



SAINIK SCHOOL BHUBANESWAR
AUTUMN VACATION TASK 2025-26
SUBJECT-PHYSICS
CLASS-XII

1. What is displacement current? Write an expression for it. Write modified form of Amperes law.
2. Derive the equation of the balanced state in a Wheatstone bridge using Kirchhoff's laws.
3. Three charges $-q$, Q and $-q$ are placed at equal distances on a straight line. If the potential energy of the system of these charges is zero, then what is the ratio $Q:q$?
4. Derive an expression for mutual inductance for two coaxial coils.
5. Derive an expression for induced emf for an A C generator. Explain the working of it.
6. Obtain the expression for the electric field intensity due to a uniformly charged spherical shell of radius R at a point distant r from the centre of the shell outside it. Draw a graph showing the variation of electric field intensity E with r , for $r > R$ and $r < R$.
7. Draw equipotential surfaces for (i) an electric dipole and (ii) two identical positive charges placed near each other.
8. In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3} \text{ m}^2$ and the separation between the plates is 3 mm. Calculate the capacitance of the capacitor (ii) If the capacitor is connected to 100V supply, what would be the charge on each plate? (iii) How would charge on the plate be affected if a 3 mm thick mica sheet of $k=6$ is inserted between the plates while the voltage supply remains connected?
9. Calculate the amount of work done in rotating a dipole of dipole moment $3 \times 10^{-8} \text{ Cm}$ from its position of stable equilibrium to the position of unstable equilibrium in a uniform electric field of intensity 10^4 N/C .
10. State Gauss theorem in electrostatics. Obtain the expression for electric field at a point due to an infinitely long thin uniformly charged straight wire of linear charge density $\lambda \text{ Cm}^{-1}$.
11. Derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time.
12. Explain the principle and working of a Transformer with the help of a diagram. Write the various losses in transformer and how can it be reduced?
13. Draw the magnetic field lines due to a current carrying long solenoid.
14. A proton and an alpha particle having the same kinetic energy are, in turn, passed through a region of uniform magnetic field, acting normal to the plane of the paper and travel in circular paths. Deduce the ratio of the radii of the circular paths described by them.
15. A circular coil of 200 turns and radius 10 cm is placed in a uniform magnetic field of 0.5 T, normal to the plane of the coil. If the current in the coil is 3.0 A, calculate the
 - (a) total torque on the coil.
 - (b) total force on the coil.
 - (c) average force on each electron in the coil, due to the magnetic field.Assume the area of cross-section of the wire to be 10^{-5} m^2 and the free electron density is $10^{29}/\text{m}^3$.

16. Derive the expression for force per unit length between two long straight parallel current carrying conductors. Hence define one ampere.
17. State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer cannot be used as such to measure current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends.
18. (a) A series LCR circuit is connected to an a.c. source of variable frequency. Draw a suitable phasor diagram to deduce the expressions for the amplitude of the current and phase angle.
(b) Obtain the condition at resonance. Draw a plot showing the variation of current with the frequency of a.c. source for two resistances R_1 and ($R_1 > R_2$). Hence define the quality factor, Q and write its role in the tuning of the circuit.
19. State Faradays law of EMI. Explain Lenzs law is in accordance with law of conservation of energy.
20. Write the expression for the force on a charge moving in a magnetic field. Deduce the condition under which this force is minimum and maximum.
21. A wire of 10Ω resistance is gradually stretched to double its length. It is then cut into two equal parts. These parts are then connected in parallel to a battery of 3 volt. Find the current drawn from the battery.
22. What happens to energy stored in a capacitor if after disconnecting the battery, the plates of a charged capacitor are moved farther?
23. Draw a labeled ray diagram of a compound microscope and write an expression for its Magnifying power.
24. The focal length of the objective and eye-lens of a compound microscope are 2 cm, 6×25 cm respectively. The distance between the lenses is 15 cm. (i) How far from the objective lens, will the object be kept, so as to obtain the final image at the near point of the eye? (ii) Also calculate its magnifying power.
25. Draw a labeled ray diagram of an astronomical telescope, in the normal adjustment position and write the expression for its magnifying power.
26. An astronomical telescope uses an objective lens of focal length 15 m and eye-lens of focal length 1 cm. What is the angular magnification of the telescope?
27. With the help of a suitable ray diagram, derive the mirror formula for a concave mirror.
28. What is T I R. Write the condition for it.
29. Derive the lens maker's formula.
30. Derive the expression for refractive index for material of prism. Draw i-d curve.

CHEMISTRY

Q 1. Name the following halides according to IUPAC system and classify them as alkyl, allyl, benzyl (primary, secondary, tertiary), vinyl or aryl halides :

- (i) $(\text{CH}_3)_2\text{CHCH}(\text{Cl})\text{CH}_3$
- (ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{C}_2\text{H}_5)\text{Cl}$
- (iii) $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{I}$
- (iv) $(\text{CH}_3)_3\text{CCH}_2\text{CH}(\text{Br})\text{C}_6\text{H}_5$
- (v) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{Br})\text{CH}_3$
- (vi) $\text{CH}_3\text{C}(\text{C}_2\text{H}_5)_2\text{CH}_2\text{Br}$
- (vii) $\text{CH}_3\text{C}(\text{Cl})(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_3$
- (viii) $\text{CH}_3\text{CH}=\text{C}(\text{Cl})\text{CH}_2\text{CH}(\text{CH}_3)_2$
- (ix) $\text{CH}_3\text{CH}=\text{CHC}(\text{Br})(\text{CH}_3)_2$
- (x) $p\text{-ClC}_6\text{H}_4\text{CH}_2\text{CH}(\text{CH}_3)_2$
- (xi) $m\text{-ClCH}_2\text{C}_6\text{H}_4\text{CH}_2\text{C}(\text{CH}_3)_3$
- (xii) $o\text{-Br-C}_6\text{H}_4\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

Q2. Give the IUPAC names of the following compounds:

- (i) $\text{CH}_3\text{CH}(\text{Cl})\text{CH}(\text{Br})\text{CH}_3$
- (ii) $\text{CHF}_2\text{CBrClF}$
- (iii) $\text{ClCH}_2\text{C}\equiv\text{CCH}_2\text{Br}$
- (iv) $(\text{CCl}_3)_3\text{CCl}$
- (v) $\text{CH}_3\text{C}(p\text{-ClC}_6\text{H}_4)_2\text{CH}(\text{Br})\text{CH}_3$
- (vi) $(\text{CH}_3)_3\text{CCH}=\text{CClC}_6\text{H}_4\text{I}-p$

Q 3. Write the structures of the following organic halogen compounds.

- (i) 2-Chloro-3-methylpentane
- (ii) p-Bromochlorobenzene
- (iii) 1-Chloro-4-ethylcyclohexane
- (iv) 2-(2-Chlorophenyl)-1-iodooctane
- (v) Perfluorobenzene
- (vi) 4-tert-Butyl-3-iodoheptane
- (vii) 1-Bromo-4-sec-butyl-2-methylbenzene
- (viii) 1,4-Dibromobut-2-ene

Q4. Write the equations for the preparation of 1-iodobutane from

- (i) 1-butanol
- (ii) 1-chlorobutane
- (iii) but-1-ene

Q 5. Define ambident nucleophiles. Explain with a suitable example.

Q6. What are the products formed by dehydrohalogenation of the given halides with sodium ethoxide in ethanol, identify the major alkene:

- (i) 1-Bromo-1-methylcyclohexane
- (ii) 2-Chloro-2-methylbutane
- (iii) 2,2,3-Trimethyl-3-bromopentane.

Q7: Explain why ;

- (i) Cyclohexyl Chloride has a higher dipole moment than chlorobenzene.
- (ii) alkyl halides, despite being polar are not miscible with water.
- (iii) Grignard reagents are prepared under anhydrous conditions.

Q8. Arrange the compounds of each set in order of reactivity towards S_N2 displacement:

- (i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane
- (ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 3-Bromo-2-methylbutane
- (iii) 1-Bromobutane, 1-Bromo-2,2-dimethylpropane, 1-Bromo-2-methylbutane, 1-Bromo-3-methylbutane.

Q9. How the following conversions can be carried out?

- (i) Propene to propan-1-ol
- (ii) Ethanol to but-1-yne
- (iii) 1-Bromopropane to 2-bromopropane
- (iv) Toluene to benzyl alcohol
- (v) Benzene to 4-bromonitrobenzene
- (vi) Benzyl alcohol to 2-phenylethanoic acid
- (vii) Ethanol to propanenitrile
- (viii) Aniline to chlorobenzene
- (ix) 2-Chlorobutane to 3, 4-dimethylhexane
- (x) 2-Methyl-1-propene to 2-chloro-2-methylpropane
- (xi) Ethyl chloride to propanoic acid
- (xii) But-1-ene to n-butyliodide
- (xiii) 2-Chloropropane to 1-propanol
- (xiv) Isopropyl alcohol to iodoform
- (xv) Chlorobenzene to p-nitrophenol
- (xvi) 2-Bromopropane to 1-bromopropane
- (xvii) Chloroethane to butane
- (xviii) Benzene to diphenyl
- (xix) tert-Butyl bromide to isobutyl bromide
- (xx) Aniline to phenylisocyanide

Q10. Primary alkyl halide C_4H_9Br (a) reacted with alcoholic KOH to give compound (b). Compound (b) is reacted with HBr to give (c) which is an isomer of (a). When (a) is reacted with sodium metal it gives compound (d), C_8H_{18} which is different from the compound formed when n-butyl bromide is reacted with sodium. Give the structural formula of (a) and write the equations for all the reactions.

Alcohols, Phenols and Ethers

Q.1 Give the structure of the compounds given below :

- (i) 2, 2, 4 -Trimethylpentan – 3 – ol
- (ii) 5 – Ethylheptane – 2, 4 – diol
- (iii) Butane – 2, 3 – diol
- (iv) Propane – 1, 2, 3 – triol
- (v) 2-Methylphenol
- (vi) 4 – Methyl phenol
- (vii) 2, 5 – Dimethylphenol
- (viii) 2, 6 – Dimethylphenol
- (ix) 1 – Methoxy – 2 – methyl propane
- (x) Ethoxy benzene
- (xi) 1 – Phenoxyheptane
- (xii) 2 – Ethoxybutane

Q.2 Give the structures of the compounds whose IUPAC names are given below :

- (i) 2 – Methylbutan – 2 – ol
- (ii) 1 – Phenylpropan – 2 – ol
- (iii) 3 , 5 – Dimethylhexane – 1 , 3 , 5 – triol
- (iv) 2, 3 – Diethylphenol
- (v) 1 – Ethoxypropane
- (vi) 2 – Ethoxy – 3 – methylpentane
- (vii) Cyclohexylmethanol
- (viii) 3 – Cyclohexylpentan – 3 – ol
- (ix) Cyclopent – 3 – en – 1 – ol
- (x) 3 – Chloromethylpentan – 1 – ol.

Q3. Explain with a suitable example the hydroboration – oxidation reaction?

Q4. Give the structures & IUPAC names of monohydric phenols of molecular formula, C_7H_8O .

Q5. While separating a mixture of para&ortho nitro phenols by steam distillation, mention the isomer which will be steam volatile. Reason your solution.

Q6. Explain the reactions for the preparation of phenol from cumene with the equation.

Q7. Write the mechanism of hydration of ethene to yield ethanol.

Q8. Show that phenol is of acidic nature by giving two reactions. Also , Compare acidity of ethanol with that of phenol.

Q9. Give reasons for the following statement: ortho-nitrophenol is more acidic than orthomethoxy phenol.

Q10. Give a detailed explain for each of the following.

- (i) Kolbe's reaction.
- (ii) Reimer – Tiemann reaction.
- (iii) Williamson ether synthesis.
- (iv) Unsymmetrical ether.

Q11. Give a detailed explanation of acid – catalyzed dehydration of ethanol to yield ethene.

Q12. Explain the procedure for following conversions.

- (a) Benzyl chloride à Benzyl alcohol
- (b) Propene à Propan – 2 – ol
- (c) Methyl magnesium bromide à 2 – Methylpropan – 2 – ol.
- (d) Ethyl magnesium chloride à Propan – 1 – ol.

ALDEHYDES, KETONES AND CARBOXYLLIC ACID

Q1. *What do you mean by the following terms? Give an example of the reaction.*

- (i) Cyanohydrin
- (ii) Acetal
- (iii) Semicarbazone
- (iv) Aldol
- (v) Hemiacetal
- (vi) Oxime
- (vii) Ketal
- (viii) Imine
- (ix) 2,4-DNP-derivative
- (x) Schiff's base

Q2. **Name the following compounds according to IUPAC system of nomenclature:**

- (i) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CHO}$
- (ii) $\text{CH}_3\text{CH}_2\text{COCH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2\text{Cl}$
- (iii) $\text{CH}_3\text{CH}=\text{CHCHO}$
- (iv) $\text{CH}_3\text{COCH}_2\text{COCH}_3$
- (v) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{C}(\text{CH}_3)_2\text{COCH}_3$
- (vi) $(\text{CH}_3)_3\text{CCH}_2\text{COOH}$
- (vii) $\text{OHCC}_6\text{H}_4\text{CHO-p}$

Q3. **Draw the structures of the following compounds.**

- (i) 3-Methylbutanal
- (ii) p-Nitropropiophenone
- (iii) p-Methylbenzaldehyde
- (iv) 4-Methylpent-3-en-2-one
- (v) 4-Chloropentan-2-one
- (vi) 3-Bromo-4-phenylpentanoic acid
- (vii) p,p'-Dihydroxybenzophenone
- (viii) Hex-2-en-4-ynoic acid

Q4. **Predict the products formed when cyclohexanecarbaldehyde reacts with following reagents.**

- (i) PhMgBr and then H_3O^+
- (ii) Tollens' reagent
- (iii) Semicarbazide and weak acid
- (iv) Excess ethanol and acid
- (v) Zinc amalgam and dilute hydrochloric acid

Q5. An organic compound with the molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1, 2-benzenedicarboxylic acid. Identify the compound.

Q6. An organic compound (A) (molecular formula $C_8H_{16}O_2$) was hydrolysed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives but-1-ene. Write equations for the reactions involved.

Q7. Arrange the following compounds in increasing order of their property as indicated:

(i) Acetaldehyde, Acetone, Di-tert-butyl ketone, Methyl tert-butyl ketone (reactivity towards HCN)

(ii) $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$, $CH_3CH_2CH_2COOH$ (acid strength)

(iii) Benzoic acid, 4-Nitrobenzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxybenzoic acid (acid strength)

Q8. Give simple chemical tests to distinguish between the following pairs of compounds.

(i) Propanal and Propanone

(ii) Acetophenone and Benzophenone

(iii) Phenol and Benzoic acid

(iv) Benzoic acid and Ethyl benzoate

(v) Pentan-2-one and Pentan-3-one

(vi) Benzaldehyde and Acetophenone

(vii) Ethanal and Propanal

Q9. How will you bring about the following conversions in not more than two steps?

(i) Propanone to Propene

(ii) Benzoic acid to Benzaldehyde

(iii) Ethanol to 3-Hydroxybutanal

(iv) Benzene to m-Nitroacetophenone

(v) Benzaldehyde to Benzophenone

(vi) Bromobenzene to 1-Phenylethanol

(vii) Benzaldehyde to 3-Phenylpropan-1-ol

(viii) Benzaldehyde to α -Hydroxyphenylacetic acid

(ix) Benzoic acid to m-Nitrobenzyl alcohol

Q10. Describe the following:

(i) Acetylation

(ii) Cannizzaro reaction

(iii) Cross aldol condensation

(iv) Decarboxylation

AMINES

Q1. Give IUPAC names for the compounds given below & categorize them into primary, secondary & tertiary amines.

(i) $(CH_3)_2CHNH_2$

(ii) $CH_3(CH_2)_2NH_2$

(iii) $CH_3NHCH(CH_3)_2$

(iv) $(CH_3)_3CNH_2$

(v) $C_6H_5NHCH_3$

(vi) $(CH_3CH_2)_2NCH_3$

(vii) $m-BrC_6H_4NH_2$

Q2. Mention chemical tests to differentiate between the pairs of compounds given below.

- (i) dimethylamine & Methylamine
- (ii) Tertiary amines & Secondary
- (iii) Aniline & Ethylamine
- (iv) benzylamine & Aniline
- (v) N – methylaniline & Aniline

Q3. Reason the following statements given below :

- (i) pK_b of methylamine is lesser than that of aniline .
- (ii) Aniline is not soluble in water whereas Ethylamine is.
- (iii) Methylamine in water when made to react with ferric chloride precipitates hydrated ferric oxide.
- (iv) Aniline when nitrated gives a substantial amount of m – nitroaniline, while amino group is o, p – directing in aromatic electrophilic substitution reactions.
- (v) Aniline does not take Friedel – Crafts reaction.
- (vi) On comparing the stabilities, we observe that, the stability of Diazonium salts of aromatic amines is more than that of aliphatic amines.
- (vii) Gabriel phthalimide synthesis is usually preferred for synthesizing primary amines.

Q4. Answer the questions given below :

- (i) Arrange the following compounds in the decreasing order of the pK_b values :
 $C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ & $C_6H_5NH_2$
- (ii) Arrange the following compounds in the escalating order of basic strength :
 $C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_2H_5)_2NH$ & CH_3NH_2
- (iii) Arrange the following compounds in the escalating order of basic strength :
 - (a) p – nitroaniline , Aniline, & p – toluidine
 - (b) $C_6H_5NH_2$, $C_6H_5NHCH_3$, $C_6H_5CH_2NH_2$.
- (iv) Arrange the following compounds in decreasing order of basic strength in gas phase :
 $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$ & NH_3
- (v) Arrange the following compounds in escalating order of boiling point :
 C_2H_5OH , $(CH_3)_2NH$, $C_2H_5NH_2$
- (vi) Arrange the following compounds in escalating order of solubility in water :
 $C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$.

Q5. How will you convert :

- (i) Ethanoic acid into methanamine
- (ii) Hexanenitrile into 1 – aminopentane
- (iii) Methanol to ethanoic acid
- (iv) Ethanamine into methanamine
- (v) Ethanoic acid into propanoic acid
- (vi) Methanamine into ethanamine
- (vii) Nitromethane into dimethylamine

(viii) Propanoic acid into ethanoic acid

Q6. **Explain the following given below:**

- (i) Carbylamine reaction
- (ii) Diazotisation
- (iii) Hofmann's bromamide reaction
- (iv) Coupling reaction
- (v) Ammonolysis
- (vi) Acetylation
- (vii) Gabriel phthalimide synthesis.

Q7. Give the structures of A, B & C in the following reactions:

An aromatic compound 'A' on treatment with aqueous ammonia & heating forms compound 'B' which on heating with Br_2 & KOH forms a compound 'C' of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structures & IUPAC names of compounds A, B & C.

Q8. Give detailed explanation for the following statements given below:

- (i) Why are alcohols more acidic than amines of comparable molecular masses?
- (ii) Why do tertiary amines have lower boiling point than primary amines?
- (iii) Why are aromatic amines weaker bases than aliphatic amines?

BIOMOLECULES

Q1. Explain monosaccharide?

Q2. Explain reducing sugars?

Q3. What are two main functions of carbohydrates in plants?

Q4. What is meant by the term glycosidic linkage?

Q5. Explain glycogen. What are the difference between starch and glycogen?

Q6. What will be the product after hydrolysing the (a) sucrose and (b) lactose?

Q7. What is the difference in structures between cellulose and starch?

Q8. What will happen when a D – glucose is treated with the reagents given below?

- (a) HI (b) Bromine water (b) HNO_3

Q9. Explain what an essential amino acid is and what a non – essential amino acid is? Also give two examples for each the types.

Q10. Relate the following with proteins.

- (a) Primary Structure (b) Peptide Linkage (c) Denaturation

Q11. What type of bonding helps in stabilising the α -helix structure of proteins?

Q12. Differentiate between fibrous and globular proteins.

Q13. What will be the outcome of denaturatuion on the structure of proteins?

Q14. What are nuclic acids? Give their two important functions.

Q15. What is the difference between a nucleotide and a nucleoside?

Biology

Part A – Short & Competency-Based Questions

1. Why did Mendel choose pea plants for his experiments?
2. Define law of segregation with a suitable example.
3. A red-flowered plant (RR) is crossed with a white-flowered plant (rr). Show the F1 and F2 generation outcomes.
4. A haemophilic father and a normal mother have children. Predict the chances of haemophilia in sons and daughters.
5. Explain how incomplete dominance differs from codominance.
6. A couple has a child with Down's syndrome. Explain the genetic cause.
7. How does crossing over during meiosis increase variation?
8. Differentiate between multiple alleles and polygenic inheritance.
9. What is the significance of the Human Genome Project?
10. Write one role each of: (i) mRNA, (ii) tRNA, (iii) rRNA.
11. How is DNA fingerprinting useful in crime investigation?
12. Describe the Meselson–Stahl experiment. What did it prove?
13. Why is DNA replication called semi-conservative?
14. What are transgenic organisms? Give one example.
15. Explain the role of *Agrobacterium tumefaciens* in genetic engineering.
16. Give any two applications of PCR in biotechnology.
17. A farmer wants pest-resistant cotton. Which genetic modification should be introduced?
18. What are cry genes? How do they help in agriculture?
19. Differentiate between innate immunity and acquired immunity.
20. Name the pathogen causing tuberculosis. Mention its mode of transmission.
21. What is cancer? Mention one diagnostic and one therapeutic method.
22. How do vaccines provide immunity?
23. Write two methods by which HIV spreads in humans.
24. How do antibiotics act against bacteria? Why can't they cure viral diseases?
25. Malaria still poses a major health threat in tropical regions. Explain the role of mosquito and *Plasmodium* in its transmission cycle.

Part B – Case Study Questions:

26. In a family, the father is blood group A, the mother is blood group B, and the child is blood group O.
 - Identify the possible genotypes of the parents.
 - Explain the inheritance pattern.
27. A farmer reports that despite spraying insecticides, bollworms destroyed his cotton crop. His neighbor used Bt cotton and had no losses.
 - What is Bt cotton?
 - Explain why it provides resistance to pests.
28. During an investigation of fossils, scientists found transitional forms between reptiles and birds.
 - Which theory of evolution does this support?
 - How does this evidence strengthen the idea of natural selection?
29. In a village, many cases of jaundice were reported after floods.
 - Identify the possible causative agent.
 - Suggest preventive measures.
30. A biotechnology company developed insulin using recombinant DNA technology.
 - How is this method better than extracting insulin from animal pancreas?
 - Name the organism commonly used in this process.

Mathematics

Answer all the following questions in separate sheets of paper and attach them together for submission when the School reopens. The questions are to be answered neatly with necessary calculations shown.

1	A relation R on set $A = \{1, 2, 3, 4, 5\}$ is defined as $R = \{(x, y) : x^2 - y^2 < 8\}$. Check whether the relation R is reflexive, symmetric and transitive.
2	A function f is defined from $R \rightarrow R$ as $f(x) = ax + b$, such that $f(1) = 1$ and $f(2) = 3$. Find function $f(x)$. Hence, check whether function $f(x)$ is one-one and onto or not.
3	An exhibit in the museum depicted many rail lines on the track near the railway station. Let L be the set of all rail lines on the railway track and R be the relation on L defined by $R = \{(l_1, l_2) : l_1 \text{ is parallel to } l_2\}$ On the basis of the above information, answer the following questions : (i) Find whether the relation R is symmetric or not. (ii) Find whether the relation R is transitive or not.
4	A relation R on set $A = \{x : -10 \leq x \leq 10, x \in Z\}$ is defined as $R = \{(x, y) : (x - y) \text{ is divisible by } 5\}$. Show that R is an equivalence relation. Also, write the equivalence class $[5]$.
5	Let $A = R - \{5\}$ and $B = R - \{1\}$. Consider the function $f : A \rightarrow B$, defined by $f(x) = \frac{x-3}{x-5}$. Show that f is one-one and onto.
6	A relation R is defined on $N \times N$ (where N is the set of natural numbers) as : $(a, b) R (c, d) \Leftrightarrow a - c = b - d$ Show that R is an equivalence relation.
7	Show that a function $f : R \rightarrow R$ defined by $f(x) = \frac{2x}{1+x^2}$ is neither one-one nor onto. Further, find set A so that the given function $f : R \rightarrow A$ becomes an onto function.
8	Evaluate : $\cot^2 \left\{ \operatorname{cosec}^{-1} 3 \right\} + \sin^2 \left\{ \cos^{-1} \left(\frac{1}{3} \right) \right\}$

9	(a) Express $\tan^{-1} \left(\frac{\cos x}{1 - \sin x} \right)$, where $-\frac{\pi}{2} < x < \frac{\pi}{2}$ in the simplest form. OR (b) Find the principal value of $\tan^{-1}(1) + \cos^{-1} \left(-\frac{1}{2} \right) + \sin^{-1} \left(-\frac{1}{\sqrt{2}} \right)$.
10	(a) Find the value of $\tan^{-1}(1) + \cos^{-1} \left(-\frac{1}{2} \right) + \sin^{-1} \left(-\frac{1}{2} \right)$. OR (b) Find the domain of the function $y = \cos^{-1}(x^2 - 4)$.
11	If $a = \sin^{-1} \left(\frac{\sqrt{2}}{2} \right) + \cos^{-1} \left(-\frac{1}{2} \right)$ and $b = \tan^{-1}(\sqrt{3}) - \cot^{-1} \left(-\frac{1}{\sqrt{3}} \right)$ then find the value of $a + b$.
12	A) If the sides of a square are decreasing at the rate of 1.5 cm/s, the rate of decrease of its perimeter is : (A) 1.5 cm/s (B) 6 cm/s (C) 3 cm/s (D) 2.25 cm/s B) The derivative of $\sin(x^2)$ w.r.t. x, at $x = \sqrt{\pi}$ is : (A) 1 (B) -1 (C) $-2\sqrt{\pi}$ (D) $2\sqrt{\pi}$ C) The rate of change of surface area of a sphere with respect to its radius 'r', when $r = 4$ cm, is : (A) $64\pi \text{ cm}^2/\text{cm}$ (B) $48\pi \text{ cm}^2/\text{cm}$ (C) $32\pi \text{ cm}^2/\text{cm}$ (D) $16\pi \text{ cm}^2/\text{cm}$
13	The function $f(x) = x^3 - 3x^2 + 12x - 18$ is : A) (A) strictly decreasing on $\mathbb{R}$ (B) strictly increasing on $\mathbb{R}$ (C) neither strictly increasing nor strictly decreasing on $\mathbb{R}$ (D) strictly decreasing on $(-\infty, 0)$ B) The function $f(x) = kx - \sin x$ is strictly increasing for (A) $k > 1$ (B) $k < 1$ (C) $k > -1$ (D) $k < -1$ C) The function $f(x) = \frac{x}{2} + \frac{2}{x}$ has a local minima at x equal to : (A) 2 (B) 1 (C) 0 (D) -2

14	Given a curve $y = 7x - x^3$ and x increases at the rate of 2 units per second.
A)	The rate at which the slope of the curve is changing, when $x = 5$ is :
	(A) -60 units/sec (B) 60 units/sec
	(C) -70 units/sec (D) -140 units/sec
B)	Find the intervals on which the function $f(x) = 10 - 6x - 2x^2$ is (a) strictly increasing (b) strictly decreasing.
C)	Show that the function $f(x) = 4x^3 - 18x^2 + 27x - 7$ has neither maxima nor minima.
D)	If M and m denote the local maximum and local minimum values of the function $f(x) = x + \frac{1}{x}$ ($x \neq 0$) respectively, find the value of $(M - m)$.
E)	Find the interval in which the function $f(x) = x^4 - 4x^3 + 10$ is strictly decreasing.
F)	The volume of a cube is increasing at the rate of $6 \text{ cm}^3/\text{s}$. How fast is the surface area of cube increasing, when the length of an edge is 8 cm ?
15	The relation between the height of the plant (y in cm) with respect to exposure to sunlight is governed by the relation $y = 4x - \frac{1}{2}x^2$, where x is the number of days it is exposed to sunlight. Based on the above, answer the following questions : (i) Find the rate of growth of the plant with respect to sunlight. (ii) What is the number of days it will take for the plant to grow to the maximum height ? (iii) What is the maximum height of the plant ?

16

A store has been selling calculators at ₹ 350 each. A market survey indicates that a reduction in price (p) of calculator increases the number of units (x) sold. The relation between the price and quantity sold is given by the demand function $p = 450 - \frac{1}{2}x$.



Based on the above information, answer the following questions :

- Determine the number of units (x) that should be sold to maximise the revenue $R(x) = xp(x)$. Also, verify the result.
- What rebate in price of calculator should the store give to maximise the revenue ?

17

Anti-derivative of $\sqrt{1 + \sin 2x}$, $x \in \left[0, \frac{\pi}{4}\right]$ is :

A)

(A) $\cos x + \sin x$

(B) $-\cos x + \sin x$

(C) $\cos x - \sin x$

(D) $-\cos x - \sin x$

B)

$$\int_0^{\pi/2} \frac{\sin x - \cos x}{1 + \sin x \cos x} dx \text{ is equal to :}$$

(A) π

(B) Zero (0)

$$(C) \int_0^{\pi/2} \frac{2 \sin x}{1 + \sin x \cos x} dx$$

(D) $\frac{\pi^2}{4}$

C)

If $\int_0^2 2e^{2x} dx = \int_0^a e^x dx$, the value of 'a' is :

(A) 1

(B) 2

(C) 4

(D) $\frac{1}{2}$

18	Find :
A)	$\int \frac{x^2}{(x^2 + 4)(x^2 + 9)} dx$
B)	Evaluate : $\int_1^3 (x - 1 + x - 2 + x - 3) dx$
C)	Evaluate : $\int_0^{\frac{\pi}{4}} \frac{\sin x + \cos x}{9 + 16 \sin 2x} dx$
D)	Evaluate : $\int_0^{\frac{\pi}{2}} \sin 2x \tan^{-1}(\sin x) dx$
	Evaluate : $\int_0^{\pi/2} e^x \left(\frac{1 + \sin x}{1 + \cos x} \right) dx$
19	Find :
A)	$\int \frac{1}{x[(\log x)^2 - 3 \log x - 4]} dx$
B)	Find : $\int x^2 \cdot \sin^{-1}(x^{3/2}) dx$
20	Find :
	$\int x^2 \log(x^2 - 1) dx$

English

The Last Lesson

1. How does the story 'The Last Lesson' by Alphonse Daudet highlight the importance of one's language?
2. Describe the character of M. Hamel as a teacher and a patriot.

Lost Spring

1. How does Anees Jung highlight the economic exploitation of children in 'Lost Spring'?
2. What contrast does the author draw between the hopes of the poor children and their grim reality?

My Mother at Sixty-Six

1. How does Kamala Das use imagery to depict the pain of separation in the poem?
2. What is the central theme of 'My Mother at Sixty-Six'?

The Third Level

1. How does Jack Finney blur the line between reality and imagination in 'The Third Level'?
2. Why do you think Charley wanted to escape to the Third Level?

The Tiger King

1. How does Kalki use irony to bring out the message in 'The Tiger King'?
2. Describe the circumstances that led to the Maharaja's death.

Journey to the end of the Earth

1. How does Tishani Doshi describe Antarctica as a lesson for humankind?
2. What lessons about environment and survival does the author derive from her journey to Antarctica?

Notice

1. Draft a notice informing students about a debate competition to be held in your school.
2. Draft a notice for students regarding a lost and found article (a wrist watch) in the school premises.

Invitation

1. Draft a formal invitation to invite the chief guest for the annual function of your school.
2. Draft an informal invitation inviting your friend to your birthday celebration.

Application for Job

1. Draft an application for the post of an English teacher in a reputed public school.
2. Draft an application for the post of a Content Writer in a publishing house.

Letter to the Editor

1. Write a letter to the editor of a newspaper expressing concern about the rising cases of cybercrime among teenagers.
2. Write a letter to the editor about the increasing problem of traffic jams in your city.

Article Writing

1. Write an article on 'Role of Youth in Nation Building'.
2. Write an article on 'Impact of Social Media on Students'.

Report Writing

1. Write a report on the Blood Donation Camp organized in your school.
2. Write a report on the Annual Sports Day of your school.

Computer Science(083)

- Q:** Write a function in Python that reads a pre-existing text file `info.txt` and counts the number of vowels (A, E, I, O, U) present. (Ref. "most expected" type questions)
- Q:** Remove duplicate lines from `story.txt`.
- Q:** Display the longest word in `star.txt`.
- Q:** Explain the difference between the methods `write()` and `writelines()` in Python.
- Q:** What does the `seek()` method do in file handling?
- Q:** Write a Python program that reads a text file and counts the total number of words.
- **Q:** Count the number of lines starting with specific letters (e.g., 'T' or 'M') in `div.txt`.
- Q:** What is global and local variable? Explain different types of argument during function call.

Networking :

- Differentiate between:
 - **HTTP and HTTPS**
 - **IP Address and MAC Address**
 - **Hub, Switch, and Router**
 - **Client-server**
- What is **Domain Name System (DNS)**?
- Define **Firewall**. Why is it used?
- What is the difference between **Packet Switching and Circuit Switching**?
- What is **bandwidth** in a network?
- What do you mean by **URL**? Give example.
- Expand: **FTP, VoIP, SMTP, TCP/IP, POP3. (FULL FORM)**
- Explain **cloud computing** and its advantages in networking.
- What is **VoIP**? How is it different from traditional telephony?
- Describe **Cyber Crime** and **Cyber Law** with examples.
- Explain **data communication modes**: Simplex, Half Duplex, Full Duplex.
- Discuss how **encryption** and **digital signatures** help in data security.

Project(GroupWise)

Using python language , MySQL Server , and MySQL connector to develop a project.