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Test Booklet Series | A

ROLL No.

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TEST BOOKLET No.

29585

**TEST FOR FIRST DEGREE PROGRAMMES IN ENGINEERING AND TECHNOLOGY****MATHEMATICS, PHYSICS AND CHEMISTRY**

Time: 3 Hours

Maximum Marks: 750

**INSTRUCTIONS TO CANDIDATES**

1. You are provided with a Test Booklet and an Optical Mark Reader (OMR) Answer Sheet with a carbonless copy to mark your responses. Do not soil the Answer Sheet. Read carefully all the instructions given on the Answer Sheet.
2. Write your Roll Number in the space provided on the top of this page.
3. Also write your Roll Number in the columns provided for the same on the **Answer Sheet**. Darken the appropriate bubbles with a **Ball Point Pen**. Put your signature in the column provided on the Answer Sheet in the presence of the Invigilator.
4. Darken the appropriate bubble corresponding to the Test Booklet Series, as given on the top of this page, in the Answer Sheet. **If the corresponding bubble is not darkened, such answer sheets will not be valued and will be summarily rejected.**
5. The paper consists of 250 objective type questions. Of this, Question No. 1 to 125 will be Mathematics, 126 to 200 will be Physics and 201 to 250 will be Chemistry. All questions carry equal marks.
6. Each question has four alternative responses marked **A, B, C** and **D** and you have to **darken** the bubble fully by **using a Ball Point Pen** corresponding to the correct response as indicated in the example shown on the Answer Sheet.
7. Each correct answer carries **3** marks and each wrong answer carries **1** minus mark.
8. Space for rough work is provided at the end of this Test Booklet.
9. You should return the Answer Sheet to the Invigilator before you leave the examination hall. However, you can retain the Test Booklet and the carbonless copy of the OMR sheet.
10. Every precaution has been taken to avoid errors in the Test Booklet. In the event of any such unforeseen happenings, the same may be brought to the notice of the Observer/Chief Superintendent in writing. Suitable remedial measures will be taken at the time of evaluation, if necessary.



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## MATHEMATICS

1.  $\left(\sin \frac{\pi}{6} + i \cos \frac{\pi}{6}\right)^6$  is equal to

(A)  $-1$   
(C)  $i$

(B)  $-i$   
(D)  $1$

2. The polar form of  $i^{27}$  is

(A)  $(1, -1)$

(B)  $\left(1, -\frac{\pi}{2}\right)$

(C)  $\left(-1, \frac{\pi}{2}\right)$

(D)  $\left(\sqrt{2}, -\frac{\pi}{4}\right)$

3. If  $\omega$  is an  $n^{\text{th}}$  root of unity and  $n$  is even, then

(A)  $1 + \omega^2 + \omega^4 + \dots + \omega^{n-2} = \omega + \omega^3 + \omega^5 + \dots + \omega^{n-1}$

(B)  $\omega^n = 0$

(C)  $\omega^{n/2} = 0$

(D)  $\omega^{n/2} = -1$

4. The equation  $\begin{vmatrix} 2x & 0 & 0 \\ x+2 & x+1 & 0 \\ x+3 & x+4 & x^2+1 \end{vmatrix} = 0$  has solutions

(A)  $x = -1, -2, -3$

(B)  $x = 0, -1, \pm i$

(C)  $x = -2, -3, -4$

(D)  $x = 0, 0, 0$

5. If  $z = \frac{1+2i}{2-i} - \frac{2-i}{1+2i}$ , then  $z^2 + z\bar{z} =$
- (A)  $z$  (B)  $-1$   
(C)  $0$  (D)  $-8$
6. The modulus of  $\left[ e^{\left(2-i\frac{3\pi}{2}\right)} \right]^5$  is
- (A)  $e^{-1}$  (B)  $e^{-7}$   
(C)  $e^{-14}$  (D)  $e^{10}$
7. If  $\theta$  is the angle between the vectors  $\vec{a}$  and  $\vec{b}$ ,  $|\vec{a} \times \vec{b}| = \sqrt{10}$  and  $\vec{a} \cdot \vec{b} = \sqrt{30}$ , then  $\cos \theta =$
- (A)  $\frac{1}{\sqrt{3}}$  (B)  $1$   
(C)  $\frac{1}{2}$  (D)  $\frac{\sqrt{3}}{2}$
8.  $y = \frac{\log x}{x^3}$  is an increasing function of  $x$ , only if
- (A)  $x < e$  (B)  $x < e^{\frac{1}{3}}$   
(C)  $0 < x < e^{\frac{1}{3}}$  (D)  $0 < x < e^3$
9. If  $\alpha$  and  $\beta$  are the roots of the equation  $x^2 - 2x + 4 = 0$ , then  $\alpha^6 - \beta^6 =$
- (A)  $64$  (B)  $128$   
(C)  $-128$  (D)  $0$



10. The product of the four roots of  $z^4 - i = 0$  is
- (A) 1 (B)  $-1$   
(C)  $-i$  (D)  $i$
11. Using differentials, an approximate value of  $627^{\frac{1}{4}}$  is
- (A) 5.002 (B) 5.003  
(C) 5.005 (D) 5.004
12.  $\lim_{x \rightarrow 0} (\cos x)^{\cot x} =$
- (A) 1 (B) 0  
(C)  $\frac{1}{e}$  (D)  $\frac{1}{e^2}$
13. The curve  $f(x) = x^3 - 6x^2 + 9x - 8$  is concave upward when
- (A)  $x \in (2, \infty)$  (B)  $x \in (-\infty, 2)$   
(C)  $x \in (0, \infty)$  (D)  $x \in (-\infty, 0)$
14. If  $a, b, c$  are all different and nonzero and if  $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = 0$ ,
- then the value of  $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$  is
- (A) 0 (B)  $-1$   
(C)  $\frac{1}{abc}$  (D) 1



15. If  $f(x) = \frac{1}{1+x}$ , then  $f^{(n)}(0) =$
- (A)  $(-1)^n n!$  (B)  $\frac{(-1)^n}{n!}$   
(C)  $\frac{1}{n!}$  (D)  $\frac{1}{n}$
16. If  $u(x, y) = x^y + y^x$ , then  $u_x(e, 1)$  is
- (A)  $e$  (B)  $1$   
(C)  $e+1$  (D)  $2e$
17.  $\lim_{x \rightarrow 5} \frac{x^k - 5^k}{x - 5} = 500$ , then the positive value of  $k$  is
- (A)  $3$  (B)  $4$   
(C)  $5$  (D)  $6$
18. If  $A = \begin{bmatrix} 3 & -1 \\ -4 & 5 \end{bmatrix}$ , then the value of  $|AA^T|$  is
- (A)  $3^2$  (B)  $4^2$   
(C)  $5^2$  (D)  $11^2$
19. If  $(G, *)$  is a group,  $a, b \in G$ , then  $(b^{-1} * a * b)^3 =$
- (A)  $(b^{-1})^3 * a^3 * b^3$  (B)  $b^{-1} * a^3 * b$   
(C)  $b^{-1} * a * b^3$  (D)  $(b^{-1})^3 * a * b^3$



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Series A

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20. If  $3-i$  is a solution of  $x^2 - 6x + k = 0$ , then  $k =$

- (A) 5 (B)  $\sqrt{5}$   
(C)  $\sqrt{10}$  (D) 10

21. For the curve  $x = e^t \cos t$ ,  $y = e^t \sin t$ , the tangent line at  $t$  is parallel to the  $x$ -axis when  $t$  is equal to

- (A)  $-\frac{\pi}{4}$  (B)  $\frac{\pi}{4}$   
(C)  $\frac{\pi}{2}$  (D) 0

22. If  $u = \log(e^x + e^y)$ , then  $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} =$

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

23. The number of points of inflection of the curve  $y = x^{\frac{1}{3}}$  is

- (A) 0 (B) 1  
(C) 2 (D) 3

24. If  $(x+iy)^{\frac{1}{3}} = a+ib$ , then  $\frac{x}{a} + \frac{y}{b}$  is equal to

- (A)  $4(a^2 - b^2)$  (B)  $4ab$   
(C)  $4(a^2 + b^2)$  (D)  $5ab$



25. If  $\sin x$  is an integrating factor of the differential equation  $\frac{dy}{dx} + Py = Q$ , then  $P$  can be
- (A)  $\log \sin x$  (B)  $\cot x$   
(C)  $\sin x$  (D)  $\log \cos x$
26. The interval in which the function  $(x-3)^2$  is strictly increasing, is
- (A)  $(-\infty, 3)$  (B)  $(-3, \infty)$   
(C)  $(3, \infty)$  (D)  $(-\infty, \infty)$
27. Which of the following is a root of the equation  $\begin{vmatrix} x & a & a \\ a & x & a \\ a & a & x \end{vmatrix} = 0$ ?
- (A)  $-a$  (B)  $2a$   
(C)  $-2a$  (D)  $3a$
28. A train 280m long, running with a speed of 63 km/hour will pass a pillar in
- (A) 15 sec (B) 16 sec  
(C) 18 sec (D) 20 sec
29. The ratio of the areas of the incircle and the circumcircle of a square is
- (A)  $\frac{1}{2}$  (B)  $\frac{1}{3}$   
(C)  $\frac{1}{4}$  (D) 1





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Series A

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30. If every element in a group is self-inverse, then the group is
- (A) cyclic (B) non-abelian  
(C) cyclic and abelian (D) abelian
31. The angle between the asymptotes of the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ , with the eccentricity  $e$ , is
- (A)  $\tan^{-1}\left(\frac{b}{a}\right)$  (B)  $2 \tan^{-1}\left(\frac{a}{b}\right)$   
(C)  $2 \sec^{-1}(e)$  (D)  $2 \sec^{-1}\left(\frac{1}{e}\right)$
32. The integrating factor of  $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x$  is
- (A)  $\operatorname{cosec} x$  (B)  $\cot x$   
(C)  $\cos x$  (D)  $\sin x$
33. The conjugate of  $i^{13} + i^{14} + i^{15} + i^{16}$  is
- (A) 1 (B) -1  
(C) 0 (D) -i
34. The line  $lx - 2y + 3 = 0$  is a tangent to the parabola  $4y^2 = x$  if  $l =$
- (A) 12 (B)  $\frac{1}{12}$   
(C)  $\pm \frac{1}{3}$  (D) 3
35. If  $x + y = 22$  and  $x^2 + y^2 = 404$ , then  $xy =$
- (A) 40 (B) 44  
(C) 80 (D) 88



36. If the remainder and the quotient when 4150 divided by  $x$  are 25 and 55, then  $x =$
- (A) 65 (B) 70  
(C) 75 (D) 80
37. The largest number from  $\sqrt{2}$ ,  $\sqrt[3]{3}$  and  $\sqrt[4]{4}$  is
- (A)  $\sqrt{2}$  (B)  $\sqrt[4]{4}$   
(C)  $\sqrt[3]{3}$  (D)  $\sqrt{2} = \sqrt[3]{3} = \sqrt[4]{4}$
38. In the group  $G = \{4, 8, 12, 16\}$  under multiplication modulo 20, the identity element is
- (A) 4 (B) 8  
(C) 12 (D) 16
39. The set  $G = \left\{ \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix} \mid a, b \in R \right\}$  under matrix multiplication forms
- (A) an abelian group (B) non-abelian group  
(C) monoid but not a group (D) None of the above
40. If  $(1+2+3+\dots+n)^x = (1^3+2^3+\dots+n^3)^2$ , then  $x =$
- (A) 1 (B) 3  
(C) 4 (D) 2