

PHYSICS

Very Short Answer Question (1 Mark each)

1. Draw schematically an equipotential surface of a uniform electrostatic field along x-axis.
2. Sketch field lines due to (a) two equal positive charges near each other (b) an electric dipole
3. Name the physical quantity whose SI unit is volt/meter. Is it a scalar or a vector quantity?

Short Answer Questions (2 marks each)

1. An oil drop of mass m carrying charge $-Q$ is to be held stationary in the gravitational field of the earth. What is the magnitude and direction of the electrostatic field required for this purpose?
2. Find the electric flux originating from a point charge of $q = 8.854 \mu\text{C}$.
3. If q is the positive charge on each molecule of water, what is the total positive charge in a Mug of water (360 g).

Short Answer Questions (3 marks each)

1. Using Gauss's theorem in electrostatics, deduce an expression for electric field intensity due to a charged spherical shell at a point (i) inside (ii) on its surface (iii) outside it. Graphically show the variation of electric field intensity with distance from the centre of shell.
2. Define electric flux. Write its SI unit. An electric flux of ϕ units passes normally through a spherical Gaussian surface of radius r , due to point charge placed at the centre.
 - (a) What is the charge enclosed by Gaussian surface?
 - (b) If radius of Gaussian surface is doubled, how much flux will pass through it?

Long Answer Questions (5 marks each)

1. Derive an expression for the strength of electric field intensity at a point on the axis of a uniformly charged circular coil of radius R carrying charge Q .
2. State the Gauss's theorem. Derive an expression for the electric field due to a charged plane sheet. Find the potential difference between the plates of a parallel plate capacitor having surface density of charge $5 \times 10^{-8} \text{ cm}^{-2}$ with the separation between plates being 4mm.

CHEMISTRY

1. Define F-Centers. [1]
2. What type of semiconductor is obtained when silicon doped with arsenic? [1]

3. Explain the following terms with suitable examples of each: [2]
 - (a) Ferromagnetism
 - (b) Antiferromagnetism .
4. What is meant by (i) 12-16 (ii) 13-15 group compounds? Give examples. [2]
5. State Raoult's law for a solution containing volatile components. How does Raoult's law become a special Case of Henry's law? [2]
6. A solution of glucose in water is labeled as 10% by weight. What would be the molarity of the solution? [3]
7. Aluminum crystallizes in a cubic close packed structure. Radius of the atom in the metal is 125 pm. [3]
 - (a) What is the length of the side of the unit cell?
 - (b) How many unit cells are there in 1cm^3 of aluminum?
8. How would you account for the following? [3]
 - (a) Frenkel defects are not found in alkali metal halides.
 - (b) Schottky defects lower the density of related solids.
 - (c) Impurity doped silicon is a semiconductor.
9. With the help of suitable diagrams, on the basis of band theory, explain the difference between [3]
 - (a) a conductor and an insulator.
 - (b) a conductor and a semiconductor.
10. Answer- [5]
 - (a) Define the terms osmosis and osmotic pressure. Is the osmotic pressure of solution a Colligative Property? Explain.
 - (b) Calculate the boiling point of a solution prepared by adding 15.00g NaCl to 250.0g of water. (K_b for water = $0.512\text{ K kg mol}^{-1}$, molar mass of NaCl = 58.44g.)

BIOLOGY

1. What is a clone?
2. What are vegetative propagules?
3. What are the vegetative propagules in eichhornia, potato, onion, ginger, penicillium, sponge?
4. Name the plant which flowers once in 12 yrs.
5. Explain embryogenesis in plants.
6. Explain embryogenesis in animals.
7. Disadvantages of external fertilization.
8. Differentiate Zoospore and Zygote
9. Explain why meiosis and embryogenesis are interlinked.
10. What is sporulation?
11. What do you mean by the term uniparental?
12. A moss plant produces a large no. of antherozoids but a few egg cells. Why?
13. What is parthenogenesis? Give few examples from animals.
14. Amoeba is immortal. Explain.
15. What is a fruit, seed and embryo?

16. The number of chromosomes in the shoot tip cells of maize plant is 20. What will be the number of chromosomes in the gametes and microspore mother cells of the same plant?
17. Explain the events of sexual reproduction.
18. What do you mean by seasonal breeders?
19. Name 2 plant groups with diploid plant body.
20. Mention a characteristic feature and a function of Zoospores in some algae.
21. Mention the site where syngamy takes place in amphibians and reptiles respectively.
22. List 2 main pre-fertilisation events.
23. Technical term to denote unisexual condition.
24. Differentiate parthenogenesis and parthenocarpy.

MATHEMATICS

1.1 Function

1. Find $f(x)$, if $f(x + 7) = x^2 - 3x + 2$
2. Is the function $f(x) = [|\sin x| + |\cos x|]$ is invertible.
3. Find the domain of definition of the function $f(x)$ is given by the equation $2^x + 2^y = 2$.
4. The Range of $f(x) = 3\sin\left(\sqrt{\frac{\pi^2 - 16x^2}{16}}\right)$
5. $y = \log_e(3x^2 - 4x + 5)$, Find the Range of the function.
6. The range of the function $f(x) = [\sin^{-1} x]$ Where $[.]$ is Greatest Integer.
7. Find the period of the functions
 - (a) $f(x) = |\sin^4 x| + |\cos^4 x|$
 - (b) $f(x) = \cos x + \{x\}$
 - (c) $f(x) = 2\cos\left(\frac{x - \pi}{3}\right)$
 - (d) $\cos\sqrt{x}$
8. Calculate $f(x) = \frac{49}{x^4} + x^4$, at the points for which $\frac{7}{x} + x = 3$
9. If $f(x) = [\sin^{-1} x + \cos^{-1} x]$, Find the Range of $f(x)$.
10. If $f: R \rightarrow R$, is defined by $f(x) = (3 - x^3)^{\frac{1}{3}}$ find $f(f(x))$
11. Find the range of $f(x) = 2^x + 2^{-x} + 5$.
12. Let $f(x + y) = f(x) \cdot f(y)$ for all x and y . Suppose $f(5) = 2$, $f'(0) = 3$. then find $f'(5)$.
13. Let the function $f: R \rightarrow R$ be defined by $f(x) = 2^{x(x-1)} \forall x \in R$, then write f^{-1} . (assume bijection)
14. If $f: [1, \infty) \rightarrow [2, \infty)$ is given by $f(x) = x + \frac{1}{x}$, then find $f^{-1}(x)$ (assume bijection)
15. Find the inverse of the function, (assuming onto)

$$y = \log_a(x + \sqrt{x^2 + 1}), (a > 1)$$

16. Let $f(x) = ax^7 + bx^3 + cx - 5$ where a, b, c are constants. If $f(-7) = 7$, then find $f(7)$
17. If $A = \{a, b, c, d\}$ and $f = \{(a, b), (b, d), (c, a), (d, c)\}$, show that f is one one from A onto A . Find f^{-1}
18. The domain of the function $f(x) = \frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$
19. Find the domain of the function $f(x) = \frac{1}{\sqrt{|x|-x}}$
20. If the set A has 3 elements and the set $B = \{3,4,5\}$, then find the number of elements in $(A \times B)$
21. If $\left(\frac{2x}{3} + 1, 3y - \frac{2}{3}\right) = \left(\frac{5}{3}, \frac{1}{3}\right)$, Find the values of x, y
22. Write the number of all one one function from the set $A = \{a, b, c, d\}$ to itself.
23. Find the domain and Range of function $f(x) = \frac{x^2}{1+x^2}$
24. If $f = \{(4,2), (6,7)\}$ and $g = \{(4,2), (7,5)\}$ Write range of g and f .
25. If $A = \{1,2,3\}$ and f and g are relations corresponding to the subject of $A \times A$ indicated against them, which of f, g is a function? Why?
26. Let the function $f: R \rightarrow R$ be defined by $(x) = 4x - 1, \forall x \in R$, then Show that f is One -One.
27. If $f(0) = 1, f(1) = 2$ and $f(x) = \frac{1}{2}[f(x+1) + f(x+2)]$, then find the value of $f(5)$.
28. Classify which of the following functions as many one, one one, onto or into functions.
- $f(x) = e^x + e^{-x}$
 - $f(x) = x^3$
 - $f(x) = \sqrt{1-x^2}$
 - $f(x) = \sin 2x, f: [-1,1] \rightarrow [-1,1]$
29. Let $E = \{1,2,3,4\}$ and $F = \{1,2\}$. Then find the number of onto functions from E to F .
30. If $(x) = x^2 + bx + 3$, is not injective for values of x in the interval $0 \leq x \leq 1$. Find the interval in which b lies.
31. If $f(x) = x + \frac{1}{x}$, then find the value of $f(f(f(x)))$
32. If $f(x)$ be a polynomial function satisfying $f(x) \cdot f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$ and $f(4) = 65$. then find the value of $f(6)$
33. Let $(x) = ax^7 + bx^3 + cx - 5$, where a, b, c are constants. If $f(-7) = 7$, then find then value of $f(7)$
34. For $x \in R$, the function $f(x)$ satisfies $2f(x) + f(1-x) = x^2$. Then find the value of $f(4)$.
35. If $f(x) + 2f(1-x) = x^2 + 2, \forall x \in R$, Find $f(x)$.

1.2 Relation

1. If R is a relation from a finite set A having m elements to a finite set B having n elements, then find the number of relations from A to B .
2. Let $A = \{0,1,2,3\}$ and define a relation R on A as follows :
 $R = \{(0,0), (0,1), (0,3), (1,1), (2,2), (3,0), (3,3)\}$
3. For a set $A = \{1,2,3\}$, defined on a relation R in a set A as follows : $R = \{(1,1), (2,2), (3,3), (1,3)\}$
4. Let R be the equivalence relation in the set Z of integer given by $R = \{(a,b): 2 \text{ divides } a - b\}$ Write the equivalence class $[0]$

1.3 Binary Operation

1. Let $*$: $R \times R \rightarrow R$ be a binary operation given by $a * b = a + 4b^2$, then compute $(-5) * (2 * 0)$.
2. Is binary operation $*$ defined on Z (set of Integer) by $m * n = m - n + mn \forall m, n \in Z$ commutative ?
3. Find the total number of binary operations possible with the set $A = \{1,8,7,4,3,2\}$
4. In the set N of natural numbers, defined the binary operation $*$ by $m * n = \gcd(m,n), m, n \in N$. Is operation $*$ commutative and Associative ?
5. If $*$ is a binary operation given by $*$: $R \times R \rightarrow R, a * b = a + b^2$, then find the value of $-2 * 5$ is
6. Let $A = \{1,2,3,4,5\}$ defined as operation $*$ by $a * b = \max\{a, b\}$, Construct binary table.

1.4 Inverse Trigonometric Function

1. Find the value of $\sin^{-1} \sin \frac{3\pi}{5}$
2. Find the principal value of $\cos^{-1} x$, for $x = \frac{\sqrt{3}}{2}$
3. Evaluate (a) $\tan(\tan^{-1}(-4))$ (b) $\tan^{-1}(\sin(-\frac{\pi}{2}))$
4. Evaluate (a) $\tan^{-1}(\tan \frac{9\pi}{8})$ (b) $\sin^{-1}[\cos(\sin^{-1} \frac{\sqrt{3}}{2})]$
5. Prove that $\tan(\cot^{-1} x) = (\cot(\tan^{-1} x))$ State with reason whether the equality is valid for all values of x .
6. Find the values of $\sec(\tan^{-1}(\frac{y}{x}))$
7. Find the value of $\tan(\cos^{-1} x)$ and hence evaluate $\tan(\cos^{-1} \frac{8}{17})$
8. Find the value of $\sin[2 \cot^{-1}(\frac{-5}{12})]$
9. Evaluate $\cos[\sin^{-1} \frac{1}{4} + \sec^{-1} \frac{4}{3}]$
10. If $\sin^{-1} x + \sin^{-1} y = \frac{\pi}{2}$, then find the value of $\cos^{-1} x + \cos^{-1} y = ?$
11. Let a, b, c be positive real numbers.

$$\text{Let } \theta = \tan^{-1} \sqrt{\frac{a(a+b+c)}{bc}} + \tan^{-1} \sqrt{\frac{b(a+b+c)}{ca}} + \tan^{-1} \sqrt{\frac{c(a+b+c)}{ab}}, \text{ then } \tan \theta = ?$$

12. The value of $\tan \left[\cos^{-1} \frac{4}{5} + \tan^{-1} \frac{2}{3} \right]$
13. Find the number of real solution $\tan^{-1} \sqrt{x(x+1)} + \sin^{-1}(\sqrt{x^2+x+1}) = \frac{\pi}{2}$
14. Find the principal value of $\sin^{-1}(\sin \frac{2\pi}{3})$
15. Show that $\sin^{-1} \frac{12}{13} + \cos^{-1} \frac{4}{5} + \tan^{-1} \frac{63}{16} = \pi$
16. Prove that $\cos \tan^{-1} \sin \cot^{-1} x = \sqrt{\frac{x^2+1}{x^2+2}}$
17. Find the value of x for which $\sin(\cot^{-1}(1+x)) = \cos \tan^{-1} x$
18. If $\sin^{-1} : [-1,1] \rightarrow \left[\frac{\pi}{2}, \frac{3\pi}{2} \right]$ is a function, then find the value of $\sin^{-1} \left(-\frac{1}{2} \right)$ is
19. Evaluate $\sin^{-1} \left\{ \sin \frac{8\pi}{5} \right\}$
20. $\sin^{-1}(1-x) - 2 \sin^{-1} x = \frac{\pi}{2}$, then find the value of x
21. Prove that $\frac{9\pi}{8} - \frac{9}{4} \sin^{-1} \frac{1}{3} = \frac{9}{4} \sin^{-1} \frac{2\sqrt{2}}{3}$
22. Evaluate $x + y + z, \sin^{-1} x + \sin^{-1} y + \sin^{-1} z = \frac{3\pi}{2}$
23. Evaluate $x + y + z, \cos^{-1} x + \cos^{-1} y + \cos^{-1} z = 0$
24. Find the principal value of $\sin^{-1} \left[\cos \left(\sin^{-1} \frac{1}{2} \right) \right]$
25. The value of $\tan^{-1} \left(\tan \frac{2\pi}{3} \right)$
26. Draw the graph of
 - a) $f(x) = \sin^{-1} x$, $f(x) = \cos^{-1} x$
 - b) $f(x) = \tan^{-1} x$, $f(x) = \sec^{-1} x$
 - c) $f(x) = \csc^{-1} x$, $f(x) = \cot^{-1} x$
 - d) $f(x) = \sin^{-1} \sin x$, $f(x) = \sin \sin^{-1} x$

1.5 Continuity and Differentiability

1. Check the Continuity and Differentiability of function $y = |x| + |x+1|$
2. Check the Continuity and Differentiability of function $y = [x] + |x|, -2 \leq x \leq 2$
3. Check the Continuity and Differentiability of function $f(x) = \begin{cases} -2x+1, & x < 0 \\ x+4, & x \geq 0 \end{cases}, -1 \leq x \leq 2$
4. Draw the graph of the function $y = |x| + |x+1| + |x-1|$
5. Draw the graph of the function $f(x) = \frac{x^2-4}{x-2}$
6. Find the values of a and b so that $f(x) = \begin{cases} ax+b & \text{if } x < 0 \\ 2\sin x + 3\cos x & \text{if } x \geq 0 \end{cases}$
7. Find the number c that makes $f(x) = \begin{cases} \frac{x-c}{c+1} & \text{if } x \leq 0 \\ x^2+c & \text{if } x > 0 \end{cases}$

ENGLISH

WRITING

1. Design a poster on “No Smoking’ in not more than 50 words. [4]

OR

Situation vacant: B &B Associates requires a customer care executive for their office in Shahdara, Delhi. Write an advertisement for the column Situation Vacant of a local daily.

2. You are the Sports Secretary of Jagjivan Memorial School, Patparganj, Delhi. You need a few items for the Annual Sports Meet to be held in your school. Write a letter to Vats Sports Company placing orders for the items. [6]

LITERATURE

1. The bangle makers of Firozabad make beautiful bangles and make everyone happy, but, they live and die in squalor. Elaborate. (80- 100 words) [4]
2. What message does the poet Stephen Spender convey through the poem ‘An Elementary School Classroom in a slum’? [3]
3. Give a brief character of Dr. Griffin.(125- 200 words) [4]
4. Mankind can either use / misuse science for their vested interests. Elucidate with reference to the novel, The Invisible Man in 125- 200 words. [4]

ENTREPRENEURSHIP

1. What is a business opportunity? What factors are involved in the process of sensing an entrepreneurial opportunity?
2. Randhir a young entrepreneur is often found in the marketplace. He enjoys seeing what are people eating, doing, wearing and using. Further he visits Trade shows not to buy but to see what’s hot. Identify Randhir’s method of spotting trend.
3. What is Idea generation?
4. Explain the investment decision under the financial plan? In which areas should the investment should be on the basis of priority?
5. Define the term environment scanning. Explain SWOT matrix in this reference.
6. What is idea field? Specify the source in following cases:-
 - a) Use of clay as soil and for ceramics.
 - b) Indianised version of American food
7. What is PESTEL model? Explain it with reference to privatisation in steel manufacturing sector.
8. Draw the enterprise process diagram.
9. Explain in detail Idea Fields.
10. Explain, in detail, the various formalities required to start a business.
11. What is a business plan? Explain its importance.
12. What is a marketing plan? Why is it required in business enterprises?

PHYSICAL EDUCATION

1. Define Planning in Sports and write down its meaning?
2. What do you mean by “BYE”?
3. What do you mean by “Seeding” in a Tournament?
4. What do you mean by the word “Tournament” and what are different types of Tournament?
5. Define Fixture and define method of preparing Fixture?
6. Draw a Knock-Out fixture for 13 teams and explain in detail the procedure?
7. Draw a Knock-Out fixture for 12 teams and explain in detail the procedure?
8. Draw a League fixture for 9 teams using cyclic method and explain in detail the procedure?
9. What is a Balanced Diet?
10. What do you understand by Nutritive and Non Nutritive components of diet?
11. What do you understand by Food Myths? Explain in detail?
12. Define YOGA and explain its elements in detail?
13. What is the importance of Yoga in games and sports?

INFORMATICS PRACTICES

1. Mr. Ashish works as a programmer in “Universal Technologies Pvt. Ltd.”. He has designed a Library software to generate the membership fee depending upon the membership type considering discount eligibility as well. A screenshot of the same is shown below:

The screenshot shows a web-based form for a library. The title is "Reader's Paradise Library". The form has the following fields and controls:

- Member Name: Text input field containing "Syueon Lee".
- Age: Text input field containing "17".
- Membership Type: Radio buttons for "Monthly", "Quaterly" (selected), and "Yearly".
- Check Fee: A blue button.
- Fee: Text input field containing "1000".
- Discount Eligibility: Radio buttons for "Students" (selected) and "Other".
- Check Discount: A blue button.
- Discount: Text input field containing "200".
- Calculate: A blue button.
- Net Fee: Text input field containing "800".
- Clear All: A blue button.

Help him in writing the code to do the following:

- a) After selecting appropriate Radio Button, when ‘Check Fee’ button is clicked, fee should be displayed in the respective text field according to the following criteria:

Membership Type	Fee
Monthly	500
Quarterly	1000
Yearly	1500

- b) After selecting appropriate Radio Button, when 'Check Discount' button is clicked, appropriate discount should be displayed in the respective text field according to the following criteria:

Discount Eligibility	Discount
Students	200
Other	100

- c) When 'Calculate' button is clicked, Net Fee should be calculated and displayed in the respective text field as per the given formula:

$$\text{Net Fee} = \text{Fee} - \text{Discount}$$

- d) When 'Clear All' button is clicked, all the text fields should be cleared.

2. Ms. Sharma works as a programmer in "ABC Car Rental Company" where she has designed a software to compute charges to be paid by the client. A client can take any car out of Deluxe/ Semi Deluxe/ Ordinary for rent. A client can also opt for services of a guide. Charges vary depending on the type of car opted. Charges of services of Guide are extra.

Help Ms. Sharma in writing the code to do the following:

- a) After selecting appropriate Radio Button and checkbox (if required), when 'CALCULATE' button is clicked, Amount, Guide Charges and Total Amount should be calculated and displayed in the respective text fields

Category of Car	Amount (in Rs.)
Deluxe Car	1000 per day
Semi Deluxe Car	800 per day
Ordinary Car	700 per day

Amount is obtained by multiplying per day charges of Car with number of days for which the car is taken. If 'Guide Required' checkbox is selected, Guide charges per day are Rs.500.00. Guide Charges is calculated as:

Car required for No. of days * 500; Total Amount = Amount + Guide Charges

3. Design a form to get the details of a student and store it in **student** table. (Use JAVA-MySQL connectivity).

4. Design a form to find the volume of cube, cuboid and cylinder.
5. Write SQL query to create a table 'Song' with the following structure:

Field	Type	Constraint
Songid	Integer	Primary key
Title	Varchar(50)	
Duration	Integer	
ReleaseDate	Date	

Computer Science (083)

1. Write the type of C++ tokens (Keywords and User Defined Identifiers) from the following:
 - (a) new
 - (b) While
 - (c) break
 - (d) Num_2
 - (e) case
 - (f) continue
 - (g) Hello
 - (h) Goto
2. Rewrite the following C++ code after removing any/all syntactical errors with each correction underlined. (Note: Assume all required header files are already being included in the program.)

```
void main()
{ cout<<"Enter an Alphabet:";
  cin>>CH;
  switch[CH]
  case 'A' cout<<"\n First Alphabet"; Break;
  case 'B' cout<<"\n Second Alphabet"; Break;
}
```

3. Find and write the output of the following C++ program code:
Note: Assume all required header files are already being included in the program.

```
void main()
{
  int *Point, L, Score[]={10,20,35,50,65,110};
  Point = Score;
  for(L=0; L<6; L++)
  { if((*Point)%10 == 0)
    *Point/=2;
    else
    *Point - = 2;
    if((*Point)%5==0)
    *Point/=5;
    Point++;
  }
  for(L=5;L>=0;L - - )
    cout<<Score[L]<<"#";
}
```

4. Study the following program and select the possible output(s) from the options (i) to (iv) following it. Also write the maximum and the minimum values that can be assigned to the variable VAL.

Note: Assume all required header files are already being included in the program.

```
void main()
{
    randomize();
    int VAL;
    VAL = random(3) + 2;
    char GUESS[] = "ABCDEFGH IJK";
    for(int I=1;I<=VAL;I++)
    {
        for(int J=VAL;J<=7;J++)
            cout<<GUESS[J];
        cout<<endl;
    }
}
```

- | | | | |
|---------|--------|-------|------|
| (i) | (ii) | (iii) | (iv) |
| BCDEFGH | CDEFGH | EFGH | FGHI |
| BCDEFGH | CDEFGH | EFGH | FGHI |
| | | EFGH | FGHI |
| | | EFGH | FGHI |

5. Answer the following questions:

- Differentiate between Call by Value and Call by Reference. Illustrate with the help of C++ program code.
- Differentiate between Formal and Actual parameters. Illustrate with the help of C++ program code.
- Differentiate between Local and Global variables. Illustrate with the help of C++ program code.
- Differentiate between Type Conversion and Type Casting. Illustrate with the help of C++ program code.
- Differentiate between Private and Protected members of a class in context of Object Oriented Programming. Also give a suitable example illustrating accessibility/non-accessibility of each using a class and an object in C++.

6. Write the definition of a class **BOX** in C++ with the following description:

Private Members:

```
BoxNumber    // data member of integer type
Side         // data member of float type
Area        // data member of float type
ExecArea()  // Member function to calculate and assign Area as
            // Side * Side
```

Public Members:

```
GetBox()     // A function to allow user to enter values of BoxNumber and
            // Side. Also, this function should call ExecArea() to calculate
            // Area.
ShowBox()    // A function to display BoxNumber, Side and Area
```

7. Write the definition of a class **Photo** in C++ with the following description:

Private Members:

```
Pno          // data member for Photo Number of integer type
Category     // data member for Photo Category of string type
Exhibit      // data member for Exhibition Gallery of string type
FixExhibit() // Member function to assign Exhibition Gallery as per
            // Category as shown in the following table
```

Category	Exhibit
Antique	Zaveri
Modern	Johnsen
Classic	Terenida

Public Members:

```
Register()   // A function to allow user to enter values of Pno, Category
            // and call FixExhibit() function.
ViewAll()    // A function to display all the data members.
```
