S.H.I.P.S.
[A Premier Institution]

SHREE HANUMAT INTERNATIONAL PUBLIC SCHOOL
(Senior Secondary)
Affiliated to the C.B.S.E., New Delhi, Vide Code No. – 1630686,
G.T. ROAD, GORAYA (Distt. Jalandhar)- 144409, Contact – 78376-36615, 99887-03474

Exploring, Learning & Growing-

Home Assignment-2025-26

(A Thoughtful Mix of Study, Play & Values)

Name :_____

Roll No. _____

Grade – XII SCIENCE

Note to Parents and Guardians

5. Marks for these assignments will be included in the Terminal Assessment.
6. Kindly encourage your child to complete the work independently. Gentle support is welcome, but let the learning be child-led.
7. You may use loose sheets for tasks requiring extra space or creativity.
8. The Best Assignment of the Year will be awarded and recognized during school events.

5. Marks for these assignments will be included in the Terminal Assessment.

Guidelines for a Balanced and Enriching Learning Experience at Home

Dear Parents and Guardians

Thank you for being an essential partner in your child's learning journey. Here are a few tips to make the most of this Home Assignment:

Academics and Term I Preparation

- Encourage a daily routine that includes time for reading, writing and activity-based learning.
- Focus on basic and conceptual skills.
- Revise the concepts covered in class as shared through circulars and communication.
- Prepare gradually for the Term I Exam in September — avoid last-minute stress.
- Create a study corner that's well-lit, quiet, and cheerful.

Play & Creative Time

- Ensure your child gets ample free play, which boosts brain development.
- Engage in art and craft using eco-friendly materials.
- Storytelling, singing rhymes and dancing together create joyful bonds.

Seva & Social Responsibility

- Introduce the child to values of compassion and sharing:
- Visit an old age home or Blind Ashram occasionally. Let the child offer fruits, biscuits or a handmade card.
- Encourage small acts of kindness like donating old toys/clothes.
- Explain the importance of Seva (selfless service) through simple examples.

Family Time & Social Visits

- Plan weekend visits to relatives or grandparents to strengthen family ties.
- Share stories from your own childhood — this builds emotional connection and moral learning.

Stay Connected with Teachers

- Don't hesitate to reach out for academic support or even emotional guidance.
- Teachers are here to help — schedule a brief chat during PTMs or via school communication channels.

Final Tips

- Assignments are meant to be child-led. Offer guidance but let the child explore.
- All submissions will be graded and the Best Assignment of the Year will be rewarded.
- Keep things light — learning should be joyful, not stressful

Let's raise not just a student, but a good human being — one kind act, one thoughtful task at a time.

ENGLISH

PROJECT (2025-26)

1. MARKING SCHEME

- The project consists of 10 MARKS. Out of which, 5 MARKS will be allotted for the PROJECT FILE, And remaining 5 MARKS for the VIVA based on the file.
- The viva will be conducted by the EXTERNAL/INTERNAL EXAMINER.

2. CONTENT OF THE PROJECT FILE:

- The project file may include the following:
- Cover page, with the title of the project, school details and details of the student
- Certificate of Completion under the guidance of the teacher (sample will be sent)
- Objectives of the topic
- Action Plan for the completion of assigned tasks (steps involved in doing the Project)
- The 800-1000 words essay/report
- Student reflections (what new learning experience/outcome you have achieved After completing the project)
- If possible, photographs that capture positive learning experience of the students (collages/pics from various online sources)

List of Resources/Bibliography (Last page of the project file)

INSTRUCTIONS:

- Refer to the topics (You can also select different videos available on YouTube, relevant to your topic)
- Listen to these podcasts, documentaries, interviews etc. on the given topics
- Do a thorough research on the topic assigned
- Prepare a report/essay in about 800-1000 words describing the topic/issue/giving your own opinion/suggestions/measures/viewpoints/its impact on people/your learning experience
- You can also state the name of various speakers/people (in the given documentaries/video links), quote them and express their viewpoints

The project should be neat, legible, with an emphasis on quality of content, accuracy of information, creative expression, proper sequencing and should be relevant as per your assigned topic

PROJECT TO BE DONE ON A4 SHEET.

No repetition or copying of project work would be accepted.

- Please don't share your work with anyone. If the External examiner points out any repetition or copying of the project, the consequences would be severe.
- No marks will be awarded for a casual approach of completing the project
- There are 15 topics. Topics are distributed Roll-No Wise. Roll no 16 will get topic no 1 and so on...

TOPICS

1. Importance of Mother Tongue
2. Language Chauvinism
3. Lost Childhoods
4. Overcoming Fears (Phobia)
5. Transforming Lives Through Kindness and Empathy
6. Gandhian Principles
7. Film City Departments
8. How to conduct an Interview
9. Fantasy World of a Teenager
10. Care of the Elderly
11. Violence Against Women in India
12. Global Warming: Revelations from Arctic and Antarctic Regions
13.How to Overcome Disability
14. Education is Empowerment: Fighting Marginalization in Society
15.Impact of Technology on Youth

Physical Education

Assignment file on 5 lifestyle diseases (Obesity , Asthma, Diabetes , Hypertension and Arthrits) . Explain the disease , their causes and preventive measures.
Write the procedure and benefits of 2 yoga asanas for each disease.

PUNJABI

1. ਹੇਠ ਲਿਖੇ ਵਿਸ਼ਿਆਂ ਵਿੱਚੋਂ ਕਿਸੇ ਦੋ ਵਿਸ਼ਿਆਂ ਤੇ ਸੁੰਦਰ ਲਿਖਾਈ ਵਿੱਚ ਕਵਿਤਾ ਲਿਖੋ।
(1) ਪੰਜਾਬੀ ਮਾਂ ਬੋਲੀ
(2) ਪੰਜਾਬੀ ਸੱਭਿਆਚਾਰ
(3) ਦੇਸੀ ਮਹੀਨੇ
(4) ਰੁੱਤਾਂ ਤੇ ਤਿਉਹਾਰ
(5) ਪੰਜਾਬ ਦੇ ਮੇਲੇ
(6) ਭੁੱਲ ਰਹੇ ਪੰਜਾਬੀ ਮਾਂ ਬੋਲੀ
(7) ਅਧਿਆਪਕ
(8) ਮਾਂ

BIOLOGY

MULTIPLE CHOICE QUESTIONS:-

1.Birth control tablets in females, popularly referred to as pills, prevent pregnancy by

A. delaying menstruation
B. inhibiting ovulation and implantation
C. suppressing sperm motility and fertility
D. blocking the entry of sperms during coitus

2.Which of the following statements is/are correct about ZIFT and GIFT as methods of helping conception in cases of infertility?

P) ZIFT can help where the female is unable to form a viable ovum.
Q) ZIFT uses methods of in vitro fertilisation.
R) GIFT involves the injection of one's own ovum into the body.
S) GIFT uses in vivo fertilisation method.

A. only P
B. only P and R
C. only Q, R and S
D. all - P, Q, R and S

3.Bartholin glands are situated

A. At reduced end of tale of on
B.Other side of vagina in humans
C. On either side of vas deferens in humans
D. Onsides of head of some amphibians

4. After ovulation the structure formed by the rupture of follicle is known as

A. Corpus albicans
B. Corpus luteum
C. Corpus callosum
D. Corpus memmilare

5. Which substance is secreted by corpus luteum ?

(A) Enzyme
(B) Bile
(C) Hormone
(D) Pheromone

6. Oestrous cycle is indication of:

(A) Menopause
(B) Pregnancy
(C) Estrogen secretion
(D) Breeding period

7. In human female ova are produced in :

(A) Ovarian follicles
(B) Uterus
(C) Vagina
(D) Oviduc

8. Sertoli cells help in of eggs

(A) Maturation of sperms
(B) Enzyme production
(C) Ovulation
D.) Maturation of eggs

9. Corpus luteum secretes.

(A) LH
(B) Progesterone
(C) Estrogen
(D) FSH

10. Acrosome is formed by:

(A) mitochondria
B) cytoplasm
(C) nucleus
(D) golgi bodies

11. Development of gamete into embryo without ferilization.

(A) Pseudogamy
(B) Parthenogenesis
(C) Apogamy
(D) Parthenocarpy

12. Study of pollen grains is called

(A) Micrology (B) Palynology (C) Microsporogensis (D) Aerology

13. When the body of ovule, embryo sac, micropyle and funicle, all lie in one vertical plane, the ovule is.

(A) Orthotropous

(B) Campylotropous

(C) Anatropous

(D) Amphitropous

14. Polar nuclei are suspended in.

(A) Egg

(B) Suspensor

(C) Central cell

(D) Nucellus

15. In flowering plants, a mature 'male gametophyte' derived from a pollen mother cell by:

(A) Three 'mitotic division

asibn

(B) One 'meiotic' two 'mitotic divisions'

(C) Two 'meiotic divisions'

(D) A single 'meiotic division'.

ASSERTION/REASON

ASSERTION/RE

A. Both assertion and reason are true, and reason is the correct explanation of assertion.

B.Both assertion and reason are true, but reason is not the correct explanation of assertion.

c.Assertion is true but reason is false.

D. Both assertion and reason are false.

1.Assertion: All flowering plants of this earth show sexual reproduction.

Reason: Some flowering plants perform vegetative mode of reproduction also.

2. Assertion : Several hormonal and structural changes are initiated in a plant before flowering.

Reason: Flower has male and female sex organs for sexual reproduction.

3. Assertion: A typical anther of a flower is bilobed.

Reason: Each lobe of anther is dithecous.

4. Assertion: The penis is the male external genitali and made up of special erectile tissue.

Reason: The enlarged end of penis is glans penis is covered by a loose fold of skin i.e., fore skin prepuce.

5. Assertion: The first menstruation cycle begins at
puberty and is called as menarche.
Reason: In human females, menstruation is repeated
at an average of interval of about 28 to 29 days.
6. Assertion: Corpus luteum is yellow endocrine gland in human female.
Reason: It secretes large amounts of progesterone and small amounts of estrogen.
7. Assertion: Zona pellucida is a cellular layer of ovum in human females.
Reason: Corona radiata is a non cellular layer of ovum.
8. Assertion: Reproductive tract infection is due to virus, bacteria or protozoans.
Reason: These infections are usually not curable
9. Assertion: In IVF, fertilisation is performed inside the test tube.
Reason: Embryo with more than 8 blastomeres transferred into the uterus.
10. Assertion: In ZIFT technique, zygote is release into the uterus for implantation.
Reason: In GIFT technique, mixture of gametes is released into the fallopian tube.

SHORT ANSWER QUESTIONS

1. Correct the following statement: i. Surgical method of contraception prevents the gamete formation.
ii. All sexually transmitted diseases are completely curable
iii. Oral pills are a very popular contraceptive among rural women.
iv. In E.T technique embryo or always transferred into the uterus.
2. Age group of 15 to 24 years is highly vulnerable to sexual transmitted diseases. What preventive measures should be taken.
3. 'Parturition is induced by a complex neuro endocrine mechanism'.Justify
4. Describe the process of fertilisation and implantation.
5. Study the graph of menstruation cycle and identify the
   A. 5th day to12th day of the cycle.
   B. 14 day of the cycle
   C. 16th day to 25th day of the cycle.
6. Why does Corpus luteum secrete large amounts of progesterone during the luteal phase of the menstruation cycle?
7. How many eggs are released by human ovary in a month? How many eggs do you think would have been released if the mother gives birth to identical twins? Would you answer change if the twins born were fraternal?
8. In case of polyembryony if an embryo develops from the synergid and another from the nucellus which is haploid and which is diploid?
9. Explain embryo formation in monocotyledons.
10. If you squeeze a seed of orange you might observe many embryos of different sizes? How is it possible to explain?

- DRAW WELL LABELLED DIAGRAMS OF UNIT REPRODUCTION.

PROJECT

1. To prepare project of 35-40 pages on the topic already discussed It should include:

- Cover page
- Index
- Acknowledgement
- Introduction
- Details about the project
- Bibliography

PRACTICAL FILE

NOTE :- Complete your notes. Complete your practical File. Learn full syllabus

New

SURE SHOT QUESTIONS 2026

Chapter – 01

Electric Charges and Fields

➢ Questions

1. Four point charges of $1\ \mu C, -2\ \mu C, 1\ \mu C$ and $-2\ \mu C$ are placed at the corners A, 6, C and D respectively, of a square of side 30 cm. Find the net force acting on a charge of 4 μC placed at the centre of the square.

2. Three point charges, 1 pC each,, are kept at the vertices of an equilateral triangle of side 10 cm. Find the net electric field at the centroid of triangle.

3. A particle of charge 2 μC and mass 1.6 g is moving with a velocity $4\hat{i}\ ms^{-1}$. At t = 0 the particle enters in a region having an electric field $\vec{E}$ (in N C^{-1}) = $80\hat{i} + 60\hat{j}$. Find the velocity of the particle at t = 5s.

4. A point charge (+Q) is kept in the vicinity of an uncharged conducting plate. Sketch the electric field lines between the charge and the plate.

5. Derive an expression for the electric field due to dipole of dipole moment $\vec{p}$ at a point on its perpendicular bisector.

OR

Derive the expression for electric field at a point on the equatorial line of an electric dipole.

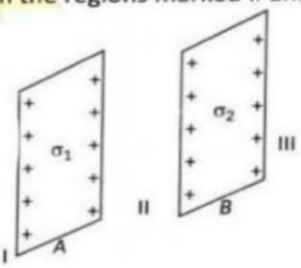
OR

Find resultant electric field due to an electric dipole of dipole moment 2aq (2a being the separation between the charges $\pm q$) at a point distance x on its equator.

6. (i) Define the term 'electric flux'. Write its SI unit.
(ii) What is the flux due to electric field $\vec{E} = 3\times10^{3}\,\hat{i}\ N/C$ through a square of side 10 cm, when it is held normal to $\vec{E}$?

7. Two point charges of +1 μC and +4 μC are kept 30 cm apart. How far from the +1 μC charge on the line joining the two charges, will the net electric field be zero?

8. (a) Derive an expression for the electric field E due to a dipole of length '2a' at a point distance r from the centre of the dipole on the axial line.
Draw a graph of E versus r for r >> a.
Two infinitely large plane thin parallel sheets having surface charges densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of the net electric fields in the regions marked II and III.



10. An electric field is uniform and acts along +x direction in the region of positive x. It is also uniform with the same magnitude but acts in -x direction in the region of negative x. The value of the field is E = 200 N C^{-1} for x > 0 and E = -200 N C^{-1} for x < 0. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one flat face is at x = +10 cm and the others is at x = -10 cm.
Find:
(i) The net outward flux through the cylinder.
(ii) The net charge present inside the cylinder.

11. Consider two hollow concentric spheres S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in figure.

SURE SHOT QUESTIONS 2026

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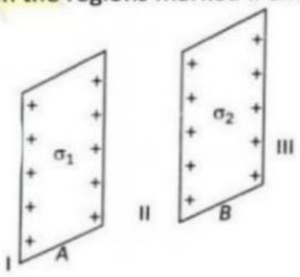
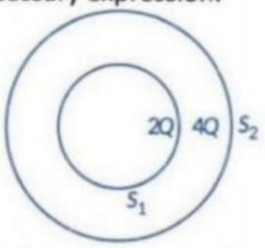


10. An electric field is uniform and acts along +x direction in the region of positive x. It is also uniform with the same magnitude but acts in -x direction in the region of negative x. The value of the field is E = 200 N C^{-1} for x > 0 and E = -200 N C^{-1} for x < 0. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one flat face is at x = +10 cm and the others is at x = -10 cm.
Find:
(i) The net outward flux through the cylinder.
(ii) The net charge present inside the cylinder.

11. Consider two hollow concentric spheres S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in figure.

(i) Find out the ratio of the electric flux through them.

(ii) How will the electric flux through the sphere S_1 change if a medium of dielectric constant 'ε_r' is introduced in the space inside S_1 in place of air? Deduce the necessary expression.



12. State Gauss's law on electrostatics and derive an expression for the electric field due to a long straight thin uniformly charged wire (linear charge density λ) at a point lying at a distance r from the wire.

13. Using Gauss law, derive expression for electric fiel due to a spherical shell of uniform charge distribution σ and radius R at a point lying at a distance x from the centre of shell, such that

14. Two large charged plane sheets of charge densities σ and $-2\sigma\ C/m^2$ are arranged vertically with a separation of d between them. Deduce expressions for the electric field at points (i) to the left of the first sheet, (ii) to the right of the second sheet, and (iii) between the two s

15. Consider a uniform electric field $\vec{E} = 3 \times 10^3 \hat{i} N/C$. Calculate the flux of this Field through a square surface of area 10 cm^2 when

(i) its plane is parallel to the $y - z$ plane

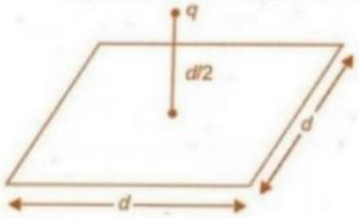
(ii) the normal to its plane makes a $60°$ angle with the $x - axis$.

16. (a) Derive an expression for the electric field at any point on the equatorial line of an electric dipole.

(b) The identical point charges, q each, are kept 2 m apart in air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.

17. A charge is distributed uniformly over a ring of radius 'a'. Obtain an expression for the electric intensity E at a point on the axis of the ring. Hence show that for points at large distances from the ring, it behaves like a point charge.

18. (a)Define Electric flux. Is it a scalar or a vector quantity? A point charge q is at a distance of d/2 directly above the centre of a square of side d, as shown in figure. Use gauss's law to obtain the expression for the electric flux through the square.

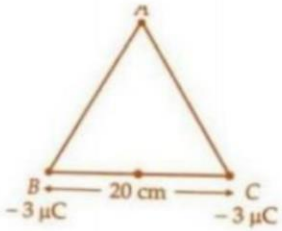


(b) If the point charge is now moved to distance 'd' from the centre of the square and the side of the square is doubled, explain how the electric flux will be affected.

19. State Coulomb's law and express it in vector form.

20. Two free point charges +4e and +e are placed at distance 'a' apart. Where should a third point charge q is placed between them such that the entire system may be in equilibrium? What should be the magnitude and sign of q? What type of equilibrium will it be?

1. Three point charges of $+2\mu C, -3\mu C$ and $-3\mu C$ are kept at the vertices A, B and C respectively of an equilateral triangle of side 20 cm as shown in figure. What should be the sign and magnitude of the charge to be placed at the midpoint (M) of side BC so that the charge at A remains in equilibrium?



22. Two point charges $+4\mu C$ and $+1\mu C$ are separated by distance of 2 m in air. Find the point on the line joining charges at which the net electric field of the system is zero?

23. Derive an expression for the electric field at a point on the axial position of an electric dipole.

24. Find the expression for electric field intensity at a point on the axis of a uniformly charged ring.

25. Define electric flux. Write its SI unit.

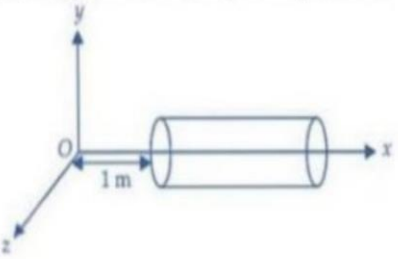
26. Derive an expression for torque on an electric dipole in a uniform electric field.

27. State Gauss theorem and use it to find the electric field at a point due to an infinitely large thin plane sheet has a uniform surface charge density

28. A hollow cylindrical box of length 1 m and area of cross-section 25 cm^2 is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by $\vec{E} = 50x\hat{\imath}$, where E is in NC^{-1} and x is in metres. Find

(i) net flux through the cylinder.

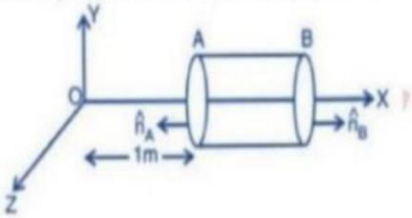
(ii) charge enclosed by the cylinder.



29. A hollow cylindrical box of length 1 m and area of cross section 25 cm^2 is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by $\vec{E} = 5x\hat{\imath}$, where E is in NC^{-1} and x is in metres. Find

(i) Net flux through the cylinder.

(ii) Charge enclosed by the cylinder.

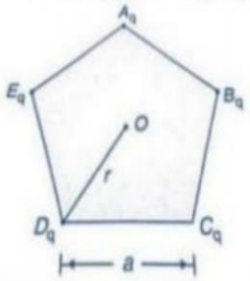


30. Derive an expression for the electric field due to an infinitely long straight uniformly charged wire.

31. Five Charges, q each are placed at the corners of a regular pentagon of side a.

(i) What will be the electric field at O if the charge from one of the corners say (A) is removed?

(ii) What will be the electric field at O if the charge q at A is replaced by -q?



32. Given a uniform field $\vec{E} = 5 \times 10^3\hat{\imath}\ N/C$, Find the flux of this field through a square of side 10 cm on a side whose plane is parallel to the y-z plane. What would be the flux through the same square if he plane makes a 30^0 angle with the x axis?

particle of mass 10^{-3} kg and charge 5 μC enters .o a uniform electric field of $2 \times 10^5\ NC^{-1}$, noving with a velocity of 20 ms^{-1} in a direction opposite to that of the field. Calculate the distance it would travel before coming to rest.

SURE SHOT QUESTIONS 2026

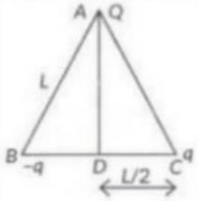
Chapter – 02

Electrostatic Potential and Capacitance

Question

1. Obtain an expression for electrostatic potential energy of a system of three charges q, 2q and -3q placed at the vertices of an equilateral triangle of side a.

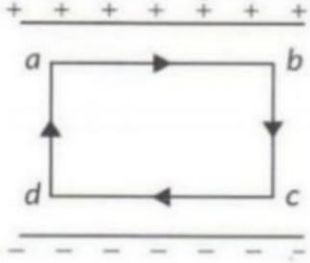
2. Three point charges Q, q and -q are kept at the vertices of an equilateral triangle of side L as shown in figure. What is
(i) The electrostatic potential energy of the arrangement? And
(ii) The potential at point D?



3. N small conducting liquid droplets, each of radius are charged to a potential V each. These droplets coalesce to form a single large drop without any charge leakage. Find the potential of the large drop.

4. Two point charges q and -2q are kept 'd' distance apart. Find the location of point relative to charge 'q' at which potential due to this system of charges is zero.

5. The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop abcda.



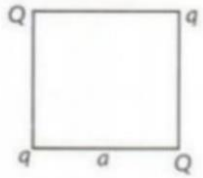
6. Establish the relation between electric field and electric potential at a point. Draw the equipotential surface for an electric field pointing in +Z direction with its magnitude increasing at constant rate along -Z direction.

7. Define an equipotential surface. Draw equipotential surfaces:
   (i) In the case of a single point charge and
   (ii) In a constant electric field in Z – direction. Why the equipotential surface about a single charge are not equidistant?
   iii) Can electric field exist tangential to an equipotential surface? Give reason.

(a) Two point charges $+Q_1$ and $-Q_2$ are placed r distance apart. Obtain the expression for the amount of work done to place a third charge Q_3 at the midpoint of the line joining the two charges.

(b) At what distance from charge $+Q_1$ on the line joining the two charges (in terms of Q_1, Q_2 and r) will this work done be zero.

Four point charges Q, q, Q and q are placed at the corners of a square of side 'a' as shown in the figure. Find the



(a) Resultant electric force on a charge Q, and
(b) Potential energy of this system.

10. (a) Three point charges q, -4q and 2q are placed at the vertices of an equilateral triangle ABC of side '*l*' as shown in the figure. Obtain the expression for the magnitude of the resultant electric force acting on the charge q.
   (c) Find out the amount of the work done to separate the charges at infinite distance.

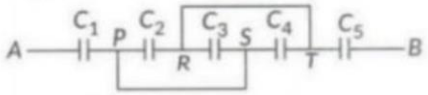
11. In a parallel plate capacitor with air between the plates, each plate has an area of 6×10^{-3} m^2 and the separation between the plates is 0.3 mm.

(i) Calculate the capacitance of the capacitor.

(ii) If this capacitor is connected to 100 V supply, what would be the charge on each plate?

(iii) How would charge on the plates be affected, if a 3 mm thick mica sheet of K = 6 is inserted between the plates while the voltage supply remains connected?

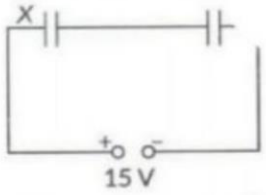
12. (i) Find the equivalent capacitance between A and B in the combination given below. Each capacitor is of 2 μF capacitance.



(i) If a dc source of 7 V is connected across AB, how much charge is drawn from the source and what is the energy stored in the network?

13. A 12 pF capacitor is connected to a 50 V battery. How much electrostatic energy is stored in the capacitor? If another capacitor of 6 pF is connected in series with it with the same battery connected across the combination, find the charge stored and potential difference across each capacitor.

14. Two parallel plate capacitors X and Y have the same area of plates and same separation betwee. them. X has air between the plates contains a dielectric of $\varepsilon_r = 4$.



(i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 μF.

(ii) Calculate the potential difference between the plates of X and Y.

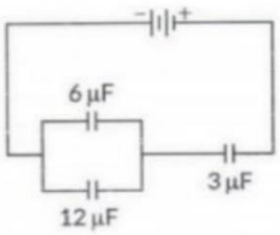
(iii) Estimate the ratio of electrostatic energy stored in X and Y.

15. In the following arrangement of capacitors, the energy stored in the 6 μF capacitor is E. Find the value of the following

(i) Energy stored in 12 μF capacitor

(ii) Energy stored in 3 μF capacitor

(iii) Total energy drawn from the battery

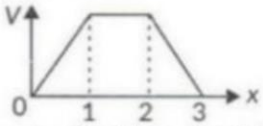


16. The magnitude of electric field (in N C^{-1}) in a region varies with the distance r (in m) as

E = 10r + 5

By how much does the electric potential increase in moving from point at r = 1 m to a point at r = 10 m.

17. The electric potential as a function of distance 'x' is shown in the figure. Draw a graph of the electric field E as a function of x.



18. Derive an expression for the potential energy of an electric dipole in a uniform electric field. Explain conditions for stable and unstable equilibrium.

19. If two similar large plates, each of area A having surface charge densities + σ and - σ are separated by a distance d in air, find the expressions for

(a) Field at points between the two plates and on outer side of the plates. Specify the direction of the field in each case.

The potential difference between the plates.

The capacitance of the capacitor so formed.

20. (a) Define an ideal electric dipole. Give an example.

(b) Derive an expression for the torque experienced by an electric dipole in a uniform electric field. What is net force acting on this dipole?

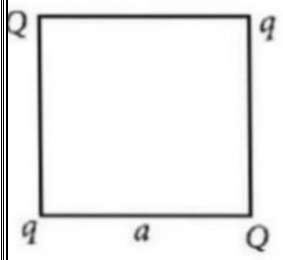
(c) An electric dipole of length 2 cm is placed with its axis making an angle of 60^0 with respect to uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ N/m, calculate the magnitude of charge on the dipole, and its potential energy.

21. Four point charges Q, q, Q and q are placed at the corners of a square of side 'a' as shown in the figure.

Find the

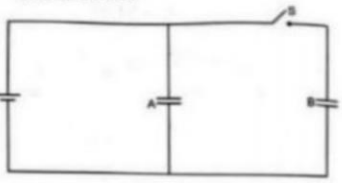
(a) resultant electric force on a charge Q, and

(b) potential energy of this system.



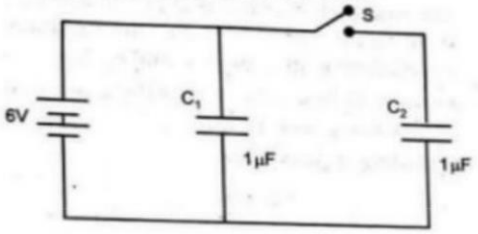
22. Show that the capacitance of a spherical conductor is $4\pi\varepsilon_0$ times the radius of the spherical conductor.

23. Two identical parallel plate capacitors A and B are connected to battery of V volts with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant K. find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.



24. A 100 μF parallel plate capacitor having plate separation of 4 mm is charged by200 V dc. The source is now disconnected. When the distance between the plates is doubled and dielectric slab thickness 4 mm and dielectric constant 5 is introduced between the plates, how will (i) the capacitance, (ii) the electric field between plates, and (iii) energy density of the capa affected? Justify your answer in each case

25. Figure shows two identical capacitors, C_1 and C_2 each of 1 μF capacitance connected to a battery of 6 V. Initially switch 'S' is closed. After sometime 'S' is left open and dielectric slabs of dielectric constant K = 3 are inserted to fill completely the space between the plates of the capacitors. How will the (i) charge and (ii) potential difference between the plates of the capacitors be affected after the slabs are inserted?



26. Two tiny spheres carrying charges 1.5 μC and 2.5 μC are located 30 cm apart. Find the potential and the electric field

a. At the mid-point of the line joining the two charges, and
b. At a point 10 cm from this mid-point in a plane normal to the line and passing through the mid-point.

27. Define an equipotential surface. Draw equipotential surfaces :

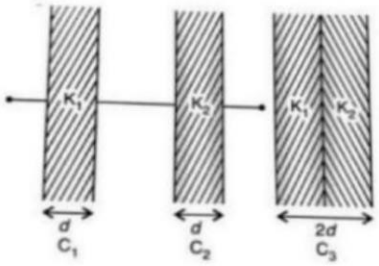
i. In the case of the single point charge and
ii. In a constant electric field in Z-direction. Why the equipotential surfaces about a single charge are not equidistant ?
iii. Can electric field exist tangential to an equipotential surface? Give reason.

28. Derive a relation between electric field & potential & explain significance of –ve sign.

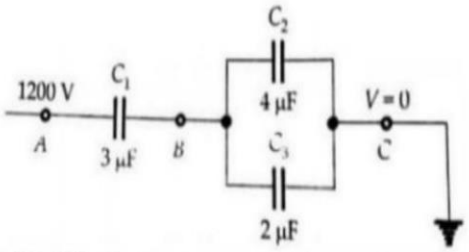
9. An electric dipole of length 4 cm, when placed with its axis making an angle of 60 with a uniform electric field experiences a torque of $4\sqrt{3}$ Nm. Calculate (i) magnitude of the electric field, (ii) potential energy of the dipole, if the dipole has charges of $\pm$ 8 nC.

Two particles have equal masses of 5.0 g each and opposite charges of +4 x 10^{-5} C and -4 x 10^{-5} C. They are released from rest with a separation of 1.0 m between them. Find the speeds of the particles when the separation is reduced to 50 cm.

31. The capacitors C_1 and C_2 having plates of area A each, are connected in series, as shown. Compare the capacitance of this combination with the capacitor C_3, again having plates of area A each, but 'made up' as shown in the figure.



32. In the circuit shown in the Fig., if the point C is earthed and point A is given a potential of +1200 V, find the charge on each capacitor and the potential at the point B

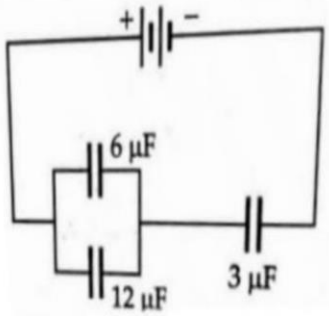


33. In the following arrangements of capacitors, the energy stored in the 6 μF capacitor is E. Find the value of the following :

(i) Energy stored in 12 μF capacitor.

(ii) Energy stored in 3 μF capacitor.

(iii) Total energy drawn from the battery.



Section A

1. To determine resistance per unit length of a given wire by plotting a graph for potential difference versus current.
2. To find resistance of a given by using Meter bridge and hence determine the specific resistance.
3. To verify the laws of combination of resistances using meter bridge.
4. To determine resistance of a galvanometer by half deflection method and to find the figure of merit.
5. To convert the given galvanometer of known resistance and figure of merit into an ammeter and voltmeter of desired range and to verify the same.

Section B

1. To find the focal length of a convex lens by plotting a graph between u and v or between 1/u and 1/v.
2. To find the value of v for different values of u in case of a concave mirror and find their focal length.
3. To determine angle of medium deviation for a given prism by plotting a graph between angle of incidence and angle of deviation.
4. To draw the I-V characteristic curve of a pn junction in forward bias and reverse bias.
5. To determine the reflective index of a glass slab using a travelling microscope.

Unit-ELECTROCHEMISTRY

Questions for Practice

Choose and write the correct answer for each of the following.

1. **The value of van't Hoff factor for ethanoic acid in benzene is**

   (*a*) 1.0 (*b*) 1.5

   (*c*) 0.5 (*d*) 2

2. **Which of the following aqueous solutions should have the highest boiling point?** [*NCERT Exemplar*]

   (*a*) 1.0 M NaOH (*b*) 1.0 M Na_2SO_4

   (*c*) 1.0 M NH_4NO_3 (*d*) 1.0 M KNO_3

3. **An unknown gas 'X' is dissolved in water at 2.5 bar pressure and has mole fraction 0.04 in solution. The mole fraction of 'X' gas when the pressure of gas is doubled at the same temperature is** [*CBSE 2022 (56/3/4)*]

   (*a*) 0.08 (*b*) 0.04

   (*c*) 0.02 (*d*) 0.92

4. **An azeotropic solution of two liquids has a boiling point lower than either of the two when it** [*CBSE 2022 (56/3/4)*]

   (*a*) shows a positive deviation from Raoult's law.

   (*b*) shows a negative deviation from Raoult's law.

   (*c*) shows no deviation from Raoult's law.

   (*d*) is saturated.

5. **Which one of the following pairs will form an ideal solution?**

   (*a*) Chloroform and acetone

   (*b*) Ethanol and acetone

   (*c*) *n*-hexane and *n*-heptane

   (*d*) Phenol and aniline

In the following questions, two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(*a*) *Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).*

(*b*) *Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).*

(*c*) *Assertion (A) is correct, but Reason (R) is incorrect statement.*

(*d*) *Assertion (A) is incorrect, but Reason (R) is correct statement.*

6. **Assertion (*A*) :** Molarity of a solution in liquid state changes with temperature.
   Reason (*R*) : The volume of a solution changes with change in temperature.

7. **Assertion (*A*) :** Osmotic pressure is a colligative property.
   Reason (*R*) : Osmotic pressure is proportional to the molality.

8. **Assertion (*A*) :** If more volatile liquid is added to another liquid, vapour pressure of solution will be greater than that of pure solvent.

   Reason (*R*) : Vapour pressure of solution is entirely due to solvent molecules.

9. **Assertion (*A*) :** The boiling point of pure solvent is always higher than the boiling point of solution.

   Reason (*R*) : The vapour pressure of the solvent decreases in the presence of non-volatile solute.

10. **Assertion (*A*) :** The boiling point of 0.1 M urea solution is less than that of 0.1 M KCl solution.

    Reason (*R*) : Elevation of boiling point is directly proportional to the number of species present in the solution.

Answer the following questions:

11. What type of deviation is shown by a mixture of ethanol and acetone? What type of azeotrope is formed by mixing ethanol and acetone? **[*CBSE (F) 2013*]**

12. Derive the relationship between relative lowering of vapour pressure and molar mass of the solute. **[*CBSE Chennai 2015*]**

13. Give reasons: **[*CBSE 2019 (56/2/1)*]**

    (*i*) Cooking is faster in pressure cooker than in cooking pan.

    (*ii*) Red Blood Cells (RBC) shrink when placed in saline water but swell in distilled water.

14. Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%.

15. Henry's law constant for the molality of methane in benzene at 298 K is 4.27×10^5 mm Hg. Calculate the solubility of methane in benzene at 298 K under 760 mm Hg.

16. At 25°C the saturated vapour pressure of water is 3.165 kPa (23.75 mm Hg). Find the saturated vapour pressure of a 5% aqueous solution of urea (carbamide) at the same temperature.

    (Molar mass of urea = 60.05 g mol^{-1})

17. Calculate the freezing point of a solution when 3 g of $CaCl_2$ (M = 111 g mol^{-1}) was dissolved in 100 g of water, assuming $CaCl_2$ undergoes complete ionisation. (K_f for water = 1.86 K kg mol^{-1}).

18. Calculate the mass of NaCl (molar mass = 58.5 g mol^{-1}) to be dissolved in 37.2 g of water to lower the freezing point by 2°C, assuming that NaCl undergoes complete dissociation.

    (K_f for water = 1.86 K kg mol^{-1})

19. (*i*) When 2.56 g of sulphur was dissolved in 100 g of CS_2, the freezing point lowered by 0.383 K. Calculate the formula of sulphur (S_x).

    [K_f for CS_2 = 3.83 K kg mol^{-1}, Atomic mass of Sulphur = 32 g mol^{-1}]

    (*ii*) Blood cells are isotonic with 0.9 % sodium chloride solution. What happens if we place blood cells in a solution containing

    (*a*) 1.2% sodium chloride solution?

    (*b*) 0.4% sodium chloride solution?

20. (*i*) Why is boiling point of 1M NaCl solution more than that of 1M glucose solution?

    (*ii*) A non-volatile solute 'X' (molar mass = 50g mol^{-1}) when dissolved in 78 g of benzene reduced its vapour pressure to 90%. Calculate the mass of X dissolved in the solution.

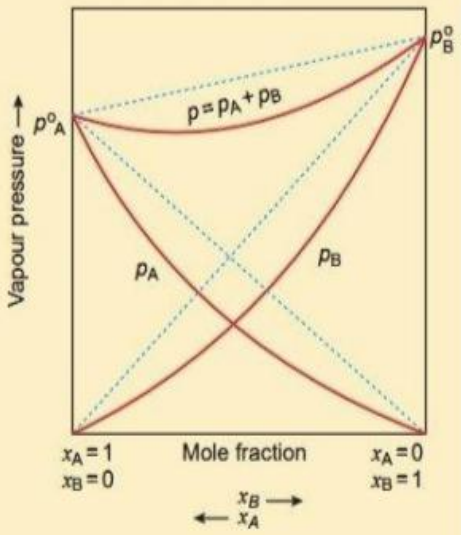
(*iii*) Calculate the boiling point elevation for a solution prepared by adding 10g of $MgCl_2$ to 200g of water assuming $MgCl_2$ is completely dissociated.

(K_b for water = 0.512 K kg mol^{-1}, Molar mass $MgCl_2$ = 95g mol^{-1})

[*CBSE 2023 (56/5/2)*]

21. (*i*) Calculate the molality of a sulphuric acid solution in which the mole fraction of water is 0.85.

(*ii*) The graphical representation of vapour pressures of two component system as a function of composition is given alongside.



By graphic inspection, answer the following questions:

(*a*) Are the A–B interactions weaker, stronger or of the same magnitude as A–A and B–B?

(*b*) Name the type of deviation shown by this system from Raoult's law.

(*c*) Predict the sign of $\Delta_{mix}H$ for this system.

(*d*) Predict the sign of $\Delta_{mix}V$ for this system.

(*e*) Give an example of such a system.

(*f*) What type of azeotrope will this system form, if possible?

Unit-SOLUTION

Questions for Practice

Choose and write the correct answer for each of the following.

1. **A hypothetical electrochemical cell is shown below:**

   $A \mid A^+(xM) \parallel B^+(yM) \mid B$

   The emf measured is +0.20 V. The cell reaction is

   (*a*) $A + B^+ \longrightarrow A^+ + B$

   (*b*) The cell reaction cannot be predicted.

   (*c*) $A^+ + e^- \longrightarrow A, B^+ + e^- \longrightarrow B$

   (*d*) $A^+ + B \longrightarrow A + B^+$

2. **When 0.1 mole of MnO_4^{2-} is oxidised, the quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^- is**

   (*a*) 96500 C (*b*) 9650 C

   (*c*) 96.50 C (*d*) 2×96500 C

3. **A voltaic cell is made by connecting two half cells represented by half equations below:** [*CBSE 2023 (56/5/2)*]

   $Sn^{2+}(aq) + 2e^- \longrightarrow Sn(s)$ $E^\circ = -0.14$ V

   $Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$ $E^\circ = +0.77$ V

   Which statement is correct about this voltaic cell?

   (*a*) Fe^{2+} is oxidised and the voltage of the cell is – 0.91 V.

   (*b*) Sn is oxidised and the voltage of the cell is 0.91 V.

   (*c*) Fe^{2+} is oxidised and the voltage of the cell is 0.91 V.

   (*d*) Sn is oxidised and the voltage of the cell is 0.63 V.

4. **In the electrolysis of aqueous sodium chloride solution, which of the following half cell reaction will occur at anode?** [*NCERT Exemplar*]

   (*a*) $Na^+(aq) + e^- \longrightarrow Na(s)$; $E^\circ_{cell} = -2.71$ V

   (*b*) $2H_2O(l) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$; $E^\circ_{cell} = 1.23$ V

   (*c*) $H^+(aq) + e^- \longrightarrow \frac{1}{2}H_2(g)$; $E^\circ_{cell} = 0.00$ V

   (*d*) $Cl^-(aq) \longrightarrow \frac{1}{2}Cl_2(g) + e^-$; $E^\circ_{cell} = 1.36$ V

5. **Which of the following cell was used in Apollo space programme?** [*CBSE 2023 (56/5/2)*]

   (*a*) Mercury cell (*b*) Daniel cell

   (*c*) H_2—O_2 Fuel cell (*d*) Dry cell

In the following questions, two statements are given—one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(*a*) *Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).*

(*b*) *Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).*

(*c*) *Assertion (A) is correct, but Reason (R) is incorrect statement.*

(*d*) *Assertion (A) is incorrect, but Reason (R) is correct statement.*

6. **Assertion (A) :** Conductivity of an electrolyte decreases with decrease in concentration.
   Reason (R) : Number of ions per unit volume increase on dilution. **[CBSE 2023 (56/2/1)]**
7. **Assertion (A) :** $\wedge_m$ for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.
   Reason (R) : For weak electrolytes, degree of dissociation increases with dilution of solution. **[CBSE 2023 (56/4/2)]**
8. **Assertion (A) :** Rusting of iron is quicker in saline water than in ordinary water.
   Reason (R) : Salt water helps in flow of current in the miniature cell developed on the iron surface.
9. **Assertion (A) :** An electrochemical cell can be set up only if the redox reaction is spontaneous.
   Reason (R) : A reaction is spontaneous if free energy change is negative.
10. **Assertion (A) :** If $\lambda^\circ_{Na^+}$ and $\lambda^\circ_{Cl^-}$ are molar limiting conductivity of sodium and chloride ions respectively, then the limiting molar conductivity for sodium chloride is given by the equation: $\lambda^\circ_{NaCl} = \lambda^\circ_{Na^+} + \lambda^\circ_{Cl^-}$
    Reason (R) : This is according to Kohlrausch law of independent migration of ions.

Answer the following questions:

11. In a plot of Λ_m against the square root of concentration ($C^{1/2}$) for strong and weak electrolyte, the value of limiting molar conductivity of a weak electrolyte cannot be obtained graphically. Suggest a way to obtain this value. Also state the related law, if any. **[CBSE 2023 (56/4/2)]**
12. (*i*) (*a*) What should be the signs (positive/negative) for E°_{Cell} and ΔG° for a spontaneous redox reaction occurring under standard conditions?
    (*b*) State Faraday's first law of electrolysis.
    (*ii*) Calculate the emf of the following cell at 298 K:
    $Fe(s) \mid Fe^{2+}(0.01M) \mid\mid H^+(1M) \mid H_2(g)$ (1 bar), $Pt(s)$
    Given: $E^\circ_{Cell} = 0.44$ V.
13. (*i*) For a weak electrolyte, molar conductance in dilute solution increases sharply as its concentration in solution is decreased. Give reason.
    (*ii*) Write overall cell reaction for lead storage battery when the battery is being charged.
14. Two half-reactions of an electrochemical cell are given below:
    $MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$; $E^\circ = +1.51$ V
    $Sn^{2+}(aq) \longrightarrow Sn^{4+}(aq) + 2e^-$; $E^\circ = +0.51$ V
    Construct the redox equation from the standard potential of the cell and predict if the reaction is reactant favoured or product favoured.
15. Calculate $\Delta_r G^\circ$ and $\log K_c$ for the following reaction: **[CBSE 2019 (56/4/1)]**
    $Cd^{2+}(aq) + Zn(s) \longrightarrow Zn^{2+}(aq) + Cd(s)$
    [Given: $E^\circ_{Cd^{2+}/Cd} = -0.403$ V, $E^\circ_{Zn^{2+}/Zn} = -0.763$ V]
16. Account for the following:
    (*i*) Alkaline medium inhibits the rusting of iron.
    (*ii*) Iron does not rust even if the zinc coating is broken in a galvanized iron pipe.

17. A voltaic cell is set up at 25°C with the following half cells:

Al/Al^{3+} (0.001 M) and Ni/Ni^{2+} (0.50 M)

Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

$E^{\circ}_{Ni^{2+}/Ni} = -0.25$ V; $E^{\circ}_{Al^{3+}/Al} = -1.66$ V ($\log 8 \times 10^{-6} = -5.097$)

18. The conductivity of 0.001028 mol L^{-1} acetic acid is 4.95×10^{-5} S cm^{-1}. Calculate its dissociation constant if Λ°_m for acetic acid is 390.5 S cm^2 mol^{-1}.

19. Give three point of differences between electrochemical cell and electrolytic cell.

20. Represent the cell in which the following reaction takes place. The value of E° for the cell is 1.260 V. What is the value of E_{cell}?

$$2Al(s) + 3Cd^{2+}(0.1M) \longrightarrow 3Cd(s) + 2Al^{3+}(0.01M)$$ ***[CBSE Sample Paper 2022]***

21. Write the Nernst equation and calculate the emf of the following cell at 298 K. ***[CBSE 2022 (56/4/2)]***

$$Zn \mid Zn^{2+}(0.001\ M) \mid\mid H^{+}(0.01\ M) \mid H_2(g)\ (1\ bar) \mid Pt(s)$$

Given: $E^{\ominus}_{Zn^{2+}/Zn} = -0.76$ V, $E^{\ominus}_{H^{+}/H_2} = 0.00$ V, [log 10 = 1]

22. (*i*) The electrical resistance of a column of 0.02 M NaOH solution of diameter 1.40 cm and length 44 cm is 5.00×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity. ***[CBSE (C) 2021(56/1/1)]***

(*ii*) Depict the galvanic cell in which the reaction take place:

$$Ni(s) + 2Ag^{+}(aq) \longrightarrow Ni^{2+}(aq) + 2Ag(s)$$

Further show:

(*i*) Which of the electrodes is positively charged?

(*ii*) The carriers of the current in the outer circuit.

23. (*i*) State Faraday's first law of electrolysis. How much charge, in terms of Faraday, is required for the reduction of 1 mol Cu^{2+} to Cu?

(*ii*) Calculate emf of the following cell at 298 K for

$Mg(s) \mid Mg^{2+}(0.1\ M) \mid\mid Cu^{2+}(0.01\ M) \mid Cu(s)$

[$E^{\circ}_{cell} = +2.71$ V, 1F = 96500 C mol^{-1}, log10 = 1] ***[CBSE 2023 (56/1/1)]***

24. (*i*) The molar conductivities of NH_4^+ and Cl^- ion are 73·8 S cm^2 mol^{-1} and 76.2 S cm^2 mol^{-1} respectively. The conductivity of 0·1 M NH_4Cl is $1{\cdot}29 \times 10^{-2}$ S cm^{-1}. Calculate its molar conductivity and degree of dissociation.

(*ii*) Calculate the half-cell potential at 298 K for the reaction

$$Zn^{2+} + 2e^- \longrightarrow Zn$$

if $[Zn^{2+}] = 0.1$ M and $E^{\circ}_{Zn^{2+}/Zn} = -0.76$ V ***[CBSE 2023 (56/4/2)]***

CLASS XII MATHEMATICS

SELF ASSESSMENT TEST (2024-25)

RELATIONS AND FUNCTIONS

Time allowed: 1 hour **Max. Marks: 30**

GENERAL INSTRUCTIONS

(a) The question paper consists of 10 questions divided into Four sections A, B, C & D.

(b) Each question in section A (Q. No. 1 – 3) MCQ/AR carry 1 Mark.

(c) Each question in section B (Q. No. 4 – 5) carries 2 Marks

(d) Each question in section C (Q. No. 6 – 8) carries 3 Marks.

(e) Each question in section D (Q. No. 9 – 10) carries 5 Marks.

(f) The case study question in section E (Q. No.11) carry 4 Mark.

SECTION – A (1 MARK EACH)

Q1. A relation R defined on set A = $\{x : x \in Z \text{ and } 0 \le x \le 10\}$ as R = $\{(x, y) : x = y\}$ is given to be an equivalence relation. The number of equivalence classes is :

(A) 1 (B) 2

(C) 10 (D) 11

Q2. A function $f : \mathbb{R} \to \mathbb{R}$ defined as $f(x) = x^2 - 4x + 5$ is :

(A) injective but not surjective. (B) surjective but not injective.

(C) both injective and surjective. (D) neither injective nor surjective.

Q3. Given below are two statements: one is labelled as **Assertion A** and other is labelled as **Reason R.**

Assertion (A) : The relation R = $\{(x, y) : (x + y)$ is a prime number and $x, y \in N\}$ is not a reflexive relation.

Reason (R) : The number '2n' is composite for all natural numbers n.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below

a. Both **A** and **R** are correct and **R** is the correct explanation of **A**
b. Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**
c. **A** is correct but **R** is not correct
d. **A** is not correct but **R** is correct

SECTION – B (2 MARKS EACH)

Q4. Show that a function $f : \mathbb{R} \to \mathbb{R}$ defined as $f(x) = \frac{5x-3}{4}$ is both one-one and onto.

Q5. A function $f : A \to B$ defined as $f(x) = 2x$ is both one-one and onto. If $A = \{1, 2, 3, 4\}$, then find the set B.

SECTION – C (3 MARKS EACH)

Q6. A relation R is defined on a set of real numbers $\mathbb{R}$ as

$$R = \{(x, y) : x \,.\, y \text{ is an irrational number}\}.$$

Check whether R is reflexive, symmetric and transitive or not.

Q7. A function $f: [-4, 4] \to [0, 4]$ is given by $f(x) = \sqrt{16 - x^2}$. Show that f is an onto function but not a one-one function. Further, find all possible values of 'a' for which $f(a) = \sqrt{7}$.

Q8. Show that the relation S in set $\mathbb{R}$ of real numbers defined by

$$S = \{(a, b) : a \leq b^3,\ a \in \mathbb{R},\ b \in \mathbb{R}\}$$

is neither reflexive, nor symmetric, nor transitive.

SECTION – D (5 MARKS EACH)

Q9. 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.

OR

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].

10. Show that a function $f : R \to R$ defined by $f(x) = \frac{2x}{1+x^2}$ is neither one-one nor onto. Further, find set A so that the given function $f : R \to A$ becomes an onto function.

SECTION – E (4 MARKS – CASE STUDY)

Q11. An organization conducted bike race under two different categories – Boys and Girls. There were 28 participants in all. Among all of them, finally three from category 1 and two from category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college project.

Let $B = \{b_1, b_2, b_3\}$ and $G = \{g_1, g_2\}$, where B represents the set of Boys selected and G the set of Girls selected for the final race.

Based on the above information, answer the following questions :

(I) How many relations are possible from B to G ?

(II) Among all the possible relations from B to G, how many functions can be formed from B to G ?

(III) Let $R : B \to B$ be defined by $R = \{(x, y) : x \text{ and } y \text{ are students of the same sex}\}$. Check if R is an equivalence relation.

OR

(III) A function $f : B \to G$ be defined by $f = \{(b_1, g_1), (b_2, g_2), (b_3, g_1)\}$.

Check if f is bijective. Justify your answer.

SELF ASSESSMENT TEST 2024-25

ANSWERS

RELATIONS AND FUNCTIONS

Q. NO.	ANSWER
1	D
2	D
3	C
4	(to show)
5	$B = \{2, 4, 6, 8\}$
6	R is symmetric , but not reflexive & transitive
7	$a = 3$
8	(to show)
9	**OR** $[5] = \{\pm 10, \pm 5, 0\}$
10	$A = [-1, 1]$
11	(I) 64(II) 8(III) R is an equivalence relation. **OR** not bijective

INVERSE TRIGONOMETRY

Time allowed: 1 hour **Max. Marks: 30**

GENERAL INSTRUCTIONS

e. The question paper consists of 10 questions divided into Four sections A, B, C & D.

f. Each question in section A (Q. No. 1 – 3) MCQ/AR carry 1 Mark.

g. Each question in section B (Q. No. 4 – 5) carries 2 Marks

h. Each question in section C (Q. No. 6 – 8) carries 3 Marks.

i. Each question in section D (Q. No. 9 – 10) carries 5 Marks.

j. The case study question in section E (Q. No.11) carry 4 Mark.

SECTION – A (1 MARK EACH)

Q1. The value of $\cos^{-1}\left(\cos\frac{2}{3}\right) + \sin^{-1}\left(\sin\frac{2}{3}\right)$ is:

(a) $\frac{4}{3}$ (b) $\frac{}{2}$ (c) $\frac{3}{4}$ (d)

Q2. The value of $\cos\left(\tan^{-1}\frac{3}{4}\right)$ is:

(a) $\frac{3}{5}$ (b) $\frac{4}{5}$ (c) $\frac{3}{5}$ (d) $\frac{1}{5}$

Q3. Given below are two statements: one is labelled as **Assertion A** and other is labelled as **Reason R.**

Assertion (A) : Domain of $y = \cos^{-1}(x)$ is $[-1, 1]$.

Reason (R) : The range of the principal value branch of $y = \cos^{-1}(x)$ is $[0,\pi]-\left\{\frac{\pi}{2}\right\}$.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below

a. Both **A** and **R** are correct and **R** is the correct explanation of **A**

b. Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**

c. **A** is correct but **R** is not correct

d. **A** is not correct but **R** is correct

SECTION – B (2 MARKS EACH)

Q4.	If $a = \sin^{-1}\left(\frac{\sqrt{2}}{2}\right) + \cos^{-1}\left(-\frac{1}{2}\right)$ and $b = \tan^{-1}\left(\sqrt{3}\right) - \cot^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ then find the value of a + b.
Q5.	Find the domain of $y = \sin^{-1}(x^2 - 4)$.

SECTION – C (3 MARKS EACH)

Q6.	Find the value of $\left[\sin^2\left\{\cos^{-1}\left(\frac{3}{5}\right)\right\} + \tan^2\left\{\sec^{-1}(3)\right\}\right]$.
Q7.	Simplify : $\cos^{-1}x + \cos^{-1}\left[\frac{x}{2} + \frac{\sqrt{3-3x^2}}{2}\right]$; $\frac{1}{2} \le x \le 1$
Q8.	Draw the graph of $f(x) = \sin^{-1} x$, $x \in \left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$. Also, write range of f(x).

SECTION – D (5 MARKS EACH)

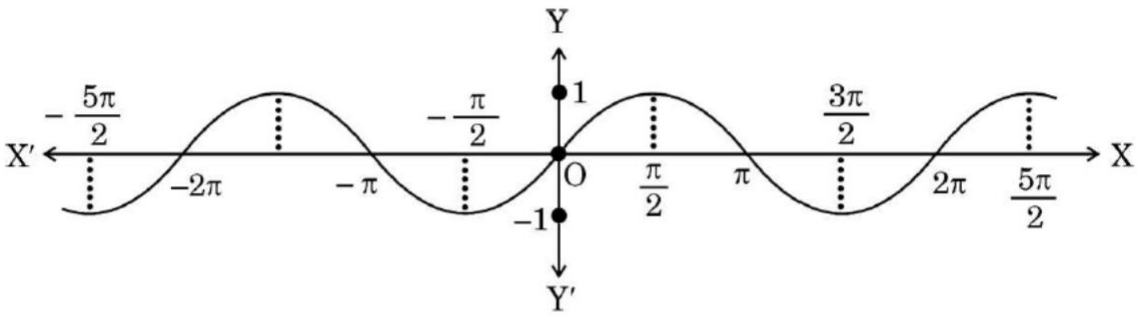
Q9.	**(a)** Prove that $\tan^{-1}\left(\frac{\cos x}{1+\sin x}\right) = \frac{\pi}{4} - \frac{x}{2}, x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$. **(b)** Show that: $\cot^{-1}\left(\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right) = \frac{x}{2}$, $x \in \left(0, \frac{\pi}{4}\right)$
Q10.	**(a)** Write $y = \tan^{-1}\left[\frac{\sqrt{1+x^2}-1}{x}\right], x \neq 0$ in the simplest form. **(b)** Prove that $\tan\left\{\frac{\pi}{4} + \frac{1}{2}\cos^{-1}\frac{a}{b}\right\} + \tan\left\{\frac{\pi}{4} - \frac{1}{2}\cos^{-1}\frac{a}{b}\right\} = \frac{2b}{a}$

SECTION – E (4 MARKS – CASE STUDY)

Q11 .

If a function f : X → Y defined as f(x) = y is one-one and onto, then we can define a unique function g : Y → X such that g(y) = x, where x ∈ X and y = f(x), y ∈ Y. Function g is called the inverse of function f.

The domain of sine function is R and function sine : R → R is neither one-one nor onto. The following graph shows the sine function.



$y = \sin x$

Let sine function be defined from set A to [– 1, 1] such that inverse of sine function exists, i.e., $\sin^{-1} x$ is defined from [– 1, 1] to A.

On the basis of the above information, answer the following questions :

(i) If A is the interval other than principal value branch, give an example of one such interval. *1*

(ii) If $\sin^{-1}(x)$ is defined from [– 1, 1] to its principal value branch, find the value of $\sin^{-1}\left(-\frac{1}{2}\right) - \sin^{-1}(1)$. *1*

(iii) (a) Draw the graph of $\sin^{-1} x$ from [– 1, 1] to its principal value branch. *2*

OR

(iii) (b) Find the domain and range of $f(x) = 2\sin^{-1}(1 - x)$. *2*

ANSWERS

INVERSE TRIGONOMETRY

Q. NO.	ANSWER
1	d
2	b
3	c
4	7 12
5	Domain is $[-\sqrt{5}, -\sqrt{3}] \cup [\sqrt{3}, \sqrt{5}]$
6	216 25
7	3
8	Range $= \left[-\frac{\pi}{4}, \frac{\pi}{4}\right]$
9	(to prove)
10	$\frac{1}{2}\tan^{-1}x$
11	(i) $A = \left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$ or, $A = \left[\frac{3\pi}{2}, \frac{5\pi}{2}\right]$ or, $A = \left[-\frac{3\pi}{2}, -\frac{\pi}{2}\right]$ etc. (ii) $-\frac{2}{3}$ (iii) domain of given function is $x \in [0, 2]$ **and** range of the function is $[-\pi, \pi]$

DETERMINANTS

Time allowed: 1 hour 15 minutes **Max. Marks: 30**

GENERAL INSTRUCTIONS

k. The question paper consists of 10 questions divided into Four sections A, B, C & D.

l. Each question in section A (Q. No. 1 – 6) MCQ/AR carry 1 Mark.

m. Each question in section B (Q. No. 7 – 9) carries 2 Marks

n. Each question in section C (Q. No. 10 – 12) carries 3 Marks.

o. Each question in section D (Q. No. 13) carries 5 Marks.

p. The case study question in section E (Q. No.14) carry 4 Mark.

SECTION – A (1 MARK EACH)

Q1. For the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ \lambda & 2 & 0 \\ 1 & -2 & 3 \end{bmatrix}$ to be invertible, the value of λ is :

(A) 0 (B) 10

(C) $\mathbb{R} - \{10\}$ (D) $\mathbb{R} - \{-10\}$

Q2. If $\begin{vmatrix} -a & b & c \\ a & -b & c \\ a & b & -c \end{vmatrix} = kabc$, then the value of k is :

(A) 0 (B) 1

(C) 2 (D) 4

Q3. If A is a square matrix of order 3 such that the value of $|\text{adj}\cdot A| = 8$, then the value of $|A^T|$ is :

(A) $\sqrt{2}$ (B) $-\sqrt{2}$

(C) 8 (D) $2\sqrt{2}$

Q4. If a_{ij} and A_{ij} represent the $(ij)^{th}$ element and its cofactor of $\begin{bmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{bmatrix}$ respectively, then the value of $a_{11}A_{21} + a_{12}A_{22} + a_{13}A_{23}$ is :

(A) 0 (B) -28

(C) 114 (D) -114

Q5. If inverse of matrix $\begin{bmatrix} 7 & -3 & -3 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$ is the matrix $\begin{bmatrix} 1 & 3 & 3 \\ 1 & \lambda & 3 \\ 1 & 3 & 4 \end{bmatrix}$, then value of λ is :

(A) -4 (B) 1

(C) 3 (D) 4

Given below are two statements: one is labelled as **Assertion A** and other is labelled as **Reason R.**

In the light of the given statements, choose the ***most appropriate*** answer from the options given below

e. Both **A** and **R** are correct and **R** is the correct explanation of **A**
f. Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**
g. **A** is correct but **R** is not correct
h. **A** is not correct but **R** is correct

Q6. *Assertion (A) :* For matrix $A = \begin{bmatrix} 1 & \cos\theta & 1 \\ -\cos\theta & 1 & \cos\theta \\ -1 & -\cos\theta & 1 \end{bmatrix}$, where $\theta \in [0, 2\pi]$, $|A| \in [2, 4]$.

Reason (R) : $\cos\theta \in [-1, 1]$, $\forall\ \theta \in [0, 2\pi]$.

SECTION – B (2 MARKS EACH)

Q7. Show that the determinant $\begin{vmatrix} x & \sin\theta & \cos\theta \\ -\sin\theta & -x & 1 \\ \cos\theta & 1 & x \end{vmatrix}$ is independent of θ.

Q8. Find the maximum value of

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+\sin\theta & 1 \\ 1 & 1 & 1+\cos\theta \end{vmatrix}.$$

Q9. If $\begin{vmatrix} x+1 & x-1 \\ x-3 & x+2 \end{vmatrix} = \begin{vmatrix} 4 & -1 \\ 1 & 3 \end{vmatrix}$, then write the value of x.

SECTION – C (3 MARKS EACH)

Q10. If $A = \begin{bmatrix} 1 & \cot x \\ -\cot x & 1 \end{bmatrix}$, show that $A'A^{-1} = \begin{bmatrix} -\cos 2x & -\sin 2x \\ \sin 2x & -\cos 2x \end{bmatrix}$.

Q11. If $A = \begin{bmatrix} -1 & a & 2 \\ 1 & 2 & x \\ 3 & 1 & 1 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 1 & -1 & 1 \\ -8 & 7 & -5 \\ b & y & 3 \end{bmatrix}$,

find the value of $(a + x) - (b + y)$.

Q12. If $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ and I is the identity matrix of order 2, then show that $A^2 = 4A - 3I$. Hence find A^{-1}.

SECTION – D (5 MARKS EACH)

Q13. Using the matrix method, solve the following system of linear equations :

$$\frac{2}{x}+\frac{3}{y}+\frac{10}{z}=4,\ \frac{4}{x}-\frac{6}{y}+\frac{5}{z}=1,\ \frac{6}{x}+\frac{9}{y}-\frac{20}{z}=2.$$

OR

Determine the product

$$\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$$ and use it to solve the system of equations $x - y + z = 4$, $x - 2y - 2z = 9$, $2x + y + 3z = 1$.

SECTION – E (4 MARKS – CASE STUDY)

Q14. A scholarship is a sum of money provided to a student to help him or her pay for education. Some students are granted scholarships based on their academic achievements, while others are rewarded based on their financial needs.

Every year a school offers scholarships to girl children and meritorious achievers based on certain criteria. In the session 2022 – 23, the school offered monthly scholarship of ₹ 3,000 each to some girl students and ₹ 4,000 each to meritorious achievers in academics as well as sports.

In all, 50 students were given the scholarships and monthly expenditure incurred by the school on scholarships was ₹ 1,80,000.

Based on the above information, answer the following questions :

(i) Express the given information algebraically using matrices. *1*

(ii) Check whether the system of matrix equations so obtained is consistent or not. *1*

(iii) (a) Find the number of scholarships of each kind given by the school, using matrices. *2*

OR

(iii) (b) Had the amount of scholarship given to each girl child and meritorious student been interchanged, what would be the monthly expenditure incurred by the school ? *2*

ANSWERS

DETERMINANTS

Q. NO.	ANSWER
1	D
2	D
3	D
4	A
5	D
6	A
7	(to show)
8	$\frac{1}{2}$
9	$x = 2$
10	(to show)
11	3
12	$A^{-1} = \begin{bmatrix} 2/3 & 1/3 \\ 1/3 & 2/3 \end{bmatrix}$
13	$x = 2, y = 3, z = 5$ OR $x = 3, y = -2, z = -1$
14	(*i*) $\begin{bmatrix} 3 & 4 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 180 \\ 50 \end{bmatrix}$ (*ii*) consistent (*iii*) (*a*) $x = 20, y = 30$ (*b*) Rs.170000

MATRICES

Time allowed: 1 hour 15 minutes **Max. Marks: 30**

GENERAL INSTRUCTIONS

(g) The question paper consists of 10 questions divided into Four sections A, B, C & D.

(h) Each question in section A (Q. No. 1 – 10) MCQ/AR carry 1 Mark.

(i) Each question in section B (Q. No. 11 – 14) carries 2 Marks

(j) Each question in section C (Q. No. 15 – 18) carries 3 Marks.

SECTION – A (1 MARK EACH)

Q1. Find the matrix A^2, where $A = [a_{ij}]$ is a 2×2 matrix whose elements are given by a_{ij} = maximum (i, j) – minimum (i, j) :

(A) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

Q2. If $A = \begin{bmatrix} x & 0 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 4 & 0 \\ -1 & 1 \end{bmatrix}$, then value of x for which $A^2 = B$ is :

(A) –2 (B) 2

(C) 2 or –2 (D) 4

Q3. If a matrix has 36 elements, the number of possible orders it can have, is :

(A) 13 (B) 3

(C) 5 (D) 9

Q4. If $A = [a_{ij}]$ be a 3×3 matrix, where $a_{ij} = i - 3j$, then which of the following is ***false*** ?

(A) $a_{11} < 0$ (B) $a_{12} + a_{21} = -6$

(C) $a_{13} > a_{31}$ (D) $a_{31} = 0$

Q5. The number of all scalar matrices of order 3, with each entry – 1, 0 or 1, is :

(A) 1 (B) 3

(C) 2 (D) 3^9

Q6. If $A = \begin{bmatrix} 2 & 1 \\ -4 & -2 \end{bmatrix}$, then the value of $I - A + A^2 - A^3 + \ldots$ is :

(A) $\begin{bmatrix} -1 & -1 \\ 4 & 3 \end{bmatrix}$ (B) $\begin{bmatrix} 3 & 1 \\ -4 & -1 \end{bmatrix}$

(C) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Q7. If $\begin{bmatrix} x+y & 2 \\ 5 & xy \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ 5 & 8 \end{bmatrix}$, then the value of $\left(\frac{24}{x} + \frac{24}{y}\right)$ is

(a) 7 (b) 6 (c) 8 (d) 18

Q8. If $A = [a_{ij}]$ is an identity matrix, then which of the following is true ?

(A) $a_{ij} = \begin{cases} 0, & \text{if } i = j \\ 1, & \text{if } i \neq j \end{cases}$ (B) $a_{ij} = 1, \forall\ i, j$

(C) $a_{ij} = 0, \forall\ i, j$ (D) $a_{ij} = \begin{cases} 0, & \text{if } i \neq j \\ 1, & \text{if } i = j \end{cases}$

Given below are two statements: one is labelled as **Assertion A** and other is labelled as **Reason R.**

In the light of the given statements, choose the ***most appropriate*** answer from the options given below

q. Both **A** and **R** are correct and **R** is the correct explanation of **A**
r. Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**
s. **A** is correct but **R** is not correct
t. **A** is not correct but **R** is correct

Q9. *Assertion (A) :* Every scalar matrix is a diagonal matrix.

Reason (R) : In a diagonal matrix, all the diagonal elements are 0.

Q10. *Assertion (A) :* For any symmetric matrix A, B′AB is a skew-symmetric matrix.

Reason (R) : A square matrix P is skew-symmetric if $P' = -P$.

SECTION – B (2 MARKS EACH)

Q11.	Matrix $A=\begin{bmatrix}0 & 2b & -2\\ 3 & 1 & 3\\ 3a & 3 & -1\end{bmatrix}$ is given to be symmetric, find values of a and b.
Q12.	If A is a square matrix such that $A^2 = I$, then find value of $(A-I)^3 + (A+I)^3 - 7A$.
Q13.	If $A^T = \begin{bmatrix}3 & 4\\ -1 & 0\\ 2 & 1\end{bmatrix}$ and $B = \begin{bmatrix}-1 & 2 & 1\\ 2 & 3 & 1\end{bmatrix}$, then find $A^T - B^T$.
Q14.	Find a matrix A such that $2A - 3B + 5C = O$, where $B=\begin{bmatrix}-2 & 2 & 0\\ 3 & 1 & 4\end{bmatrix}$ and $C=\begin{bmatrix}2 & 0 & -2\\ 7 & 1 & 6\end{bmatrix}$.

SECTION – C (3 MARKS EACH)

Q15.	Find matrix A such that $\begin{bmatrix}2 & -1\\ 1 & 0\\ -3 & 4\end{bmatrix}A=\begin{bmatrix}-1 & -8\\ 1 & -2\\ 9 & 22\end{bmatrix}$ **OR** Express the following matrix as the sum of a symmetric and skew symmetric matrix. $A=\begin{bmatrix}3 & -2 & -4\\ 3 & -2 & -5\\ -1 & 1 & 2\end{bmatrix}$
Q16.	If $A=\begin{bmatrix}-3 & 2\\ 1 & -1\end{bmatrix}$ and $I=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$, find scalar k so that $A^2 + I = kA$.
Q17.	If $A=\begin{bmatrix}1 & 2 & 2\\ 2 & 1 & 2\\ 2 & 2 & 1\end{bmatrix}$, then prove that $A^2 - 4A - 5I = O$.
Q18.	Find the value of $x + y$ from the following equation: $2\begin{bmatrix}x & 5\\ 7 & y-3\end{bmatrix}+\begin{bmatrix}3 & -4\\ 1 & 2\end{bmatrix}=\begin{bmatrix}7 & 6\\ 15 & 14\end{bmatrix}$

ANSWERS

MATRICES

Q. NO.	ANSWER

Q1	c	**Q2**	a
Q3	d	**Q4**	c
Q5	b	**Q6**	a
Q7	d	**Q8**	d
Q9	c	**Q10**	d

11 $a = \frac{-2}{3}$ and $b = \frac{3}{2}$

12 A

13
$$\begin{bmatrix} 4 & 3 \\ -3 & 0 \\ -1 & -2 \end{bmatrix}$$

14
$$A = \begin{bmatrix} -8 & 3 & 5 \\ -13 & -1 & -9 \end{bmatrix}$$

15
$$A = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$$

OR

$$\begin{bmatrix} 3 & 1/2 & -5/2 \\ 1/2 & -2 & -2 \\ -5/2 & -2 & 2 \end{bmatrix} + \begin{bmatrix} 0 & -5/2 & -3/2 \\ 5/2 & 0 & -3 \\ 3/2 & 3 & 0 \end{bmatrix}$$

16 $k = -4$

17 (to show)

18 11