WARNING :	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER – II MATHEMATICS

Version Code		Question Booklet Serial Number	
Time : 150 Minutes		Number of Questions : 120	Maximum Marks : 480
Name of Candidate			
Roll Number			
Signature of Candidate			

INSTRUCTIONS TO THE CANDIDATE

1. Please ensure that the **VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different **VERSION CODE**, please get it replaced with a Question Booklet with the same VERSION CODE as that of the OMR Answer Sheet from the Invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill in the items such as name, signature and roll number of the candidate in the columns given above. Please also write the Question Booklet Sl. No. given at the top of this page against item 4 in the OMR Answer Sheet.
3. Please read the instructions given in the OMR Answer Sheet for marking answers. Candidates are advised to strictly follow the instructions contained in the OMR Answer Sheet.
4. This Question Booklet contains 120 Questions. For each Question, five answers are suggested and given against (A), (B), (C), (D) and (E) of which, only one will be the **Most Appropriate Answer**. Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black ball - point pen only.**
5. Negative Marking: In order to discourage wild guessing, the score will be subject to penalization formula based on the number of right answers actually marked and the number of wrong answers marked. Each correct answer will be awarded FOUR marks. One mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

IMMEDIATELY AFTER OPENING THIS QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO

PLEASE ENSURE THAT THIS BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120 (Printed Pages : 32)

1. The equation of the plane through the point (1, 0, –1) and perpendicular to the line $\frac{x+1}{2}=\frac{y+3}{4}=\frac{z+7}{-3}$ is

(A) $2x+4y-3z=0$ (B) $2x+4y-3z=-1$ (C) $x+3y+7z=-6$

(D) $2x+4y-3z=5$ (E) $x+3y+7z=6$

2. Suppose that a line makes the same angle θ with each of the x and z axes. If β is the angle made by the line with the y-axis and if $\sin^2\beta = 3\sin^2\theta$, then $\cos^2\theta$ is equal to

(A) $\frac{7}{9}$ (B) $\frac{2}{3}$ (C) $\frac{1}{5}$ (D) $\frac{2}{5}$ (E) $\frac{3}{5}$

3. Which of the following is a point on the line

$\vec{r}=\left(-5\vec{i}+2\vec{j}+3\vec{k}\right)+\mu\left(9\vec{i}-5\vec{j}+3\vec{k}\right)$?

(A) (4, 3, 5) (B) (–41, 22, –8) (C) (–14, –7, 0)

(D) (13, –8, 8) (E) (–50, 27, –12)

4. If the planes $\vec{r}\cdot(2\vec{i}-\lambda\vec{j}+3\vec{k})=0$ and $\vec{r}\cdot(\lambda\vec{i}+5\vec{j}-\vec{k})=5$ are perpendicular to each other then the value of $\lambda^2+\lambda$ is

(A) 0 (B) –2 (C) –1 (D) 2 (E) 1

5. The cartesian form of the plane $\vec{r}=(s-2t)\vec{i}+(3-t)\vec{j}+(2s+t)\vec{k}$ is

(A) $2x-5y-z-15=0$ (B) $2x-5y+z-15=0$ (C) $2x-5y-z+15=0$

(D) $2x+5y-z+15=0$ (E) $2x+5y+z+15=0$

(Space for Rough Work)

6. Let P (–7, 1, –5) be a point on a plane and let O be the origin. If OP is normal to the plane, then the equation of the plane is

(A) $7x - y + 5z + 75 = 0$ (B) $7x - y + 5z + 73 = 0$ (C) $7x + y + 5z + 73 = 0$

(D) $7x - y - 5z + 75 = 0$ (E) $7x - y - 5z + 73 = 0$

7. The values of λ for which the plane $x + y + z = \sqrt{3}\,\lambda$ touches the sphere $x^2 + y^2 + z^2 - 2x - 2y - 2z - 6 = 0$ are

(A) $\pm\sqrt{3}$ (B) ± 3 (C) $3 \pm \sqrt{3}$ (D) $\sqrt{3} \pm 1$ (E) $\sqrt{3} \pm 3$

8. The point in the xy-plane which is equidistant from the points (2, 0, 3), (0, 3, 2) and (0, 0, 1) is

(A) (1, 2, 3) (B) (–3, 2, 0) (C) (3, –2, 0)

(D) (3, 2, 0) (E) (3, 2, 1)

9. The average of the four-digit numbers that can be formed using each of the digits 3, 5, 7 and 9 exactly once in each number is

(A) 4444 (B) 5555 (C) 6666

(D) 7777 (E) 8888

(Space for Rough Work)

10. If A and B are any two events, then $P(A \cap B') =$

(A) $P(A)+P(B')$

(B) $P(A)+P(A \cap B)$

(C) $P(B)-P(A \cap B)$

(D) $P(A)-P(A \cap B)$

(E) $1-P(A \cap B)$

11. A die has four blank faces and two faces marked 3. The chance of getting a total of 12 in 5 throws is

(A) ${}^5C_4\left(\frac{1}{3}\right)^4\left(\frac{2}{3}\right)$ (B) ${}^5C_4\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)^4$ (C) ${}^5C_4\left(\frac{1}{6}\right)^5$

(D) ${}^5C_4\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right)$ (E) ${}^5C_4\left(\frac{5}{6}\right)^4\left(\frac{1}{6}\right)$

12. The standard deviation for the scores 1, 2, 3, 4, 5, 6 and 7 is 2. Then the standard deviation of 12, 23, 34, 45, 56, 67 and 78 is

(A) 2 (B) 4 (C) 22 (D) 11 (E) 44

13. $\lim_{x \to -\infty} \frac{2x-1}{\sqrt{x^2+2x+1}} =$

(A) 2 (B) −2 (C) 1 (D) −1 (E) 0

(Space for Rough Work)

14. If $f(x)=2x+1$ and $g(x)=\frac{x-1}{2}$ for all real x, then $(f\ o\ g)^{-1}\left(\frac{1}{x}\right)$ is equal to

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

15. If $f(x)=\frac{2x-3\sin x}{3x+4\tan x}, x\neq 0$, is continuous at $x=0$, then $f(0)=$

(A) 3 (B) $\frac{2}{7}$ (C) $\frac{-3}{7}$ (D) $\frac{2}{3}$ (E) $\frac{-1}{7}$

16. If $f(x)=\begin{cases}\frac{\sqrt{4+ax}-\sqrt{4-ax}}{x}, -1\leq x<0\\ \frac{3x+2}{x-8}, 0\leq x\leq 1\end{cases}$

is continuous in the interval $[-1, 1]$, then the value of a is equal to

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

17. If $f(x)=\sqrt{x^2+1}$, $g(x)=\frac{x+1}{x^2+1}$ and $h(x)=2x-3$, then $f'(h'(g'(x)))=$

(A) 0 (B) $\frac{1}{\sqrt{x^2+1}}$ (C) $\frac{2}{\sqrt{5}}$ (D) $\frac{x}{\sqrt{x^2+1}}$ (E) $\frac{1}{\sqrt{5}}$

(Space for Rough Work)

18. If $y = \tan^{-1}\left(\frac{4x}{1+5x^2}\right) + \tan^{-1}\left(\frac{2+3x}{3-2x}\right)$, then $\frac{dy}{dx}$ is equal to

(A) $\frac{5}{1+25x^2}$ (B) $\frac{2}{1+4x^2}$ (C) 0

(D) $\frac{7}{1+49x^2}$ (E) $\frac{3}{1+9x^2}$

19. If $\varphi(x) = \log_5 \log_3 x$, then $\varphi'(e) =$

(A) $\frac{1}{e}\log_5 e$ (B) 1 (C) $e\log_e 5$ (D) $\log_5 e$ (E) 0

20. If $y = \sin^{-1}(3x - 4x^3) + \cos^{-1}(4x^3 - 3x) + \tan^{-1}(e)$, then $\frac{dy}{dx} =$

(A) $\frac{3}{\sqrt{1-x^2}} - \frac{3}{\sqrt{x^2-1}}$ (B) 0 (C) $\frac{\pi}{2}$

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

21. If $f(x) = \frac{x-1}{4} + \frac{(x-1)^3}{12} + \frac{(x-1)^5}{20} + \frac{(x-1)^7}{28} + \cdots$, where $0 < x < 2$, then $f'(x) =$

(A) $\frac{1}{4x(2-x)}$ (B) $\frac{1}{4(x-2)^2}$ (C) $\frac{1}{2-x}$ (D) $\frac{1}{x-1}$ (E) $\frac{1}{(x-4)^2}$

(Space for Rough Work)

22. If $f(x) = \sin x$, the derivative of $f(\log x)$ with respect to x is

(A) $\cos x$ (B) $f'(\log x)$ (C) $\cos(\log x)$

(D) $\frac{\cos(\log x)}{x}$ (E) $\frac{1}{x}$

23. If $f(x+y) = 2f(x)f(y)$, $f'(5) = 1024 (\log 2)$ and $f(2) = 8$, then the value of $f'(3)$ is

(A) 64 (log 2) (B) 128 (log 2) (C) 256

(D) 256 (log 2) (E) 1024 (log 2)

24. A spotlight on the ground shines on a wall 12 m away from the light. If a man of 2 m height walks from the spotlight towards the wall at a speed of $\frac{1}{2}$ m per second, then the rate at which the length of his shadow on the wall is decreasing at the instant when he is 8 m from the wall is

(A) $\frac{3}{4}$ m/s (B) $\frac{5}{4}$ m/s (C) $\frac{3}{8}$ m/s (D) $\frac{5}{8}$ m/s (E) $\frac{1}{2}$ m/s

25. The area of the triangle formed by the co-ordinate axes and the normal to the curve $y = e^{2x} + x^2$ at the point (0, 1) is

(A) 0 (B) 1 (C) $\frac{1}{2}$ (D) 2 (E) $\sqrt{2}$

26. The greatest distance from the point $(\sqrt{7}, 0)$ to the curve $9x^2 + 16y^2 = 144$ is

(A) 4 (B) $\sqrt{7}$ (C) $2+\sqrt{7}$ (D) $3+\sqrt{7}$ (E) $4+\sqrt{7}$

(Space for Rough Work)

27. A spherical iron ball of radius 10 cm, coated with a layer of ice of uniform thickness, melts at a rate of 100π cm^3/min. The rate at which the thickness of ice decreases when the thickness of ice is 5 cm, is

(A) $\frac{1}{54}$ cm/min (B) $\frac{1}{9\pi}$ cm/min (C) $\frac{1}{36}$ cm/min

(D) $\frac{1}{18}$ cm/min (E) $\frac{1}{9}$ cm/min

28. If ax^2+bx+4 attains its minimum value -1 at $x=1$, then the values of a and b are respectively

(A) 5, −10 (B) 5, −5 (C) 5, 5 (D) 10, − 5 (E) 10, 10

29. The function $f(x)=(9-x^2)^2$ increases in

(A) $(-3, 0)\cup(3, \infty)$ (B) $(-\infty, -3)\cup(3, \infty)$ (C) $(-\infty, -3)\cup(0, 3)$

(D) $(-\infty, 3)$ (E) $(3, \infty)$

30. Let $g(x)=\begin{cases} e^{2x} & \text{if } x\le 1 \\ \log(x-1) & \text{if } x>1 \end{cases}$. The equation of the normal to $y=g(x)$ at the point (3, log 2) is

(A) $y-2x=6+\log 2$ (B) $y+2x=6+\log 2$ (C) $y+2x=6-\log 2$

(D) $y+2x=-6+\log 2$ (E) $y-2x=-6+\log 2$

(Space for Rough Work)

31. $\int \frac{\sec x \operatorname{cosec} x}{2\cot x - \sec x \operatorname{cosec} x} dx =$

(A) $\log|\sec x + \tan x| + c$

(B) $\log|\sec x + \operatorname{cosec} x| + c$

(C) $\frac{1}{2}\log|\sec 2x + \tan 2x| + c$

(D) $\frac{1}{2}\log|\sec 2x + \operatorname{cosec} 2x| + c$

(E) $\frac{1}{2}\log|\sec 2x \operatorname{cosec} 2x| + c$

32. If $\int f(x)\cos x\,dx = \frac{1}{2}f^2(x) + c$, then $f(x)$ can be

(A) x (B) $\sin x$ (C) 1 (D) $\cos x$ (E) $x \sin x$

33. $\int \tan(\sin^{-1} x)dx =$

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

(D) $\frac{x}{\sqrt{1-x^2}} + c$ (E) $-\sqrt{1-x^2} + c$

(Space for Rough Work)

34. $\int (\sin x - \cos x)^4 (\sin x + \cos x)\, dx =$

(A) $\dfrac{\sin x - \cos x}{5} + c$

(B) $\dfrac{(\sin x - \cos x)^5}{5} + c$

(C) $\dfrac{\cos x - \sin x}{5} + c$

(D) $\dfrac{(\cos x - \sin x)^5}{5} + c$

(E) $\dfrac{\sin^4 x}{4} + \dfrac{\cos^4 x}{4} + \dfrac{\sin^2 x}{2} + \dfrac{\cos^2 x}{2} + c$

35. $\int e^{\sin\theta}\, [\log \sin\theta + \operatorname{cosec}^2\theta]\, \cos\theta\, d\theta$ is equal to

(A) $e^{\sin\theta}\, [\log \sin\theta + \operatorname{cosec}^2\theta] + c$

(B) $e^{\sin\theta}\, [\log \sin\theta + \operatorname{cosec}\theta] + c$

(C) $e^{\sin\theta}\, [\log \sin\theta - \operatorname{cosec}\theta] + c$

(D) $e^{\sin\theta}\, [\log \sin\theta - \operatorname{cosec}^2\theta] + c$

(E) $e^{\sin\theta}\, [\log \sin\theta + \cos^2\theta] + c$

36. $\int e^{3\log x}(x^4+1)^{-1} dx$ is equal to

(A) $e^{3\log x} + c$

(B) $\dfrac{1}{4}\log(x^4+1) + c$

(C) $\dfrac{1}{3}\log(x^4+1) + c$

(D) $\dfrac{e^{3\log x}}{x^4+1} + c$

(E) $\dfrac{x^4}{x^4+1} + c$

(Space for Rough Work)

37. If $\int \frac{\sin x}{\sin(x-\alpha)} dx = Ax + B\log|\sin(x-\alpha)| + K$ then the value of $A - B$ at $\alpha = \frac{\pi}{2}$ is

(A) –1 (B) 1 (C) 2 (D) 0 (E) –2

38. $\int_0^1 \frac{\sqrt{x}}{\sqrt{x}+\sqrt{1-x}} dx =$

(A) $\frac{3}{2}$ (B) $\frac{\pi}{2}$ (C) 3 (D) 4 (E) $\frac{1}{2}$

39. The value of $\int_{-\pi}^{\pi} \frac{\cos^2 x}{1+a^x} dx,\ a > 0$ is

(A) $a\pi$ (B) π (C) $\frac{\pi}{2}$ (D) 2π (E) $-\pi$

40. The area of the region bounded by the curves $y = \cos\left(\frac{\pi}{2}x\right)$ and $y = x^2 - 1$ between $x = 0$ and $x = 2$ is

(A) $\frac{4}{\pi} - 2$ (B) $\frac{4}{\pi} + 2$ (C) $\frac{\pi - 3}{\pi}$ (D) $\frac{\pi + 3}{\pi}$ (E) π

41. The value of $\int_{\log\frac{1}{2}}^{\log 2} \log(x + \sqrt{1+x^2})dx$ is

(A) 2 log 2 (B) 1 – log 2 (C) log 2
(D) 0 (E) 1 + log 2

(Space for Rough Work)

42. If $\int_a^b x^3\,dx = 0$ and $\int_a^b x^2\,dx = \frac{2}{3}$, then the values of a and b respectively are

(A) $1, -1$ (B) $-1, 1$ (C) $1, 1$
(D) $-1, -1$ (E) $1, 0$

43. The differential equation representing the family of curves $y^2 = 2c\left(x + \sqrt[3]{c}\right)$, where c is a positive parameter, is of

(A) order 1, degree 1
(B) order 1, degree 2
(C) order 1, degree 3
(D) order 1 , degree 4
(E) order 2, degree 1

44. The differential equation representing the family of curves $y = xe^{cx}$ (c is a constant) is

(A) $\frac{dy}{dx} = \frac{y}{x}\left(1 - \log\frac{y}{x}\right)$

(B) $\frac{dy}{dx} = \frac{y}{x}\log\left(\frac{y}{x}\right) + 1$

(C) $\frac{dy}{dx} = \frac{y}{x}\left(1 + \log\frac{y}{x}\right)$

(D) $\frac{dy}{dx} + 1 = \frac{y}{x}\log\left(\frac{y}{x}\right)$

(E) $\frac{dy}{dx} = \frac{x}{y}\left(1 + \log\frac{y}{x}\right)$

(Space for Rough Work)

45. The solution of $\frac{dy}{dx}=1+y+y^2+x+xy+xy^2$ is

(A) $\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2y+1}{\sqrt{3}}\right)=x+x^2+c$

(B) $4\tan^{-1}\left(\frac{2y+1}{\sqrt{3}}\right)=\frac{\sqrt{3}}{2}\left(2x+x^2\right)+c$

(C) $\sqrt{3}\tan^{-1}\left(\frac{3y+1}{3}\right)=4\left(1+x+x^2\right)+c$

(D) $\sqrt{3}\tan^{-1}\left(\frac{2y+1}{3}\right)=4\left(2x+x^2\right)+c$

(E) $4\tan^{-1}\left(\frac{2y+1}{\sqrt{3}}\right)=\sqrt{3}\left(2x+x^2\right)+c$

46. The integrating factor of the differential equation $\frac{dy}{dx}+\frac{y}{(1-x)\sqrt{x}}=1-\sqrt{x}$ is

(A) $\frac{1-\sqrt{x}}{1+\sqrt{x}}$ (B) $\frac{1+x}{1-x}$ (C) $\frac{1+\sqrt{x}}{1-\sqrt{x}}$

(D) $\frac{\sqrt{x}}{1-\sqrt{x}}$ (E) $\frac{\sqrt{x}}{1+\sqrt{x}}$

(Space for Rough Work)

47. Let n be a natural number. Then the range of the function $f(n) = {}^{8-n}P_{n-4}$, $4 \le n \le 6$, is

(A) $\{1, 2, 3, 4\}$ (B) $\{1, 2, 3, 4, 5, 6\}$ (C) $\{1, 2, 3\}$
(D) $\{1, 2, 3, 4, 5\}$ (E) $\varnothing$

48. If $f(x) = ax + b$ and $g(x) = cx + d$, then $f[g(x)] - g[f(x)]$ is equivalent to

(A) $f(a) - g(c)$ (B) $f(c) + g(a)$ (C) $f(d) + g(b)$
(D) $f(b) - g(b)$ (E) $f(d) - g(b)$

49. Which one of the following functions is one-to-one?

(A) $f(x) = \sin x, \quad x \in [-\pi, \pi)$ (B) $f(x) = \sin x, \quad x \in \left[\frac{-3\pi}{2}, \frac{-\pi}{4}\right]$

(C) $f(x) = \cos x, \quad x \in \left[\frac{-\pi}{2}, \frac{\pi}{2}\right)$ (D) $f(x) = \cos x, \quad x \in [\pi, 2\pi)$

(E) $f(x) = \cos x, \quad x \in \left[\frac{-\pi}{4}, \frac{\pi}{4}\right]$

50. In a certain town 25% families own a cell phone, 15% families own a scooter and 65% families own neither a cell phone nor a scooter. If 1500 families own both a cell phone and a scooter, then the total number of families in the town is

(A) 10,000 (B) 20,000 (C) 30,000
(D) 40,000 (E) 50,000

51. If $f(x) = \log\left(\frac{1+x}{1-x}\right)$, $-1 < x < 1$, then $f\left(\frac{3x + x^3}{1 + 3x^2}\right) - f\left(\frac{2x}{1 + x^2}\right)$ is

(A) $[f(x)]^3$ (B) $[f(x)]^2$ (C) $-f(x)$
(D) $f(x)$ (E) $3f(x)$

(Space for Rough Work)

52. Let $a_n = i^{(n+1)^2}$, where $i = \sqrt{-1}$ and $n = 1, 2, 3, \cdots$. Then the value of $a_1 + a_3 + a_5 + \cdots + a_{25}$ is

(A) 13 (B) $13 + i$ (C) $13 - i$
(D) 12 (E) $12 - i$

53. If $\frac{5z_2}{11z_1}$ is purely imaginary, then the value of $\left|\frac{2z_1 + 3z_2}{2z_1 - 3z_2}\right|$ is

(A) $\frac{37}{33}$ (B) 2 (C) 1
(D) 3 (E) $\frac{33}{37}$

54. If $2\alpha = -1 - i\sqrt{3}$ and $2\beta = -1 + i\sqrt{3}$, then $5\alpha^4 + 5\beta^4 + 7\alpha^{-1}\beta^{-1}$ is equal to

(A) -1 (B) -2 (C) 0
(D) 1 (E) 2

55. If $\frac{i^4 + i^9 + i^{16}}{2 - i^8 + i^{10} + i^3} = a + ib$, then (a, b) is

(A) $(1, 2)$ (B) $(-1, 2)$ (C) $(2, 1)$
(D) $(-2, -1)$ (E) $(1, -2)$

56. If $\left(\sqrt{5} + \sqrt{3}\, i\right)^{33} = 2^{49} z$, then modulus of the complex number z is equal to

(A) 1 (B) $\sqrt{2}$ (C) $2\sqrt{2}$
(D) 4 (E) 8

(Space for Rough Work)

57. If a is positive and if A and G are the arithmetic mean and the geometric mean of the roots of $x^2 - 2ax + a^2 = 0$ respectively, then

(A) $A = G$ (B) $A = 2G$ (C) $2A = G$
(D) $A^2 = G$ (E) $A = G^2$

58. Suppose that two persons A and B solve the equation $x^2 + ax + b = 0$. While solving A commits a mistake in constant term and finds the roots as 6 and 3 and B commits a mistake in the coefficient of x and finds the roots as -7 and -2. Then the equation is

(A) $x^2 + 9x + 14 = 0$ (B) $x^2 - 9x + 14 = 0$ (C) $x^2 + 9x - 14 = 0$
(D) $x^2 - 9x - 14 = 0$ (E) $x^2 + 9x + 4 = 0$

59. If $x^2 + 2x + n > 10$ for all real number x, then which of the following conditions is true?

(A) $n < 11$ (B) $n = 10$ (C) $n = 11$
(D) $n > 11$ (E) $n < -11$

60. If α, β are the roots of the equation $x^2 + x + 1 = 0$, then the equation whose roots are α^{22} and β^{19}, is

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

61. If sec θ and tan θ are the roots of $ax^2 + bx + c = 0$ $(a, b \neq 0)$, then the value of sec θ − tan θ is

(A) $-\frac{a}{b}$ (B) $-\frac{b}{a}$ (C) $\frac{a^2}{b^2}$
(D) $1 + \frac{a^2}{b^2}$ (E) $1 - \frac{a^2}{b^2}$

(Space for Rough Work)

62. If the sum of 12^{th} and 22^{nd} terms of an A.P is 100, then the sum of the first 33 terms of the A.P. is

(A) 1700 (B) 1650 (C) 3300
(D) 3400 (E) 3500

63. The coefficient of x in the expansion of $(1+x)(1+2x)(1+3x)\cdots(1+100x)$ is

(A) 5050 (B) 10100 (C) 5151
(D) 4950 (E) 1100

64. Let a, b, c be in A.P. If $0 < a,b,c < 1$, $x = \sum_{n=0}^{\infty} a^n$, $y = \sum_{n=0}^{\infty} b^n$ and $z = \sum_{n=0}^{\infty} c^n$, then

(A) $2y = x + z$ (B) $2x = y + z$ (C) $y = \frac{x+z}{xz}$
(D) $y = \frac{2xz}{x+z}$ (E) $z = \frac{2xy}{x+y}$

65. The sum of the first n terms of the series $\frac{1}{\sqrt{2}+\sqrt{5}} + \frac{1}{\sqrt{5}+\sqrt{8}} + \frac{1}{\sqrt{8}+\sqrt{11}} + \cdots$ is

(A) $\frac{1}{3}(\sqrt{3n+2}-\sqrt{2})$ (B) $\sqrt{3n+2}-\sqrt{2}$ (C) $\sqrt{3n+2}+\sqrt{2}$
(D) $\frac{1}{3}(\sqrt{2}-\sqrt{3n+2})$ (E) $\frac{1}{3}(\sqrt{3n+2}+\sqrt{2})$

(Space for Rough Work)

66. The H.M. of two numbers is 4. Their A.M. is A and G.M. is G. If $2A+G^2=27$ then A is equal to

(A) 9 (B) $\frac{9}{2}$ (C) 18

(D) 27 (E) $\frac{27}{2}$

67. The coefficient of x^{101} in $\frac{a-bx}{\underline{|1}}+\frac{(a-bx)^2}{\underline{|2}}+\frac{(a-bx)^3}{\underline{|3}}+\cdots$ is equal to

(A) $\frac{e^a b^{101}}{\underline{|101}}$ (B) $\frac{-e^a b^{100}}{\underline{|100}}$ (C) $\frac{e^a b}{\underline{|101}}$

(D) $\frac{-e^a b^{101}}{\underline{|101}}$ (E) $\frac{e^a b^{100}}{\underline{|100}}$

68. The value of $\log_2 20 \log_2 80 - \log_2 5 \log_2 320$ is equal to

(A) 5 (B) 6 (C) 7

(D) 8 (E) 10

69. The sum of the series $\log_9 3+\log_{27} 3-\log_{81} 3+\log_{243} 3-\cdots$ is

(A) $1-\log_e 2$ (B) $1+\log_e 2$ (C) $\log_e 2$

(D) $\log_e 3$ (E) $1+\log_e 3$

70. The number of ways in which 5 ladies and 7 gentlemen can be seated in a round table so that no two ladies sit together, is

(A) $\frac{7}{2}(720)^2$ (B) $7(360)^2$ (C) $7(720)^2$

(D) 720 (E) 360

(Space for Rough Work)

71. The number of four-letter words that can be formed (the words need not be meaningful) using the letters of the word MEDITERRANEAN such that the first letter is E and the last letter is R, is

(A) $\frac{\lfloor 11}{\lfloor 2 \lfloor 2 \lfloor 2}$ (B) 59 (C) 56

(D) $\frac{\lfloor 11}{\lfloor 3 \lfloor 2 \lfloor 2}$ (E) $\frac{\lfloor 11}{\lfloor 3 \lfloor 3 \lfloor 2}$

72. All the words that can be formed using alphabets A,H,L,U,R are written as in a dictionary (no alphabet is repeated). Then the rank of the word RAHUL is

(A) 70 (B) 71 (C) 72
(D) 73 (E) 74

73. The coefficient of $a^5 b^6 c^7$ in the expansion of $(bc + ca + ab)^9$ is

(A) 100 (B) 120 (C) 720
(D) 1260 (E) 1440

74. The value of $({}^7C_0 + {}^7C_1) + ({}^7C_1 + {}^7C_2) + \cdots + ({}^7C_6 + {}^7C_7)$ is

(A) $2^8 - 1$ (B) $2^8 + 1$ (C) 2^8
(D) $1 - 2^8$ (E) $2^8 - 2$

75. If the expansion of $\left(\frac{3\sqrt{x}}{7} - \frac{5}{2x\sqrt{x}}\right)^{13n}$ contains a term independent of x, then n should be a multiple of

(A) 10 (B) 5 (C) 6
(D) 4 (E) 11

(Space for Rough Work)

76. If the matrix M_r is given by $M_r = \begin{bmatrix} r & r-1 \\ r-1 & r \end{bmatrix}$, $r = 1, 2, 3, \cdots$, then the value of det (M_1) + det (M_2)+ $\cdots$ + det (M_{2008}) is

(A) 2007 (B) 2008 (C) $(2008)^2$
(D) $(2007)^2$ (E) 2009

77. Let $A = \begin{pmatrix} \alpha^2 & 5 \\ 5 & -\alpha \end{pmatrix}$ and $|A^{10}| = 1024$, then $\alpha =$

(A) 2 (B) −2 (C) 3
(D) −3 (E) −5

78. If $\omega \neq 1$ is a cube root of unity, then the value of

$$\begin{vmatrix} 1+2\omega^{100}+\omega^{200} & \omega^2 & 1 \\ 1 & 1+\omega^{100}+2\omega^{200} & \omega \\ \omega & \omega^2 & 2+\omega^{100}+\omega^{200} \end{vmatrix}$$ is equal to

(A) 0 (B) 1 (C) ω (D) ω^2 (E) $1+\omega$

79. If $\alpha^3 \neq 1$ and $\alpha^9 = 1$, then the value of $\begin{vmatrix} \alpha & \alpha^3 & \alpha^5 \\ \alpha^3 & \alpha^5 & \alpha \\ \alpha^5 & \alpha & \alpha^3 \end{vmatrix}$ is equal to

(A) $3\alpha^3$ (B) $3(\alpha^3+\alpha^6+\alpha^9)$ (C) $3(\alpha+\alpha^2+\alpha^3)$
(D) $3\alpha^4$ (E) 3

(Space for Rough Work)

80. If $f(\alpha)=\begin{vmatrix} 1 & \alpha & \alpha^2 \\ \alpha & \alpha^2 & 1 \\ \alpha^2 & 1 & \alpha \end{vmatrix}$, then $f\left(\sqrt[3]{3}\right)$ is equal to

(A) 1 (B) -4 (C) 4
(D) 2 (E) -2

81. If $A=\begin{bmatrix} 3 & 3 & 3 \\ 3 & 3 & 3 \\ 3 & 3 & 3 \end{bmatrix}$, then A^4 is equal to

(A) 27A (B) 81A (C) 243A
(D) 729A (E) 3A

82. Suppose a, b and c are real numbers such that $\frac{a}{b} > 1$ and $\frac{a}{c} < 0$. Which one of the following is true?

(A) $a+b-c>0$ (B) $a>b$ (C) $(a-c)(b-c)>0$
(D) $a+b+c>0$ (E) $abc>0$

83. The set of admissible values of x such that $\frac{2x+3}{2x-9}<0$ is

(A) $\left(-\infty,\frac{-3}{2}\right)\cup\left(\frac{9}{2},\infty\right)$ (B) $(-\infty,0)\cup\left(\frac{9}{2},\infty\right)$ (C) $\left(\frac{-3}{2},0\right)$
(D) $\left(0,\frac{9}{2}\right)$ (E) $\left(-\frac{3}{2},\frac{9}{2}\right)$

(Space for Rough Work)

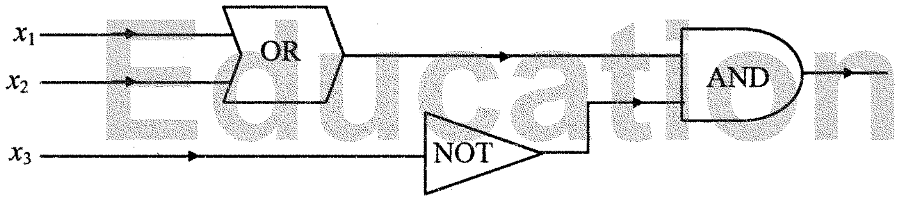
84. Let P be the statement 'Ravi races' and let Q be the statement 'Ravi wins.' Then the verbal translation of $\sim(P \vee (\sim Q))$ is

(A) Ravi does not race and Ravi does not win
(B) It is not true that Ravi races and that Ravi does not win
(C) Ravi does not race or Ravi wins
(D) It is not true that Ravi races or that Ravi does not win
(E) It is not true that Ravi does not race and Ravi does not win

85. Let B be a Boolean algebra. If $a, b \in B$, then $(a + b)'.(a' + b')$ is equal to

(A) $a.b$ (B) $a'.b$ (C) $a.b'$ (D) $a.a'$ (E) $a'.b'$

86. The output of the circuit is



(A) $x_3 \cdot (x_1' + x_2)$ (B) $(x_3' + x_2) \cdot x_1$ (C) $x_3' \cdot (x_1 + x_2)$
(D) $(x_1 + x_2) \cdot x_3$ (E) $(x_1' + x_2') \cdot x_3$

87. If $\sin\theta = \sin 15° + \sin 45°$, where $0° < \theta < 90°$, then θ is equal to

(A) 45° (B) 54° (C) 60°
(D) 72° (E) 75°

(Space for Rough Work)

88. If $(\tan^{-1} x)^2 + (\cot^{-1} x)^2 = 5\frac{\pi^2}{8}$, then x is equal to

(A) 0 (B) $2\sqrt{2}-1$ (C) 1 (D) -1 (E) $2\sqrt{2}$

89. If O is at the origin, OA is along the x-axis and $(-40, 9)$ is point on OB, then the value of $\sin\underline{|AOB}$ is

(A) $\frac{13}{40}$ (B) $\frac{7}{41}$ (C) $\frac{9}{41}$ (D) $\frac{9}{40}$ (E) $\frac{13}{41}$

90. If $x = h + a \sec\theta$ and $y = k + b\,\text{cosec}\,\theta$, then

(A) $\frac{a^2}{(x+h)^2} - \frac{b^2}{(y+k)^2} = 1$ (B) $\frac{a^2}{(x-h)^2} + \frac{b^2}{(y-k)^2} = 1$

(C) $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$ (D) $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$ (E) $x^2 + y^2 = a^2 + b^2$

91. If $5\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right) + 7\sin^{-1}\left(\frac{2x}{1+x^2}\right) - 4\tan^{-1}\left(\frac{2x}{1-x^2}\right) - \tan^{-1} x = 5\pi$, then x is equal to

(A) 3 (B) $\frac{1}{3}$ (C) $\frac{1}{\sqrt{3}}$ (D) 1 (E) $\sqrt{3}$

92. If $\cos\alpha + \cos\beta = 0 = \sin\alpha + \sin\beta$, then $\cos 2\alpha + \cos 2\beta$ is equal to

(A) $-2\sin(\alpha+\beta)$ (B) $2\cos(\alpha+\beta)$ (C) $2\sin(\alpha+\beta)$

(D) $-2\cos(\alpha+\beta)$ (E) $-2\cos(\alpha-\beta)$

(Space for Rough Work)

93. In a triangle with one angle $\frac{2\pi}{3}$, the lengths of the sides form an A.P. If the length of the greatest side is 7 cm, then the radius of the circumcircle of the triangle is

(A) $\frac{7\sqrt{3}}{3}$ cm (B) $\frac{5\sqrt{3}}{3}$ cm (C) $\frac{2\sqrt{3}}{3}$ cm

(D) $7\sqrt{3}$ cm (E) $5\sqrt{3}$ cm

94. The area of the triangle whose sides are 6, 5, $\sqrt{13}$ (in square units) is

(A) $5\sqrt{2}$ (B) 9 (C) $6\sqrt{2}$

(D) 11 (E) 13

95. In a triangle ABC, $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$. If $a = \frac{1}{\sqrt{6}}$, then the area of the triangle (in square units) is

(A) $\frac{1}{24}$ (B) $\frac{1}{8\sqrt{3}}$ (C) $\frac{1}{8}$

(D) $\frac{1}{24\sqrt{3}}$ (E) $\frac{5}{12\sqrt{3}}$

96. In ΔABC, $a = 13$ cm, $b = 12$ cm and $c = 5$ cm. Then the distance of A from BC is

(A) $\frac{25}{13}$ cm (B) $\frac{60}{13}$ cm (C) $\frac{65}{12}$ cm

(D) $\frac{144}{13}$ cm (E) $\frac{65}{13}$ cm

(Space for Rough Work)

97. In any triangle ABC, $c^2 \sin 2B + b^2 \sin 2C$ is equal to

(A) $\frac{\Delta}{2}$ (B) Δ (C) 2Δ (D) 3Δ (E) 4Δ

98. A flagpole stands on a building and an observer on a level ground is 300 feet from the base of the building. The angle of elevation of the bottom of the flagpole is 30° and the height of the flagpole is 50 feet. If θ is the angle of elevation of the top of the flagpole, then $\tan\theta$ is equal to

(A) $\frac{2\sqrt{3}+1}{6}$ (B) $\frac{\sqrt{3}}{2}$ (C) 1 (D) $\frac{6\sqrt{3}+1}{6}$ (E) $\frac{4\sqrt{3}+1}{6}$

99. If $A(0, 0)$, $B(12, 0)$, $C(12, 2)$, $D(6, 7)$ and $E(0, 5)$ are vertices of the pentagon $ABCDE$, then its area in square units, is

(A) 58 (B) 60 (C) 61 (D) 62 (E) 63

100. If the line segment joining the points $P(a, b)$ and $Q(c, d)$ subtends an angle θ at the origin, then the value of $\cos\theta$ is

(A) $\frac{ab+cd}{\sqrt{a^2+b^2}\sqrt{c^2+d^2}}$ (B) $\frac{ac}{\sqrt{a^2+b^2}}+\frac{bd}{\sqrt{c^2+d^2}}$

(C) $\frac{ac+bd}{\sqrt{(a^2+b^2)}\sqrt{(c^2+d^2)}}$ (D) $\frac{ac-bd}{\sqrt{a^2+b^2}\sqrt{c^2+d^2}}$ (E) $\frac{ab-cd}{\sqrt{a^2+b^2}\sqrt{c^2+d^2}}$

(Space for Rough Work)

101. The equation of a line through the point (1, 2) whose distance from the point (3, 1) has the greatest value, is

(A) $y = 2x$ (B) $y = x+1$ (C) $x+2y = 5$
(D) $y = 3x-1$ (E) $y = x+7$

102. If a line with y-intercept 2, is perpendicular to the line $3x-2y=6$, then its x-intercept is

(A) 1 (B) 2 (C) −4
(D) 4 (E) 3

103. If the lines $ax+ky+10=0$, $bx+(k+1)y+10=0$ and $cx+(k+2)y+10=0$ are concurrent, then

(A) a,b,c are in G.P. (B) a,b,c are in H.P. (C) a,b,c are in A.P.
(D) $(a+b)^2=c$ (E) $a+b=c$

104. The lines $(a + 2b)x+(a-3b)y = a-b$ for different values of a and b pass through the fixed point whose coordinates are

(A) $\left(\frac{2}{5},\frac{2}{5}\right)$ (B) $\left(\frac{3}{5},\frac{3}{5}\right)$ (C) $\left(\frac{1}{5},\frac{1}{5}\right)$
(D) $\left(\frac{3}{5},\frac{2}{5}\right)$ (E) $\left(\frac{2}{5},\frac{3}{5}\right)$

105. A line passes through the point of intersection of the lines $100x + 50y - 1 = 0$ and $75x + 25y + 3 = 0$ and makes equal intercepts on the axes. Its equation is

(A) $25x + 25y - 1= 0$ (B) $5x - 5y + 3 = 0$ (C) $25x + 25y - 4 = 0$
(D) $25x - 25y + 6 = 0$ (E) $5x - 5y + 7 = 0$

(Space for Rough Work)

106. The circumcentre of the triangle with vertices (0, 30), (4, 0) and (30, 0) is

(A) (10, 10) (B) (10, 12) (C) (12, 12)
(D) (15, 15) (E) (17, 17)

107. The lines $2x+3y+6=0$ and $3x-2y-18=0$ are tangents respectively at the points $(0,-2)$ and $(6,0)$ on a circle. Then the centre of the circle is

(A) $\left(\frac{36}{13},-28\right)$ (B) $\left(\frac{-72}{13},28\right)$ (C) $\left(\frac{74}{13},\frac{-28}{13}\right)$
(D) $\left(\frac{36}{13},\frac{28}{13}\right)$ (E) $\left(\frac{74}{13},\frac{28}{13}\right)$

108. If (3, –2) is the centre of a circle and $4x+3y+19=0$ is a tangent to the circle, then the equation of the circle is

(A) $x^2+y^2-6x+4y+25=0$ (B) $x^2+y^2-6x+4y+12=0$
(C) $x^2+y^2-6x+4y-12=0$ (D) $x^2+y^2-6x+4y+13=0$
(E) $x^2+y^2-6x+4y+9=0$

109. The circles $x^2+y^2-4x-6y-12=0$ and $x^2+y^2+4x+6y+4=0$

(A) touch externally (B) do not intersect (C) touch internally
(D) intersect at two points (E) are concentric

(Space for Rough Work)

110. A conic section is defined by the equations $x=-1+\sec t$, $y=2+3\tan t$. The coordinates of the foci are

(A) $(-1-\sqrt{10}, 2)$ and $(-1+\sqrt{10}, 2)$

(B) $(-1-\sqrt{8}, 2)$ and $(-1+\sqrt{8}, 2)$

(C) $(-1, 2-\sqrt{8})$ and $(-1, 2+\sqrt{8})$

(D) $(-1, 2-\sqrt{10})$ and $(-1, 2+\sqrt{10})$

(E) $(\sqrt{10}, 0)$ and $(-\sqrt{10}, 0)$

111. If the foci of the ellipse $\frac{x^2}{9}+\frac{y^2}{16}=1$ are $\left(0,\sqrt{7}\right)$ and $\left(0,-\sqrt{7}\right)$, then the foci of the ellipse $\frac{x^2}{9+t^2}+\frac{y^2}{16+t^2}=1,\ t\in R$, are

(A) $\left(0,\sqrt{7}\right),\left(0,-\sqrt{7}\right)$

(B) $\left(0,7\right),\ \left(0,-7\right)$

(C) $\left(0,2\sqrt{7}\right),\left(0,-2\sqrt{7}\right)$

(D) $\left(\sqrt{7},0\right),\left(-\sqrt{7},0\right)$

(E) $\left(\sqrt{7},2\sqrt{7}\right),\left(\sqrt{7},-2\sqrt{7}\right)$

(Space for Rough Work)

112. If the lines joining the foci of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, where $a > b$, and an extremity of its minor axis are inclined at an angle 60°, then the eccentricity of the ellipse is

(A) $\frac{2}{3}$ (B) $\frac{1}{2}$ (C) $\frac{\sqrt{3}}{4}$ (D) $\frac{3}{5}$ (E) $\frac{\sqrt{3}}{7}$

113. Equation of the directrix of the conic $x^2+4y+4=0$ is

(A) $y=1$ (B) $y=-1$ (C) $y=0$ (D) $x=0$ (E) $x=1$

114. If $\vec{a},\vec{b},\vec{c}$ are position vectors of the vertices of the triangle ABC, then $\frac{|(\vec{a}-\vec{c})\times(\vec{b}-\vec{a})|}{(\vec{c}-\vec{a})\cdot(\vec{b}-\vec{a})}$ is equal to

(A) $\cot A$ (B) $\cot C$ (C) $-\tan C$ (D) $\tan C$ (E) $\tan A$

115. The vectors $\vec{a},\vec{b},\vec{c}$ are such that the projection of $\vec{c}$ on $\vec{a}$ is equal to the projection of $\vec{c}$ on $\vec{b}$. If $|\vec{a}|=2$, $|\vec{b}|=1$, $|\vec{c}|=3$ and $\vec{a}\cdot\vec{b}=1$, then $|\vec{a}-2\vec{b}-\vec{c}|$ is equal to

(A) 3 (B) $\sqrt{10}$ (C) $\sqrt{12}$ (D) $\sqrt{13}$ (E) $\sqrt{14}$

116. If the volume of parallelopiped with $\vec{a}\times\vec{b}$, $\vec{b}\times\vec{c}$, $\vec{c}\times\vec{a}$ as co-terminus edges is 9 cu. units, then the volume of the parallelopiped with $(\vec{a}\times\vec{b})\times(\vec{b}\times\vec{c})$, $(\vec{b}\times\vec{c})\times(\vec{c}\times\vec{a})$, $(\vec{c}\times\vec{a})\times(\vec{a}\times\vec{b})$ as co-terminus edges is

(A) 9 (B) 729 (C) 81 (D) 27 (E) 243

(Space for Rough Work)

117. Let $\vec{a} = a_1\vec{i} + a_2\vec{j} + a_3\vec{k}$, $\vec{b} = b_1\vec{i} + b_2\vec{j} + b_3\vec{k}$, $\vec{c} = c_1\vec{i} + c_2\vec{j} + c_3\vec{k}$. If $\vec{c}$ is perpendicular to both $\vec{a}$ and $\vec{b}$, $|\vec{c}| = 1$ and the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{4}$, then $[\vec{a}, \vec{b}, \vec{c}]^2 =$

(A) $|\vec{a}||\vec{b}|$ (B) $|\vec{a}|^2|\vec{b}|^2$ (C) $(\vec{a} \cdot \vec{b})$ (D) $\frac{1}{2}|\vec{a}|^2|\vec{b}|^2$ (E) $|\vec{a}|^2 + |\vec{b}|^2$

118. If $\vec{a} = p\vec{i} - \vec{j} + 8\vec{k}$ and $\vec{b} = 2\vec{i} + 4\vec{j} + q\vec{k}$ and if $(\vec{a} + 3\vec{b}) \times (3\vec{a} - \vec{b}) = \vec{0}$, then $p - q$ is equal to

(A) $\frac{63}{2}$ (B) $\frac{63}{4}$ (C) $-\frac{63}{2}$ (D) $-\frac{63}{4}$ (E) $-\frac{17}{32}$

119. Let x, y and z be distinct non-negative numbers. If the vectors $\vec{i} + \vec{k}$, $x\vec{i} + x\vec{j} + z\vec{k}$, $z\vec{i} + z\vec{j} + y\vec{k}$ lie in a plane, then z is

(A) zero
(B) the harmonic mean of x and y
(C) the geometric mean of x and y
(D) the arithmetic mean of x and y
(E) 1

120. If G is the centroid of the triangle PQR, where $\overrightarrow{GP} = 2\vec{i} + \vec{j} + 3\vec{k}$, $\overrightarrow{GQ} = \vec{i} - \vec{j} + 2\vec{k}$, then the area of the triangle PQR is

(A) $\sqrt{35}$ (B) $\frac{3\sqrt{35}}{2}$ (C) $\frac{\sqrt{35}}{2}$ (D) $\frac{5\sqrt{35}}{2}$ (E) $\frac{\sqrt{17}}{2}$

(Space for Rough Work)