of order  $n$ , where  $n \geq 2$  and  $I$  is the identity (or unit) matrix.

If  $A^2 = 2A - I$ , then which of the following equals to  $A^{10}$ ?

- (A)  $2A^9 - I$  (B)  $10A - 9I$  (C)  $4A - I$  (D)  $12A - 10I$

45. If  $A$  is a square matrix such that  $A^2 = I$ , then  $A^{-1} =$

- (A)  $2A$  (B)  $A$  (C)  $0$  (D)  $A + I$

46. If  $A$  and  $C$  are  $3 \times 3$  matrices where  $A = (2B)^{-1}$  and  $\det(2ABC) = 16$ , then find

$$|2A^2(\text{adj } B)C|$$

- (A) 2 (B) 128 (C) 4 (D) None of these

47. In the system of linear equation given below  $m$  &  $n$  are constants and determinant of the coefficient matrix is  $-6$ . Which of the following is the solution set of the system?

$$\begin{cases} my + nz = 4 \\ x - 2y + 3z = 0 \\ x + y + 4z = 0 \end{cases} \quad \begin{matrix} \text{(A) } \{(6, -2, 1)^T\} \\ \text{(B) } \{(6, 2, -2)^T\} \end{matrix} \quad \begin{matrix} \text{(C) } \left\{ \left( 0, \frac{4}{m}, -\frac{1}{n} \right)^T \right\} \\ \text{(D) } \left\{ \left( 0, -\frac{1}{m}, \frac{4}{n} \right)^T \right\} \end{matrix}$$

48. If the imaginary part of  $\frac{2Z+1}{iZ+1}$  is  $-2$ , where  $Z = x + yi$ , then which of the following statements is true?

(A)  $(x-1)^2 + (y+1)^2 = 4$

(C)  $2x + y = -2$

(B)  $2y + x = 2$

(D)  $x^2 + 2y^2 - 8 = 0$

49. If for a complex number  $Z$ ,  $\overline{\left(\frac{Z(1-i)}{2-i}\right)} = \frac{9-7i}{5}$ , then the value of  $Z$  is equal to:

(A)  $2 - 3i$

(B)  $\frac{1+3i}{10}$

(C)  $2 + 3i$

(D)  $-i$

50. If  $\theta$  is a second quadrant angle and  $\sin 2\theta = -\frac{7}{9}$ , then  $\cos \theta - \sin \theta$  is equal to:

(A)  $\frac{4}{3}$

(B)  $-\frac{4}{3}$

(C)  $-\frac{2}{3}$

(D) None of these

51. Which of the following is not correct?

(A)  $\sin^{-1}(-x) = -\sin^{-1} x$

(C)  $\cos^{-1}(-x) = \pi - \cos^{-1} x$

(B)  $\sec^{-1}(-x) = \sec^{-1} x$

(D)  $\tan^{-1}(-x) = -\tan^{-1} x$

52. The value of  $\sec[\tan^{-1}(-\sqrt{3})]$  is equal to:

(A) 2

(B)  $-2$

(C)  $\frac{3\sqrt{3}}{2}$

(D)  $\frac{1}{2}$

53. The solution set of the trigonometric equation  $\cos^2 x - \sin^2 x - \cos x + 1 = 0$ , on the interval

$[0, \pi]$  is:

(A)  $\left\{\frac{\pi}{6}, \frac{\pi}{2}\right\}$

(B)  $\left\{\frac{\pi}{2}, \frac{2\pi}{3}\right\}$

(C)  $\left\{\frac{\pi}{3}, \frac{\pi}{2}\right\}$

(D)  $\left\{\frac{\pi}{3}\right\}$

54. The period of the function  $f(x) = \tan\left(\frac{2x-\pi}{3}\right)$  is :

(A)  $2\pi$

(B)  $\pi$

(C)  $\frac{2\pi}{3}$

(D)  $\frac{3\pi}{2}$

55.  $2 \tan 32^\circ \tan 58^\circ - 3 \cot 13^\circ \cot(-77^\circ)$  is equal to:

(A)  $-\tan 26^\circ$

(B)  $-1$

(C) 5

(D)  $4\sqrt{3}$

56. Let  $A = \begin{bmatrix} 1 & -1 & -2 & -3 \end{bmatrix}$  and  $B = \begin{bmatrix} 3 & 2x+1 \\ x-1 & 1-3x \end{bmatrix}$ . If  $AB = [11]$ , then the value of  $x$  equals to:

(A) 3

(B) 2

(C)  $-1$

(D)  $-2$

57.  $\sin^{-1}\left(\frac{1}{\sqrt{5}}\right) + \sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$  is equal to :

(A)  $\frac{\pi}{4}$

(B)  $\frac{\pi}{3}$

(C)  $\frac{\pi}{2}$

(D)  $\pi$

58. Given vectors  $\vec{u}$  and  $\vec{v}$  with  $|\vec{u}| = 6, |\vec{v}| = 4$  and the angle between them is  $\frac{\pi}{3}$ . Find  $(\vec{u} - \vec{v})^2$ .

(A) 18

(B) 28

(C) 24

(D) 16

59. The vector equation of the line passing through  $P(4, 1)$  and  $Q(5, 3)$  (for  $t \in \mathbb{R}$ ) is:

(A)  $(x, y) = (4, 1) + t(3, 7)$

(C)  $(x, y) = (5, 3) + t(6, 1)$

(B)  $(x, y) = (4, 1) + t(1, 2)$

(D)  $(x, y) = (5, 3) + t(2, 1)$

60. Let  $\vec{u} = (-1, 10)$  and  $\vec{v} = (1, 3)$ . Then, the unit vector in the direction of  $\vec{u} - 2\vec{v}$  is:

(A)  $\left(-\frac{3}{5}, -\frac{4}{5}\right)$

(B)  $\left(\frac{3}{5}, -\frac{4}{5}\right)$

(C)  $\left(\frac{3}{5}, \frac{4}{5}\right)$

(D)  $\left(-\frac{3}{5}, \frac{4}{5}\right)$

61. The angle between  $\vec{u} = 3\vec{i} + 2\vec{j}$  and  $\vec{v} = 5\vec{i} - \vec{j}$  is:

(A)  $30^\circ$

(B)  $45^\circ$

(C)  $60^\circ$

(D)  $90^\circ$

62. In how many ways can 4 boys and 5 girls sit in a row if the boys and girls must alternate?

(A) 2880

(B) 1024

(C) 1440

(D) 2220

63. In the expansion of the expression  $\left(x - \frac{1}{x}\right)^{20}$  the coefficient of  $x^6$  is:

(A)  $\binom{20}{6}$

(B)  $\binom{20}{7}$

(C)  $-1 \times \binom{20}{6}$

(D)  $-1 \times \binom{20}{7}$

64. Let  $X$  be a population function with mean  $\bar{x} = 31.2$  and variance  $\sigma_x^2 = 2$ . If  $Y$  is another population function given by  $Y = 3X$  (i.e., every data value of  $Y$  is obtained by multiplying each data value of  $X$  by 3). Which of the following is the variance of  $Y$ ?

(A) 6

(B) 18

(C) 36

(D) None of these

65. The solution set of the equation  $x^3 - 2x - 4 = 0$  under the set of complex number is:

(A)  $\{2, -i, i\}$

(B)  $\{-2, -i, i\}$

(C)  $\{2, -1 - i, -1 + i\}$

(D)  $\{2, 1 - i, -1 + i\}$

