

Roll No. 754990 to be filled in by the candidate.

(For all sessions)

Paper Code	8	1	9	1
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# Mathematics (Objective Type)

RWP-21

Time: 30 Minutes

Marks:20

NOTE: Write answers to the questions on objective answer sheet provided. Four possible answers A,B,C & D to each question are given. Which answer you consider correct, fill the corresponding circle A,B,C or D given in front of each question with Marker or pen ink on the answer sheet provided.

1-1. If  $g(x) = \frac{1}{x^2}, x \neq 0$  then  $g \circ g(x)$  equals.

- (A)  $x$  (B)  $x^2$  (C)  $x^4$  (D)  $x^3$

2.  $\lim_{\theta \rightarrow 0} \frac{1 - \cos \theta}{\theta}$  equals.

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

3. The derivative of  $\sqrt{x}$  at  $x = 1$  is:

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

4.  $\frac{d}{dx} \left[ \frac{1}{g(x)} \right]$  equals.

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

5. If  $y = 5e^x$  then  $y_3$  equals.

- (A)  $25e^x$  (B)  $75e^x$  (C)  $15e^x$  (D)  $5e^x$

6. If  $f(x+h) = \cos(x+h)$  then  $f'(x)$  equals.

- (A)  $\cos x$  (B)  $-\cos x$  (C)  $-\sin x$  (D)  $\sin x$

7. Inverse of  $\int \dots dx$  is:

- (A)  $\frac{d}{dy}$  (B)  $\frac{d}{dx}$  (C)  $\frac{dy}{dx}$  (D)  $\frac{dx}{dy}$

8.  $\int_a^b f(x) dx$  equals:

- (A)  $-\int_b^a f(x) dx$  (B)  $\int_{-b}^a f(x) dx$  (C)  $\int_b^{-a} f(x) dx$  (D)  $\int_a^{-b} f(x) dx$

9. The general solution of  $\frac{dy}{dx} = \frac{-y}{x}$  is:

- (A)  $xy = c$  (B)  $x^2 y^2 = c$  (C)  $\frac{x}{y} = c$  (D)  $\frac{y}{x} = c$

10.  $\int e^{-x} (\cos x - \sin x) dx$  equals:  
 (A)  $-e^{-x} \sin x + c$  (B)  $e^{-x} \cos x + c$  (C)  $e^{-x} + c$  (D)  $e^{-x} \sin x + c$
11. The distance of point (3,7) from x-axis is:  
 (A) 3 (B) 7 (C) -3 (D) -7
12. Slope of Y-axis is:  
 (A) zero (B) 1 (C) 2 (D) undefined
13. Equation of horizontal line through (7,-9) is:  
 (A)  $y = -9$  (B)  $y = 7$  (C)  $x = -9$  (D)  $x = 7$
14. (0,2) is solution of inequality.  
 (A)  $3x + 5y > 7$  (B)  $3x + 5y < 7$  (C)  $x < 0$  (D)  $x > 0$
15. Centre of circle  $x^2 + y^2 + 2gx + 2fy + c = 0$  is:  
 (A)  $(g, f)$  (B)  $(-g, -f)$  (C)  $(0, 0)$  (D)  $(-g, -f)$
16. Equation of Latus rectum of parabola  $x^2 = 4ay$  is:  
 (A)  $y = -a$  (B)  $y = a$  (C)  $x = -a$  (D)  $x = a$
17. Vertices of  $\frac{x^2}{16} - \frac{y^2}{25} = 1$  are:  
 (A)  $(0, \pm 4)$  (B)  $(0, \pm 5)$  (C)  $(\pm 4, 0)$  (D)  $(\pm 5, 0)$
18. The non zero vectors  $\underline{a}$  and  $\underline{b}$  are parallel if  $\underline{a} \times \underline{b}$  is:  
 (A) zero (B) 1 (C) 2 (D) 3
19.  $\cos \theta$  equals:  
 (A)  $\underline{a} \cdot \underline{b}$  (B)  $\underline{a} \times \underline{b}$  (C)  $|\underline{a} \times \underline{b}|$  (D)  $\hat{a} \cdot \hat{b}$
20. If any two vectors of scalar triple product are equal then its value is:  
 (A) -1 (B) zero (C) 1 (D) 2

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**Mathematics** (Essay Type)

Time: 2:30 Hours

**RWP-21**  
Section -I

Marks: 80

2. Write short answers of any eight parts from the following.

2x8=16

- i. If  $f(x) = x^2 - x$ , find (a).  $f(-2)$  (b).  $f(x-1)$
- ii. Find  $\lim_{x \rightarrow 2} \frac{x^3 - 8}{x^2 + x - 6}$ .
- iii. Find  $\lim_{\theta \rightarrow 0} \frac{1 - \cos \theta}{\sin \theta}$ .
- iv. Differentiate w.r.t "x".  $\left(\sqrt{x} - \frac{1}{\sqrt{x}}\right)^2$ .
- v. Find  $\frac{dy}{dx}$  if  $3x + 4y + 7 = 0$ .
- vi. Differentiate w.r.t "x"  $\cos \sqrt{x} + \sqrt{\sin x}$ .
- vii. Differentiate w.r.t "x"  $\cot^{-1}\left(\frac{x}{a}\right)$ .
- viii. If  $y = \log_{10}(ax^2 + bx + c)$ , then find  $\frac{dy}{dx}$ .
- ix. If  $y = x^2 \cdot e^{-x}$ , then find  $\frac{d^2y}{dx^2}$ .
- x. Apply Maclaurin series, Prove that  $\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$
- xi. If  $f(x) = \sqrt{x+1}$  and  $g(x) = \frac{1}{x^2}$ , then find (a).  $(f \circ g)(x)$  (b).  $(g \circ f)(x)$ .
- xii. Find the intervals in which  $f(x)$  is increasing or decreasing  $f(x) = \cos x$ ,  $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ .

3. Write short answers of any eight parts from the following.

2x8=16

- i. Using differential find  $\frac{dy}{dx}$ , if  $x^2 + 2y^2 = 16$ .
- ii. Evaluate  $\int x\sqrt{x^2-1} dx$ .
- iii. Evaluate  $\int \frac{(1-\sqrt{x})^2}{\sqrt{x}} dx$ .
- iv. Evaluate  $\int \sin^2 x dx$ .
- v. Evaluate  $\int \frac{ax+b}{ax^2+2bx+c} dx$ .
- vi. Evaluate  $\int e^{3x} \left( \frac{3 \sin x - \cos x}{\sin^2 x} \right) dx$ .
- vii. Solve  $\frac{dy}{dx} = \frac{y^2+1}{e^{-x}}$ .
- viii. Find an equation of the vertical line through (-5,3).
- ix. Find an equation of the line through (-5,-3), (9,-1)
- x. Convert  $4x + 7y - 2 = 0$  in normal form.
- xi. Find the area below the curve  $y = 3\sqrt{x}$  and above the x-axis between  $x = 1$  and  $x = 4$ .
- xii. Find the mid point of the line segment joining the points A(3,1), B(-2,-4).

4. Write short answers of any nine parts from the following.

2x9=18

- i. Graph the solution set by shading of inequality  $5x - 4y \leq 20$ .
- ii. Find equation of circle with centre at  $(\sqrt{2}, -3\sqrt{3})$  and radius  $2\sqrt{2}$ .
- iii. Write equation of tangent to the circle  $3x^2 + 3y^2 + 5x - 13y + 2 = 0$  at  $\left(1, \frac{10}{3}\right)$ .

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- iv. Find vertex of  $x^2 - 4x - 8y + 4 = 0$ .
- v. Find point of intersection of conics  $3x^2 - 4y^2 = 12$  and  $3y^2 - 2x^2 = 7$ .
- vi. Find equation of parabola whose focus is  $F(-3,4)$  and directrix is  $3x - 4y + 5 = 0$ .
- vii. Find the unit vector in the same direction of vector  $\underline{V} = [3, -4]$ .
- viii. If  $\overline{AB} = \overline{CD}$  find the co-ordinate of the point A when points B,C,D are (1,2)(-2,5) and (4,11) respectively
- ix. Find  $|\underline{3v} + \underline{w}|$  if  $\underline{u} = \underline{i} + 2\underline{j} - \underline{k}$ ,  $\underline{v} = 3\underline{i} - 2\underline{j} + 2\underline{k}$ ,  $\underline{w} = 5\underline{i} - \underline{j} + 3\underline{k}$ .
- x. Find a vector of length 5 in the direction opposite that of  $\underline{v} = \underline{i} - 2\underline{j} + 3\underline{k}$ .
- xi. Compute  $\underline{b} \times \underline{a}$  if  $\underline{b} = \underline{i} - \underline{j} + \underline{k}$ ,  $\underline{a} = 2\underline{i} + \underline{j} - \underline{k}$ .
- xii. Find the work done if the point at which the constant force  $\overline{F} = 4\underline{i} + 3\underline{j} + 5\underline{k}$  is applied to an object, moves from  $p_1(3,1,-2)$  to  $p_2(2,4,6)$ .
- xiii. If  $\underline{a} + \underline{b} + \underline{c} = 0$  then prove that  $\underline{a} \times \underline{b} = \underline{b} \times \underline{c} = \underline{c} \times \underline{a}$ .

Section -II

Note: Attempt any three questions from the following.

10x3=30

5. (a) If  $f(x) = \begin{cases} 3x-1 & \text{if } x < 1 \\ 4 & \text{if } x = 1 \\ 2x & \text{if } x > 1 \end{cases}$ , then show  $f(x)$  is continuous at  $x = 1$ .

(b) If  $x = \frac{a(1-t^2)}{1+t^2}$ ,  $y = \frac{2bt}{1+t^2}$ , then find  $\frac{dy}{dx}$ .

6. (a) Find the approximate increase in the volume of a cube if the length of its each edge changes from 5 to 5.02.
- (b) Determine the value of P such that the lines  $2x - 3y - 1 = 0$ ,  $3x - y - 5 = 0$  and  $3x + py + 8 = 0$  meet at a point.

7. (a) Evaluate  $\int_2^3 \left(x - \frac{1}{x}\right)^2 dx$ .

(b) Minimize  $z = 2x + y$  subject to the constraints  $x + y \geq 3$ ,  $7x + 5y \leq 35$ ,  $x \geq 0$ ,  $y \geq 0$ .

8. (a) Write equations of two tangents from (2,3) to the circle  $x^2 + y^2 = 9$ .

(b) Prove by vector method  $\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$ .

9. (a) Show that  $\cos(x+h) = \cos x - h \sin x - \frac{h^2}{2!} \cos x + \frac{h^3}{3!} \sin x + \dots$

(b) Show that an equation of the parabola with focus at  $(a \cos \alpha, a \sin \alpha)$  and

directrix  $x \cos \alpha + y \sin \alpha + a = 0$  is  $(x \sin \alpha - y \cos \alpha)^2 = 4a(x \cos \alpha + y \sin \alpha)$ .

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