The Laurence School, Lovedale

HOLIDAY ASSIGNMENT - DECEMBER 2025

CLASS XII

ENGLISH

SAMPLE QUESTION PAPER
ENGLISH CORE (Code No. 301)
CLASS-XII-(2024-25)

Time allowed: 3 Hrs. **Maximum Marks: 80**

General Instructions
Read the following instructions very carefully and strictly follow them:

i. *This question paper has 13 questions. All questions are compulsory.*
ii. *This question paper contains three sections:*
Section A: Reading Skills,
Section B: Creative Writing Skills
Section C: Literature.
iii. *Attempt all questions based on specific instructions for each part. Write the correct question number and part thereof in your answer sheet.*
iv. *Separate instructions are given with each question/part, wherever necessary.*
v. *Adhere to the prescribed word limit while answering the questions.*

SECTION A
READING SKILLS **(22 marks)**

1. Read the following passage carefully: **12**

(1) In a room filled with people, each face illuminated by the soft glow of their smartphones, moments drift away like autumn leaves in the wind. The constant hum of notifications fills the air, punctuating conversations like an incessant drumbeat. Every vibration or ping sends fingers flying to screens, a response ingrained by years of digital conditioning. The once-reliable tick-tock of analog timepieces has been overshadowed by the constant flicker of notifications on the wrist watch, blurring the boundaries between the virtual and the real.

(2) Anxiety gnaws at the edges of consciousness when the phone is out of reach, a phantom limb syndrome that leaves us feeling incomplete without our digital appendage. The fear of missing out permeates every moment spent away from the screen, driving us to constantly check for updates and notifications.

(3) Thumbs move with the speed and precision of skillful pianists, tapping out messages and scrolling through feeds with practiced ease. Yet amidst the flurry of activity, the true rhythm of life remains unheard, drowned out by the dissonance of digital noise. The weight of constant connectivity forms a hunch upon our shoulders, a physical manifestation of the burden we carry in an age of information overload. Our minds are perpetually on high alert, scanning for the next wave of excitement that comes with each like, share, or comment.

(4) And yet, for all our efforts to stay connected, we find ourselves increasingly isolated in a sea of digital faces. Genuine connections are fleeting, drowned out by the constant clamour for attention. In the pursuit of digital validation, we sacrifice the wealth of lived experience, trading meaningful moments for fleeting glimpses of connection. The true essence of life lies not in the pixels on a screen, but in the depth of human connection and the richness of shared experiences

1

(5) As we navigate this brave new world of constant connectivity, let us not forget the value of presence and the beauty of being fully engaged in the moments that matter most. For in the end, it is not the number of likes or followers that defines us, but the depth of our connections and the richness of our experiences that truly matter.

Created for Academic Usage / 421 words

Answer the following questions, based on the passage above.

I. According to paragraph 1, what effect do smartphone notifications have on the people in the room? 1

II. How does the author use the metaphor of 'autumn leaves in the wind' to interpret the passing of time in the setting described? 1

III Read and complete the following sentence suitably. 1
The phrase '*a phantom limb syndrome that leaves us feeling incomplete without our digital appendage'* suggests that just as an amputee might feel pain in a limb they no longer have, individuals can feel a sense of loss or incompleteness when they are separated from their digital devices.
Choose the correct response from the two options to complete the sentence.
The concern this analogy points towards is about _____.

A. a deep (psychological) dependence on technology for a sense of wholeness or connection
B. excessive physical damage that can be caused due to constant use of digital devices

IV Complete the following suitably with ONE advantage, with reference to paragraph 2.
Designating specific hours each day to intentionally avoid checking digital devices can help _____. 1

V Why does the writer refer to digital noise as 'dissonance' in paragraph 3? 1
Because-

A. It creates a jarring and chaotic environment that disrupts focus.
B. It contributes to a sense of overload, overwhelming the senses.
C. It interferes with our ability to engage with meaningful aspects of our life.
D. It induces stress by interrupting with regular updates about the device.

VI. Provide ONE textual evidence with reference to paragraph 3, to prove the following: 1
The need to be perpetually engaged with digital notifications manifests in the body.

VII. In the line, 'Yet amidst the flurry of activity, the true rhythm of life remains unheard…,' what does the phrase 'true rhythm of life' refer to? (Paragraphs 3-4) 2

VIII Complete the analogy with ONE word from paragraph 4. 1
whisper: quietly: _____: loudly

A. validation
B. fleeting
C. essence
D. clamour

IX Why is it fair to say that the statement 'And yet, for all our efforts to stay connected, we find ourselves increasingly isolated in a sea of digital faces' from paragraph 4, employs irony? 1

A. Despite the intent to connect more effectively, the result is the opposite.
B. The writer mocks the seriousness with which people approach digital connectivity.
C. The writer exaggerates the effects of digital connectivity to highlight its impact.
D. Use of 'a sea of digital faces' to symbolically represent digital platforms.

X Assess the potential challenges OR benefits of relying on survey outcomes for designing health interventions, as outlined in paragraph 5. 2

2. Read the following carefully. **10**

(1) Introduction:
In the hasty lifestyle of today's world, the choice of snacks can greatly impact one's health and well-being. This case study aims to analyse the preference for seasonal fruits compared to packaged snacks among different age groups and the implications for overall health.

(2) Methodology:
A survey was conducted among individuals across various age groups, ranging from children to seniors, to determine their snacking preferences. Participants were asked to indicate their preferred snack choices and provide reasons for their preferences. The data was then analysed to identify trends and patterns among different age demographics.

(3) Survey Examination:
The survey encompassed a comprehensive examination of snacking habits, including not only preferred snack choices but also delving into the underlying motivations and influences guiding these choices. Beyond mere preference, participants were encouraged to articulate the reasons behind their selections, providing invaluable insights into the multifaceted nature of snacking behavior.

(4) Results:
The survey results revealed interesting insights into snacking preferences among different age groups:

Age-group	%	Preferred snack	Reasons for preference
Children	77	Seasonal fruits	Taste, Health benefits, Parental guidance
Teenagers	65	Packaged snacks	Convenience, Taste, Peer influence
Young adults	52	seasonal fruits and packaged snacks	Transitional lifestyle(college, beginning careers, and establishing independence), Health consciousness, Convenience
Middle-aged	83	Seasonal fruits	Freshness, Nutrition, Health consciousness
Elderly	90	Seasonal fruits	Health benefits, Digestive ease

(5) Implications for Interventions:
By discerning the diverse preferences among different age groups, policymakers and health practitioners can tailor interventions to address specific demographic needs. For instance, targeting educational campaigns towards parents could empower them to instill healthy eating habits in their children from an early age. Concurrently, efforts to mitigate the

influence of advertising and peer pressure on teenagers could involve regulatory measures and educational initiatives aimed at promoting critical thinking and informed decision-making. Furthermore, the prominence of seasonal fruits as a preferred snack choice among middle-aged adults and senior's points towards the importance of promoting access to fresh produce and nutritional education across all age demographics.

(6) Conclusion:
The survey outcomes serve as a roadmap for designing targeted interventions that not only cater to diverse demographic needs but also nurture a culture of health and well-being. By harnessing the insights gleaned from this study, stakeholders can collaboratively work towards building healthier communities and promoting sustainable practices for generations to come.

Created for Academic Usage / 315 words

Answer the following questions, based on given passage.

I. Complete the following suitably. 1

In the introduction, the researcher links a hasty lifestyle with the choice of snacks in the study to highlight_____.

II. What would the following be classified as? 1
To examine snacking preferences across various age groups in detail, and assess health implications.
Select the appropriate response.

A. Primary purpose B. Secondary objective
C. Method of analysis D. Research outcome

III. Give **two** points to support why it is likely that fresh fruits were given as an option to the survey participants to choose from in the study on snacking preferences. 2

IV. Paragraph 3 includes words – 'motivations' and 'influences.' 1
Classify the following sentences as 'influence' or 'motivation':

Sentence 1: Peer pressure leads teenagers to prefer packaged snacks over healthier options.
Sentence 2: The drive to maintain health as one ages makes middle-aged adults to choose seasonal fruits.

V. **Read the following:** 1

Seema regularly enjoys snacking on chips and cool drinks while watching movies. Mohan, her neighbour, prefers to snack on oranges and also some nuts occasionally. Arindam, who lives across, often tends to eat a mix of carrot sticks and instant noodles, in between meals.
Select the option that identifies the correct demographic Seema, Mohan and Arindam belong to.

A. Seema – young adult; Mohan – teenager; Arindam -middle-age
B. Seema - teenager; Mohan – middle-age; Arindam -child
C. Seema – young adult; Mohan – child; Arindam - teenager
D. Seema - teenager; Mohan – elderly; Arindam -young adult

VI. Although children, middle-aged, and elderly groups all prefer seasonal fruits, why is the preference percentage highest among the elderly? 1

VII. Analyse how targeted interventions based on the diverse snacking preferences of different age groups can lead to improved health outcomes. (Paragraph 5) 2

VIII What is the ultimate goal for stakeholders, based on the insights from the study? 1

A. Increase profitability through enhanced snack marketing
B. Building healthier communities
C. Reducing the cost of healthcare services
D. Expanding the range of available snack product

SECTION B
CREATIVE WRITING SKILLS (18 marks)

3. Attempt **any one** of the two, (A) or (B), in about 50 words **1x4=4**

A. Your school is planning to conduct an inter-class seminar on the topic–The Importance of Mental Health–to create awareness in adolescents. As the head of the organising committee, write a notice to inform all students about the seminar and invite registrations from classes XI-XII. Include other necessary details. Put your notice in a box.

OR

B. Your school is organising an inter-House webinar on enhancing coding skills, As the President of the Computer Club, write a notice to inform all House members from IX-XII about the webinar and specify the number of registrations invited per House. Include other necessary details. Put your notice in a box.

4. Attempt **any one** of the two, (A) or (B), in about 50 words. **1x4=4**

A. Draft an invitation in not more than 50 words from Vani Gopalan, Chief Project Officer of an NGO, for the launch of the 'Each One Teach One' programme, addressed to school Principals and Coordinators. Mention a compelling highlight of the programme along with other necessary details

OR

B. An invitation had been issued by Mr. Cherian, the HR Head of your company inviting you for the company picnic. As Joseph Vijayan, Asst. Manager, Operations, draft a reply in not more than 50 words, consenting to attend.

5. Attempt **any one** of the two, (A) or (B), in 120 150 words **1x5=5**

A. Financial literacy is increasingly recognised as a crucial 21st-century skill for young individuals. Write a letter to the editor of a local daily discussing the benefits of providing financial literacy education to children. Also, suggest effective ways to raise awareness about the importance of this education among parents and guardians. You may use some of the given cues along with your own ideas to draft the letter. You are a counsellor, Chitra Mahapatra from Puri, Odisha.

- What are the long-term benefits of learning financial independence from a young age?
- Why is understanding the power of finances beneficial for young learners?
- Why skills learned during childhood tend to have a lasting impact.

OR

B. You are Maya Syiem from Shillong. You read the given advertisement and wish to apply for the post advertised. Write this job application along with your bio-data.

Join our Creative Team!
A renowned publishing house in Shillong
–A NEW WORLD–
is seeking a talented illustrator for children's books.
Creative individuals with a passion for storytelling through art, welcome.
Experience, not mandatory.
Team players with degree/ diploma in Fine Arts/ Graphic Design may apply with 5 samples from portfolio illustrating a variety of work.
Write to the Project Lead, 23-C Rosewood Lane, Shillong-793005

Attempt **any one** of the two, (A) or (B), in 120 150 words **1x5=5**

6.

A. In an era of rapid globalisation and technological advancement, the preservation of cultural heritage remains a vital challenge, particularly for the youth. India continues to navigate the complexities of maintaining tradition alongside modernity. Write an article exploring the role of cultural heritage in shaping the identities of today's Indian youth. Provide examples to illustrate your points wherever necessary. You may use some of the given cues along with your own ideas. You are Arti Nirula of Class XII-A.

- How have global interactions and technologies influenced or changed these traditional practices among today's youth?
- What are the benefits of preserving cultural heritage for young people? How does it contribute to their sense of identity and community?
- Suggest ways in which young people and institutions can work together to ensure the preservation of cultural heritage.

OR

B. You are Hina Aziz, student of Class XII-D and a member of the school magazine editorial board. Write a comprehensive report detailing the activities undertaken by students as part of the celebrations on Yoga Day. Include descriptions of the events, participation details, and the overall impact of these activities on the school community. You may organise your report by following - Who - What – When – Where – Why – How

SECTION C

6

LITERATURE (40 marks)

7. Read the following extracts and answer the questions for any one of the given two-A or B **1x6=6**

A Those who prepare green wars,
wars with gas, wars with fire,
victory with no survivors,
would put on clean clothes
and walk about with their brothers
in the shade, doing nothing. (poem - *Keeping Quiet*)

I. What is a common outcome of all the wars described?

II What does the imagery of 'walking about with their brothers in the shade' primarily represent?

A. The readiness for further conflicts.
B. A return to normal activities post-conflict.
C. A moment of unity and peaceful reflection.
D. The physical environment of a typical war zone.

III. Complete the following suitably.
The putting on of 'clean clothes' by the warmongers, symbolises_____.

IV. Select the correct option from those given in brackets, to fill in the blank.

The excerpt tells us that the speaker _____ (condemns / glorifies) the destructive nature of modern warfare.

V. Read the assertion and the reason below, with reference to the given extract.

Assertion: The poet advocates for 'doing nothing' as a way to prevent the devastation of war.
Reason: 'Doing nothing' refers to a time for stopping any action for a few moments.

Choose the correct option regarding their relationship.

A. Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.
B. Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
C. The assertion is true, but the reason is false.
D. The assertion is false, but the reason is true.

VI. How can the message in the excerpt, about the outcome of wars be applied to promote peace?

OR

B While greedy good-doers, beneficent beasts of prey,
Swarm over their lives enforcing benefits

That are calculated to soothe them out of their wits,
And by teaching them how to sleep they sleep all day,
Destroy their sleeping at night the ancient way. *(poem-The Roadside Stand)*

I Select the phrase that suggests the following:
The so-called aids are not offered out of genuine care or consent but are imposed in a controlling and perhaps unwelcome manner.

II What does the imagery of 'swarm' NOT represent in the given extract?
A. Coordinated help B. Overwhelming force
C. Discomfort and chaos D. Neglect of individual needs

III Complete the following suitably.
In the line, 'destroy their sleeping at night the ancient way,' the phrase 'the ancient way' refers to_____.

IV. Select the correct option from those given in brackets, to fill in the blank.

The poet has used phrases like 'greedy good-doers' and 'beneficent beasts of prey' to illustrate the _____ (irony/satire) in the situation where those claiming to help the rural poor actually impose self-serving and detrimental actions on them.

V. Read the assertion and the reason below, with reference to the given extract.

Assertion: The poet criticizes the way the rural poor are treated by benefactors, suggesting it instills ambition.
Reason: The interventions are overwhelmingly calming and lead to a loss of critical thinking among the rural poor.
Choose the correct option regarding their relationship:
A. Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.
B. Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
C. The assertion is true, but the reason is false.
D. The assertion is false, but the reason is true.

VI. State in one sentence, what cautionary advice your address to the rural poor from the extract, is most likely to include.

8. Read the following extracts and answer the questions for any one of the given two, (A) or (B) 4x1=4

A. To visit Antarctica now is to be a part of that history; to get a grasp of where we've come from and where we could possibly be heading. It's to understand the significance of Cordilleran folds and pre-Cambrian granite shields; ozone and carbon; evolution and extinction. When you think about all that can happen in a million years, it can get pretty mind-boggling. Imagine: India pushing northwards, jamming against Asia to buckle its crust and form the Himalayas; South America drifting off to join North America, opening up the Drake Passage to create a cold circumpolar current, keeping Antarctica frigid, desolate, and at the bottom of the world. (*Journey to the End of the Earth*)

I. Complete the following suitably.
The passage suggests that visiting Antarctica offers insight into geological processes and

Earth's history by _____.

II. How does the author imply the role of geological knowledge in understanding the Earth's past and potential future changes?

III. The writer says, 'When you think about all that can happen in a million years, it can get pretty mind-boggling.'
What is the most likely impact on the writer?
A. Feels overwhelmed by the vastness of geological time scales.
B. Is uneasy about the rapid pace of geological changes.
C. Feels indifferent towards geological phenomena.
D. Is surprised by the lack of significant geological events over a million years.

IV. How might understanding the geological processes mentioned in the passage help scientists in predicting and mitigating future environmental changes, particularly in polar regions?

OR

B. I cried aloud, shaking my head all the while until I felt the cold blades of the scissors against my neck, and heard them gnaw off one of my thick braids. Then I lost my spirit. Since the day I was taken from my mother I had suffered extreme indignities. People had stared at me. I had been tossed about in the air like a wooden puppet. And now my long hair was shingled like a coward's! In my anguish I moaned for my mother, but no one came to comfort me. Not a soul reasoned quietly with me, as my own mother used to do; for now, I was only one of many little animals driven by a herder. (*Memories of Childhood: The Cutting of My Long Hair*)

I. Complete the following suitably.
Zitkala-Sa's description of her experience at the boarding school conveys a sense of abandonment through her portrayal of _____

II. List any one emotion that Zitkala-Sa experiences as her hair is being cut.

III. Select the suitable option to complete the following.
The metaphor of being 'tossed about in the air like a wooden puppet' contribute to the reader's understanding of Zitkala-Sa's feelings of being _____.
A. forced to interact with others
B. manipulated and controlled
C. preached at and insulted
D. made to exist like toy animals

VI In what ways does the imagery of her 'long hair shingled like a coward's' symbolise the erasure of Zitkala's cultural heritage and the imposition of Western norms?

9. Read the following extracts and answer the questions for any one of the given two, A or B. 1x6=6

9

A. What a thunderclap these words were to me! Oh, the wretches; that was what they had put up at the town-hall! My last French lesson! Why, I hardly knew how to write! I should never learn anymore! I must stop there, then! Oh, how sorry I was for not learning my lessons, for seeking birds' eggs, or going sliding on the Saar! My books, that had seemed such a nuisance a while ago, so heavy to carry, my grammar, and my history of the saints, were old friends now that I couldn't give up. And M. Hamel, too; the idea that he was going away, that I should never see him again, made me forget all about his ruler and how cranky he was. (*The Last Lesson*)

I. What was the writer's purpose in using the metaphor of a 'thunderclap'?

II. Select the correct option from those given in brackets to fill in the blank.

The use of exclamatory marks in the first five sentences of the extract serves to express the speaker's _____ (hidden/ intense) emotions.

III. Complete the following suitably.
The activities of seeking birds' eggs and sliding on the Saar reveal two things about Franz's character before his change in perspective. First, his youthful carefree nature and second, his preference for _____.

IV. What is reflected through the shift in the speaker's perception of Mr. Hamel, conveyed through his readiness to forget the ruler?

V. Select the textual option that is closest to indicating a sense of panic.

A. Oh, how sorry I was for not learning my lessons…
B. Why, I hardly knew how to write!
C. Oh, the wretches; that was what they had put up at the town-hall!
D. And M. Hamel, too;

VI. What does the following line from the extract, showcase?

My books, that had seemed such a nuisance a while ago, so heavy to carry, my grammar, and my history of the saints, were old friends now that I couldn't give up.

A. realization B. confusion
C. expectation D. affirmation

OR

B. And survival in Seemapuri means rag-picking. Through the years, it has acquired the proportions of a fine art. Garbage to them is gold. It is their daily bread, a roof over their heads, even if it is a leaking roof. But for a child it is even more "I sometimes find a rupee, even a ten-rupee note," Saheb says, his eyes lighting up. When you can find a silver coin in a heap of garbage, you don't stop scrounging, for there is hope of finding more. It seems that for children, garbage has a meaning different from what it means to their parents. For the children it is wrapped in wonder, for the elders it is a means of survival.
(*Lost Spring – Stories of Stolen Childhood*)

I. What does Saheb's statement about finding money in the garbage reveal about his daily life and aspirations?

10

II. Select the correct option from those given in brackets to fill in the blank.
Describing garbage as 'gold' metaphorically elevates its value to the children, helping the reader understand the _____ (dynamic / desperate) conditions under which these children live, where even garbage can represent crucial economic resources.

III. Complete the following with a suitable reason.
Children continue to scrounge in the garbage because _____.

IV. How does the perception of garbage differ between children and adults in Seemapuri?

V. What is implied by the description of rag-picking as having 'acquired the proportions of a fine art' in the excerpt?
A. Rag-picking is an undesirable and simple task that anyone can do without effort.
B. Rag-picking has evolved into a complex skill that is valued within the community.
C. Rag-picking is a temporary activity that does not significantly impact the community.
D. Rag-picking has the status of an artistic hobby that children pursue for enjoyment.

VI. What is the reason for Saheb's eyes 'lighting up'?
A. The immediate experience of finding something valuable.
B. Discussing his findings with others.
C. Reminiscing about past findings in the garbage.
D. Planning future scavenging expeditions

10. Answer **any five** of the following six questions in 40 50 words each : **5x2=10**

I. Identify an instance of hope or resilience in 'Lost Spring' and analyse how it reflects one of the story's themes.
II. Interpret the use of visual imagery by Kamala Das in her poem to depict the passage of time.
III. What does the contrasting imagery of the church clock and the Prussian trumpets represent, in 'The Last Lesson'?
IV. How does the author's writing style in 'The Interview' affect the reader's understanding of the story?
V. Explain how the rattrap symbolises the dual aspects of human nature. (*The Rattrap*)
VI What factor/s were largely instrumental in the victory of the peasants in 'Indigo'?

11. Answer **any two** of the following three questions in 40 50 words each : **2x2=4**

I. Discuss the significance of the toy tiger in the climax of 'The Tiger King.'

II. Interpret the significance of both literal and metaphorical journeys in the story, 'The Third Level.'

III. How does Susan Hill subtly portray a blend of pessimism and optimism in 'On the Face of It'?

12. Answer **any one** of the following two questions, in about 120-150 words. **1x5=5**

A Analyse the poems, *A Roadside Stand* and *Aunt Jennifer's Tigers* for the theme of inequality and its impact on the bearers.

OR

B How do the characters of Sophie from 'Going Places' and Subbu from 'Poets and Pancakes' compare and contrast in terms of their aspirations, constraints, and the pursuit of their dreams?

13. Answer **any one** of the following two questions, in about 120-150 words **1x5=5**

A The influence of belief in traditions such as religion, family bonds, or patriotism can be used to develop narrative techniques like setting, motivation, sources of conflict, and pacing. Analyse how the writer has incorporated such influences to good effect in the story, *The Enemy*. Support your answer with valid textual evidence.

OR

B Discuss the narrative techniques used by the author in *The Third Level.* How do these techniques effectively convey the themes of escapism and nostalgia? Provide specific examples from the text to support your analysis.

Class XII – English Core
Sample Question Paper – 2025–26Time: 3 Hours Maximum Marks: 80

SECTION – A: READING SKILLS (22 Marks)

Read the passage given below and answer the questions that follow: (12 Marks)

In many modern cities, the increasing pressure on food supply has led people to reconsider how and where food is produced. One emerging solution is **urban farming**, which involves growing plants and vegetables within city limits—on rooftops, balconies, community gardens, and even vertical structures.
Urban farming is more than just a trend; it offers numerous environmental and social benefits. By growing food locally, cities can reduce dependence on long-distance transportation, thereby lowering carbon emissions. Moreover, rooftop gardens help cool buildings, reduce rainwater runoff, and improve air quality by trapping pollutants.
A study conducted in Barcelona revealed that rooftops converted into green spaces reduced indoor temperatures by up to 3°C during summer. With rising global temperatures, such initiatives can significantly reduce the load on air-conditioning systems.
Another major advantage of urban farming is the sense of community it fosters. Many urban residents feel isolated in fast-paced, digital lifestyles. Community gardens bring people together, encouraging cooperation, conversation, and shared responsibility.
However, challenges remain. Space in cities is limited and expensive. Many people lack awareness about techniques such as hydroponics and aquaponics, which require very little soil or space. Initial installation costs are another deterrent. Yet, with increased awareness and government incentives, urban farming may become a vital component of sustainable city life.

Questions:

(i) What is one major environmental benefit of urban farming?
(a) Increased city temperatures
(b) Reduction in carbon emissions
(c) Higher transportation costs
(d) Increase in pollution

(ii) Rooftop gardens help reduce
(a) groundwater levels
(b) indoor temperatures
(c) digital dependency
(d) vegetable prices

(iii) In 40–50 words, explain how urban farming contributes to social well-being.

(iv) In 40–50 words, mention two challenges faced by urban farming.

(v) The word *"deterrent"* in the passage means
(a) encouragement
(b) attraction

(c) obstacle
(d) solution

(vi) State one reason why urban farming may grow in the future. (40–50 words)

2. Read the passage given below and answer the questions that follow: (10 Marks)

The table below shows the percentage of adults reading physical books, e-books, and listening to audiobooks in a survey conducted between 2020 and 2024.

Year	Physical Books	E-Books	Audiobooks
2020	62%	28%	10%
2021	60%	32%	12%
2022	57%	35%	15%
2023	53%	37%	18%
2024	48%	40%	22%

The data reveals changing reading preferences over the years. While the popularity of physical books is declining, the use of e-books and audiobooks is steadily rising due to convenience, portability, and the availability of digital reading platforms.

Questions:

(i) Which format shows a consistent decline?
(a) E-books
(b) Physical books
(c) Audiobooks
(d) All three

(ii) Which format gained the most popularity between 2020 and 2024?
(a) Physical books
(b) E-books
(c) Audiobooks
(d) Newspapers

(iii) In 40–50 words, what conclusions can be drawn about changing reading habits?

(iv) In 40–50 words, mention two reasons why audiobooks have gained popularity.

(v) Which year shows the steepest drop in reading physical books?
(a) 2022
(b) 2023
(c) 2024
(d) 2021

SECTION – B: CREATIVE WRITING SKILLS (18 Marks)

3.You are the Cultural Secretary of Greenwood Senior Secondary School. Draft a notice in not more than 50 words announcing auditions for the *Inter-School Music Fest 2025*. Include necessary details. (4 Marks)

4. Attempt ANY ONE: (4 Marks)

(a) Write a formal invitation in 50 words inviting the Principal to inaugurate the newly renovated school auditorium.
OR
(b) Write an informal invitation to a friend inviting him/her to spend the Diwali holidays with you.

5. Attempt ANY ONE: (5 Marks)

(a) You are Rishi/Ritika. Write a letter to the Editor of *The National Herald* expressing concern about the rising air pollution in your city and suggesting measures to control it. (120–150 words)
OR
(b) Write an application to the HR Manager of Sunrise Publications applying for the post of Junior Content Writer. Attach a brief biodata. (120–150 words)

6. Attempt ANY ONE: (5 Marks)

(a) Write an article in 120–150 words on *"The Importance of Sports in a Student's Life."*
OR
(b) Write a report on the *Annual Science Expo 2025* held in your school.

SECTION – C: LITERATURE (40 Marks)

7. Read the extract and answer the following: (6 Marks)

"A thing of beauty is a joy for ever:
Its loveliness increases; it will never
Pass into nothingness…"

(i) Name the poem and the poet.
(ii) Why is a thing of beauty "a joy for ever"?
(iii) What does the phrase *"pass into nothingness"* mean?
(iv) In 40–50 words, explain how nature is portrayed as a source of comfort.

8. Read the following extract: (4 Marks)

"At the last, the Maharaja forbade people to even mention the word 'tiger.' But such was his fate that the hundredth tiger eluded him."

(i) Name the chapter.
(ii) Why was the Maharaja obsessed with killing tigers?
(iii) What does the phrase *"eluded him"* imply?
(iv) In 40–50 words, explain how fate plays a role in the story.

9. Read the following extract: (6 Marks)

"But today everything was quiet. The classrooms were empty. It was as still as Sunday morning."

(i) Name the lesson.
(ii) Why were the classrooms empty?
(iii) What is the significance of "still as Sunday morning"?
(iv) In 40–50 words, describe Franz's feelings when he entered the classroom.

10. Answer ANY FIVE in 40–50 words each: 5 × 2 = 10 Marks

(i) Why does the poet advocate stillness in *Keeping Quiet*?
(ii) How does the poet highlight ageing in *My Mother at Sixty-Six*?
(iii) What hardships do ragpickers face in *Lost Spring*?
(iv) How did Gandhi use persuasion in *Indigo*?
(v) Why was the roadside stand disappointing for its owners?
(vi) How does the waterfall incident affect Douglas in *Deep Water*?

11. Answer ANY TWO in 40–50 words each: 2 × 2 = 4 Marks

(i) What dilemma does Roger face in *Should Wizard Hit Mommy?*
(ii) Why does Dr. Sadao decide to save the prisoner in *The Enemy*?
(iii) How is Derry's attitude transformed in *On the Face of It*?

12. Attempt ANY ONE in 120–150 words:

(i) Discuss the theme of fear and self-confidence in *Deep Water*.
OR
(ii) Explain how *The Last Lesson* highlights the importance of mother tongue.

13. Attempt ANY ONE in 120–150 words:

(i) Analyse the satire used in *The Tiger King* to expose arrogance and power.
OR
(ii) Describe the environmental awareness created in *Journey to the End of the Earth*

BUSINESS STUDIES

- **SOLVE THE FOLLOWING QUESTION PAPER MM 80 Time: 3 Hours**

General Instructions:

Read the following instructions very carefully and strictly follow them:

(i) This question paper contains 34 questions. All questions are compulsory.

(ii) Marks are indicated against each question.

(iii) Answers should be brief and to the point.

(iv) Answers to the questions carrying 3 marks may be from 50 to 75 words.

(v) Answers to the questions carrying 4 marks may be in about 150 words.

(vi) Answers to the questions carrying 6 marks may be in about 200 words.

(vii) Attempt all parts of a question together.

---

1. "To ensure that enough funds are available at right time to honour the commitments and to carry out the plans' is discussed in which of the following concepts?

(A) Capital Structure

(B) Financial Leverage

(C) Financial Planning

(D) Investment Decision

2. Read the following statements carefully:

Statement - I: The cost of debt is more than the cost of equity.

Statement - II: Lender’s risk is lower than the equity shareholder’s risk.

In the light of the given statements, choose the correct alternative from the following:

(A) Both the Statements are true.

(B) Both the Statements are false.

(C) Statement I is true, Statement II is false.

(D) Statement I is false, Statement II is true.

3. 'Increase in the profit earned by the equity shareholders due to the presence of fixed financial charges like interest' is called

(A) Financial planning

(B) Dividend decision

(C) Financing decision

(D) Trading on equity

4. Akshara runs a business in the name of 'AK Solutions' in a well reputed area of her city where people provide spaces to students as library, as study centres and as training and event centres to businesses. Akshara provides only conference halls to big and small enterprises for their meetings and events.

Suddenly, in July 2024, floods affected some libraries and study centres in her neighbouring area. The exams were fast approaching and students were facing a lot of problems as these study centres and libraries had to be closed.

Taking advantage of this opportunity and to help the students 'AK Solutions' adapted itself to the needs of the environment, they decided to convert some of their conference halls into libraries and study centres. They also decided to provide food and other facilities required by the students at subsidized rates.

This initiative increased their business manifold and earned them significant goodwill.

The feature of management highlighted in the above case is:

(A) Management is a continuous process.

(B) Management is an intangible force.

(C) Management is a dynamic function.

(D) Management is a group activity.

5. Match the techniques of scientific management given in Column I with their meaning given in Column II:

Column - I	**Column - II**
(a) Method Study	(i) It refers to the study of movements like lifting, putting objects, sitting and changing positions etc. which are undertaken while doing a typical job.
(b) Motion Study	(ii) It determines the amount and frequency of rest intervals in completing a task.
(c) Time Study	(iii) It determines the standard time taken to perform a well defined job.

Column - I	Column - II
(d) Fatigue Study	(iv) It determines one best way of doing a job.

Choose the correct option from the options given below:

(A) (c)-(ii), (b)-(i), (a)-(iii), (d)-(iv)

(B) (c)-(i), (b)-(iv), (a)-(ii), (d)-(iii)

(C) (c)-(iv), (b)-(i), (a)-(iii), (d)-(ii)

(D) (c)-(iii), (b)-(ii), (a)-(iv), (d)-(i)

6. Given below are two statements, Assertion (A) and Reason (R):

Assertion (A): Planning involves looking ahead and preparing for the future.

Reason (R): The purpose of planning is to meet future events effectively to the best advantage of an organization.

Choose the correct alternative from the alternatives given below:

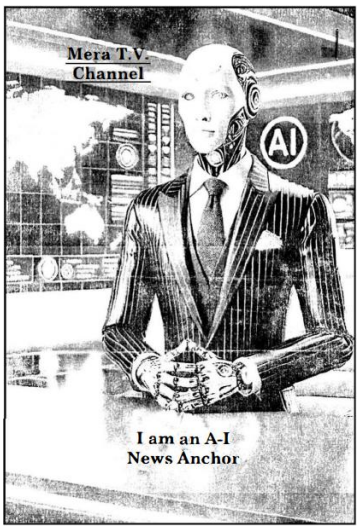
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

7. Identify the dimension of business environment illustrated by the given picture:



(A) Social

(B) Political

(C) Technological

(D) Economic

OR

Shifts in demand from steam locomotives to electric engines, from fountain pens to ball-point pens, from typewriters to computer-based word processors highlights which of the following dimension of business environment?

(A) Economic

(B) Technological

(C) Political

(D) Social

8. As per the Consumer Protection Act, 2019 which of the following statement is correct?

(A) In case the aggrieved party is not satisfied with the order of the District Commission, he can directly appeal before the National Commission.

(B) In case the aggrieved party is not satisfied with the order of the District Commission, he can directly appeal before the Supreme Court.

(C) In case the aggrieved party is not satisfied with the order of the State Commission, he can directly appeal before the Supreme Court.

(D) In case the aggrieved party is not satisfied with the order of the National Commission, he can appeal before the Supreme Court.

9. "The process of organizing allows a business enterprise to accommodate changes in the business environment. It allows the organization structure to be suitably modified to pave the way for a smooth transition.'

The point of importance of organizing function of management highlighted in the above lines is:

(A) Benefits of specialization

(B) Clarity in working relationships

(C) Optimum utilization of resources

(D) Adaptation to change

10. Nimesh was working as a Production Manager in H.L. Ltd., an electrical wire manufacturing company. One of the vendors who was supplying copper to H.L. Ltd. wanted to close down his business within 15 days as he had to go abroad to live with his son. The vendor was selling all his stocks at 60% discount. Nimesh wrote a letter to the General Manager to seek approval for

procurement of this material. But due to rigid rules and cumbersome procedures there was delay in getting sanction and order could not be placed.

The type of communication barrier that led to procedural delay was:

(A) Semantic barrier

(B) Psychological barrier

(C) Organizational barrier

(D) Personal barrier

11. A buyer buys a product or service for what it does for him / her or the benefit it provides to him / her. There can be three types of benefits, a consumer may seek to satisfy from the purchase of a product: (i) Functional benefits, (ii) Social benefits and (iii) _____

(A) Technological benefits

(B) Economic benefits

(C) Psychological benefits

(D) Environmental benefits

12. "The obligation of a subordinate to properly perform the assigned duty" is called:

(A) Delegation

(B) Authority

(C) Responsibility

(D) Accountability

13. 'Isha Sweets' was set by Isha Sharma to prepare and sell organic, vegan and healthy sweets alternatives like hazelnuts date ladoos, dry fruit date burfi, stuffed Medjool date etc. For the last many years, the demand for her products was very high as people these days prefer to buy healthier alternatives for consumption as well as gifting purposes.

But this year suddenly, the cost of dates, dry fruits and other ingredients used for preparing these healthy sweets had increased. With rising prices of raw materials, larger amounts of funds were required to maintain a constant volume of production and sales. As a result, the working capital requirement of 'Isha Sweets' became higher.

The factor which led to an increase in the working capital requirements of 'Isha Sweets' was:

(A) Availability of raw material

(B) Inflation

(C) Scale of business

(D) Production cycle

14. Atul was working as an employee in a readymade garments factory. He was very sincere and dedicated and always completed his work in time. It pained him to see that his colleagues were reluctant to do the work even though they had the ability to do it.

Due to his good behaviour and willingness to work, he was promoted to the post of the supervisor of the same team in which he was a worker earlier. He understood very well that it was not always possible to get the best of work from employees merely by exercising formal authority. He had insights into the causes of behaviour of people. He knew how to get the work done by the workers in a desired manner to achieve the organizational objectives. Under his supervision even the workers who were reluctant to work started working efficiently and effectively.

From the following, identify the concept used by Atul, as a supervisor to get the work completed:

(A) Leadership

(B) Financial Incentives

(C) Motivation

(D) Non-financial Incentives

15. Choose the statement that correctly highlights the benefit of using internal sources of recruitment.

(A) It helps in simplifying the process of selection.

(B) It provides wider choice while selecting the employees.

(C) It brings new blood in the organization.

(D) It is an expensive and time-consuming source.

16. Read the following statements carefully:

Statement - I: Staffing is that part of the process of management which is concerned with obtaining, utilizing and maintaining a satisfied and satisfactory workforce.

Statement - II: Staffing is a continuous process.

In the light of the given statements, choose the correct alternative from the following:

(A) Both the Statements are true.

(B) Both the Statements are false.

(C) Statement I is true, but Statement II is false.

(D) Statement II is true, but Statement I is false.

17. CVX Ltd. was a leading company, manufacturing home appliances like food processors, juicers and mixer grinders. The company was earning good profits and was paying high dividends to its shareholders consistently. The company now decided to manufacture soup-making machines, pop-up toasters and electric irons.

The company wanted to enter into emerging markets out of India also. Entering these markets will require additional capital investment which will facilitate in production and distribution infrastructure etc. For this, the management decided to retain money out of their earnings to finance the required investment and distribute smaller dividend to the shareholders.

The factor affecting dividend decision which was kept in mind by the management of CVX Ltd. for entering into emerging markets and launching new products was:

(A) Amount of Earnings

(B) Stability of Earnings

(C) Stability of Dividends

(D) Growth Opportunities

18. Given below are two statements, Assertion (A) and Reason (R):

Assertion (A): Directing facilitates introduction of needed changes in the organization.

Reason (R): Directing increases resistance to changes in the organization.

Choose the correct alternative from the alternatives given below:

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Assertion (A) is true, but Reason (R) is false.

(C) Assertion (A) is false, but Reason (R) is true.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

19. Kavi works as a Marketing Manager in stationery mart. It deals in various types of stationery items for many schools across the country. When new session starts in schools, Kavi forecasts the sales of different stationery products for each school for every month. All items are represented in numbers so that it becomes easier for him to compare the actual sales with expected sales.

The type of plan discussed above is:

(A) Strategy

(B) Policy

(C) Programme

(D) Budget

20. 'It is the process of designing and maintaining an environment in which individuals, working together in groups, efficiently accomplish selected aims.'

Identify the process.

(A) Management

(B) Organising

(C) Staffing

(D) Directing

21. Aman, a young graduate was living away from home in another city. He had problems in cooking and heating food. He decided to purchase a microwave oven for the same. He went to the market, visited many shops and compared various microwave oven brands available in the market. He compared features, price, after-sale-service and customer reviews etc. to make an informed choice as per his needs.

After selecting the oven, he checked that it should have an ISI mark. This gave him confidence about the safety, standards and quality of the oven. After reaching home he followed the manufacturer's instructions for safe installation and use of microwave oven. This helped him in avoiding any risk associated with the usage of microwave oven.

By doing all this Aman kept in mind various responsibilities while purchasing and using the microwave oven. Still, he left some of the responsibilities that were not fulfilled by him.

State any three such responsibilities.

22.

(a) Explain the following functions of Stock Exchange:

(i) Providing liquidity and marketability to existing securities

(ii) Pricing of securities

(iii) Safety of transaction

OR

(b) Differentiate between 'Primary Market' and 'Secondary Market' on the basis of any three points.

23.

(a) Give the meaning of 'Money Market'. Differentiate between 'Capital Market' and 'Money Market' on the basis of:

(i) Investment Outlay

(ii) Duration

OR

(b) State any three 'Development functions' of Securities and Exchange Board of India.

24. Radhika started a business of supplying high class facial kits to beauty parlours in various cities of the country. Initially, the business was doing well and her products were popular. Despite the high quality of the products, Radhika faced difficulties in certain parlours, especially in Kanpur city, where her products failed to gain a strong market presence.

To understand the cause, she appointed a qualified marketing manager. The marketing manager discovered that there was no proper exchange of facts, ideas and views etc. between the in charge of Kanpur city and the employees at different parlours at Kanpur. Vicky, who was the in charge and responsible for overseeing all parlours in Kanpur, was unable to effectively foster a common understanding of the product among the employees. As a result, the employees did not grasp the key benefits and features of the high-class facial kits. In turn, the employees were not able to convince potential clients about the product's value.

(i) Identify the concept discussed in the above case.

(ii) The concept identified in (i) above can be defined as a process having various elements. State first five elements of this process.

25.

(a) Explain the following principles of management given by Fayol

(i) Unity of Command

(ii) Order

OR

(b) Explain the following points of significance of principles of management:

(i) Scientific Decision

(ii) Fulfilling Social Responsibility

26.

(a) Explain the following features of co-ordination:

(i) Co-ordination ensures unity of action.

(ii) Co-ordination is a continuous process.

OR

(b) Explain the following features of management:

(i) Management is a group activity.

(ii) Management is an intangible force.

27. The demand for take away food business is increasing day-by-day. People working in multi-national companies have to work till night very often and they are reluctant to cook food. Taking advantage of this opportunity, Amit and Bijoy started 'Langar', a take away food business. The food became famous because of its good quality and standards of hygiene followed by them.

Over the years, the business became very profitable. They decided to expand the business by opening more branches in different cities. To ensure consistent food quality at all branches and to maintain the hygiene and quality they planned to import machines with advanced technology. The

cost of each machine was Rs. 12 crores. They knew that this decision has to be taken very carefully, as it involves a huge cost and that the decision, once taken is irreversible.

(i) Identify and state the financial decision discussed in the above para.

(ii) Explain any two factors affecting the decision identified in (i) above.

28. Going to gym and following a protein diet has become a popular trend these days. However, with the busy work culture, many people, especially the youth struggle to find time for weight loss programmes.

Anika was working in a multi-national company, wanted to join a gym for weight loss but could not find time. There is no good gym near her house. One day, Anika was walking out of the office during lunch time and saw an attractive poster of a gym which was near her house. Anika was curious to enquire about their weight loss programme.

Next day, when she went to the gym, she was surprised to know about various schemes offered by the gym. They were not only offering 50% discount on the fee of weight loss programme, but were also providing free coach facility and free protein diet for the customer. But these offers were valid only for 10 days. Attracted by these schemes Anika immediately submitted the fee and joined the gym.

(i) Identify and give the meaning of the element of marketing-mix discussed above.

(ii) The element of marketing-mix identified in (i) above includes various tools of communication. Identify and explain the tools highlighted in the above para.

29. Nisha had given some old dresses of her own to her house-helper Beenu. After a few days, Nisha was happily surprised when she saw Beenu wearing one of the dresses beautifully refurbished. On enquiry, Beenu told Nisha that this was done by her daughter who had just completed her Class 12th studies. Beenu also told Nisha that she was a little concerned as her daughter did not want to study further.

Nisha was very much impressed by the creativity of Beenu's daughter, so she decided to setup a small business for her. Nisha bought 15 sewing machines and appointed 15 girls to refurbish the old dresses. Nisha also arranged old dresses from various sources and employed a person who will sell these dresses at a very low cost for the one's who could not purchase news dresses due to their low income.

Nisha divided the girls in three equal groups, each having five sewing machines. Each group was given a target of refurbishing 150 old dresses in a fortnight with a cost of Rs. 30 per dress.

After a fortnight, Nisha who was supervising this business with Beenu was informed that Group I was able to meet the target by refurbishing 150 old dresses at a cost of Rs. 30 per dress. Group II was able to refurbish 150 old dresses at a cost of Rs. 35 per dress, whereas Group III could refurbish only 140 old dresses but at a cost of Rs. 27 per dress.

(i) Identify the concepts of management discussed above for each of the three groups giving reason in support of your answer.

(ii) Give meaning of the concepts identified in (i) above and state which one is important for the management and why?

30. Prachi is working as an academic counsellor for especially abled students at one of the top schools to provide special support and guidance to these students. She clearly states in advance the methods of teaching and tackling the students. She ensures that the goals are clearly stated for each and every teacher so that they act as a guide for deciding what action should be taken and in which direction.

Her well laid plans will serve as a basis for coordinating the activities and efforts of teachers teaching different subjects to these students. It helps the teachers in bringing clarity of thought and action to their work.

Identify and explain the two points of importance of 'Planning' function of management highlighted in the above para.

31.

(a) Explain the following steps in the process of selection:

(i) Selection Decision

(ii) Medical Examination

(iii) Job Offer

(iv) Contract of Employment

OR

(b) Explain the following financial incentives:

(i) Profit sharing

(ii) Co-partnership

(iii) Productivity linked wage incentives

(iv) Perquisites

32. Asha was running a business of producing and selling pickles, murabbas and papad etc. She was earning a good profit for the last many years. Now, she wanted to add some new products in her product line. Seeing the growing demand of millets, she decided to add some millet products. After doing a lot of market research, she found out that the demand for millet noodles, pasta and ready to eat millet cereals was increasing day-by-day.

To give a different taste and to have uniqueness in her products, she prepared a new tasty herb-based sauce for cooking these products and decided to launch this along with millet products in the market.

For this Asha hired 10 additional women workers specially trained for the same. However, despite adding more workers, to her surprise, production was not upto the mark.

Concerned about this and to ensure that the activities were performed as per the plans, and that the resources were being used effectively and efficiently for the achievement of predetermined goals, Asha appointed a supervisor, Nabita. Nabita monitored the activities and discovered that two of the

newly hired workers were spending their whole day gossiping and distracting the other workers. As a result, the production was low.

(i) Identify and state the function of management discussed above.

(ii) State any five points of importance of the function identified in (i) above.

33.

(a) State any three advantages and any three limitations of informal organization.

OR

(b) State any three advantages and any three disadvantages of divisional structure of organization.

34. Ravi and Megha started 'Energy lights' a company manufacturing energy-efficient LED lighting after realizing an increasing demand for the same. Manufacturing high-quality LED lights with some unique features required substantial investment in technology and high-grade materials. This pushed up their cost of manufacturing. To determine the price of their LED lights they not only wanted to cover all costs but also wanted to earn a margin of profit over and above the costs. This will set for them the minimum level or the floor price at which the LED lights would be sold.

The high demand and the utility provided by these lights will set the upper limit of the price.

Though there was enough competition in LED lights business, even then they kept the price of their lights higher than the competitors because of good quality and its features. They justified the higher price because of the product differentiation and unique methods of advertising and sales promotion etc.

Quoting lines from the above para, identify and explain any three factors which were taken into consideration by Ravi and Megha to determine the price of their LED lights.

APPLIED MATHEMATICS

a) Do all the sample papers given in the Sample Paper Book given.

b) Follow the instructions which will be given in the WhatsApp group formed for monitoring the Holiday exam preparations.

c) Complete the Record work.

SET I

1. Evaluate :

$$\int_0^{\pi/2} \frac{1}{1+\cot^{5/2} x}\,dx$$

2. If $\vec{a} = \hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{c} = -\hat{i} + 2\hat{j} - \hat{k}$ are three vectors, then find a vector perpendicular to both the vectors $(\vec{a} + \vec{b})$ and $(\vec{b} - \vec{c})$.

3. A bag contains cards numbered 1 to 25. Two cards are drawn at random, one after the other, without replacement. Find the probability that the number on each card is a multiple of 7.

4. One bag contains 4 white and 5 black balls. Another bag contains 6 white and 7 black balls. A ball, drawn at random, is transferred from the first bag to the second bag and then a ball is drawn at random from the second bag. Find the probability that the ball drawn is white.

5. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then find the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$.

6. (a) Find the general solution of the differential equation

$$x \cos y \, dy = (x \log x + 1) e^x \, dx.$$

OR

(b) Find the value of $(2a - 3b)$, if a and b represent respectively the order and the degree of the differential equation

$$x\left[y\left(\frac{d^2y}{dx^2}\right)^3 + x\left(\frac{dy}{dx}\right)^2 - \frac{y}{x}\frac{dy}{dx}\right] = 0.$$

7. (a) Find the area of the region $\{(x, y) : x^2 + y^2 \leq 9, \; x + y \geq 3\}$, using integration.

OR

(b) Using integration, find the area of the region bounded by the parabola $y^2 = 4x$, the lines $x = 0$ and $x = 3$ and the x-axis.

8. Find :

$$\int \frac{\sin x}{\sin(x - 2a)} \, dx$$

9. Find the equation of the plane passing through three points whose position vectors are $-\hat{j}$, $3\hat{i} + 3\hat{j}$ and $\hat{i} + \hat{j} + \hat{k}$.

10. (a) Find the distance between the following parallel lines :

$$\vec{r} = (2\hat{i} + \hat{j} - \hat{k}) + \lambda(\hat{i} + \hat{j} - \hat{k})$$

$$\vec{r} = (\hat{i} - 2\hat{j} + \hat{k}) + \mu(\hat{i} + \hat{j} - \hat{k})$$

OR

(b) Find the coordinates of the point where the line through the points $(-1, 1, -8)$ and $(5, -2, 10)$ crosses the ZX-plane.

11. Find the equation of the plane passing through the intersection of the planes $\vec{r} \cdot (2\hat{i} + 2\hat{j} - 3\hat{k}) = 7$ and $\vec{r} \cdot (2\hat{i} + 5\hat{j} + 3\hat{k}) = 9$ and through the point (2, 1, 3).

12. (a) Find :

$$\int \cos x \cdot \tan^{-1}(\sin x)\, dx$$

OR

(b) Find :

$$\int \frac{e^x}{(e^x + 1)(e^x + 3)} dx$$

13. Find the particular solution of the differential equation

$$x \frac{dy}{dx} + 2y = x^2 \log x$$

CLASS 12 - MATHEMATICS - SET 2
HOLIDAY ASSIGNMENT

General Instructions :

Read the following instructions very carefully and follow them :

(i) *This question paper contains **38** questions. **All** questions are compulsory.*

(ii) *Question paper is divided into **FIVE** Sections – Section **A**, **B**, **C**, **D** and **E**.*

(iii) *In **Section A** – Question Number **1** to **18** are Multiple Choice Questions (MCQ) type and Question Number **19** & **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B** – Question Number **21** to **25** are Very Short Answer (VSA) type questions of **2** marks each.*

(v) *In **Section C** – Question Number **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D** – Question Number **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E** – Question Number **36** to **38** are case study based questions carrying **4** marks each where **2 VSA** type questions are of **1** mark each and **1** SA type question is of **2** marks. Internal choice is provided in **2** marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in **2** questions in Section – **B**, **3** questions in Section – **C**, 2 questions in Section – **D** and **2** questions in Section – **E**.*

(ix) *Use of calculators is **NOT** allowed.*

SECTION – A
(Multiple Choice Questions)

Each question carries **1** mark.

Select the correct option out of the four given options :

1. Let R be a relation in the set N given by

   $R = \{(a, b) : a = b - 2, b > 6\}$.

   Then

   (a) $(8, 7) \in R$ (b) $(6, 8) \in R$

   (c) $(3, 8) \in R$ (d) $(2, 4) \in R$

2. If $A = \begin{bmatrix} 5 & x \\ y & 0 \end{bmatrix}$ and $A = A^T$, where A^T is the transpose of the matrix A, then

   (a) $x = 0, y = 5$ (b) $x = y$

   (c) $x + y = 5$ (d) $x = 5, y = 0$

3. $\sin\left[\frac{\pi}{3} + \sin^{-1}\left(\frac{1}{2}\right)\right]$ is equal to

   (a) 1 (b) $\frac{1}{2}$

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

4. If for a square matrix A, $A^2 - A + I = O$, then A^{-1} equals

   (a) A (b) A + I

   (c) I – A (d) A – I

5. If $\begin{vmatrix} \alpha & 3 & 4 \\ 1 & 2 & 1 \\ 1 & 4 & 1 \end{vmatrix} = 0$, then the value of α is

   (a) 1 (b) 2

   (c) 3 (d) 4

6. If $f(x) = |\cos x|$, then $f\left(\frac{3\pi}{4}\right)$ is

(a) 1 (b) -1

(c) $\frac{-1}{\sqrt{2}}$ (d) $\frac{1}{\sqrt{2}}$

7. If $x = A \cos 4t + B \sin 4t$, then $\frac{d^2x}{dt^2}$ is equal to

(a) x (b) $-x$

(c) $16x$ (d) $-16x$

8. The function $f(x) = [x]$, where $[x]$ denotes the greatest integer less than or equal to x, is continuous at

(a) $x = 1$ (b) $x = 1.5$

(c) $x = -2$ (d) $x = 4$

9. The function $f(x) = x^3 + 3x$ is increasing in interval

(a) $(-\infty, 0)$ (b) $(0, \infty)$

(c) $\mathbb{R}$ (d) $(0, 1)$

10. $\int_{-1}^{1} \frac{|x-2|}{x-2}\, dx$, $x \neq 2$ is equal to

(a) 1 (b) -1

(c) 2 (d) -2

11. $\int \frac{\sec x}{\sec x - \tan x}\, dx$ equals

(a) $\sec x - \tan x + c$ (b) $\sec x + \tan x + c$

(c) $\tan x - \sec x + c$ (d) $-(\sec x + \tan x) + c$

12. The order and the degree of the differential equation $\left(1+3\frac{dy}{dx}\right)^2 = 4\frac{d^3y}{dx^3}$ respectively are :

(a) 1, $\frac{2}{3}$ (b) 3, 1

(c) 3, 3 (d) 1, 2

13. If $\vec{a} \cdot \hat{i} = \vec{a} \cdot (\hat{i} + \hat{j}) = \vec{a} \cdot (\hat{i} + \hat{j} + \hat{k}) = 1$, then $\vec{a}$ is

(a) $\hat{k}$ (b) $\hat{i}$

(c) $\hat{j}$ (d) $\hat{i} + \hat{j} + \hat{k}$

14. Five fair coins are tossed simultaneously. The probability of the events that atleast one head comes up is

(a) $\frac{27}{32}$ (b) $\frac{5}{32}$

(c) $\frac{31}{32}$ (d) $\frac{1}{32}$

15. If for any two events A and B, P(A) = $\frac{4}{5}$ and P(A $\cap$ B) = $\frac{7}{10}$, then P(B/A) is equal to

(a) $\frac{1}{10}$ (b) $\frac{1}{8}$

(c) $\frac{7}{8}$ (d) $\frac{17}{20}$

16. The angle between the lines $2x = 3y = -z$ and $6x = -y = -4z$ is

(a) 0^o (b) 30^o

(c) 45^o (d) 90^o

17. If a line makes angles of 90°, 135° and 45° with the x, y and z axes respectively, then its direction cosines are

(a) $0, -\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$ (b) $-\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}}$

(c) $\frac{1}{\sqrt{2}}, 0, -\frac{1}{\sqrt{2}}$ (d) $0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$

18. The magnitude of the vector $6\hat{i} - 2\hat{j} + 3\hat{k}$ is

(a) 1 (b) 5

(c) 7 (d) 12

Assertion – Reason Based Questions

In the following questions **19** and **20**, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices :

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(c) (A) is true and (R) is false.

(d) (A) is false, but (R) is true.

19. **Assertion (A) :** $\int_2^8 \frac{\sqrt{10-x}}{\sqrt{x}+\sqrt{10-x}}\, dx = 3$

Reason (R) : $\int_a^b f(x)\, dx = \int_a^b f(a+b-x)\, dx$

20. **Assertion (A) :** Two coins are tossed simultaneously. The probability of getting two heads, if it is known that at least one head comes up, is $\frac{1}{3}$.

Reason (R) : Let E and F be two events with a random experiment, then $P(F/E) = \frac{P(E \cap F)}{P(E)}$.

SECTION – B

This section comprises of Very Short Answer (VSA) type questions of 2 marks each.

21. (a) Find the value of k for which the function f given as

$$f(x) = \begin{cases} \dfrac{1-\cos x}{2x^2}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases} \text{ is continuous at } x = 0.$$

OR

(b) If $x = a \cos t$ and $y = b \sin t$, then find $\dfrac{d^2y}{dx^2}$.

22. Find the value of $\tan^{-1}\left[2\cos\left(2\sin^{-1}\dfrac{1}{2}\right)\right] + \tan^{-1} 1$.

23. Find the vector and the cartesian equations of a line that passes through the point A(1, 2, –1) and parallel to the line $5x - 25 = 14 - 7y = 35z$.

24. Sketch the region bounded by the lines $2x + y = 8$, $y = 2$, $y = 4$ and the y-axis. Hence, obtain its area using integration.

25. (a) If the vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a}| = 3$, $|\vec{b}| = \dfrac{2}{3}$ and $\vec{a} \times \vec{b}$ is a unit vector, then find the angle between $\vec{a}$ and $\vec{b}$.

OR

(b) Find the area of a parallelogram whose adjacent sides are determined by the vectors $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$.

SECTION – C

This section comprises of Short Answer (SA) type questions of 3 marks each.

26. 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.

27. Using integration, find the area of the region bounded by $y = mx$ $(m > 0)$, $x = 1$, $x = 2$ and the x-axis.

28. (a) Find the coordinates of the foot of the perpendicular drawn from point (5, 7, 3) to the line $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$.

OR

(b) If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$ then find a unit vector perpendicular to both $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$.

29. Find the distance between the lines :

$$\vec{r} = (\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k});$$

$$\vec{r} = (3\hat{i} + 3\hat{j} - 5\hat{k}) + \mu(4\hat{i} + 6\hat{j} + 12\hat{k})$$

30. (a) Differentiate $\sec^{-1}\left(\frac{1}{\sqrt{1-x^2}}\right)$ w.r.t. $\sin^{-1}(2x\sqrt{1-x^2})$.

OR

(b) If $y = \tan x + \sec x$, then prove that $\frac{d^2y}{dx^2} = \frac{\cos x}{(1-\sin x)^2}$.

31. (a) Evaluate : $\int_0^{2\pi} \frac{1}{1+e^{\sin x}}\, dx$

OR

(b) Find : $\int \frac{x^4}{(x-1)(x^2+1)}\, dx$

SECTION – D

This section comprises of Long Answer (LA) type questions of 5 marks each.

32. Solve the following Linear Programming Problem graphically :

Minimise : $Z = 60x + 80y$

subject to constraints :

$3x + 4y \geq 8$

$5x + 2y \geq 11$

$x, y \geq 0$

33. (a) The median of an equilateral triangle is increasing at the rate of $2\sqrt{3}$ cm/s. Find the rate at which its side is increasing.

OR

(b) Sum of two numbers is 5. If the sum of the cubes of these numbers is least, then find the sum of the squares of these numbers.

34. Evaluate : $\int_0^{\frac{\pi}{2}} \sin 2x \tan^{-1}(\sin x)\, dx$

35. In answering a question on a multiple choice test, a student either knows the answer or guesses. Let $\frac{3}{5}$ be the probability that he knows the answer and $\frac{2}{5}$ be the probability that he guesses. Assuming that a student who guesses at the answer will be correct with probability $\frac{1}{3}$. What is the probability that the student knows the answer, given that he answered it correctly ?

.

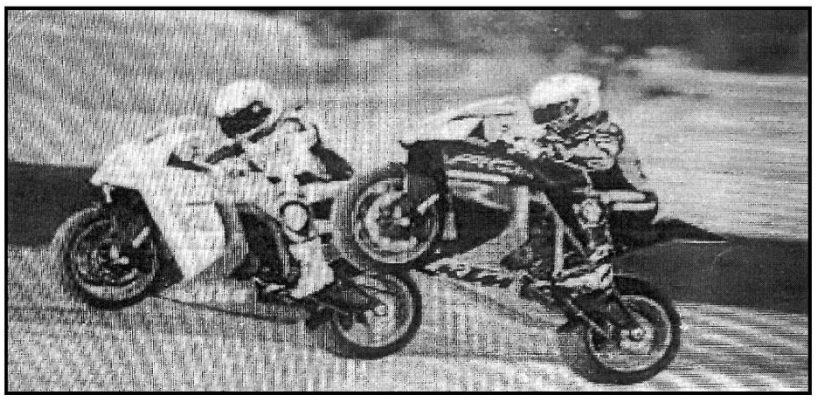
SECTION – E

This section comprises of 3 case study/passage-based questions of 4 marks each with two sub-parts. First two case study questions have three sub – parts (I), (II), (III) of marks 1, 1, 2 respectively. The third case study question has two sub – parts (I) and (II) of marks 2 each.

Case Study-I

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

OR

(III) A function f : B $\rightarrow$ 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.

Case Study-II

37. Gautam buys 5 pens, 3 bags and 1 instrument box and pays a sum of ₹ 160. From the same shop, Vikram buys 2 pens, 1 bag and 3 instrument boxes and pays a sum of ₹ 190. Also Ankur buys 1 pen, 2 bags and 4 instrument boxes and pays a sum of ₹ 250.

Based on the above information, answer the following questions :

(I) Convert the given above situation into a matrix equation of the form $AX = B$.

(II) Find $|A|$.

(III) Find A^{-1}.

OR

(III) Determine $P = A^2 - 5A$.

Case Study-III

38. An equation involving derivatives of the dependent variable with respect to the independent variables is called a differential equation. A differential equation of the form $\frac{dy}{dx} = F(x, y)$ is said to be homogeneous if $F(x, y)$ is a homogeneous function of degree zero, whereas a function $F(x, y)$ is a homogenous function of degree n if $F(\lambda x, \lambda y) = \lambda^n F(x, y)$. To solve a homogeneous differential equation of the type $\frac{dy}{dx} = F(x, y) = g\left(\frac{y}{x}\right)$, we make the substitution $y = vx$ and then separate the variables.

Based on the above, answer the following questions :

(I) Show that $(x^2 - y^2)\,dx + 2xy\,dy = 0$ is a differential equation of the type $\frac{dy}{dx} = g\left(\frac{y}{x}\right)$.

(II) Solve the above equation to find its general solution.

- **THIS TASK IS PART OF THE PROJECT WORK. TO BE ADDED TO THE SAME PROJECT FILE.**

QUESTION 1 (CASH FLOW – PAGE 6.83)

From the following information PREPARE CASH FLOW STATEMENT & RELATED WORKING NOTES.

BALANCE SHEET

as at 31.3.2022 and 31.3.2021

Particulars	Note No.	31.3.2022 (₹)	31.3.2021 (₹)
I. EQUITY AND LIABILITIES:			
(1) Shareholders' Funds:			
(a) Share Capital		1,00,000	80,000
(b) Reserve and Surplus	**1**	2,000	1,600
(2) Non-Current Liabilities:			
Long-term Borrowings	**2**	14,000	12,000
(3) Current Liabilities:			
(a) Short-term Borrowings	**3**	13,600	29,400
(b) Trade Payables		31,600	34,000
(c) Other Current Liabilities	**4**	2,000	–
(d) Short-term Provisions (Provision for Tax)		8,400	6,000
TOTAL		**1,71,600**	**1,63,000**
II. ASSETS:			
(1) Non-Current Assets:			
Property, Plant and Equipment and Intangible Assets:			
(i) Property, Plant and Equipment	**5**	50,000	60,000
(2) Current Assets:			
(a) Inventories		70,000	60,000

(b) Trade Receivables		48,000	40,000
(c) Cash and Cash Equivalents		2,600	2,400
(d) Prepaid Expenses		1,000	600
TOTAL		**1,71,600**	**1,63,000**

NOTES:	**31.3.2022**	**31.3.2021**
(1) Reserve & Surplus:	₹	₹
General Reserve	4,000	4,000
Profit & Loss Balance	(2,000)	(2,400)
Total	**2,000**	**1,600**
(2) Long-term Borrowings:		
15% Debentures	14,000	12,000
(3) Short-term Borrowings:		
Cash Credit	13,600	29,400
(4) Other Current Liabilities:		
Dividend Payable	2,000	-----
(5) Property, Plant and Equipment:		
Machinery	80,000	82,000
Less: Accumulated Depreciation	(30,000)	(22,000)
Total	**50,000**	**60,000**

Additional Information:

(a) Contingent Liability:

Proposed Dividend (₹)	**11,600**	**10,000**

(b) Provision for Tax made: ₹9,400

(c) Machinery sold for ₹10,000, their cost ₹20,000 and accumulated depreciation till date of sale ₹6,000.

(d) An interim dividend paid during the year ₹9,000.

QUESTION 2 (ACCOUNTING RATIOS – PAGE 5.104)

Calculate (i) G.P. Ratio, (ii) Operating Ratio, (iii) Operating Profit Ratio (iv) Net Profit Ratio from the following:

	₹
Opening Inventory	3,00,000
Closing Inventory	4,20,000
Purchases	14,00,000
Wages	3,70,000
Carriage Inwards	1,50,000
Administrative Exp.	84,000
Selling Exp.	36,000
Income Tax	1,00,000
Profit on Sale of Fixed Assets	20,000
Revenue from Operations (Sales)	24,00,000

QUESTION 3 (ACCOUNTING RATIOS – PAGE 5.111)

Calculate Return on Investment Ratio and Inventory Turnover Ratio from the figures given below:

	₹
Opening Inventory	30,000
Closing Inventory	40,000
Carriage Inwards	10,000
Purchases	1,00,000
Current Assets	50,000
Current Liabilities	20,000
Non-Current Assets	80,000
Indirect Expenses	15,000
Revenue from Operations	2,00,000

QUESTION 4 (ACCOUNTING RATIOS – PAGE 5.68)

Following information is given to you:

Calculate (i) Cost of Revenue from Operations, (ii) Opening Inventory and Closing inventory, and (iii) Quick Assets and Current Assets.

(I) Inventory Turnover Ratio 5 Times

(II) Inventory at the end is ₹5,000 more than the inventory in the beginning.

(III) Revenue from Operations (all credit) ₹2,00,000

(IV) Gross Profit Ratio 1/4 on cost.

(V) Current Liabilities ₹60,000

(VI) Quick Ratio 0.75

QUESTION 5 (COMPARATIVE STATEMENTS – PAGE 3.9)

From the following information, prepare Comparative Balance Sheets of X Ltd.:

Particulars	31.3.2024	31.3.2023
	₹	₹
Reserves and Surplus	12,00,000	6,00,000
Share Capital	10,00,000	10,00,000
Trade Payables	12,70,000	9,00,000
Land and Buildings	16,00,000	15,00,000
Plant and Machinery	6,30,000	5,00,000
Goodwill	--	1,00,000
Investments	1,20,000	1,00,000
Current Assets	15,20,000	8,00,000
Long-term Borrowings	4,00,000	5,00,000

QUESTION 6 (COMMON SIZE STATEMENTS – PAGE 4.15/4.16)

From the following data, prepare a Common Size Statement of Profit & Loss of Pitambar Ltd.

Particulars	31-3-2016	31-3-2015
	₹	₹
Revenue from Operations (% of Other Income)	200%	200%
Other Income	2,00,000	1,50,000
Cost of Materials Consumed (% of Operating Revenue)	60%	50%
Other Expenses (% of Material Cost)	10%	20%
Tax Rate	30%	30%

HISTORY

OBJECTIVES: - Project work will help students:- To develop skills to gather data from a variety of sources investigate diverse viewpoints and arrive at logical deductions. To develop skills to comprehend, analyse, interpret, evaluate historical evidence and also understand the limitations of historical evidence. To develop 21st century managerial skills of co-ordination, self-direction and time management.

CLASS XII PROJECT WORK THEMES IN INDIAN HISTORY TOPIC

Town planning and Artifacts of the Harappan civilization
Mahabharata through a Readers eye.
Through the Travelers Eyes. Ibn Batuta, Al Biruni, Marco Polo, Nicolo Conti, Abdur Razaq, Francois Bernier Athanasius Nikitin, Duarte Barbosa, Jean-Baptiste Tavernier, Jesuit Roberto Nobili .
Understanding the Bhakti-Sufi Movement in India Kabir, Guru Nanak, Mira Bai, Bassavana.
Depiction of Life during Mughal period through Paintings.
How the Partition in 1947 was not just a division of territory but also a division of hearts and how it affected the common people.
Great philosophers of India- Gautam Buddha and Mahavira.
The Vijayanagara empire with special focus on the city called Hampi.
The tribal groups of India- The pahariyas and the Santhals.
Colonial cities- Bombay, Madras and Calcutta with special reference to architectural style of these cities.
Role of women in the Mughal empire- Agrarian women and imperial women with special reference to Nur Jahan, Gulbadan Banu, Jahanara, Roshanara.
Role of Mahatma Gandhi in the nationalist movement.
The Constitution of India- Framing, implementation, importance.

Prepare for the History Practical CBSE Exam to be held in January 2026.

Solve one sample paper every day in the holidays.

https://www.kvnschool.in/wp-content/uploads/2024/12/History-SQP_2.pdf

kvnschool.in/wp-content/uploads/2024

https://www.kvnschool.in/wp-content/uploads/2024/12/History-Exclusive-sample-paper.pd

https://www.kvnschool.in/wp-c

Practice Map work.

BIOLOGY

1. Complete the project work and the practical record work.
2. Prepare based on project report and practical for Board Exam.
3. Prepare answers for any three set of question paper from sample paper book provided to you.

GEOGRAPHY

PSYCHOLOGY

1. Revise your CBSE Psychology Project during the holidays.
2. Ensure the project includes cover page, index, content, pictures, bibliography, and all required sections.
3. Maintain neatness and proper presentation.
4. Kindly rectify the corrections provided during the term, on the return to our school after the winter vacation.
5. Prepare thoroughly for the viva based on your project work.
6. Prepare any two experiments thoroughly right from Aim till Conclusion.
7. Write the experiments in a sheet and practice. Write and learn the order or sequence of the experiment's sub headings. Practice it in a sheet.
8. Try recollecting the method of scoring for the two chosen experiments.
9. Learn the instructions to be given for the respective experiment and practice, to be given to the non Psychology student (subject) on the SSCE Practical Exam to be conducted in the month of January 2026.
10. Prepare for the theory exam, and then attempt the practice paper provided in the guide, for 3 Hrs, similar like the board exam and send the scanned copy of the answer script to me.

CHEMISTRY (12 B)

1.To complete the chemistry project.

2.To solve the chapter wise work sheet which was sent through mail.

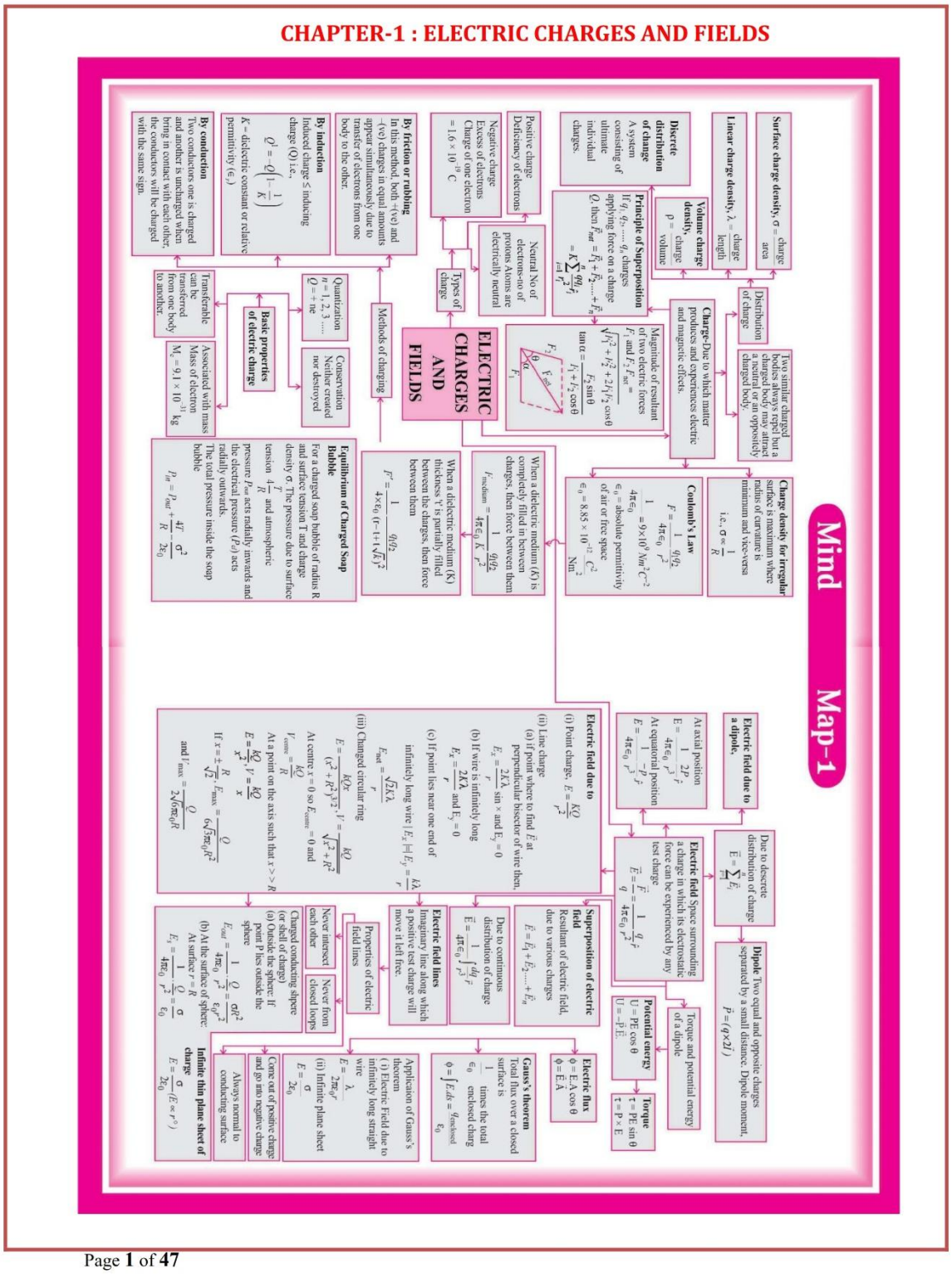
ECONOMICS

- Complete your CBSE Economics Project during the holidays.
- Use one-side ruled and one-side plain sheets (write on ruled side, paste pictures on plain side).
- Ensure the project includes cover page, index, content, pictures, bibliography, and all required sections.
- Maintain neatness and proper presentation.
- Prepare thoroughly for the viva based on your project work.

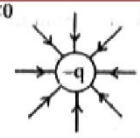
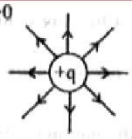
POLITICAL SCIENCE

1. **Complete your CBSE Project**
   - Ensure it is neat, well-organised, and fully aligned with CBSE guidelines.
   - Prepare all sections thoroughly for the viva voce.
2. **Attempt the Two Sample Papers**
   - The links to two CBSE question papers has been given below.

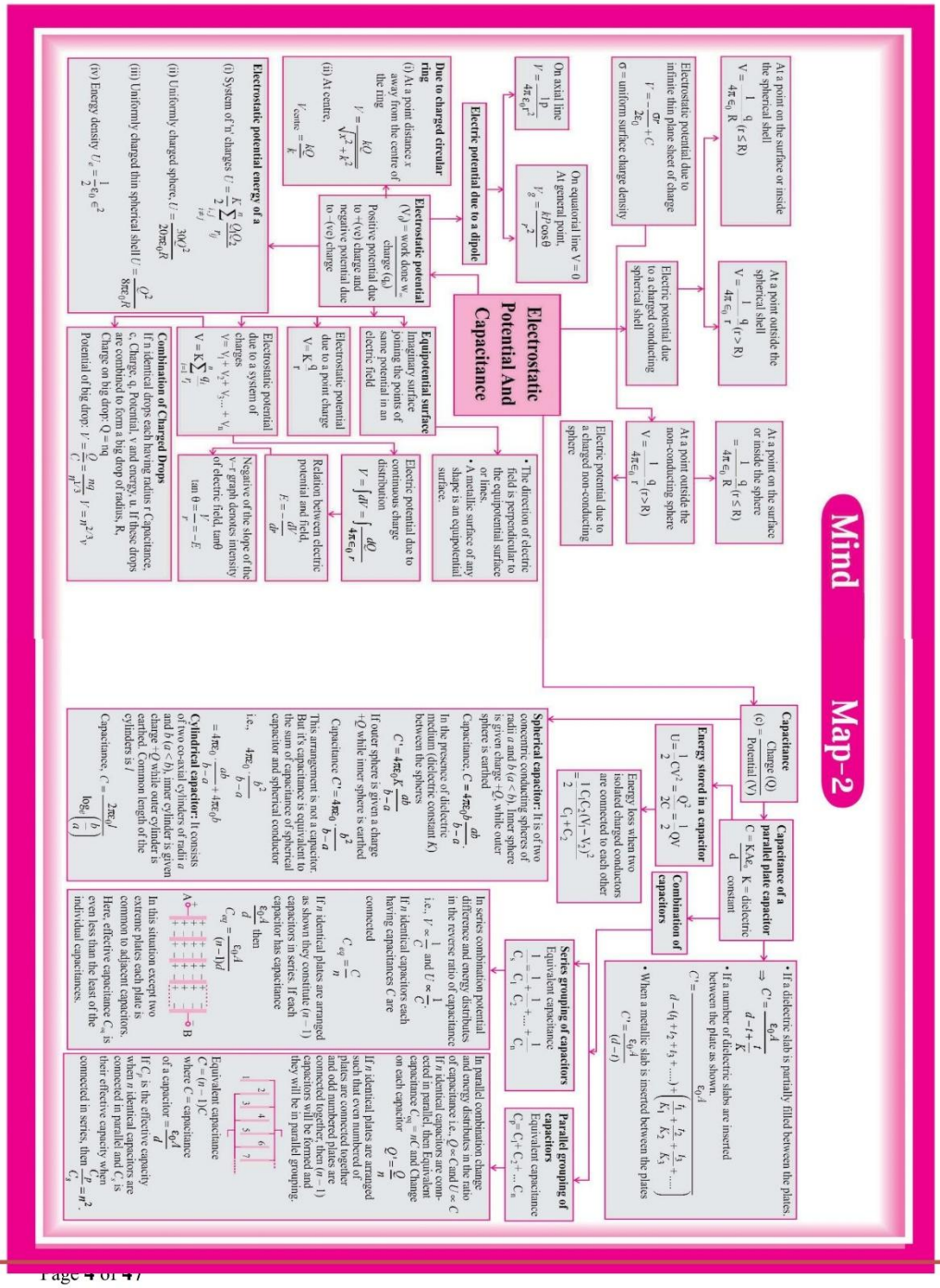
     https://drive.google.com/drive/folders/1f3R-xxo_lGuwhBzbtX-BpuBUw-Rw_Pow?usp=sharing
   - Attempt each paper in one sitting of 3 hours, exactly like the board exam.
   - Write answers on ruled sheets in proper exam format.
   - Do not consult books or notes while writing.
   - Scan the entire answer sheet clearly (PDF preferred).
   - Send your scanned copies to me on or before 30/12/2025

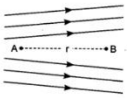

CHAPTER-1 : ELECTRIC CHARGES AND FIELDS
Mind Map-1
ELECTRIC CHARGES AND FIELDS
Surface charge density, σ = charge/area
Linear charge density, λ = charge/length
Volume charge density, ρ = charge/volume
Discrete distribution of charge
Distribution of charge
Two similar charged bodies always repel but a charged body may attract a neutral or an oppositely charged body.
Charge-Due to which matter produces and experiences electric and magnetic effects.
Charge density for irregular surface is maximum where radius of curvature is minimum and vice-versa i.e., σ ∝ 1/R
Principle of Superposition
Magnitude of resultant of two electric forces
Coulomb's Law
Positive charge Deficiency of electrons
Negative charge Excess of electrons
Charge of one electron = 1.6 × 10⁻¹⁹ C
Neutral No of electrons-ions of protons Atoms are electrically neutral
Types of charge
Methods of charging
By friction or rubbing
By induction
By conduction
Basic properties of electric charge
Transferable
Quantization
Conservation
Associated with mass
Equilibrium of Charged Soap Bubble
When a dielectric medium (K) is completely filled in between charges, then force between them
When a dielectric medium (K) thickness 't' is partially filled between the charges, then force between them
Electric field due to
Electric field due to a dipole
Due to descrete distribution of charge
Dipole Two equal and opposite charges separated by a small distance. Dipole moment, p = (q×2l)
Electric field Space surrounding a charge in which its electrostatic force can be experienced by any test charge
Torque and potential energy of a dipole
Potential energy
Torque
Superposition of electric field
Electric flux
Gauss's theorem
Electric field lines
Properties of electric field lines
Never intersect each other
Never from closed loops
Application of Gauss's theorem
(i) Electric Field due to infinitely long straight wire
(ii) Infinite plane sheet
Charged conducting shpere (or shell of charge)
Infinite thin plane sheet of charge

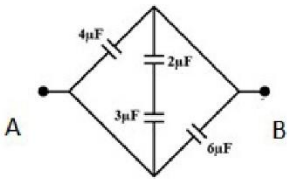
A.	**Choose the correct answer from the four options given below each question: (1 Mark)**
1	Which one of the following is the unit of electric field? (a) Coulomb (b) Newton (c) Volt (d) N/C
2	If an electric dipole is kept in a uniform electric field then resultant electric force on it is (a) always zero (b) never zero (c) increases gradually (d) None
3	When placed in a uniform field, a dipole experience (a) a net force (b) a torque (c) both a net force and torque (d) neither a net force nor a torque
4	Two charges q1 and q2 are placed in vacuum at a distance d and the force acting between them is F. If a medium of dielectric constant 4 is introduced between them, the force now will be (a) F (b) F/2 (c) F/4 (d) 4F
5	The torque on a dipole placed in a uniform electric field will be maximum when the angle between **p** and **E** becomes- (a) 0^0 (b) 45^0 (c) 90^0 (d) 60^0
6	In non-uniform electric field, electric dipole experiences: (a) torque only (b) torque as well as net force (c) force only (d) None of these
B.	**Short Answer Type Questions (2 Marks)**
7	Why do the electric field lines never cross each other?
8	A charge q is enclosed by a spherical surface of radius R. If the radius is reduced to half, how would the electric flux through the surface change?
9	Draw the electric field lines of a point charge q when (i) $q < 0$ and (ii) $q > 0$
C.	**Short Answer Type Questions (3 Marks)**
10	Derive the expressions for the electric field due to a electric dipole On the axis of the dipole On the equatorial plane of the dipole.
11	Derive an expression for the Torque on a dipole in uniform external field.
12	State Gauss's law and apply it to find electric field due to an infinitely long straight uniformly charged wire.
E.	**Long Answer Type Questions (5 Marks)**
13	Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it. How is the field directed if (i) the sheet is positively charged, (ii) negatively charged?
	Answer Key
1	d
2	a
3	b
4	c
5	c
6	b
7	The electric lines of force give the direction of the electric field. In case, two lines of force intersect, there will be two directions of the electric field at the point of intersection, which is not possible.
8	Since flux is independent on radius, electric flux remain same.

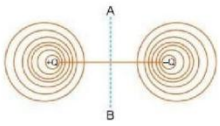
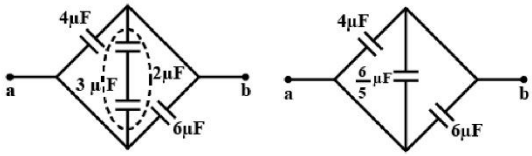
9	i) q<0  ii) q>0 
10	Derivation
11	Torque = Either force × Perpendicular distance between the two forces = qE × 2a sin θ = pE sin θ [∵ $\tau = pE \sin\theta$ $\vec{\tau} = \vec{p} \times \vec{E}$
12	Derivation
13	Derivation

CHAPTER-2 : ELECTROSTATIC POTENTIAL AND CAPACITANCE



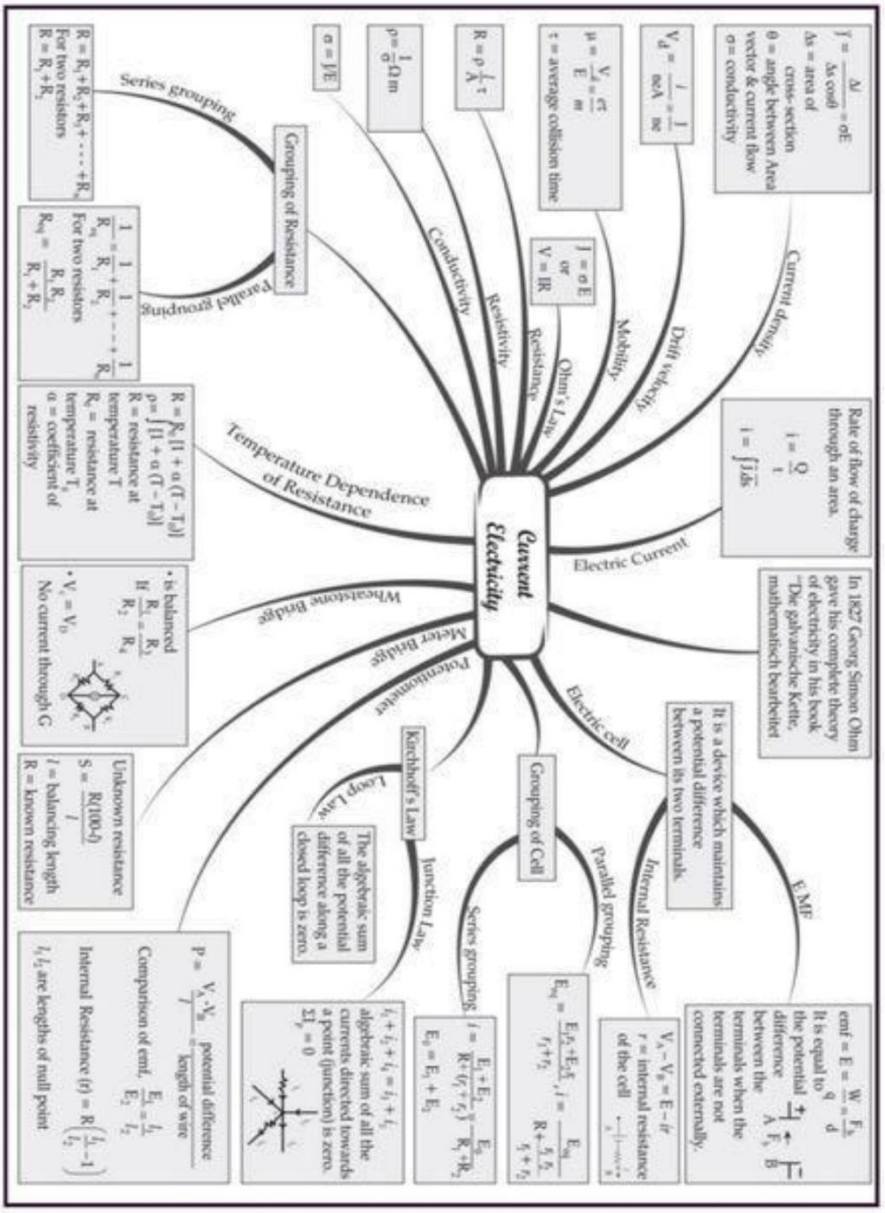
A.	**Choose the correct answer from the four options given below each question (1 Mark)**
1	If a unit positive charge is taken from one point to another over an equipotential surface, then (a) work is done on the charge (b) work is done by the charge. (c) work done is constant (d) no work is done.
2	A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the centre of the sphere is (a) 0 V (b) 10 V (c) Same as at point 8 cm away from the surface (d) Same as at point 10cm away from the surface
3	The capacitance of a parallel plate capacitor C having a charge Q and area A, is (a) proportional to the square root of the distance between the plates. (b) linearly proportional to the distance between the plates. (c) independent of the distance between the plates. (d) inversely proportional to the distance between the plates.
4	Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are EA and EB respectively and if the displacement between A and B is  r then (a) EA > EB (b) EA < EB (c) EA = EB/r (d) EA = EB /r^2
5	Which of the following options is correct? In a region of constant potential (a) the electric field is uniform (b) the electric field is zero. (c) there can be charge inside the region. (d) the electric field shall necessarily change if a charge is placed outside the region.
6	A parallel plate capacitor is connected with the terminals of a battery. The distance between the plates is 6mm. If a glass plate (dielectric constant K = 9) of 4.5 mm is introduced between them, then the capacitance will become (a) 2 times (b) the same (c) 3 times (d) 4 times.
B.	**Short Answer Type Questions (2 Marks)**

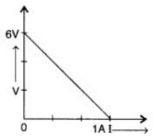
7	In which orientation, a dipole placed in a uniform electric field is in (i) stable and (ii) unstable equilibrium ?
8	Why is the electrostatic potential inside a charged conducting shell constant throughout the volume of the conductor?
9	Draw an equipotential surface for a system consisting of two charges Q, — Q separated by a distance r in Locate the points where the potential due to the dipole is zero.
C.	**Short Answer Type Questions (3 Marks)**
10	From the given figure, find the equivalent capacitance between the points A and B. 
11	Derive an expression for the capacitance of a parallel plate capacitor. Mention the factors on which the capacitance of a capacitor depends. What will happen to the capacitance of a capacitor if the charge on the plates will doubled? Explain
12	(a) Explain briefly, using a proper diagram, the difference in behavior of a conductor and a dielectric in the presence of external electric field. (b) Define the term polarization of a dielectric and write the expression for a linear isotropic dielectric in terms of electric field.
E.	**Long Answer Type Questions (5 Marks)**
13	Derive an expression for the capacitance of a parallel plate capacitor when a dielectric slab of dielectric constant K and thickness t but of same area as that of the plates is inserted between the capacitor plates.
	Answer Key
1	D
2	B
3	D
4	A
5	b
6	c
7	(i)For stable equilibrium, a dipole is placed parallel to the electric field. (ii) For unstable equilibrium, a dipole is placed antiparallel to the electric field.
8	No work is done in moving charge inside or on the surface of the conductor. & Potential constant. I Or No work is done in moving a charge inside the conductor
9	The equipotential surface for the system is as shown. Electric potenLial is zero at all points in the plane passing through the dipole equator AB.

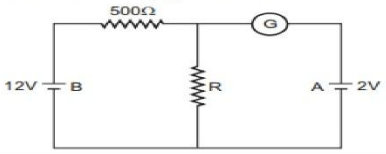
	
10	In series combination C = (C1C2) / (C1+C2) = 3μfx 2μf / 5μf = 6/5 μfn parallel combination C_{AB}=C1+C2+C3 = 4μf + 6/5μf + 6μf = 56/5μf = 11.2μf 
11	C= ε_0A/d Factors affecting the capacitance a. Area of the plates b. Distance between them c. Medium between them No change because the capacitance of a capacitor doesn't depend the charge.
12	Derivation
13	Derivation

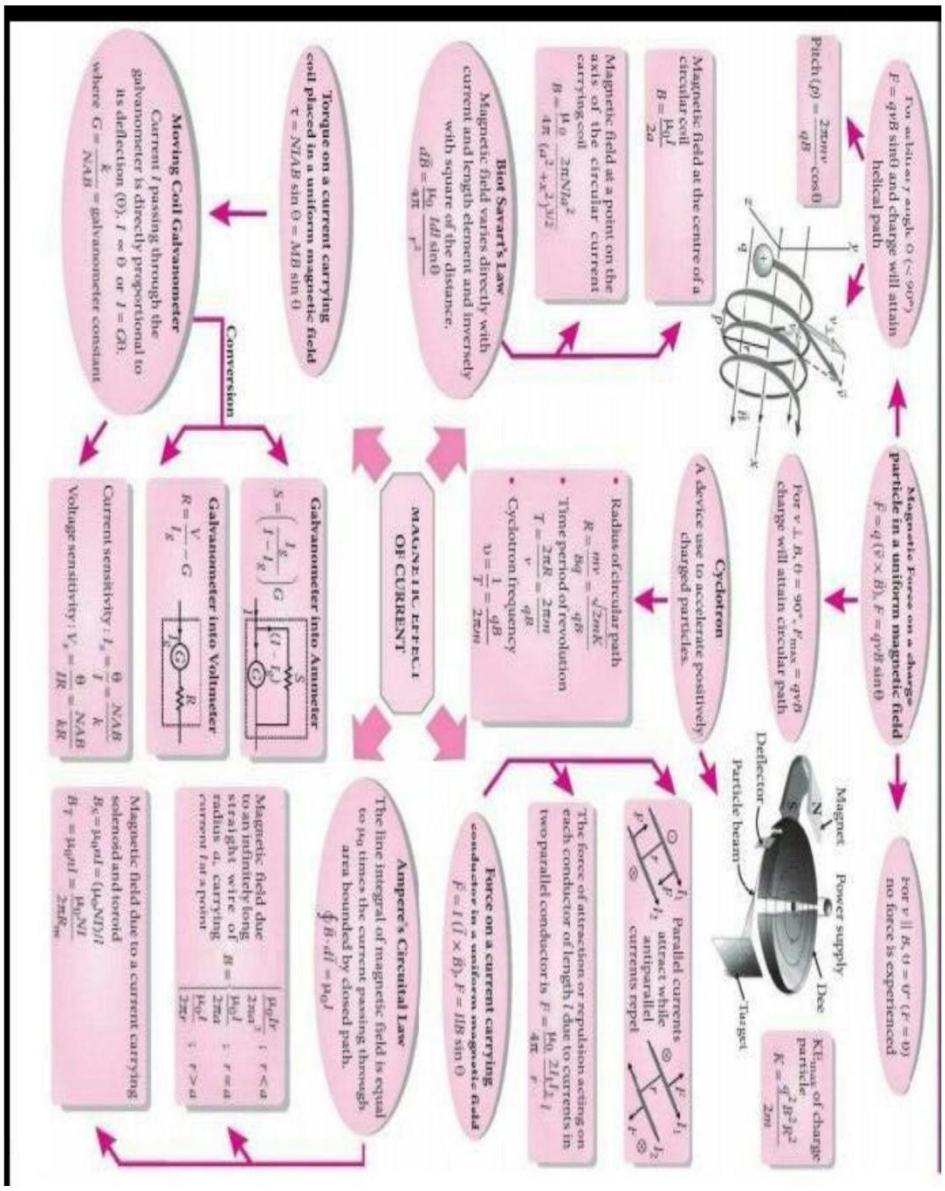
CHAPTER 3

CURRENT ELECTRICITY



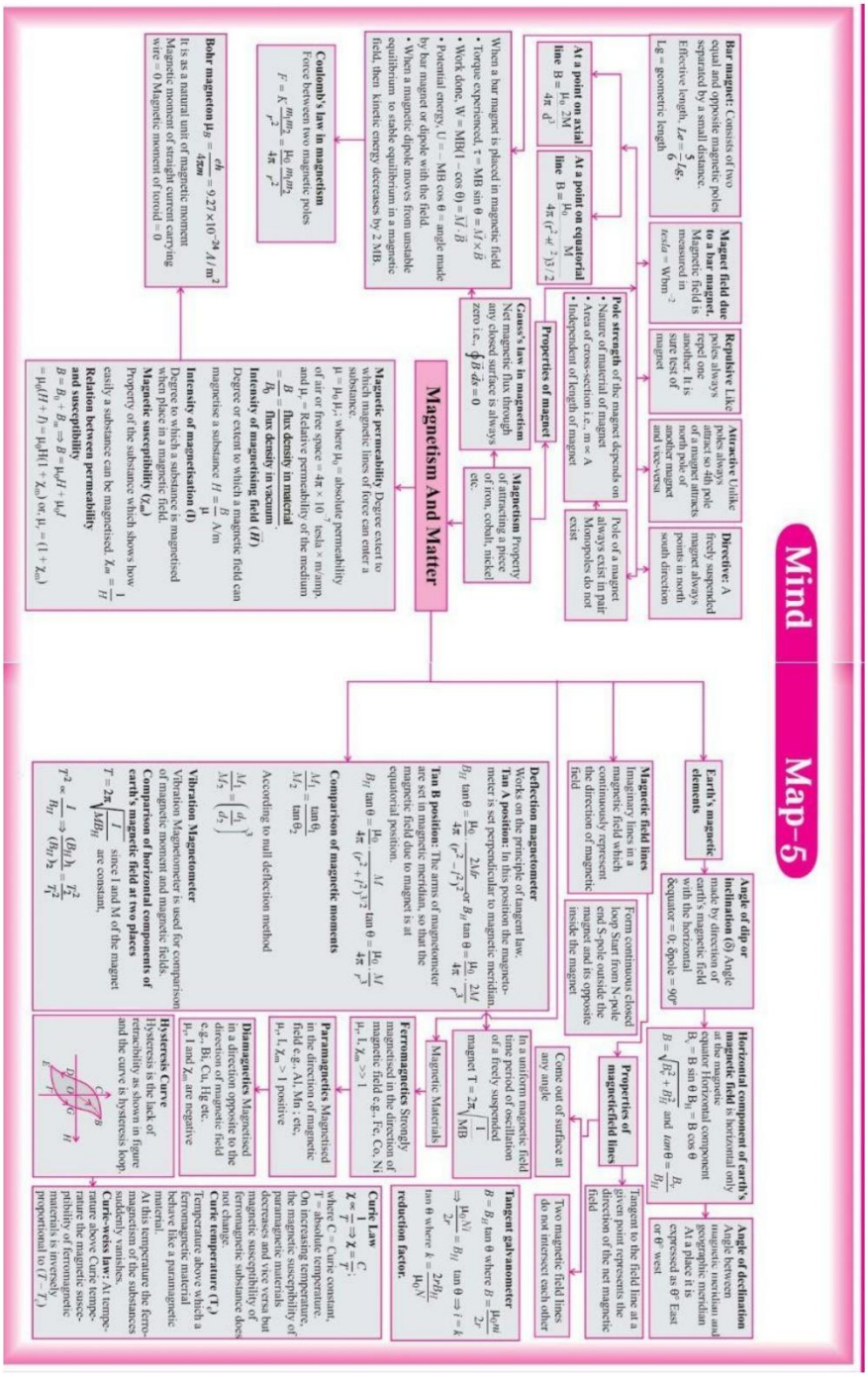
A.	**Choose the correct answer from the four options given below each question (1 Mark)**
1	A current of 1 mA is flowing in a conductor, the number of electrons passing through the conductor per second is: a) 6.25×10^{17} b)6.25×10^{15} c) 1.6×10^{16} c) 1.6×10^{-16}
2	Power P_s is dissipated through a series combination and power P_p is dissipated through the parallel combination of 3 equal resistors. The ratio of P_p to P_s is a) 9 b) 1 c) 1/9 d) 6
3	In a Wheatstone bridge if the battery and galvanometer are interchanged then the deflection in galvanometer a) change in previous direction b) not change c) change in opposite direction d) none of the above
4	The conductivity of a metal decreases with the increase in temperature on account of a)Decrease in number density of electrons. b)Decrease in resistivity. c) Decrease in relaxation time d)Decrease in mean free path.
5	Two unequal resistors are connected in parallel across a battery. Then the a) potential difference across each resistor is same. b) current in the larger resistor is larger. c) potential difference across the bigger resistor is greater. d) potential difference is lower across lower resistance.
6	A wire is stretched so as to change its length by 0.1%, the percentage increase in its resistance will be (a) 0.2% (b) 0.5% (c) 0.02% (d) 0.05%
B.	**Short Answer Type Questions (2 Marks)**
7	Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behavior explained?
8	Two wires of equal length, one of copper and the other of magainin have the same resistance. Which wire is thicker?
9	The plot of the variation of potential difference A across a combination of three identical cells in series, versus current is shown along the question. What is the emf and internal resistance of each cell? 
C.	**Short Answer Type Questions (3 Marks)**
10	Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'.

11	In the circuit shown in the figure, the galvanometer G gives zero deflection. If the batteries A and B have negligible internal resistance, find the value of the resistance R 
12	A wire of 15 Ω resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a 3.0 volt battery. Find the current drawn from the battery. ii) How does one explain increase in resistivity of a metal with increase of temperature?
E.	**Long Answer Type Questions (5 Marks)**
13	What is a Wheatstone bridge? When it is said to be balanced? ii) What do you mean by sensitivity of a wheatstone bridge? iii) What are the advantages of measuring resistance by wheatstone bridge method?
	Answer Key
1	B
2	A
3	B
4	C
5	A
6	A
7	Derivation
8	Derivation
9	Derivation
10	Derivation
11	Derivation
12	Derivation
13	Derivation


MAGNETIC EFFECT OF CURRENT
Magnetic Force on a charge particle in a uniform magnetic field
$\vec{F} = q(\vec{v} \times \vec{B})$, $F = qvB \sin\theta$
For $v \perp B$, $\theta = 90°$, $F_{max} = qvB$
charge will attain circular path
For $v \parallel B$, $\theta = 0°$ ($F = 0$)
no force is experienced
Two ordinary angle θ ($\neq 90°$)
$F = qvB \sin\theta$ and charge will attain helical path
Pitch (p) $= \frac{2\pi mv}{qB} \cos\theta$
Biot Savart's Law
Magnetic field varies directly with current and length element and inversely with square of the distance.
$dB = \frac{\mu_0}{4\pi} \frac{Idl \sin\theta}{r^2}$
Magnetic field at a point on the axis of the circular current carrying coil
$B = \frac{\mu_0}{4\pi} \frac{2\pi NIa^2}{(a^2+x^2)^{3/2}}$
Magnetic field at the centre of a circular coil
$B = \frac{\mu_0 I}{2a}$
Torque on a current carrying coil placed in a uniform magnetic field
$\tau = NIAB \sin\theta = MB \sin\theta$
Moving Coil Galvanometer
Current I passing through the galvanometer is directly proportional to its deflection (θ); $I \propto \theta$ or $I = G\theta$.
where $G = \frac{k}{NAB}$ = galvanometer constant
Conversion
Galvanometer into Ammeter
$S = \left(\frac{I_g}{I - I_g}\right) G$
Galvanometer into Voltmeter
$R = \frac{V}{I_g} - G$
Current sensitivity: $I_s = \frac{\theta}{I} = \frac{NAB}{k}$
Voltage sensitivity: $V_s = \frac{\theta}{IR} = \frac{NAB}{kR}$
Cyclotron
A device use to accelerate positively charged particles.
Deflector
Particle beam
Magnet
Power supply
Dee
Target
KE_{max} of charge particle $K = \frac{q^2B^2R^2}{2m}$
• Radius of circular path $R = \frac{mv}{Bq} = \frac{\sqrt{2mK}}{qB}$
• Time period of revolution $T = \frac{2\pi R}{v} = \frac{2\pi m}{qB}$
• Cyclotron frequency $\upsilon = \frac{1}{T} = \frac{qB}{2\pi m}$
Force on a current carrying conductor in a uniform magnetic field
$\vec{F} = I(\vec{l} \times \vec{B})$, $F = IlB \sin\theta$
The force of attraction or repulsion acting on each conductor of length l due to currents in two parallel conductor is $F = \frac{\mu_0}{4\pi} \frac{2I_1I_2}{r} l$
Parallel currents attract while antiparallel currents repel
Ampere's Circuital Law
The line integral of magnetic field is equal to μ_0 times the current passing through area bounded by closed path.
$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$
Magnetic field due to an infinitely long straight wire of radius a, carrying current I at a point
$B = \frac{\mu_0 Ir}{2\pi a^2}$; $r < a$
$\frac{\mu_0 I}{2\pi a}$; $r = a$
$\frac{\mu_0 I}{2\pi r}$; $r > a$
Magnetic field due to a current carrying solenoid and toroid
$B_S = \mu_0 nI = (\mu_0 N)I$
$B_T = \mu_0 nI = \frac{\mu_0 NI}{2\pi R_m}$

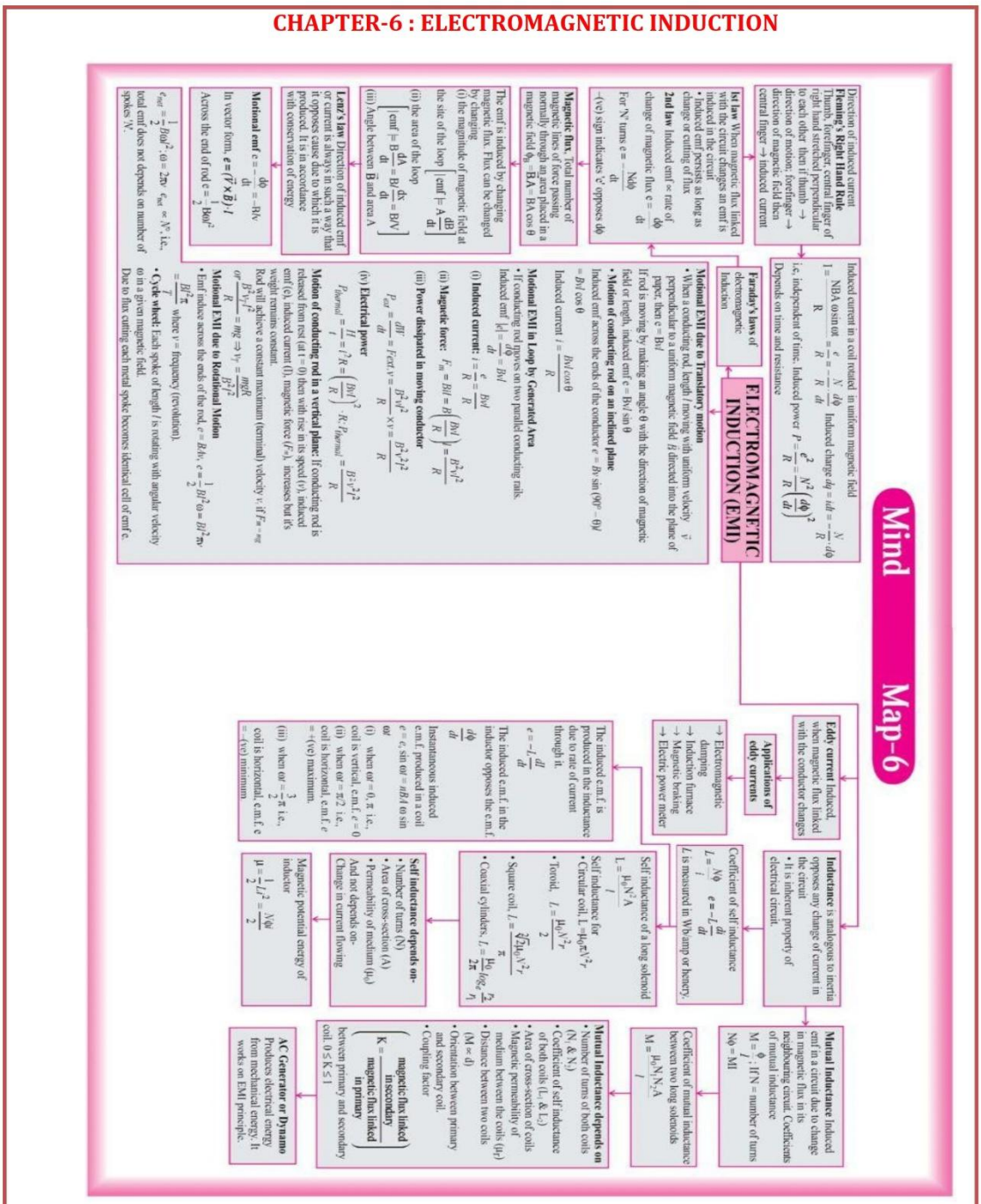
A.	**Choose the correct answer from the four options given below each question (1 Mark)**
1	An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true? (a) The electron will be accelerated along the axis. (b) The electron path will be circular about the axis. (c) The electron will experience a force at 45° to the axis and hence execute a helical path. (d) The electron will continue to move with uniform velocity along the axis of the solenoid.
2	(a) Fleming's left hand rule (b) Fleming's right hand rule (c) Ampere's rule (d) Right hand clasp rule
3	A solenoid is connected to a battery so that a steady current flows through it. If an iron core is inserted into the solenoid, the current will (a) Increase (b) Decrease (c) Remain same (d) First increase then decrease
4	According to Biot-Savart law, moving electrons having velocity 'v' produce magnetic field B such that (a)Magnetic field B is parallel to v (b)Magnetic field B is perpendicular to v (c)Along the line which is joining the electron and point of observation (d)None of the above
5	A current-carrying loop is placed in a uniform magnetic field. The torque acting on it does not depend upon (a) area of loop (b) value of current (c) magnetic field (d) None of these
6	The sensitivity of a moving coil galvanometer can be increased by increasing (a) the radius of the coil (b) the external magnetic field (c) the number of turns of the coil (d) all of the above
B.	**Short Answer Type Questions (2 Marks)**
7	What happens if an ammeter is connected in parallel to the circuit? What is the resistance of an ideal ammeter?
8	A charge 'q' moving along the X-axis with a velocity v is subjected to a uniform magnetic field B acting along the Z-axis as it crosses the origin O. (i) Trace its trajectory. (ii) Does the charge gain kinetic energy as it enters the magnetic field? Justify your answer.
9	Equal currents are flowing through the two infinitely long parallel conductors. What shall be the magnetic field at a point mid way between them when the currents: (a) in them are flowing in the same direction? (b) in them are flowing in the opposite direction?

C.	**Short Answer Type Questions (3 Marks)**
10	An ammeter of resistance 0.6 Ω can measure current upto 1.0 A. Calculate (i) The shunt resistance required to enable the ammeter to measure current upto 5.0 A (ii) The combined resistance of the ammeter and the shunt.
11	Given two parallel wires carrying currents I_1 and I_2 are kept at a distance d apart. Obtain the expression for force exerted by one on other.
12	What do you understand by the sensitivity of moving coil galvanometer? Write its expression. On what factors does it depend and how?
E.	**Long Answer Type Questions (5 Marks)**
13	State Biot-Savart law and express this law in vector form. (b) Two identical circular coils, P and Q each of radius R, carrying currents 1 A and $\sqrt{3}$ A respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.
14	Derive an expression for the intensity of magnetic field at a point on the axis of a circular current loop. (b) Resistance of a Galvanometer is 50 ohms, when 0.01 A current flows through it, full scale defections is obtained. How it can be converted into i) 5 A range ammeter and ii) 5 volts range voltmeter.
	Answer Key
1	d
2	b
3	b
4	b
5	d
6	d
7	Derivation
8	Derivation
9	Derivation
10	Derivation
11	Derivation
12	Derivation
13	Derivation
14	Derivation


Mind Map-5
Magnetism And Matter
Bar magnet: Consists of two equal and opposite magnetic poles separated by a small distance.
Effective length, $L_e = \frac{5}{6} L_g$,
L_g = geometric length
Magnet field due to a bar magnet. Magnetic field is measured in tesla = Wbm^{-2}
Repulsive Like poles always repel one another. It is sure test of magnet
Attractive Unlike poles always attract so 4th pole of a magnet attracts north pole of another magnet and vice versa
Directive: A freely suspended magnet always points in north south direction
Properties of magnet
Pole strength of the magnet depends on
• Nature of material of magnet
• Area of cross-section i.e.; m ∝ A
• Independent of length of magnet
Pole of a magnet always exist in pair Monopoles do not exist
At a point on axial line $B = \frac{\mu_0}{4\pi} \frac{2M}{d^3}$
At a point on equatorial line $B = \frac{\mu_0}{4\pi} \frac{M}{(r^2 - l^2)^{3/2}}$
When a bar magnet is placed in magnetic field
• Torque experienced, $\tau = MB \sin\theta = \vec{M} \times \vec{B}$
• Work done, $W = MB(1 - \cos\theta) = \vec{M} \cdot \vec{B}$
• Potential energy, $U = -MB \cos\theta$ = angle made by bar magnet or dipole with the field.
• When a magnetic dipole moves from unstable equilibrium to stable equilibrium in a magnetic field, then kinetic energy decreases by 2 MB.
Gauss's law in magnetism Net magnetic flux through any closed surface is always zero i.e.; $\oint \vec{B} \cdot d\vec{s} = 0$
Magnetism Property of attracting a piece of iron, cobalt, nickel etc.
Coulomb's law in magnetism Force between two magnetic poles $F = K \frac{m_1 m_2}{r^2} = \frac{\mu_0}{4\pi} \frac{m_1 m_2}{r^2}$
Bohr magneton $\mu_B = \frac{eh}{4\pi m} = 9.27 \times 10^{-24}\ A/m^2$
It is as a natural unit of magnetic moment
Magnetic moment of straight current carrying wire = 0 Magnetic moment of toroid = 0
Intensity of magnetisation (I) Degree to which a substance is magnetised when place in a magnetic field.
Magnetic susceptibility (χ_m) Property of the substance which shows how easily a substance can be magnetised. $\chi_m = \frac{I}{H}$
Relation between permeability and susceptibility $B = B_0 + B_m \Rightarrow B = \mu_0 H + \mu_0 I$
$= \mu_0(H + I) = \mu_0 H(1 + \chi_m)$ or, $\mu_r = (1 + \chi_m)$
Magnetic permeability Degree extent to which magnetic lines of force can enter a substance.
$\mu = \mu_0 \mu_r$, where μ_0 = absolute permeability of air or free space = $4\pi \times 10^{-7}$ tesla × m/amp. and μ_r = Relative permeability of the medium
$= \frac{B}{B_0}$ = flux density in material
B_0 = flux density in vacuum.
Intensity of magnetising field ($\vec{H}$) Degree or extent to which a magnetic field can magnetise a substance $H = \frac{B}{\mu}$ A/m
Earth's magnetic elements
Angle of dip or inclination (δ) Angle made by direction of earth's magnetic field with the horizontal
δequator = 0; δpole = 90°
Horizontal component of earth's magnetic field is horizontal only at the magnetic equator Horizontal component $B_h = B \sin\theta$ $B_H = B \cos\theta$
$B = \sqrt{B_h^2 + B_H^2}$ and $\tan\theta = \frac{B_v}{B_H}$
Angle of declination Angle between magnetic meridian and geographic meridian At a place it is expressed as θ° East or θ° west
Magnetic field lines Imaginary lines in a magnetic field which continuously represent the direction of magnetic field
Form continuous closed loop Start from N pole end S-pole outside the magnet and its opposite inside the magnet
Properties of magneticfield lines
Tangent to the field line at a given point represents the direction of the net magnetic field
Two magnetic field lines do not intersect each other
Come out of surface at any angle
Deflection magnetometer Works on the principle of tangent law.
Tan A position: In this position the magnetometer is set perpendicular to magnetic meridian
$B_H \tan\theta = \frac{\mu_0}{4\pi} \frac{2Mr}{(r^2 - l^2)^2}$ or $B_H \tan\theta = \frac{\mu_0}{4\pi} \frac{2M}{r^3}$
Tan B position: The arms of magnetometer are set in magnetic meridian, so that the magnetic field due to magnet is at equatorial position.
$B_H \tan\theta = \frac{\mu_0}{4\pi} \frac{M}{(r^2 + l^2)^{3/2}}$ $\tan\theta = \frac{\mu_0}{4\pi} \frac{M}{r^3}$
Comparison of magnetic moments
$\frac{M_1}{M_2} = \frac{\tan\theta_1}{\tan\theta_2}$
According to null deflection method
$\frac{M_1}{M_2} = \left(\frac{d_1}{d_2}\right)^3$
Vibration Magnetometer
Vibration Magnetometer is used for comparison of magnetic moment and magnetic fields.
Comparison of horizontal components of earth's magnetic field at two places
$T = 2\pi\sqrt{\frac{I}{MB_H}}$ since I and M of the magnet are constant.
$T^2 \propto \frac{I}{B_H} \Rightarrow \frac{(B_H)_1}{(B_H)_2} = \frac{T_2^2}{T_1^2}$
In a uniform magnetic field time period of oscillation of a freely suspended magnet $T = 2\pi\sqrt{\frac{I}{MB}}$
Tangent galvanometer $B = B_H \tan\theta$ where $B = \frac{\mu_0 n}{2r}$
$\tan\theta$ where $k = \frac{2\pi B_H}{\mu_0 N}$
reduction factor.
Magnetic Materials
Ferromagnetics Strongly magnetised in the direction of magnetic field e.g., Fe, Co, Ni
μ_r I, $\chi_m >> 1$
Curie Law
$\chi \propto \frac{1}{T} \Rightarrow \chi = \frac{C}{T}$.
where C = Curie constant, T = absolute temperature.
On increasing temperature, the magnetic susceptibility of paramagnetic materials decreases and vice versa but magnetic susceptibility of ferromagnetic substance does not change.
Curie temperature (T_c) Temperature above which a ferromagnetic material behave like a paramagnetic
At this temperature the ferromagnetism of the substances suddenly vanishes.
Curie-weiss law: At temperature above Curie temperature the magnetic susceptibility of ferromagnetic materials is inversely proportional to $(T - T_c)$
Paramagnetics Magnetised in a direction opposite to the field e.g., Al, Mn ; etc,
μ_r I, $\chi_m > 1$ positive
Diamagnetics Magnetised in a direction opposite to the direction of magnetic field e.g., Bi, Cu, Hg etc.
μ_r, I and χ_m are negative
Hysteresis Curve
Hysteresis is the lack of retraceability as shown in figure and the curve is hysteresis loop.
B
C
D
O
A
E
F
H

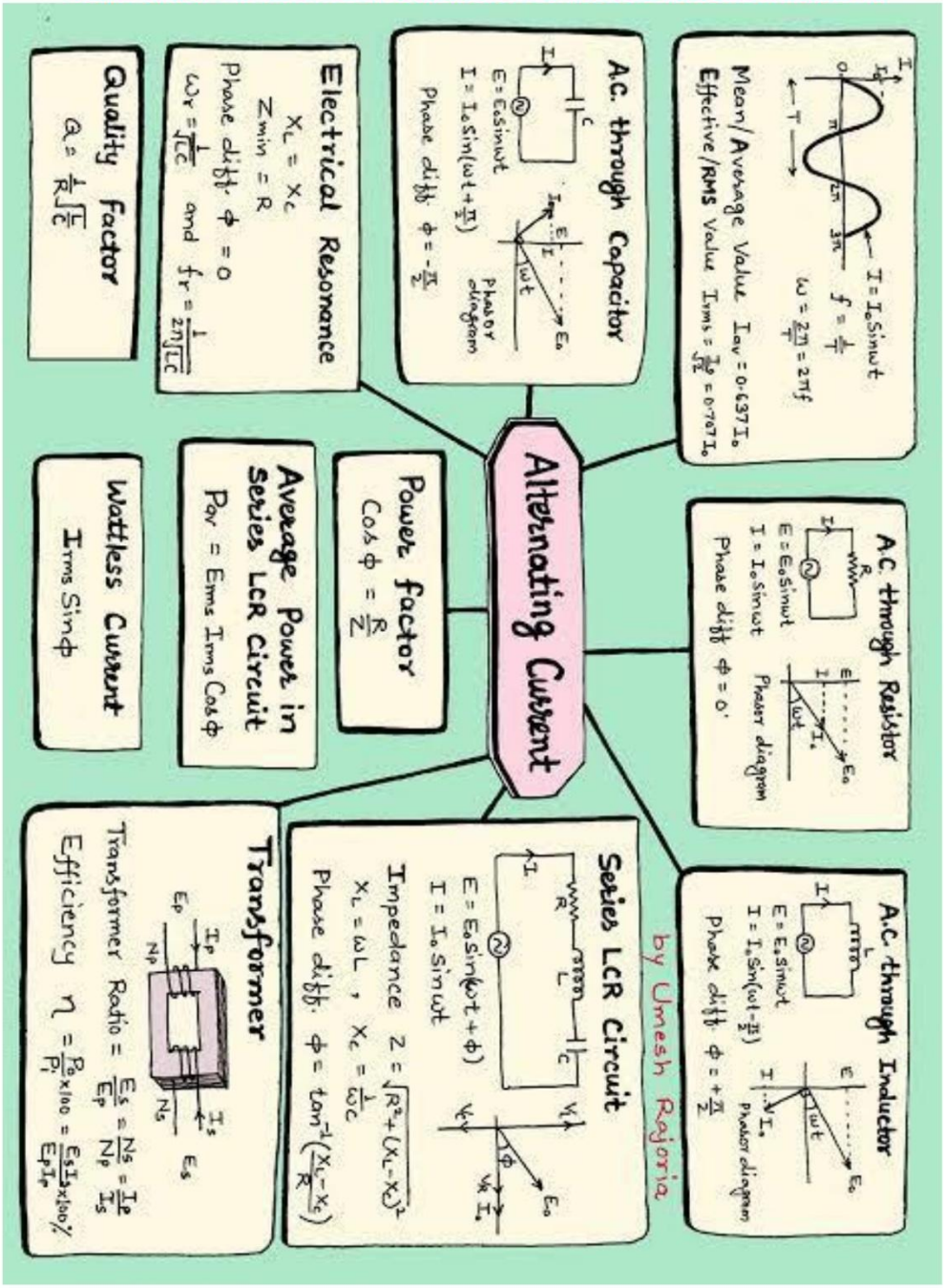
A.	**Choose the correct answer from the four options given below each question (1 Mark)**
1	A stationary magnet doesn't interact with (a) Iron rod (b) Moving charge (c)Magnet (d) stationary charge
2	The S.I. Unit of magnetic pole strength is (a) Ampere/metre (b) Ampere-metre (c) Volt/metre (d) ampere/metre-square
3	A bar magnet AB with magnetic moment M is cut into two equal parts perpendicular to its axis. One part is kept over the another so that B is exactly over A. What will me the magnetic moment of the combination so formed? (a) Zero (b) M/4 (c) M (d) 3M/4
4	Which of the following is an example of diamagnetic substance? (a) Copper (b) Nickel (c) aluminum (d) iron
5	A sensitive magnetic instrument can be shielded very effectively from outside fields by placing it inside a box of (a) teak wood (b) plastic materials (c) soft iron of high permeability (d) a metal of high conductivity
6	The ratio of magnetic fields due to a small bar magnet in the end on position to the broad side on position is (a) 1:4 (b) 1:2 (c) 1:1 (d) 2:1
B.	**Short Answer Type Questions (2 Marks)**
7	Define magnetic moment. A steel wire has magnetic moment M. Find the new magnetic moment if it is bent into a semi-circle.
8	The permeability of a magnetic material is 0.9983. Identify the magnetic material and draw its field lines when placed in a uniform magnetic field.
9	The susceptibility of a magnetic material is -2.6×10^{-5} . Identify the type of magnetic material and state its two properties.
C.	**Short Answer Type Questions (3 Marks)**
10	(i) Write the mathematical expression for magnetic field due to a magnetic dipole. (ii) From the above formula, Find the magnetic field for axial and equatorial point.
11	A wire of length L is bent round in the form of (i) a square, and then (ii) an equilateral triangle. If current I is passed through each of them, find the ratio of magnetic moment of the square loop to that of the triangle.
12	A wire of length L is in the form of a circular loop A of one turn. This loop is reshaped into loop B of three turns. Find the ratio of the magnetic fields at the centres of loop A and loop B for the same current through them.
	Answer Key
1	d
2	b
3	a
4	a
5	c
6	d

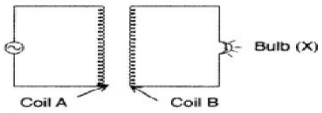
7	M=2ml=NIA $M_1=\frac{2}{\pi}M$
8	It is a diamagnetic material. The magnetic field lines will not pass through the material
9	Diamagnetic material: low permeability, tendency to move from stronger to weaker part of external magnetic field.
10	The magnetic field intensity due to magnetic dipole is $B=\frac{\mu M}{4\pi r3}\sqrt{1+3(cos\Theta)(cos\Theta)}$ For axial point ,Use $\Theta=0^0$ At equatorial point,use $\Theta=90^0$
11	For square, L=4a so Area A= $L^2/16$ For equilateral triangle, L=3b so area =$\sqrt{3}L^2/36$ So ratio of magnetic moments is the ratio of the areas as same current is flowing through them. $M_1/M_2=\frac{3}{4}\sqrt{3}$
12	Use $B=\mu NI/2r$ $R_b=r_a/3$,so $B_A/B_B=1/9$

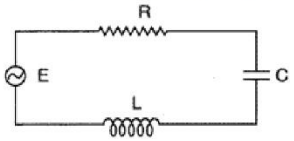

CHAPTER-6 : ELECTROMAGNETIC INDUCTION
Mind Map-6
ELECTROMAGNETIC INDUCTION (EMI)
Faraday's laws of electromagnetic induction
Lenz's law
Motional EMF due to Translatory motion
Motional EMF due to Rotational Motion
Eddy current
Applications of eddy currents
Inductance
Self inductance of a long solenoid
Mutual Inductance
Coefficient of mutual inductance between two long solenoids
Mutual Inductance depends on
AC Generator or Dynamo

A.	**Choose the correct answer from the four options given below each question (1 Mark)**
1	Which of the following states that an emf is induced whenever there is a change in the magnetic field linked with electric circuits?
2	Which of the following gives the polarity of the induced emf? (a)Biot-Savart Law (b)Lenz's Law (c)Ampere's circuital Law (d)Fleming's right-hand Rule
3	Which of the following apparatus construction uses electromagnetic induction? (a)Voltmeter (b)Galvanometer (c)Generator (d)Electric Motor
4	Which of the following factors is the self inductance associated with a coil is independent of? (a)length (b)current (c) cross sectional area (d) number of turns
5	An induced e.m.f. is produced when a magnet is plunged into a coil. The strength of the induced e.m.f. is independent of (a) the strength of the magnet (b) number of turns of coil (c) the resistivity of the wire of the coil (d) speed with which the magnet is moved
6	A coil of insulated wire is connected to a battery. If it is taken to galvanometer, its pointer is deflected, because (a) the induced current is produced (b) the coil acts like a magnet (c) the number of turns in the coil of the galvanometer are changed (d) None of these
B.	**Short Answer Type Questions (2 Marks)**
7	How does the mutual inductance of a pair of coils change when (i) distance between the coils is increased and (ii) number of turns in the coils is increased
8	Derive an expression for the self-inductance of a long air-cored solenoid of length l and number of turns N.
9	The magnetic flux is given by the equation $\phi = 3t^2 + 4t + 2$; find induced emf at t=2sec.
C.	**Short Answer Type Questions (3 Marks)**
10	State Lenz's Law related to electromagnetic induction. Show that Lenz's law is in accordance with the law of conservation of energy.
11	Define self-inductance of a coil. Show that magnetic energy required to build up the current I in a coil of self inductance L is given by $0.5LI^2$.
12	A coil of number of turns N, area A, is rotated at a constant angular speed ω, in a uniform magnetic field B, and connected to a resistor R. Deduce expressions for : (i) Maximum emf induced in the coil. (ii) Power dissipation in the coil.
	Long Answer Type Questions (5 Marks)
13	Define mutual inductance between two long coaxial solenoids. (b) Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length. (c) A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?
	Answer Key
1	c
2	b

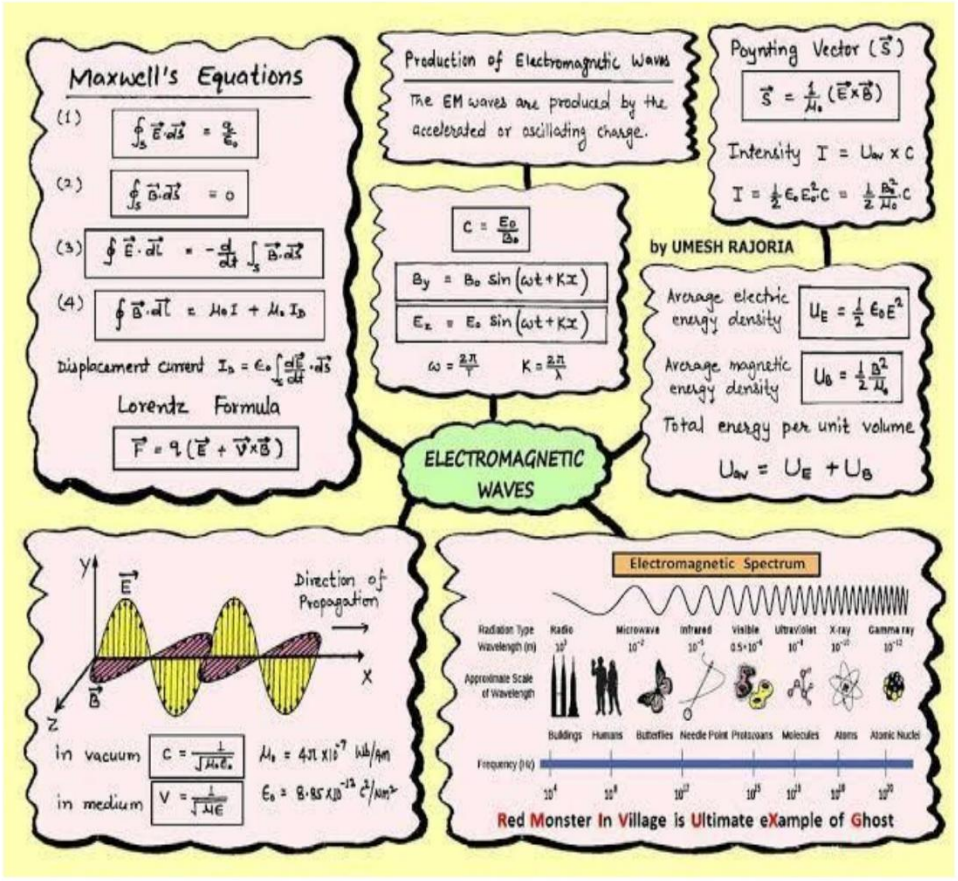
3	c
4	b
5	c
6	a
7	(i) Mutual inductance decreases', because flux linked with the secondary coil decreases. (ii) $M=\mu_0 n_1 n_2 Al$, so when n_1 and n_2 increase, mutual inductance (M) increases.
8	Consider a long solenoid of length l and radius r with r << 1 and having n turns per unit length. If a current I flows through the coil, then the magnetic field inside the coil is almost constant and is given by $B = \mu_0 nI$. Also,Magnetic flux linked with each turn = $BA = \mu_0 nIA$. Magnetic flux linked with entire solenoid= $\mu_0 n^2 IAl$ Also,Magnetic flux=LI. Using these equations,$L=(\mu_0 N^2 A)/l$
9	Total magnetic flux $\phi=3t^2+4t+9$ $E = d/dt(3t^2+4t+9)$, $E = 6t+4$ Therefore E =16volt
10	Lenz's law: According to this law the direction of induced current in a closed circuit is always such as to oppose the cause that produces it. The induced EMF produces a current that opposes the change in flux and hence energy. As the change starts, induction opposes and slows the change. If the induced EMF were in the same direction as the change in flux, then that would give us free energy from no apparent source violating conservation of energy. Thus Lenz's law is in accordance with the law of conservation of energy.
11	The self-inductance of a coil may be defined as the induced emf set up in the coil due to a unit rate of change of current through it. For derivation,Use $E=-LdI/dt$.Also we know, $dW=EIdt$. Put value of E and integrate dW to get final result.
12	Use Magnetic flux= $NAB(Cos\omega t)$ Induced emf E= -d(Magnetic flux)/dt We get,$E= NAB\omega(Sin\omega t)$ where $NAB\omega$ is maximum value of induced emf. For power use,$P= E^2/R$ and average value of sine function over the cycle is ½. So power is equal to $=(N^2 A^2 B^2 \omega^2)/2R$
13	(a) Mutual induction is the phenomenon of inducing emf in a coil due to the rate of change of current in a nearby coil. (b) When a current I_2 is set up through S_2 (outer solenoid), it in turn sets up a magnetic flux through S_1. Let us denote it by ϕ_1, The corresponding flux linkage with solenoid S_1 is, $N_1 \phi_1 = M_{12} I_2$ M_{21} is referred to as coefficient of mutual inductance of solenoid S_2 with respect to solenoid S_1 and vice-versa. Put the value of total flux linked ammd we get $M= \mu_r \mu_0 n_1 n_2 \pi r_1^2 l$ (c) Given : M = 1.5 H, $I_1 = 0$, $I_2 = 20$ A, $\Delta t = 0.5$ sec, $d\phi$ = ? Change in flux ($d\phi$) = $MdI = M(I_2 - I_1) = 1.5 (20 - 0) = 30$ Weber


Alternating Current
A.C. through Resistor
E = E₀Sinωt
I = I₀Sinωt
Phase diff. Φ = 0°
Phasor diagram
A.C. through Inductor
E = E₀Sinωt
I = I₀Sin(ωt-π/2)
Phase diff. Φ = +π/2
Phasor diagram
A.C. through Capacitor
E = E₀Sinωt
I = I₀Sin(ωt+π/2)
Phase diff. Φ = -π/2
Phasor diagram
Mean/Average Value Iav = 0.637 I₀
Effective/RMS Value Irms = I₀/√2 = 0.707 I₀
I = I₀Sinωt
ω = 2π/T = 2πf
Series LCR Circuit
E = E₀Sin(ωt+Φ)
I = I₀Sinωt
Impedance Z = √(R²+(X_L-X_C)²)
X_L = ωL , X_C = 1/ωC
Phase diff. Φ = tan⁻¹((X_L-X_C)/R)
Power factor
Cos Φ = R/Z
Average Power in Series LCR circuit
Pav = Erms Irms Cos Φ
Wattless Current
Irms Sin Φ
Electrical Resonance
X_L = X_C
Z_min = R
Phase diff. Φ = 0
ω_r = 1/√LC and f_r = 1/2π√LC
Quality Factor
Q = 1/R √(L/C)
Transformer
Transformer Ratio = E_s/E_p = N_s/N_p = I_p/I_s
Efficiency η = P_o/P_i × 100 = E_s I_s/E_p I_p × 100%
by Umesh Rajoria

A.	**Choose the correct answer from the four options given below each question (1 Mark)**
1	In series LCR circuit, the phase angle between supply voltage and current is (a) $\tan\phi = \frac{X_L - X_C}{R}$ (b) $\tan\phi = \frac{R}{X_L - X_C}$ (c) $\tan\phi = \frac{R}{X_L + X_C}$ (d) $\tan\phi = \frac{X_L + X_C}{R}$
2	In a series LCR circuit the voltage across an inductor, capacitor and resistor are 20 V, 20 V and 40 V respectively. The phase difference between the applied voltage and the current in the circuit is (a) 30° (b) 45° (c) 60° (d) 0°
3	A transformer works on the principle of (a) self induction (b) electrical inertia (c) mutual induction (d) magnetic effect of the electrical current
4	At resonant frequency the current amplitude in series LCR circuit is (a) maximum (b) minimum (c) zero (d) infinity
5	$\sqrt{LC}$ has the dimensions of (a) time (b) frequency (c) work (d) angle
6	For an ideal-step-down transformer, the quantity which is constant for both the coils is (a) current in the coils (b) voltage across the coils (c) resistance of coils (d) power in the coils
B.	**Short Answer Type Questions (2 Marks)**
7	The figure given shows an arrangement by which current flows through the bulb (X) connected with coil B, when a.c. is passed through coil A.  (i) Name the phenomenon involved. (ii) If a copper sheet is inserted in the gap between the coils, explain, how the brightness of the bulb would change.
8	A 15.0 μF capacitor is connected to 220 V, 50 Hz source. Find the capacitive reactance and the rms current.

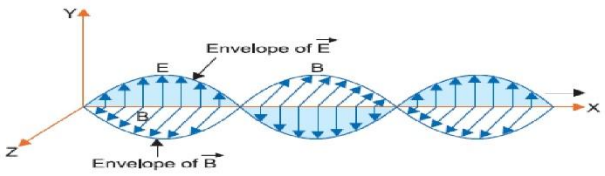
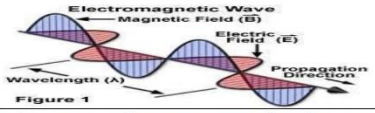
9	Define capacitor reactance. Write its S.I. unit.
C.	**Short Answer Type Questions (3 Marks)**
10	Derive an expression for the impedance of an a.c. circuit consisting of an inductor and a resistor.
11	The figure shows a series LCR circuit connected to a variable frequency 250 V source with L = 40 mH, C = 100 μF and R = 50 Ω.  Determine : (i) the source frequency which derives the circuit in resonance; (ii) Find out the impedance of given LCR circuit.
12	Derive the expression of average power loss across series LCR circuit.
	Long Answer Type Questions (5 Marks)
13	Draw a sketch showing the basic elements of an transformer.. State its principle and explain briefly its working. Also explain how can we minimise energy lossses in transformer.
	Answer Key
1	a
2	d
3	c
4	a
5	a
6	d
7	derivation
8	derivation
9	derivation
10	derivation
11	derivation
12	derivation
13	derivation

CHAPTER-8: ELECTROMAGNETIC WAVES

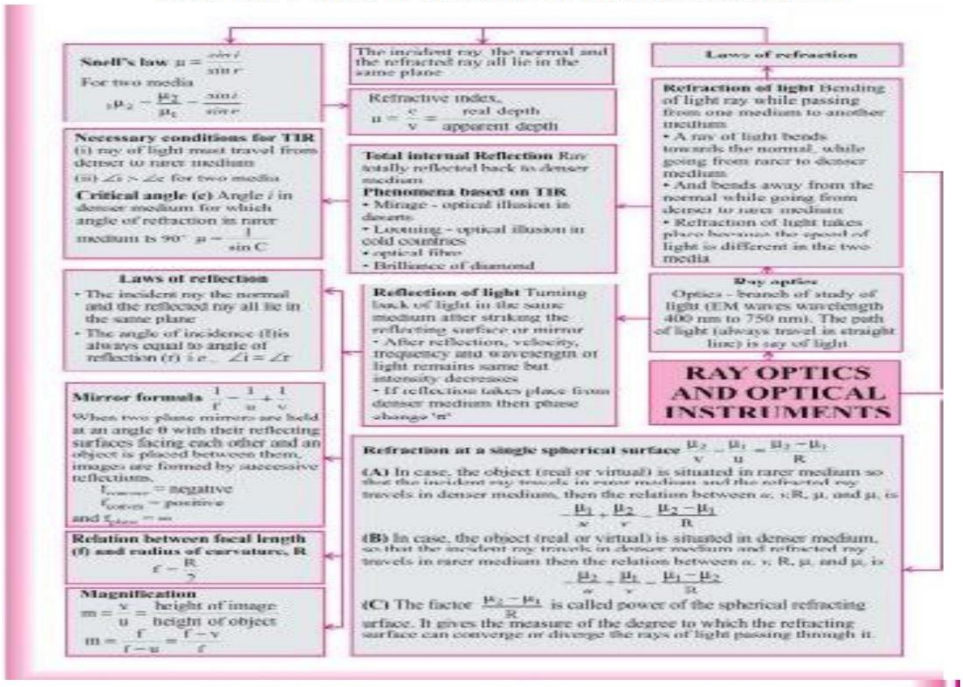


SL. NO.	MCQs and Reasoning and assertion types	1 Mark
1.	An electromagnetic wave can be produced, when charge is (a) moving with a constant velocity (b) oscillating (c) falling in an electric field (d) both (b) and (c)	1
2.	The waves used by artificial satellites for communication is (a) microwaves (b) infrared waves (c) radio waves (d) X-rays	1
3.	Which of the following electromagnetic waves is used in medicine to destroy cancer cells? (a) IR-rays (b) Visible rays (c) Gamma rays (d) Ultraviolet rays	1

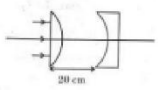
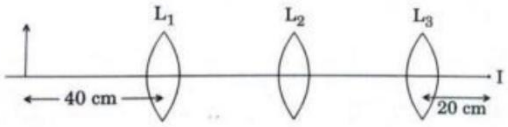
4.	The study of crystal can be studied by: (a) X-Ray (b) Gamma ray (c) U.V. ray (d) Microwave	1
5.	The ultra-high frequency band of radio waves in electromagnetic wave is used as in: (a) television waves (b) cellular phone communication (c) commercial FM radio (d) both (a) and (c)	1
6.	The ratio of contributions made by the magnetic field and electric field components to the intensity of an EM wave is (a) 1:1 (b) c:1 (c) c^2:1 (d) $\sqrt{c}$:1	1
7.	If E and B denote electric and magnetic fields respectively, which of the following is dimensionless? (a) $\sqrt{\mu_0\varepsilon_0}\,\frac{E}{B}$ (b) $\mu_0\varepsilon_0\,\frac{E}{B}$ (c) $\mu_0\varepsilon_0\left(\frac{B}{E}\right)^2$ (d) $\frac{E}{\varepsilon_0}\frac{\mu_0}{B}$	1
8.	Assertion: Electromagnetic wave are transverse in nature. Reason: The electric and magnetic fields in electromagnetic waves are perpendicular to each other and the direction of propagation.	1
9.	Assertion: Electromagnetic waves exert radiation pressure. Reason: Electromagnetic waves carry energy.	1
10.	Assertion: The velocity of electromagnetic waves depends on electric and magnetic properties of the medium. Reason: Velocity of electromagnetic waves in free space is constant.	1
	SHORT ANSWER – 1	2 M
11.	Name the electromagnetic radiation to which waves of wavelength in the range of 10^{-2} m belong. Give one use of this part of EM spectrum.	2
12.	Name the part of electromagnetic spectrum which is suitable for: (a) radar systems used in aircraft navigation (b) Treatment of cancer tumours.	2
13.	A plane electromagnetic wave travels in vacuum along z-direction. What can you say about the direction of electric and magnetic field vectors?	2
	SHORT ANSWER – II	3 M
14.	(a) How does oscillating charge produce electromagnetic waves? (b) Sketch a schematic diagram depicting oscillating electric and magnetic fields of an EM wave propagating along positive Z-direction.	3
15.	Answer the following questions: (a) Optical and radio telescopes are built on the ground while X-ray astronomy is possible only from satellites orbiting the earth. Why? (b) The small ozone layer on top of the stratosphere is crucial for human survival. Why?	3

16.	Answer the following questions: (a) Show, by giving a simple example, how EM waves carry energy and momentum. (b) How are microwaves produced? Why is it necessary in microwaves ovens to select the frequency of microwaves to match the resonant frequency of water molecules? (c) Write two important uses of infrared waves.	3
	ANSWERS	
1.	(d)	
2.	(a)	
3.	(c)	
4.	(a)	
5.	(d)	
6.	(a)	
7.	(a)	
8.	(a)	
9.	(a)	
10.	(b)	
11.	Microwaves have wavelength in the range of 10^{-2} m	
12.	(i) Microwave (ii) Gamma ray	
13.	The direction of propagation of electromagnetic wave is given by $\vec{E}\times\vec{B}$ (a) $\hat{i}=\hat{j}\times\hat{k}$.  (b) The speed of electromagnetic wave $\|c\|=\frac{\|E_0\|}{\|B_0\|}$	
14.	 Figure 1	
15.	(a) Since, the transmission of signals using ground waves restricted upto a frequency of 1500 Hz to save the loss of energy. (b) The ultraviolet radiations from the sun is harmful to the living cells and plants. The ozone layer absorbs ultraviolet radiation and prevents it from reaching the earth. It also keeps the earth warm.	
16.	It is necessary to select microwave frequency in a microwave oven as the resonant frequency of a water molecule to transfer the energy of high-energy photons of microwave as kinetic energy of the water molecule. As a result the thermal energy of the water molecules increases. This results in cooking and heating food	

CHAPTER-9 : RAY OPTICS AND OPTICAL INSTRUMENTS

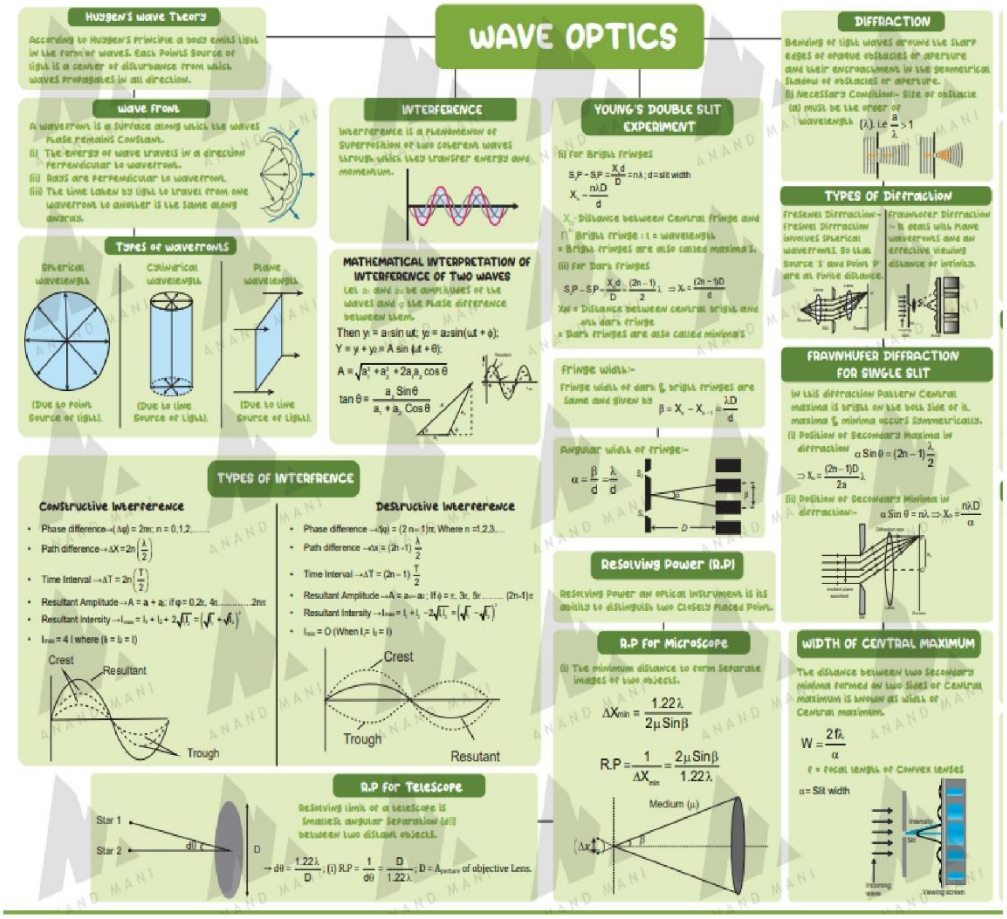


SL.NO	MCQs and Reasoning Assertion Questions	1 Mark
1	A small object lies at the bottom of a vessel filled with water (refractive index 4/3) up to a height H. when viewed from a point above the surface of water, the object appears raised by n% of H. The value of n is : (a) 15 (b) 20 (c) 25 (d) 33	1
2	A ray of monochromatic light propagating in air, is incident on the surface of water. Which of the following will be same for the reflected and refracted rays? (a) Energy carried (b) Speed (c) Frequency (d) Wavelength	1
3	A ray of light travels a distance of 12 m in a transparent sheet in 60 ns. The absolute refractive index of the sheet is (a) 1.33 (b) 1.50 (c) 1.65 (d) 1.75	1
4	A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5 X 108 ms-1 and 230 nm respectively. The wavelength of light in air will be (a) 230nm (b) 345 nm (c) 460 nm (d) 690 nm	1
5	Optical fibres are based on the phenomenon of (a) reflection (b) refraction (c) dispersion (d) total internal reflection	1
6	An astronomical telescope has a large aperture to: (a) increase span of observation (b) have low dispersion (c) reduce spherical aberration (d) have high resolution	1
7	A prism has refractive angle 60°. When a light ray is incident at 50°, then minimum deviation is obtained. What is the value of minimum deviation? (a) 40° (b) 45° (c) 50° (d) 60°	1
8	The focal length of a lens, made up of glass, is 4 cm in air. What would be the focal length of the same lens in water? The refractive indices of glass and water are 3/2 and 4/3 respectively. (a)12cm (b)-12 cm (c) 16 cm (d)-16cm	1
9	An image is formed on the screen by a convex lens when upper half part of lens is covered with black paper then (a)half image is formed (b)full image is formed (c)intensity of image is enhanced (d)all of the above	1
10	How does the magnifying power of a telescope change on increasing the linear diameter of its objective? (a) Power increases on increases diameter (b) Power decreases on decreases diameter (c) Power remain constant on increases diameter (d) Power doesn't depends on diameter	1
	Assertion- Reason Questions	1 mark
11	**(a) Both A and R are true and R is the correct explanation of A** **(b) Both A and R are true and R is NOT the correct explanation of A** **(c) A is true but R is false** **(d) A is false and R is also false** Assertion: the apparent depth of a tank of water decreases if viewed obliquely Reason: the real depth of a tank of water decreases if viewed obliquely	1
12	Assertion: proper cutting of diamond makes it sparkle	1

	Reason: diamond has a very large refractive index	
	Short Answer type - I	2 Marks
13	Draw the labelled diagram to show the image formation by a compound microscope and write the expression for its resolving power.	2
14	Under what conditions does the phenomenon of total internal reflection take place? Draw the ray diagram showing how a ray of light deviates by 900 after passing through a right-angled isosceles prism.	2
15	Two monochromatic rays of light are incident normally a face AB of an isosceles right angled prism ABC. The refractive indices of the glass prism for the two rays'1' and '2' are respectively 1.35 and 1.45. Trace the paths of these rays after entering through the prism.	2
	Short answer type - II	3 Marks
16.	A ray of light is refracted by a glass prism. Obtain an expression for the refractive index of the glass in terms of prism angle A and the angle of minimum deviation δm.	3
17	In the given figure the radius of curvature of curved face in the plano-convex and plano-concave lens 15 cm each. The refractive index of the material of the lenses is 1.5. find the final position of the image formed.  	3
18	You are given three lenses L1, L2 and L3 each of focal length 20 cm. An object is kept at 40 cm in front of L1. The final real image is formed at the focus 'I' of L3. Find the separations between L1, L2 and L3.  	3
	Long Answer Type	5 Marks
19.	(a) Derive lens maker's formula for a biconvex lens. (b) A point object is placed at a distance of 12 cm on the principal axis of a convex lens of focal length 10 cm. A convex mirror is placed coaxially on the other side of the lens at a distance of 10 cm. If the final image coincides with the object, sketch the ray diagram and find the focal length of the convex mirror.	
	Case Study based	4 Marks
20.	A compound microscope consists of two lenses. A lens of short aperture and short focal length facing the object is called the object lens and another lens of short focal length but large aperture is called the eye lens. Magnifying power is defined as the ratio of angle subtended by the final image at the eye to the angle subtended by the object is seen directly, when both are placed at least distance of distinct vision. (i) An objective lens consists of (a) Short aperture and short focal length (b) Large aperture and large focal length (c) Short aperture and large focal length (d) Large aperture and short focal length (ii) An eyepiece consists of (a) short aperture and short focal length (b) large aperture and large focal length (c) short aperture and large focal length	4

	(d) large aperture and short focal length (iii) Formula of magnifying power (a) M= (beta/alpha) (b) M=(alpha/beta) (c) M=(1+(alpha/beta)) (d) M=(1+(beta/alpha)) (v) Final image formed by compound microscope (a) inverted (b)erect (c)virtual (d) highly diminished	
21.	If a beam of white light is made to fall on one face of prism the light emerging from the other face of the prism consist of seven colours violet, indigo, blue, green, yellow, orange, red. The phenomenon of splitting of white light into its constituent colours is called dispersion of light. (i) Which one of the following colours will suffer greatest dispersion? (a) violet (b)indigo (c) blue (d)red (ii) The critical angle between an equilateral prism and air is 45°. If the incident ray is perpendicular to refracting surface then (a) it is reflected totally from the second surface and emerges perpendicular from the third surface. (b) it gets reflected from second and third surface and emerges from the first surface. (c) it keeps reflecting from all the three side of the prism and never emerges out. (d) after deviation, it gets refracted from the second surface. (iii) Which colour is taken as the mean colour (i.e. mean refractive index for a material) (a) yellow (b) red (c) violet (d) green (iv) A prism with a refracting angle of 60° gives angle of minimum deviation 53°,51°,52° for blue, red, yellow light respectively. What is the dispersive power of the material of the prism (a) 385 (b) 0.385 (c) 0.0385 (d) 38.5	4
	ANSWERS	
1.	C	1
2	C	1
3	B	1
4	C	1
5	D	1
6.	D	1
7	A	1
8	C	1
9	B	1
10	D	1
11	C	1
12	B	1
20	(i) a (ii) b (iii) a (iv) a	4
21	(i) a (ii) b (iii) a (iv) c	4

CHAPTER-10 : WAVE OPTICS



SL.NO	MCQs and Reasoning Assertion Questions	1 Mark
1	Huygen's principle of secondary wavelets may be used to a. find the velocity of light in vacuum b. explain the particles behaviour of light c. find the new position of a wavefront d. explain photoelectric effect	1
2	The direction of wavefront of a wave with the wave motion is a. parallel b. perpendicular c. opposite d. at an angle of θ	1
3	Ray diverging from a point source on a wave front are a. cylindrical b. spherical c. plane d. cubical	1

4	According to Huygen's principle each point of the wave front is the source of: a. secondary disturbance b. primary disturbance c. third disturbance d. fourth disturbance	1
5	When light is refracted into a denser medium a. it's wavelength and frequency both increases b. it's wavelength increases but frequency remains unchanged c. it's wavelength decreases but frequency remains the same d. both wavelength and frequency decreases	1
6	The phase difference between the two light waves reaching at a point P is 100π.Their path difference is equal to : a. 10λ b. 25 λ c. 50 λ d. 100v	1
7	In the phenomenon of interference, energy is a. destroyed at destructive interference b. created at constructive interference c. conserved but it is redistributed d. same at all points	1
8	The ratio of maximum and minimum intensities of two sources is 4:1 ,the ratio of their amplitude is a. 1:81 b. 3:1 c. 1:9 d. 1:16	1
9	The interference is produced by two waves of intensity ratio 16:9,the ratio of maximum and minimum intensities in interference pattern is a. 4:3 b. 49:1 c. 25:7 d. 256:81	1
10	Light seems to propagate in rectilinear path because a. it's speed is very large b. it's wavelength is very small c. reflected from the upper surface of the atmosphere d. it is not absorbed by the atmosphere	1
	Assertion- Reason Questions	1 mark
11	**(a) Both A and R are true and R is the correct explanation of A** **(b) Both A and R are true and R is NOT the correct explanation of A** **(c) A is true but R is false** **(d) A is false and R is also false** A: The speed of light in vacuum doesn't depend on nature of the source, direction of propagation, motion of the source or observer wavelength and intensity of the wave. R: The speed of light in vacuum is a universal constant independent of all the factors listed and anything else.	1
12	A: The speed of light, sound waves, water waves in a medium is independent of the nature of the source or intensity (so long it is low). R: Speed of the waves in a medium depends on wavelength.	1
	Short Answer type - I	2 Marks
13	What happens to the interference pattern when two coherent sources are (a) infinitely close, and (ii) far apart from each other.	2
14	Use Huygens principle to show how a plane wavefront propagates from a denser to rarer medium. Hence verify the Snell's law of refraction.	2
15	Draw the intensity pattern for single slit diffraction and double slit interference. Hence state two differences between interference and diffraction patterns.	2
	Short answer type - II	3 Marks

16.	A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 0.2 mm. If the resulting diffraction pattern is observed on a screen 1 m away, find the distance of (i) first minimum, and (ii) second maximum, from the central maximum	3
17	Explain the following giving reasons: (a) When monochromatic light is incident on a surface separating two media, the reflected and refracted light both have same frequency as the incident frequency. (b) When light travels from a rarer to a denser medium, the speed decreases. Does this decrease in speed imply a reduction in the energy carried by the wave? I (c) In the wave picture of light, intensity of light is determined by the square of the amplitude of the wave. What determines the intensity in the photon picture of light?	3
18	A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 0.2 mm. If the resulting diffraction pattern is observed on a screen 1 m away, find the distance of (i) first minimum, and (ii) second maximum, from the central maximum.	3
	Long Answer Type	5 Marks
19.	a) Consider two coherent sources S1 and S2 producing monochromatic waves to produce Interference pattern. Let the displacement of the wave produced by S1 be given by Y1 = a cos ωt and the displacement by S2 be Y2 = a cos (ωt+ϕ). Find out the expression for the amplitude of the resultant displacement at a point and show that the intensity at that point will be I = 4a2 cos2 $\phi/2$. Hence establish the condition for constructive and destructive interference. (b) What is the effect on the interference fringes in Young's double slit experiment when (i) the width of the slit is increased; (ii) the mono chromatic source is replaced by a source of white light?	
	ANSWERS	
1.	C	1
2	B	1
3	B	1
4	A	1
5	C	1
6.	C	1
7	C	1
8	B	1
9	B	1
10	B	1
11	A	1
12	B	1
20	(i) a (ii) b (iii) c (iv) d	4
21	(i) b (ii) c (iii) c (iv) d	4

CHAPTER-11 : DUAL NATURE OF RADIATION AND MATTER

Mind Mapping of Dual Nature of Radiation and Matter

Photoelectric Effect: **P**henomenon of emission of electrons from the surface of metal when light radiations of suitable frequency fall on it.

Work Function: The minimum amount of energy required to eject an electron from the metal surface. Work function, $w_0 = h\,\nu_0$

Threshold Frequency: Minimum frequency of incident light below which no photoelectrons emission takes place from a metal surface.

Threshold Wavelength: Longest wavelength of incident light which can emit photoelectrons from a metal surface.

Cut-off Potential: For a particular frequency of incident radiation minimum retarding potential V_0 of colleting plate for which photoelectric current becomes zero.

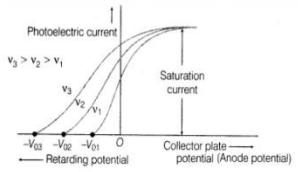
Relation between cut – off potential and maximum kinetic energy of photoelectrons:

$(KE)_{max} = e\,V_0$

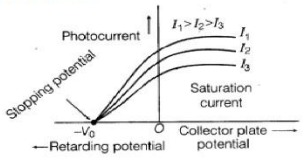
Or, $\frac{1}{2} m\,v_{max}^2 = e\,V_0$

Important Graphical Representation

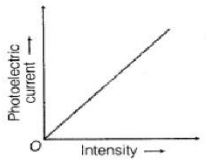
Variation of photocurrent with potential of collector plate for different frequencies of incident radiation, but constant intensity.



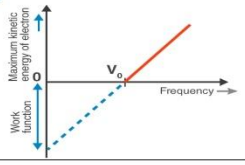
Variation of photocurrent with potential of collector plate for different intensities of incident radiation, but constant frequency.



Variation of photocurrent with intensity of incident radiation.



Effect of Frequency of Incident Radiation on stopping potential/Max KE of photoelectrons



Laws of Photoelectric emission:

1. For a given metal and a radiation of fixed frequency, the rate of emission of photoelectrons is proportional to the intensity of incident radiation.

Matter Wave

The De Broglie wave length λ associated with a particle of momentum 'p' is, **λ = h/p.**

De Broglie wavelength of accelerated electrons:

KE acquired by the electron when through a potential V is K = e V.

$\therefore p = \sqrt{2\,m\,K} = \sqrt{2\,m\,e\,V}$

$\therefore \lambda = h/p = \frac{h}{\sqrt{2\,m\,e\,V}}$

Or, $\lambda = \frac{12.27}{\sqrt{V}}\,A^o$

Note: The expression can be extended for any charge as,

$\lambda = \frac{h}{\sqrt{2\,m\,q\,V}}$

2. For every metal, there is a certain minimum frequency below which no photoelectrons are emitted; however high is the intensity of the incident radiation. This frequency is called threshold frequency.
3. For the radiation of frequency higher than the threshold frequency, the maximum kinetic energy of the photo electrons is directly proportional to the frequency of incident radiation and is independent of the intensity of incident radiation.
4. The photoelectric emission is an instantaneous process.

Einstein Photoelectric Equation:

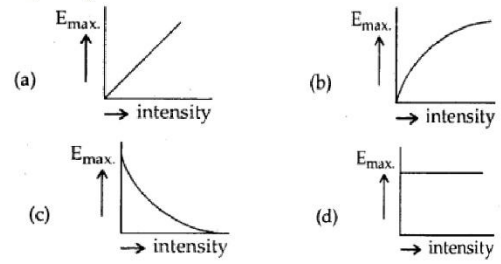
According to Einstein, Energy of an incident photon ($h\,\nu$) = work function of metal surface (Φ_0) + Max Kinetic energy of photoelectrons (K_{max}).

i.e., $\boldsymbol{h\,\nu = \Phi_0 + K_{max}}$

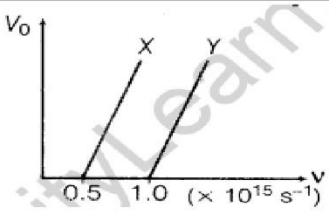
Or, $\boldsymbol{e\,V_0 = h\,\nu - h\,\nu_0}$

Or, $\boldsymbol{V_0 = \frac{h}{e}(\nu - \nu_0)}$

Or, $\boldsymbol{V_0 = \frac{h}{e}\left(\frac{c}{\lambda} - \frac{c}{\lambda_0}\right)}$ $\left(\because \boldsymbol{\nu = \frac{c}{\lambda}}\right)$

SL.NO	**MCQs and Reasoning Assertion Questions**	1 Mark
1	The work function of a metal is independent of (i) nature of the surface of the metal (ii) dimensions of the metal (iii) properties of the metal (iv) abundance of the metal (a) (i) only (b) (i) and (iii) c) (ii) and (iii) (d) (ii) and (iv)	1
2	The photoelectric current does not depend upon the (i) frequency of incident light (ii) work function of the metal (iii) stopping potential (iv) intensity of incident light (a) (i) and (iv) only (b) (i), (ii) and (iii) only (c) (iii) only (d) (ii) only	1
3	Which one of the following graphs represent correctly the variation of maximum kinetic energy E_{max} with the intensity of incident radiations having a constant frequency.  	1

4	The threshold frequency for a certain metal is v_0. When light of frequency $\nu = 2\ \nu_0$ is incident on it, the maximum velocity of photo electrons is 4×10^6 ms^{-1}. If the frequency of incident radiation is increased to $5\ \nu_0$, then the maximum velocity of photo electrons (m/s) is (a) 8×10^5 (b) 2×10^6 (c) 2×10^7 (d) 8×10^6	1
5	The stopping potential is directly related to (a) the work function of the metal (b) intensity of incident radiation (c) Saturation current for the given frequency (d) K.E. gained by photoelectrons	1
6	Einstein's Law of photoelectric effect is based on the law of conservation of (a) momentum (b) energy (c) angular momentum (d) mass	1
7	Ultra-violet radiation of 6.2 eV falls on an aluminium surface having work-function 4.2 eV. The kinetic energy (in J) of the fastest electron emitted is nearly. (a) 3.2×10^{-19} (b) 3.2×10^{-15} (c) 3.2×10^{-17} (d) 3.2×10^{-21}	1
8	The energy E and momentum p of a photon is given by E = hv and p = h/λ. The velocity of photon will be (a) E/p (b) $(E/p)^2$ (c) $\sqrt{\frac{E}{p}}$ (d) Ep	1
9	An electron of mass m, when accelerated through a potential difference V, has de-Broglie wavelength λ. The de-Broglie wavelength associated with a proton of mass M and accelerated through the same potential difference will be (a) $\lambda\sqrt{\frac{m}{M}}$ (b) $\lambda\frac{m}{M}$ (c) $\lambda\sqrt{\frac{M}{m}}$ (d) $\lambda\frac{M}{m}$	1
10	De-Broglie wavelength of a body of mass m and kinetic energy E is given by (a) h/2mE (b) h/mV (c) 2mE/h (d) $h/(2mE)^{1/2}$	1
	Assertion- Reason Questions	1 mark
11	**(a) Both A and R are true and R is the correct explanation of A** **(b) Both A and R are true and R is NOT the correct explanation of A** **(c) A is true but R is false** **(d) A is false and R is also false** **Assertion (A):** Photoelectric saturation current increases with the increase in frequency of incident light. **Reason (R):** Energy of incident photons increases with increase in frequency and as a result photoelectric current increase.	1
12	**Assertion (A):** The de Broglie equation has significance for any microscopic or sub-microscopic particles. **Reason (R):** The de Broglie wavelength is inversely proportional to the mass of the object if velocity is constant.	1
	Short Answer type - I	2 Marks
13	Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photosensitive materials having work functions W_1 and W_2 ($W_1 > W_2$). On what factors does the slope and intercept of the lines depend?	2

14	Two monochromatic radiations of frequencies ν_1 and ν_2 $(\nu_1 > \nu_2)$ and having the same intensity are, in turn, incident on a photosensitive surface to cause photoelectric emission. Explain, giving reason, in which case (i) a greater number of electrons will be emitted and (ii) maximum kinetic energy of the emitted photoelectrons will be more.	2
15	de - Broglie wavelength associated with an electron associated through a potential difference V is $'\lambda'$? What will be the new wavelength when the accelerating potential is increase to 4V?	2
	Short answer type - II	3 Marks
16.	The following graph shows the variation of stopping potential, V_0 with the frequency $'\nu'$ of the incident radiation for two photosensitive metals, X and Y: (i) Which of the metals has larger threshold wavelength? Give reason.  (ii) Explain giving reason, which metal gives out electrons having larger kinetic energy. For the same wavelength of the incident radiation. (iii) If the distance between light source and metal X is halved, how will the kinetic energy of electrons emitted from it change? Give reason.	3
17	The wavelength $'\lambda'$ of a photon and de -Broglie wavelength of an electron has the same value. Show that the energy of the photon is $\frac{2\,\lambda mc}{h}$ times the kinetic energy of electron where m, c, and h have their usual meanings?	3
18	The Kinetic Energy (K.E.), of a beam of electrons, accelerated through a potential V, equals the energy of a photon of wavelength 5460 nm. Find the de Broglie wavelength associated with this beam of electrons.	3
	Long Answer Type	5 M
(a) Draw a graph for the following cases. (i) Showing Variation of photocurrent with potential of collector plate for different frequencies of incident radiation, but constant intensity. (ii) Showing variation of photocurrent with potential of collector plate for different intensities of incident radiation, but constant frequency. (iii) Variation of photocurrent with intensity of incident radiation. (iv) Effect of Frequency of Incident Radiation on stopping potential/Max KE of photoelectrons (b) Write Einstein's photoelectric equation. Explain how this equation can be used to describe any the three salient features observed in photoelectric effect.		5
	ANSWERS	
1.	(d) (ii) and (iv)	1
2	(b) (i), (ii) and (iii) only	1
3	(d)	1
4	(a) $8 \times 10^5\ ms^{-1}$	1

5	(d) the kinetic energy gained by the photoelectrons				1
6.	(b) energy				1
7	(a) 3.2×10^{-19} J				1
8	(a) E/p				1
9	(a) $\lambda \sqrt{\frac{m}{M}}$				1
10	(d) $h/(2mE)^{1/2}$				1
11	(d)				1
12	(a)				1
20	(i) d	(ii) a	(iii) a	(iv) c	4
21	(i) a	(ii) c	(iii) c	(iv) b	4

CHAPTER-12 : ATOMS

Observation of the Alpha (α) Scattering Experiment:

1. Most of the α-particles pass through the foil without any deviation.
2. About 1 in 8000 deflect by more than 90^0.
3. **Distance of Closest Approach:**

$r_0 = \frac{1}{4\pi\varepsilon_0}.\frac{2Ze^2}{K}$, where, '$K$' is KE of α-particle, and Z is atomic number of the nucleus.

Conclusion from Alpha (α) Scattering Experiment: (Rutherford's Atomic Model)

1. Scattering of alpha particles is due to columbic repulsion between positive charge of α particle and positive charge of an atom.
2. Atom has a lot of empty space in it.
3. Entire mass and positive of an atom is confined at the nucleus of an atom.
4. The size of the nucleus to be about 10^{-15} m to 10^{-14} m.

Postulates of Bohr Model of the Hydrogen Atom:

(i) Electrons in an atom revolves in certain permitted stable orbits without the emission of energy.

(ii) Electrons take those orbits in which angular momentum of the electron is an integral multiple of $h/2\pi$,

i. e., $L = m\,r\,v = n\,h/2\pi$

(iii) Electrons may jump from higher energy level to lower energy level or vice versa emitting or absorbing energy equal to the difference between the two levels. i.e., $\Delta E = h\,\nu = E_i - E_f$, where, E_i and E_f are the energies of the initial and final states.

Important Characters of hydrogen atoms:

Radius electrons orbit:

$r_n = n^2 \left(\frac{\varepsilon_0}{e^2}\frac{h^2}{m\,\pi}\right)$

i.e., $r_n \alpha n^2$

$r_n = 0.53 \times n^2\ A^0$

Speed of electrons in its orbit:

$v_n = \frac{e^2}{2\varepsilon_0 h\,n}$

i.e. $v_n \alpha \frac{1}{n}$

Total Energy of electron in the orbit: $E_n = K_n + U_n$

$E_n = \frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^2 n^2} + \left(-\frac{1}{4}\frac{e^4 m}{\varepsilon_0^2 h^2 n^2}\right)$

Or, $E_n = -\frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^2 n^2}$

Or, $E_n = \left(-\frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^2}\right)\left(\frac{1}{n^2}\right)$

Hydrogen spectral series:

Energy of emitted radiation:

$h\,\nu = E_{n_i} - E_{n_f}$.

Or, $\nu = \left(\frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^3}\right)\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

In terms of wavelength of the radiation is, $1/\lambda = \nu/c$

P. E. of electron in the orbit:

$U_n = -\frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{r} = -\frac{1}{4}\frac{e^4 m}{\varepsilon_0^2 h^2 n^2}$

Or, $U_n = \left(-\frac{1}{4}\frac{e^4 m}{\varepsilon_0^2 h^2}\right)\left(\frac{1}{n^2}\right)$

Or, $U_n = -\frac{27.2\ eV}{n^2}$

K. E of electron in the orbit:

$K_n = \frac{1}{2}mv^2 = \frac{1}{2}x\left(\frac{1}{4\pi\varepsilon_0}\cdot\frac{Ze^2}{r}\right)$

Or, $K_n = \frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^2 n^2}$

Or, $K_n = \left(\frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^2}\right)\left(\frac{1}{n^2}\right)$

Or, $K_n = -\frac{13.6\ eV}{n^2}$

In ground state, n= 1, so,

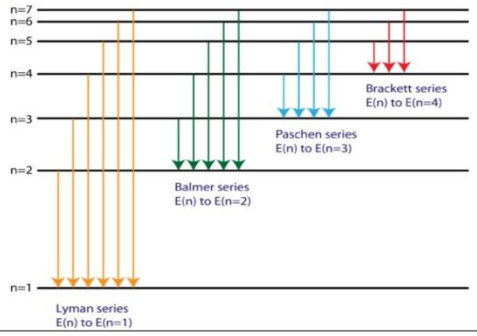
$E_n = \left(-\frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^2}\right) = -13.6$ eV

Thus, for an electron in any orbit, total energy is,

$E_n = -\frac{13.6\ eV}{n^2}$

This shows that, $E \propto \frac{1}{n^2}$

Hydrogen spectrum series in terms of transition of electrons



Or, $\frac{1}{\lambda} = \left(\frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^3 c}\right)\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

Or, $\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

$R = \frac{1}{8}\frac{e^4 m}{\varepsilon_0^2 h^3 c} = 1.097 \times 10^7\ m^{-1}$.

1. **Lyman Series (u v region);**

$n_f = 1$; $n_i = 2, 3, 4, \ldots\ldots$

$\lambda_{mim} = 1/R = 912\ A^0$,

$\lambda_{max} = 4/3R = 1216\ A^0$,

2. **Balmer series; (visible region);**

$n_f = 2$; $n_i = 3, 4, 5, \ldots\ldots$

$\lambda_{mim} = 4/R = 3648\ A^0$,

$\lambda_{max} = 36/5R = 6563\ A^0$,

3. **Paschen series; (I-R region);**

$n_f = 3$; $n_i = 4, 5, 6, \ldots\ldots$

$\lambda_{mim} = 9/R$, $\lambda_{max} = 144/7R$

4. **Bracket series; (I-R region);**

$n_f = 4$; $n_i = 4, 5, 6, \ldots\ldots$

$\lambda_{mim} = 16/R$, $\lambda_{max} = 400/9R$

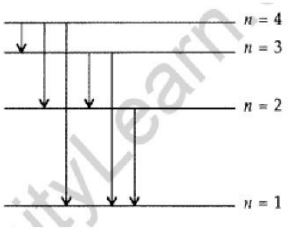
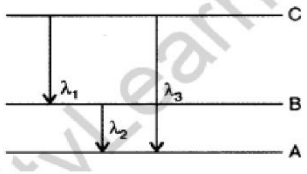
5. **Pfund series; (I-R region);**

$n_f = 4$; $n_i = 4, 5, 6, \ldots\ldots$

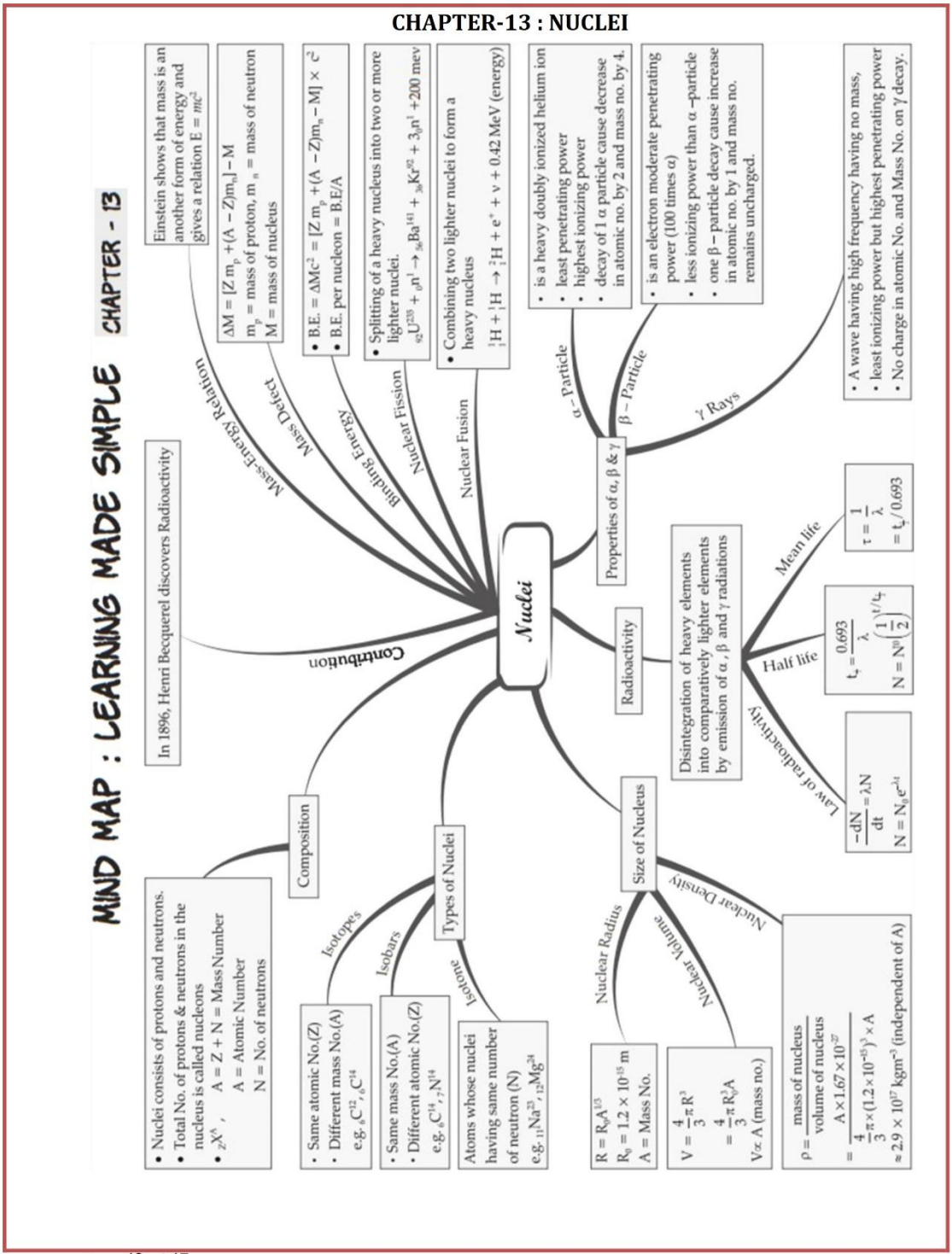
$\lambda_{mim} = 16/R$, $\lambda_{max} = 400/9R$

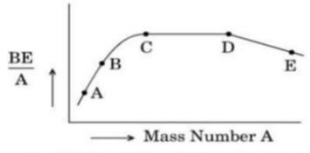
SL.NO	**MCQs and Reasoning Assertion Questions**	1 Mark
1	In a Rutherford scattering experiment when a projectile of charge Z_1 and mass M_1 approaches a target nucleus of charge Z_2 and mass M_2, the distance of closest approach is r_0. The energy of the projectile is (a) directly proportional to $Z_1 Z_2$ (b) inversely proportional to Z_1 (c) directly proportional to mass M_1 (d) directly proportional to $M_1 \times M_2$	1
2	The ratio of first three Bohr radii of electrons around the nucleus of hydrogen atom is (a) 1: 2: 3 (b) 2: 4: 6 (c) 1: 4: 9 (d) 1 : 3 : 5	1

3	Which of the following postulates of the Bohr model led to the quantization of energy of the hydrogen atom? (a) The electron goes around the nucleus in circular orbits. (b) The angular momentum of the electron can only be an integral multiple of $h/2\pi$. (c) The magnitude of the linear momentum of the electron is quantized. (d) Quantization of energy is itself a postulate of the Bohr model.	1
4	Which of the following in a hydrogen atom is independent of the principal quantum number n? (The symbols have their usual meanings). (a) ν_n (b) r_n (c) E_n (d) None of these	1
5	In terms of Rydberg constant R, the shortest wavelength in Balmer series of hydrogen atom spectrum will have wavelength (a) $\frac{1}{R}$ (b) $\frac{4}{R}$ (c) $\frac{3}{2R}$ (d) $\frac{9}{R}$	1
6	According to Bohr the difference between the energies of the electron in the two orbits is equal to (a) $h\nu$ (b) hc/λ (c) both (a) and (b) (d) neither (a) nor (b)	1
7	The ionisation energy of hydrogen atom is 13.6 eV. Following Bohr's theory, the energy corresponding to a transition between 3rd and 4th orbits is (a) 3.40 eV (b) 1.51 eV (c) 0.85 eV (d) 0.66 eV	1
8	The transition of electron from n = 4, 5, 6, ...to n = 3 corresponds to (a) Lyman series (b) Balmer series (c) Paschen series (d) Brackett series	1
9	In Bohr model of hydrogen atom, let P.E. represents potential energy and T.E. represents the total energy. In going to a higher level. (a) P. E. decreases, T.E. increases (b) P. E. increases, T.E. decreases (c) P. E. decreases, T.E. decreases (d) P. E. increases, T.E. increases	1
10	What is the ratio of minimum to maximum wavelength in the Lyman series? a) 1:3 (b) 1:1 (c) 1:4 (d) 3:4	1
	Assertion- Reason Questions	1 mark
11	**(a) Both A and R are true and R is the correct explanation of A** **(b) Both A and R are true and R is NOT the correct explanation of A** **(c) A is true but R is false** **(d) A is false and R is also false** **Assertion (A):** The ground state of an atom is the state of lowest energy, with all electrons in their lowest possible energy levels. **Reason (R):** In the ground state, electrons occupy the lowest energy orbitals available.	1
12	**Assertion (A):** Hydrogen atom consists of only one electron but its emission spectrum has many lines. **Reason (R):** Only Lyman series is found in the absorption spectrum of hydrogen atom whereas in the emission spectrum, all the series are found.	1
	Short Answer type - I	2 Marks

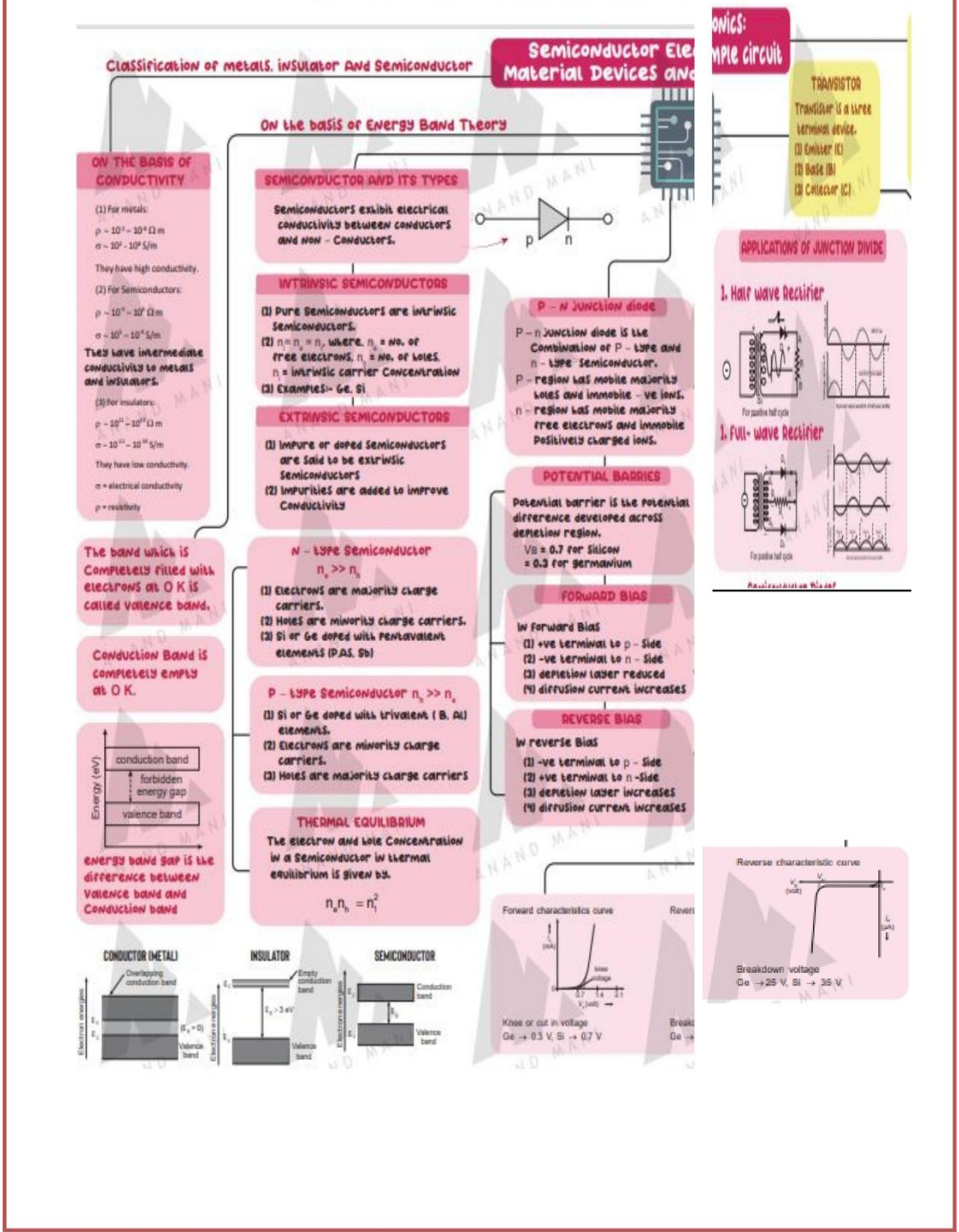
13	A difference of 2.3eV separates two energy levels in an atom. What is the radiation frequency when the atom transitions from the upper level to the lower level?	2
14	Define the distance of closest approach. An a-particle of kinetic energy 'K' is bombarded on a thin gold foil. The distance of the closest approach is 'r_0'. What will be the distance of closest approach for an a-particle of double the kinetic energy?	2
15	Calculate the shortest wavelength in the Balmer series of hydrogen atom. In which region (infra-red, visible, ultraviolet) of hydrogen spectrum does this wavelength lie?	2
	Short answer type - II	3 Marks
16.	Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?	3
17	The ground state energy of hydrogen atom is -13.6 eV. (i) Find the potential energy and K.E of an electron in the 3rd excited state? (ii) If the electron jumps to the ground state from the 3rd excited state, calculate the wavelength of the photon emitted.	3
18	**The figure shows energy level diagram of hydrogen atom** (a) Find out the transition which results in the emission of a photon of wavelength 496 nm. (b) Which transition corresponds to the emission of radiation of maximum wavelength? Justify your answer. 	3
	Long Answer Type	5 M
19.	(i) State Bohr's quantization condition for defining stationary orbits. How does de-Broglie hypothesis explain the stationary orbits? (ii) Find the relation between the three wave-lengths λ_1, λ_2 and λ_3 from the energy level diagram shown below: 	5
	ANSWERS	
1.	(a) directly proportional to $Z_1 Z_2$	1
2	(c) 1: 4: 9	1
3	(b) The angular momentum of the electron can only be an integral multiple of $h/2\pi$.	1
4	(b) Er	1
5	(b) $\frac{4}{R}$	1

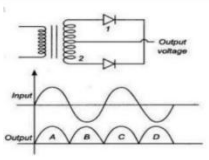
6.	(c) both (a) and (b)	1
7	(d) 0.66 eV	1
8	(c) Paschen series	1
9	(d) P. E. increases, T.E. increases	1
10	(d) 3:4	1
11	(a)	1
12	(b)	1
20	(i) a (ii) b (iii) b (iv) d	4
21	(i) b (ii) b (iii) c (iv) d	4


MIND MAP : LEARNING MADE SIMPLE
CHAPTER - 13
Nuclei
Contribution
In 1896, Henri Becquerel discovers Radioactivity
Composition
• Nuclei consists of protons and neutrons.
• Total No. of protons & neutrons in the nucleus is called nucleons
• ZX^A , A = Z + N = Mass Number
A = Atomic Number
N = No. of neutrons
Types of Nuclei
Isotopes
• Same atomic No.(Z)
• Different mass No.(A)
e.g. 6C12 , 6C14
Isobars
• Same mass No.(A)
• Different atomic No.(Z)
e.g. 6C14 , 7N14
Isotone
Atoms whose nuclei having same number of neutron (N)
e.g. 11Na23 , 12Mg24
Size of Nucleus
Nuclear Radius
R = R0A1/3
R0 = 1.2 × 10-15 m
A = Mass No.
Nuclear Volume
V = 4/3 π R3
= 4/3 π R03A
V∝ A (mass no.)
Nuclear Density
ρ = mass of nucleus / volume of nucleus
= A×1.67×10-27 / 4/3 π×(1.2×10-15)3×A
≈ 2.9 × 1017 kgm-3 (independent of A)
Radioactivity
Disintegration of heavy elements into comparatively lighter elements by emission of α , β and γ radiations
Law of radioactivity
-dN/dt = λN
N = N0e-λt
Half life
t1/2 = 0.693/λ
N = N0(1/2)t/t1/2
Mean life
τ = 1/λ
= t1/2 / 0.693
Properties of α, β & γ
α – Particle
• is a heavy doubly ionized helium ion
• least penetrating power
• highest ionizing power
• decay of 1 α particle cause decrease in atomic no. by 2 and mass no. by 4.
β – Particle
• is an electron moderate penetrating power (100 times α)
• less ionizing power than α –particle
• one β – particle decay cause increase in atomic no. by 1 and mass no. remains uncharged.
γ Rays
• A wave having high frequency having no mass,
• least ionizing power but highest penetrating power
• No charge in atomic No. and Mass No. on γ decay.
Nuclear Fusion
• Combining two lighter nuclei to form a heavy nucleus
1H + 1H → 2H + e+ + ν + 0.42 MeV (energy)
Nuclear Fission
• Splitting of a heavy nucleus into two or more lighter nuclei.
92U235 + 0n1 → 56Ba141 + 36Kr92 + 3 0n1 +200 mev
Binding Energy
• B.E. = ΔMc2 = [Z mp +(A – Z)mn – M] × c2
• B.E. per nucleon = B.E/A
Mass Defect
ΔM = [Z mp +(A – Z)mn] – M
mp = mass of proton, mn = mass of neutron
M = mass of nucleus
Mass-Energy Relation
Einstein shows that mass is an another form of energy and gives a relation E = mc2

SL.NO	MCQs and Reasoning Assertion Questions	1 Mark
1	Density of a nucleus is (a) more for lighter elements and less for heavier elements (b) more for heavier elements and less for lighter elements (c) very less compared to ordinary matter (d) a constant	1
2	F_{pp} , F_{nn} *and* F_{np} are the nuclear forces between proton-proton, neutron-neutron and neutron-proton,respectively. Then, relation between them is (a) $F_{pp} = F_{nn} \neq F_{np}$ (b) $F_{pp} \neq F_{nn}\ F_{np}$ (c) $F_{pp} = F_{nn} = F_{np}$ (d) $F_{pp} \neq F_{nn} \neq F_{np}$	1
	Assertion- Reason Questions	1 mark
3	**(a) Both A and R are true and R is the correct explanation of A** **(b) Both A and R are true and R is NOT the correct explanation of A** **(c) A is true but R is false** **(d) A is false and R is also false** **Assertion:** Two atoms of different elements having same mass number but different atomic numbers are called isobars. **Reason:** Atomic number is the number of protons present and atomic mass is the totalnumber of protons and neutrons present in a nucleus	1
4	**Assertion:** The nuclear force becomes weak if the nucleus contains too many protons compared to neutrons. **Reason**: The electrostatic forces weaken the nuclear force.	1
	Short Answer type - I	2 Marks
5	State four properties of nuclear forces.	2
6	Show that the density of nucleus over a wide range of nuclei is constant and independent of mass number.	2
7	Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions which you can draw regarding the nature of nuclear forces.	2
	Short answer type - II	3 Marks
8	Explain the processes of nuclear fission and nuclear fusion by using the plot of binding energy per nucleon (BE/A) versus the mass number A.	3
9	The figure shows the plot of binding energy (BE) per nucleon as a function of mass number A. The letters A, B, C, D and E represent the positions of typical nuclei on the curve. Point out, giving reasons, the twoprocesses (in terms of A, B, C, D and E), one of which can occur  due to nuclear fission and the other due to nuclear fusion.	3

10	(a) Draw a graph showing variation of binding energy per nucleon (BE/A) vs mass number A for the nuclei in $20 \leq A \leq 170$. (b) A nucleus of mass number 240 and having BE/A of 7.6MeV splits into two fragments Y, Z of mass numbers 110 and 130 respectively. If the B.E./A of Y, Z is equal to 8.5 MeV each, calculate the energy released in the nuclear reaction.	3
	ANSWERS	
1.	(d)	1
2	(c)	1
3	(a)	1
4	(d)	1
11	(i) (a) (ii) (c) (iii) (a) (iv) (a)	1


Classification of metals, insulator and Semiconductor
Semiconductor Ele
Material Devices and
On the basis of Energy Band Theory
ON THE BASIS OF CONDUCTIVITY
(1) For metals:
ρ ~ 10⁻⁷ – 10⁻⁴ Ω m
σ ~ 10² - 10⁷ S/m
They have high conductivity.
(2) For Semiconductors:
ρ ~ 10⁻⁵ – 10² Ω m
σ ~ 10⁵ – 10⁻⁵ S/m
They have intermediate conductivity to metals and insulators.
(3) For insulators:
ρ ~ 10¹¹ – 10¹⁷ Ω m
σ ~ 10⁻¹¹ – 10⁻¹⁷ S/m
They have low conductivity.
σ = electrical conductivity
ρ = resistivity
SEMICONDUCTOR AND ITS TYPES
Semiconductors exhibit electrical conductivity between conductors and non – Conductors.
INTRINSIC SEMICONDUCTORS
(1) Pure Semiconductors are intrinsic Semiconductors.
(2) n = n_e = n_i where, n_e = No. of free electrons, n_h = No. of holes, n_i = intrinsic carrier Concentration
(3) Examples:- Ge, Si
EXTRINSIC SEMICONDUCTORS
(1) Impure or doped Semiconductors are said to be extrinsic Semiconductors
(2) Impurities are added to improve Conductivity
The band which is Completely filled with electrons at O K is called Valence band.
Conduction Band is completely empty at O K.
conduction band
forbidden energy gap
valence band
Energy (eV)
Energy band gap is the difference between Valence band and Conduction band
N – type Semiconductor
n_e >> n_h
(1) Electrons are majority charge carriers.
(2) Holes are minority charge carriers.
(3) Si or Ge doped with Pentavalent elements (P,As, Sb)
P – type Semiconductor n_h >> n_e
(1) Si or Ge doped with trivalent (B, Al) elements.
(2) Electrons are minority charge carriers.
(3) Holes are majority charge carriers
THERMAL EQUILIBRIUM
The electron and hole Concentration in a Semiconductor in thermal equilibrium is given by.
n_e n_h = n_i²
P – N JUNCTION diode
P – n junction diode is the Combination of P – type and n – type Semiconductor.
P – region has mobile majority holes and immobile – ve ions.
n – region has mobile majority free electrons and immobile positively charged ions.
POTENTIAL BARRIES
Potential barrier is the potential difference developed across depletion region.
VB = 0.7 for Silicon
= 0.3 for germanium
FORWARD BIAS
In forward Bias
(1) +ve terminal to p – Side
(2) -ve terminal to n – Side
(3) depletion layer reduced
(4) diffusion current increases
REVERSE BIAS
In reverse Bias
(1) -ve terminal to p – Side
(2) +ve terminal to n -Side
(3) depletion layer increases
(4) diffusion current increases
onics:
mple circuit
TRANSISTOR
Transistor is a three terminal device.
(1) Emitter (E)
(2) Base (B)
(3) Collector (C)
APPLICATIONS OF JUNCTION DIVIDE
1. Half wave Rectifier
For positive half cycle
2. Full- wave Rectifier
For positive half cycle
Forward characteristics curve
Knee or cut in voltage
Ge → 0.3 V, Si → 0.7 V
Reverse characteristic curve
Breakdown voltage
Ge → 25 V, Si → 35 V
CONDUCTOR (METAL)
Overlapping conduction band
Valence band
INSULATOR
Empty conduction band
Valence band
SEMICONDUCTOR
Conduction band
Valence band
Electron energies

SL.NO	MCQs and Reasoning Assertion Questions	1 Mark
1	The conductivity of a semiconductor increases with increase in temperature because (a) number density of free current carriers increases. (b) relaxation time increases. (c) both number density of carriers and relaxation time increase. (d) number density of current carriers increases	1
2	Electrical conduction in a semiconductor occurs due to (a) electrons only (b) holes only (c) electrons and holes both (d) neither electrons nor holes	1
3	The substance which is doped in an intrinsic semiconductor to make p-type semiconductor is: (a) phosphorus (b) antimony (c) aluminium (d) arsenic	1
4	Which is the correct relation for forbidden energy gap in conductor, semi-conductor and insulator: (a) $\Delta(E_g)_c > \Delta(E_g)_i > \Delta(E_g)_{sc}$ (b) (a) $\Delta(E_g)_c > \Delta(E_g)_{sc} > \Delta(E_g)_i$ (c) $\Delta(E_g)_i > \Delta(E_g)_{sc} > \Delta(E_g)_c$ (d) $\Delta(E_g)_i > \Delta(E_g)_c > \Delta(E_g)_{sc}$	1
5	A full wave rectifier circuit along with the input and output voltages is shown in the figure. The contribution to output voltage from diode 2 is (a) A, C (b) B, D (c) B, C (d) A, D 	1
6	Which of the following statements is incorrect for the depletion region of a diode? (a) There the mobile charges exist (b) Equal number of holes and electrons exist, making the region neutral (c) Recombination of holes and electrons exist, making the region neutral (d) None of these	1
	Assertion- Reason Questions	1 mark
7	**(a) Both A and R are true and R is the correct explanation of A** **(b) Both A and R are true and R is NOT the correct explanation of A** **(c) A is true but R is false** **(d) A is false and R is also false** **Assertion (A):** The energy gap between the valence band and conduction band is greater in silicon than in germanium. **Reason (R):** Thermal energy produces fewer minority carriers in silicon than in germanium	1
8	**Assertion-** The diffusion current in a p-n junction is from the p side to n side. **Reason-** The diffusion current in a p-n junction is greater than the drift current when the junction is in forward biased.	1
	Short Answer type - I	2 Marks
9	Write two characteristic features to distinguish between n-type and p-type semiconductors.	2

10	Draw the energy band diagram when intrinsic semiconductor (Ge) is doped with impurity atoms of Antimony (Sb). Name the extrinsic semiconductor so obtained and majority charge carriers in it.	2
11	Draw the energy band diagrams of an n-type and p-type semiconductor at temperature T> 0K. Mark the donor and acceptor energy levels with their energies.	2
	Short answer type - II	3 Marks
12	Explain how the V-I characteristics of a p-n junction diode. Answer the following questions: (a) Why is the current under reverse bias almost independent of the applied potential upto a critical voltage? (b) Why there is no current even with increase of the applied voltage under forward biased upto a cut off voltage?	3
13	Describe briefly with the help of a diagram, the role of the two important processes involved in the formation of a p-n junction diode.	3
14	(a) Draw the circuit diagram of a full wave rectifier. (b) Explain its working in brief. (c) Draw the input and output waveforms of a full wave rectifier.	3
	Long Answer Type	5 M
15.	Draw the typical V–I characteristics of a silicon diode. Describe briefly the following terms: (a) "minority carrier injection" in forward bias (b) "breakdown voltage" in reverse bias.	5
	ANSWERS	
1.	(a)	1
2	(c)	1
3	(c)	1
4	(c)	1
5	(b)	1
6.	(a)	1
7 & 8	7. (b) & 8 (b)	1 & 1