Meghalaya Board of School Education

SAMPLE PAPERS

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MATHEMATICS

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

General Instructions :

(i) All questions are compulsory.

(ii) This question paper contains 36 questions divided into four Sections—A, B, C and D. Section—A comprises of 20 questions of *1* mark each, Section—B comprises of 6 questions of *2* marks each, Section—C comprises of 6 questions of *4* marks each and Section—D comprises of 4 questions of *6* marks each.

(iii) There is no overall choice. However, internal choice has been provided in 9 questions of Section—A, 5 questions of Section—B, 5 questions of Section—C and 3 questions of Section—D. You have to attempt only one of the alternatives in all such questions.

(iv) Use of calculator is not permitted.

SECTION—A

1. Define an equivalence relation. 1

Or

A relation R in the set N of natural numbers is defined as $R \quad \{(x, y) : y \quad x \quad 5 \text{ and } x \quad 4\}$. Find the range of R. 1

2. Find the principal value of $\cos^{1}\ \frac{1}{2}$. 1

Or

Evaluate : 1

$$\cos^{1}\ \frac{1}{2}\quad 2\sin^{1}\ \frac{1}{2}$$

3. Find the value of x, if

$$\begin{vmatrix} 2 & 3 \\ 4 & 5 \end{vmatrix}\quad \begin{vmatrix} x & 3 \\ 2x & 5 \end{vmatrix}$$ 1

Or

If $A\ \begin{matrix} 0 & 1 \\ 0 & 2 \end{matrix}$ and $B\ \begin{matrix} 3 & 5 \\ 0 & 0 \end{matrix}$, find AB and BA. 1

4. What is an objective function of a linear programming problem? 1

5. Evaluate : 1

$$\int_{0}^{/2} \cos 2x\, dx$$

Or

Evaluate : 1

$$\int_{0}^{1} \frac{dx}{1\quad x^{2}}$$

6. Differentiate : 1

$$2\sqrt{\cot x}$$

Or

Find $\frac{dy}{dx}$, if y $\sec(\tan x)$. 1

7. Write the order and degree of the differential equation

$$\frac{ds}{dt}^{4} \quad 3s\frac{d^2s}{dt^2} \quad 0$$ 1

8. Prove that y Ax is a solution of the differential equation

$$xy \quad y, \quad (x \quad 0)$$

and A is a constant. 1

9. Show that the function $f : R$ R given by $f(x)$ x^3 is injective, where R is the set of real numbers. 1

Or

Show that the modulus function $f : R$ R given by $f(x)$ $|x|$ is not one-one, where R is the set of real numbers. 1

10. Find $\frac{dy}{dx}$, if y $\log(\cos e^x)$. 1

Or

If $2x$ $3y$ $\sin x$, find $\frac{dy}{dx}$. 1

11. If $P(A) \quad \frac{6}{11}$, $P(B) \quad \frac{5}{11}$ and $P(A \quad B) \quad \frac{7}{11}$, find $P(A \quad B)$. 1

12. Let E and F be events with $P(E) \quad \frac{3}{5}$, $P(F) \quad \frac{3}{10}$ and $P(E \quad F) \quad \frac{1}{5}$. Are E and F independent? 1

13. Evaluate : 1

$$x^2 \ 1 \ \frac{1}{x^2} \ dx$$

Or

Evaluate : 1

$$\tan^2 x \, dx$$

14. Compute the magnitude of the following vector : 1

$$\vec{a} \quad \frac{1}{\sqrt{3}}\hat{i} \quad \frac{1}{\sqrt{3}}\hat{j} \quad \frac{1}{\sqrt{3}}\hat{k}$$

15. Evaluate : 1

$$\int_{/2}^{/2} \sin^7 x \, dx$$

16. Prove that the function

$$f(x) \quad x^3 \quad 3x^2 \quad 3x \quad 100$$

is increasing in R, where R is the set of real numbers. 1

Choose the correct answer :

17. If $\sin^{1} x \quad y$, then

(a) $0 \quad y$

(b) $\frac{}{2} \quad y \quad \frac{}{2}$

(c) $0 \quad y$

(d) $\frac{}{2} \quad y \quad \frac{}{2}$ 1

18. If $A \begin{matrix} \cos & \sin \\ \sin & \cos \end{matrix}$, then $A \quad A \quad I$, if the value of is

(a) $\frac{}{6}$

(b) $\frac{}{3}$

(c)

(d) $\frac{3}{2}$ 1

19. The anti-derivative of $\sqrt{x} \quad \frac{1}{\sqrt{x}}$ is equal to

(a) $\frac{1}{3}x^{\frac{1}{3}} \quad 2x^{\frac{1}{2}} \quad c$

(b) $\frac{2}{3}x^{\frac{2}{3}} \quad \frac{1}{2}x^{2} \quad c$

(c) $\frac{2}{3}x^{\frac{3}{2}} \quad 2x^{\frac{1}{2}} \quad c$

(d) $\frac{3}{2}x^{\frac{3}{2}} \quad \frac{1}{2}x^{\frac{1}{2}} \quad c$ 1

Or

The rate of change of the area of a circle with respect to its radius r at r 6 cm is

(a) 10

(b) 12

(c) 8

(d) 11 1

20. The value of $\hat{i} \quad (\hat{j} \quad \hat{k}) \quad \hat{j} \quad (\hat{i} \quad \hat{k}) \quad \hat{k} \quad (\hat{i} \quad \hat{j})$ is

(a) 0

(b) 1

(c) 1

(d) 3 1

SECTION—B

21. Find x and y, if

$$2\begin{bmatrix} 1 & 3 \\ 0 & x \end{bmatrix} \quad \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} \quad \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix} \qquad 2$$

Or

If $A \quad \begin{bmatrix} 1 & 2 \\ 4 & 2 \end{bmatrix}$, show that $|2A| \quad 4|A|$. 2

22. Find the value of k, if the function defined by

$$f(x) \quad \begin{matrix} kx^2 & \text{, if } x \quad 2 \\ 3 & \text{, if } x \quad 2 \end{matrix}$$

is continuous at $x \quad 2$. 2

Or

Show that $f(x) \quad 5x \quad 3$ is continuous at $x \quad 5$. 2

23. Evaluate : 2

$$x\,e^x\,dx$$

Or

Evaluate : 2

$$e^x \quad \frac{1}{x} \quad \frac{1}{x^2}\,dx$$

24. If $y \quad 500e^{7x} \quad 600e^{\ 7x}$, show that

$$\frac{d^2y}{dx^2} \quad 49y$$ 2

25. Find $|\vec{a} \quad \vec{b}|$, if $\vec{a} \quad 2\hat{i} \quad \hat{j} \quad 3\hat{k}$ and $\vec{b} \quad 3\hat{i} \quad 5\hat{j} \quad 2\hat{k}$. 2

Or

Show that the points $A(2, 3, 4)$, $B(\ 1, \quad 2, 1)$ and $C(5, 8, 7)$ are collinear. 2



26. Find $\frac{dy}{dx}$, if

$$y \quad \cos^{\ 1} \frac{1 \quad x^2}{1 \quad x^2}, \quad 0 \quad x \quad 1$$ 2

Or

Evaluate : 2

$$\frac{x^2}{1 \quad x^6}\, dx$$

SECTION—C

27. Show that the function $f : R \quad R$ defined by $f(x) \quad 3 \quad 4x$ is one-one and onto, where R is the set of real numbers. 4

Or

Show that the relation R in the set $A \quad \{1, 2, 3, 4, 5\}$ given by $R \quad \{(a, b) : |a \quad b| \text{ is even}\}$ is an equivalence relation. 4

28. Find the intervals in which the function f given by

$$f(x) \quad 4x^3 \quad 6x^2 \quad 72x \quad 30$$

is *(a)* strictly increasing and *(b)* strictly decreasing. 4

Or

Sand is pouring from a pipe at the rate of 12 cm^3 / s. The falling sand forms a cone on the ground in such a way that the height of the cone is always one-sixth of the radius of the base. How fast is the height of the sand cone increasing when the height is 4 cm? 4

29. Using the properties of definite integrals, evaluate

$$\int_0^{/4} \log(1 \quad \tan x)\, dx$$ 4

Or

Using partial fraction, evaluate

$$\frac{1}{x^4 \quad 1}\, dx$$ 4

30. Solve the following homogeneous differential equation : 4

$$xdy \quad ydx \quad \sqrt{x^2 \quad y^2}\, dx$$

Or

Solve the following linear differential equation :

$$(1 \quad x^2)\frac{dy}{dx} \quad 2xy \quad \frac{1}{1 \quad x^2}$$

given $y \quad 0$, when $x \quad 1$. 4

31. If a unit vector $\vec{a}$ makes angle $\frac{}{3}$ with $\hat{i}$, $\frac{}{4}$ with $\hat{j}$ and an acute angle with $\hat{k}$, then find and hence the components of $\vec{a}$. 4

Or

If $\vec{a}$, $\vec{b}$, $\vec{c}$ are unit vectors and $\vec{a} \quad \vec{b} \quad \vec{c} \quad \vec{0}$, find the value of $\vec{a} \quad \vec{b} \quad \vec{b} \quad \vec{c} \quad \vec{c} \quad \vec{a}$. 4

32. Solve the following linear programming problem graphically : 4

Maximize $Z \quad 4x \quad y$

subject to the constraints

$$x \quad y \quad 50$$
$$3x \quad y \quad 90$$
$$x \quad 0, y \quad 0$$

SECTION—D

33. Verify $A(\text{adj } A) \quad (\text{adj } A)A \quad |A|I$ for the matrix

$$A \quad \begin{matrix} 1 & 1 & 2 \\ 3 & 0 & 2 \\ 1 & 0 & 3 \end{matrix} \qquad 6$$

Or

Solve the following system of linear equations using matrix method : 6

$$\begin{matrix} x & y & 2z & 7 \\ 3x & 4y & 5z & 5 \\ 2x & y & 3z & 12 \end{matrix}$$

34. Prove that the volume of the largest cone that can be inscribed in a sphere of radius R is $\frac{8}{27}$ of the volume of the sphere. 6

Or

Using definite integral, find the area of the region bounded by the ellipse

$$\frac{x^2}{16} \quad \frac{y^2}{9} \quad 1 \qquad 6$$

35. Find the shortest distance between the lines whose vector equations are

$$\vec{r} \quad (\hat{i} \quad 2\hat{j} \quad 3\hat{k}) \quad (\hat{i} \quad 3\hat{j} \quad 2\hat{k})$$

and

$$\vec{r} \quad (4\hat{i} \quad 5\hat{j} \quad 6\hat{k}) \quad (2\hat{i} \quad 3\hat{j} \quad \hat{k}) \qquad 6$$

36. A manufacturer has three machine operators *A*, *B* and *C*. The first operator *A* produces 1% defective items whereas the other two operators *B* and *C* produce 5% and 7% defective items respectively. *A* is on the job for 50% of the time, *B* is on the job for 30% of the time and *C* is on the job for 20% of the time. A defective item is produced. What is the probability that it was produced by *A*? 6

Or

Let *X* denote the number of hours you study during a randomly selected school day. The probability that *X* can take the values *x* has the following form, where *k* is a constant :

$$P(X \quad x) \begin{cases} 0\ 1 & , \text{ if } x \quad 0 \\ kx & , \text{ if } x \quad 1 \text{ or } 2 \\ k(5 \quad x) & , \text{ if } x \quad 3 \text{ or } 4 \\ 0 & , \text{ otherwise} \end{cases}$$

Find the value of *k*. What is the probability that you study at least 2 hours, exactly 2 hours and at most 2 hours? 6

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