

Model Examination – Mathematics

HSE – I

Max.marks : 80

Time : 2½hr

1. Consider  $U = \{x : x \in \mathbb{N}, x \leq 10\}$  be the universal set,  $A = \{x : x \text{ is an odd integer}\}$  and  $B = \{x : x \text{ is an even integer}\}$ 
  - (a) Write A and B in Roster form.
  - (b) Verify that  $(A \cap B)' = A' \cup B'$
  - (c) Write  $(A - B)'$  (1+2+2)
  
2. (a) Let  $A = \{1,2\}$ ,  $B = \{a,b,c\}$  be two sets. Write the universal relation from A to B  
 (b) Define the signum function and draw the graph  
 (c) Write the domain and range of the signum function (1+3+1)
  
3. (a) If  $\sin x = \cos x$ , then find x  
 (b) Find the value of  $\sin x - \sin y$   
 (c) Prove that  $\frac{\sin x - \sin 3x}{\sin^2 x - \cos^2 x} = 2 \sin x$  (1+1+2)
  
4. (a) Prove that  $\frac{\tan(\frac{\pi}{4} + x)}{\tan(\frac{\pi}{4} - x)} = \left(\frac{1 + \tan x}{1 - \tan x}\right)^2$   
 (b) If  $A = 45^\circ$ , Verify that  $\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$  (3+2)
  
5. Consider the statement  $P(n) = 2^{3n} - 1$  is divisible by 7  
 (a) Is the statement  $P(1)$  true? Justify your answer  
 (b) Assuming  $P(k)$  is true, show that  $P(k+1)$  is true (1+3)
  
6. If  $Z = 3 - 2i$ , then  
 (a) Find  $\bar{z}$   
 (b) Find the multiplicative inverse of Z (1+2)
  
7. (a) Express  $\frac{1+3i}{1-2i}$  in a+ib form  
 (b) Find polar form of this complex number (2+2)
  
8. (a) Solve  $1 \leq \frac{3x-5}{2} \leq 6$   
 (b) Solve the following inequalities graphically  
 $X \geq 0, y \geq 0, 5x + y \leq 5, x + 3y \geq 5$  (2+3)
  
9. (a) If  $\frac{1}{6!} + \frac{1}{7!} = \frac{x}{8!}$ , find the value of x  
 (b) Find the number of arrangements of 6 boys and 5 girls in a row so that boys and girls occupy alternate positions  
 (c) Find n if  ${}^2n C_3 : n C_3 = 11 : 1$  (2+2+3)
  
10. Consider binomial expansion of  $\left(x + \frac{1}{x}\right)^8$   
 (a) Find the number of terms.  
 (b) Write the general term  
 (c) Find the term independent of x (1+2+2)

11. Consider  $1.2.3 + 2.3.4 + 3.4.5 + \dots$

(a) Find the n-th term

(b) Find the sum to n-terms (1+3)

12 (a) Reduce  $\sqrt{3}x + y - 8 = 0$  into normal form. Find the angle made by the perpendicular from the origin to the line and the length of the perpendicular.

(b) Find the slope of this line. (3+1)

13.(a) Find the focus, equation of directrix and length of latus rectum of the parabola  $x^2 + 16y = 0$

(b) Determine foci and eccentricity of the ellipse  $16x^2 + 9y^2 = 144$

(c) Find centre and radius of the circle  $x^2 + y^2 + 8x + 10y - 8 = 0$  (2+2+2)

14. If the centroid of a triangle with vertices  $(x,3,4), (2,y,-1)$  and  $(-1,0,z)$  is  $(3,4,5)$ , find  $x, y$  and  $z$  (2)

15.(a) Evaluate  $\lim_{x \rightarrow 0} \frac{(x+1)^5 - 1}{x}$  (2)

16(a) Find the derivative of  $\sin x$  using first principle

Or

(4)

(b) Find the derivative of  $x^2 + 1$  using first principle

17. Prove by contrapositive method :  $\sqrt{3}$  is an irrational number (2)

18. The table gives scores of 50 students of a class in their Mathematics Examination

Scores in the exam	30-40	40-50	50-60	60-70	70-80
Number of students	5	9	17	13	6

(a) Find the mean of scores

(b) Find the standard deviation of scores (2+2)

19. Consider a random experiment of throwing a die. Let A be an event of getting an odd number and B be an event of getting an even number

(a) Write A and B

(b) Find  $P(A \cup B)$

(c) Find  $P(\text{not A and not B})$  (1+2+2)

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