CLASS 12

CBSE SCIENCE

PHYSICS WALLAH

As Per Latest CBSE Syllabus 2024-25

30 SAMPLE PAPERS


PHYSICS


CHEMISTRY


MATHEMATICS


BIOLOGY


ENGLISH

Aligned with CBSE Board Pattern

2025 EXAMINATION

Chapter-wise Weightage and Trend Analysis of

CBSE Past 5 Years' Papers

PHYSICS

CHAPTERS	2020	2021	2022	2023	2024
Electric Charges and Fields	6	Exam not conducted	7	9	11
Electrostatic Potential and Capacitance	8		8	9	10
Current Electricity	8		7	9	1
Moving Charges and Magnetism	8		5	5	10
Magnetism and Matter	-		9	1	1
Electromagnetic Induction	3		3	5	1
Alternating Current	8		11	3	5
Electromagnetic Waves	4		-	3	4
Ray Optics and Optical Instruments	8		6	8	7
Wave Optics	5		10	8	7
Dual Nature of Radiation and Matter	4		4	5	4
Atoms	5		6	3	4
Nuclei	7		4	6	1
Semiconductor Electronics: Materials, Devices and Simple Circuits	5		5	4	5

CHEMISTRY

CHAPTERS	2020	2021	2022		2023	2024
			Term-I	Term-II		
Solutions	7	Exam not conducted	11.5	-	7	7
Electrochemistry	9		-	5	9	9
Chemical Kinetics	5		-	5	7	7
The d-and f-Block Elements	3		-	6	7	7
Coordination Compounds	4		-	3	7	7
Haloalkanes and Haloarenes	4		11.5	-	7	6
Alcohols, Phenols and Ethers	1		9	-	5	6
Aldehydes, Ketones and Carboxylic Acids	9		-	8	8	8
Amines	4		-	5	6	6
Biomolecules	4		9	-	7	7

How to Rock Your Board Exams?

Admit Card: Double-check your admit card before heading to the exam center.

Stationary: Bring pens, pencils, erasers, sharpeners, ruler, and a geometry box. Ensure working pens with sufficient ink and carry spares.

Water bottle and wrist watch: Bring a transparent water bottle for hydration and a wrist watch to monitor time; avoid digital watches which may not be permitted.

Arrive Early at the Examination Center: Arrive before your admit card's reporting time for smooth security checks and room location.

Read the Instructions carefully: Read the instructions of the paper carefully to know the format, marking and special guidelines. Ask the invigilator for any doubts about instructions.

Manage your Time: Assign time for each section/question based on allotted marks and adhere to it for effective time management.

Don't Panic: If you find the paper difficult, remember that everyone else is likely feeling the same way. Stay focused, do your best, and don't let anxiety take over.

Start with your Strengths: Start with your strongest section/question to boost confidence for tougher parts.

Answer clearly and neatly: Write neatly, use headings, subheadings, and bullets for clarity and fetching more marks. Start with margins on both sides. This sets a structured format for your answers.

Don't spend too much time on one question: If a question is challenging or time-consuming, move on and revisit it later if possible. Avoid getting stuck on a single question.

Use of HB pencil: HB pencils produce a relatively dark and easily readable mark. Try to use HB pencils while making diagrams in the exam.

Attempt all questions: Even if unsure, attempt all questions; there is no negative marking in CBSE exams.

SELF ASSESSMENT

Self-assessment plays a crucial role in exam preparation and offers several advantages:

- **Enhanced Self-awareness:** Self-assessment sheets help students gain a deeper understanding of their strengths and weaknesses across various subjects. Specific feedback on their performance provides valuable insights into areas of excellence and those that require improvement.
- **Focused Study:** These sheets provide clear guidance to students on where to direct their efforts. Identifying which questions to review, reattempt, or practice allows for more efficient and purposeful study sessions.
- **Targeted Improvement:** By categorizing questions into different categories (e.g., Easy, Revise, Reattempt), students can concentrate on areas that require the most attention. This targeted approach can result in significant improvements in their comprehension and performance.
- **Motivation:** Self-assessment sheets serve as a source of motivation for students. Observing their progress and understanding the steps needed for improvement can boost their motivation to work harder and achieve better results.
- **Reduced Exam Anxiety:** Having a clear understanding of their preparation progress helps reduce exam-related anxiety. Students feel more confident when they know what aspects to focus on, leading to a calmer and more effective exam experience.
- **Time Management:** Self-assessment sheets aid students in managing their study time more effectively. They can allocate more time to areas requiring extensive revision or reattempt while spending less time on topics they have already mastered.

Self evaluation Instruction: After completing the test, evaluate it using the provided explanations. Use only a pencil to mark the evaluations (allowing for revisions and reattempts). Record the marks obtained in the Marks section and provide remarks in the Remarks column.

Remarks abbreviations:

- **Easy (E):** Use for questions that you should find straightforward, indicating a good understanding and correct answers.
- **Revise (R):** Assign to questions where your response contains minor errors or gaps in understanding, suggesting the need for topic review.
- **Reattempt (RA):** Use for questions with incorrect responses, significant misconceptions, or a lack of understanding. Students receiving this remark should revisit the topic thoroughly, seek additional help if necessary, and attempt similar questions to enhance their grasp of the concept.

M: Marks Re: Remark

Sub.	PHYSICS												CHEMISTRY											
SQP	SQP 1		SQP 2		SQP 3		SQP 4		SQP 5		SQP 6		SQP 1		SQP 2		SQP 3		SQP 4		SQP 5		SQP 6	
S.No.	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re	M	Re
Q.1																								
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Q.32																								
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Q.34																								
Q.35																								
Q.36																								
Q.37																								
Q.38																								
Total																								

CONTENTS

Roll No. | | | | | | | | |

Q.P. Code 01

Candidates must write the Q.P. Code on the title page of the answer-book.

SAMPLE QUESTION PAPER- I

BIOLOGY

Time allowed: 3 hours | Maximum Marks: 70

NOTE:

*(i) Please check that this question paper contains **33** questions.*

(ii) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

*(iii) **Please write down the serial number of the question in the answer-book before attempting it.***

(iv) 15 minute time has been allotted to read this question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.

General Instructions:

Read the following instructions carefully and follow them:

*(i) This question paper contains **33** questions. **All** questions are **compulsory**.*

*(ii) Question paper is divided into **five** sections - Sections **A, B, C, D** and **E**.*

*(iii) **Section A** - questions number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*

*(iv) **Section B** - questions number **17** to **21** are very short answer type questions. Each question carries **2** marks.*

*(v) **Section C** - questions number **22** to **28** are short answer type questions. Each question carries **3** marks.*

*(vi) **Section D** - questions number **29** and **30** are case-based questions. Each question carries **4** marks. Each question has subparts with internal choice in one of the subparts.*

*(vii) **Section E** - questions number **31** to **33** are long answer type questions. Each question carries **5** marks.*

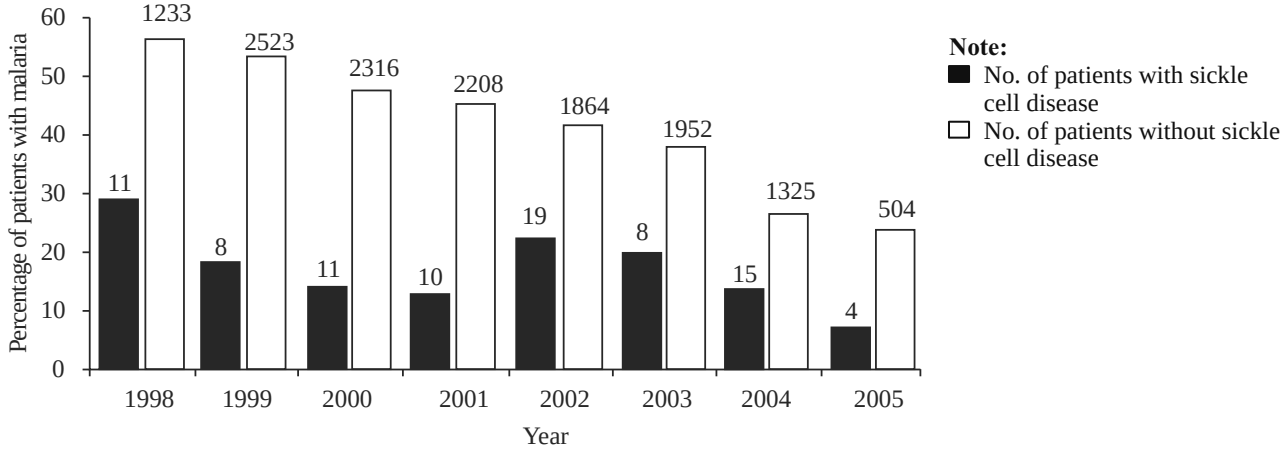
*(viii) There is no overall choice. However, an internal choice has been provided in Section **B**, **C**, and **D** of the question paper. A candidate has to write answer for only **one** of the alternatives in such questions.*

(ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION - A

Questions no. ***1*** *to* ***16*** *are Multiple Choice Type Questions, carrying* ***1*** *mark each.* ***16 × 1 = 16***

1. The provided graph illustrates the incidence of malaria among individuals with and without Sickle Cell Disease (SCD) in Kenya from 1998 to 2005.



The following statements are drawn as conclusions from the above data.

I. Patients with SCD (Sickle Cell Disease) are less likely to be infected with malaria.
II. Patients with SCD (Sickle Cell Disease) are more likely to be infected with malaria.
III. Over the years the percentage of people infected with malaria has been decreasing.
IV. Year 2000 saw the largest percentage difference between malaria patients with and without SCD.

Choose from below the correct alternative.

(*a*) Only I is true (*b*) I and IV are true (*c*) II and III are true (*d*) I and III are true

2. Select the correct arrangement of countries in sequence of biodiversity of bird species-
[A - India, B - Greenland, C - Colombia, D - New York]

(*a*) D > C > B > A (*b*) A > C > D > B (*c*) C > A > D > B (*d*) C > D > B > A

3. Non-albuminous seeds are present in

(*a*) Maize (*b*) Wheat (*c*) Rice (*d*) Groundnut

4. Identify the incorrect pair of evolutionary concepts and examples provided in each option.

(*a*) Divergent evolution- Forelimbs of whales, bats, cheetah and human
(*b*) Convergent evolution- Flippers of penguins and dolphins
(*c*) Homologous structures-Vertebrate hearts
(*d*) Analogous structures- Thorns and tendrils of *Bougainvillea* and *Cucurbita*

5. A person with trisomy of 21st chromosome shows

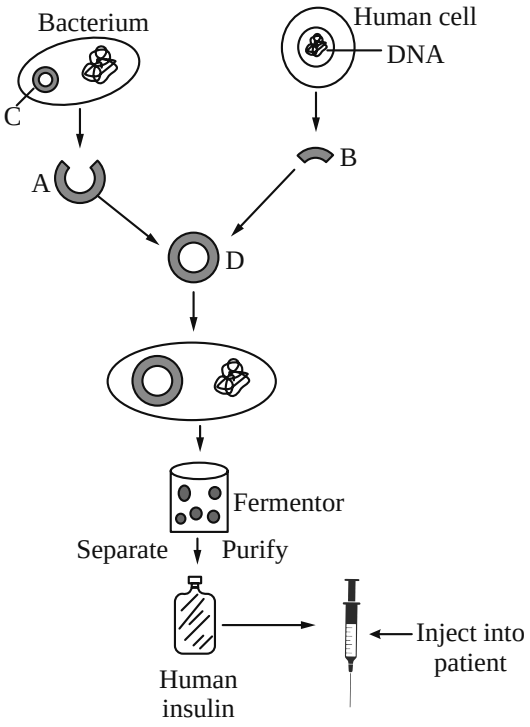
(*i*) Furrowed tongue (*ii*) Characteristic palm crease
(*iii*) Rudimentary ovaries (*iv*) Gynaecomastia

Select the correct option, from the choices given below:

(*a*) (*ii*) and (*iv*) (*b*) (*i*), (*ii*) and (*iv*) (*c*) (*ii*) and (*iii*) (*d*) (*i*) and (*ii*)

6. A murder has occurred, and you are asked to help solve it. The police bring you a sample from the crime scene of what they believe is the killer's DNA and ask you for a chemical analysis. Your study of this sample reveals the presence of adenine, thymine, ribose, and uracil, leading you to conclude that the sample is

(*a*) Pure DNA (*b*) Pure RNA
(*c*) Probably a mixture of DNA and RNA (*d*) Probably a mixture of rRNA and mRNA



(*a*) Please label the components A, B, C, and D depicted in the diagram.

(*b*) Which bacterium is typically employed for insulin production?

(*c*) Name the American company and explain how they initially synthesized human insulin using rDNA technology.

25. (*a*) Explain the process of pollination in *Vallisneria*. How is it different in water-lily, which is also an aquatic plant? **3**

OR

(*b*) Describe the structure of an anatropous ovule with a neat labelled diagram. **3**

26. 'Fitness is a result while natural selection is a process.' Explain the statement. **3**

27. (*a*) List any four characteristics of an ideal contraceptive.

(*b*) Name two intrauterine contraceptive devices that affect the motility of sperms. **3**

28. X is the first restriction enzyme isolated from strain H of *Bacillus amyloliquefaciens*. This enzyme cuts between two guanine bases of the following palindromic sequence:

5′-G G A T C C-3′

3′-C C T A G G-5′

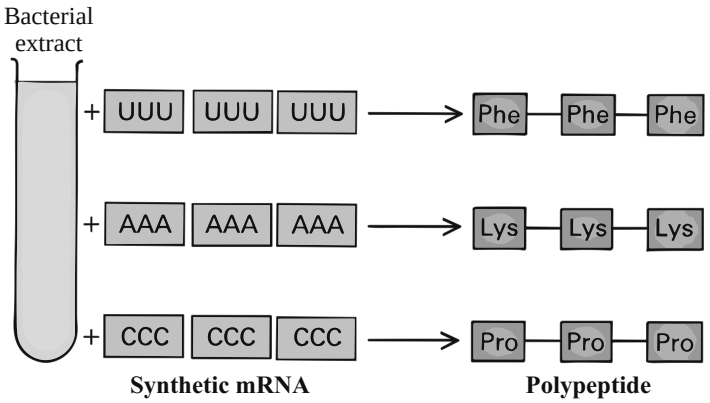
(*a*) Name the restriction enzyme X. Explain how you arrived at this name.

(*b*) Draw the DNA fragments produced due to the action of enzyme X on the palindromic sequence shown above. **3**

SECTION - D

*Questions No. **29** and **30** are case-based questions. Each question has **3** sub-questions with internal choice in one sub-question.*

29. In 1961, some scientists conducted an experiment using synthetic mRNAs containing a single ribonucleotide. When they added this synthetic mRNA to a bacterial extract with all the necessary components for protein synthesis except any other mRNA, it resulted in the creation of polypeptides composed of a single amino acid type.



(*a*) Name the scientist who provided proof that the codon was a triplet using cell free system. **1**

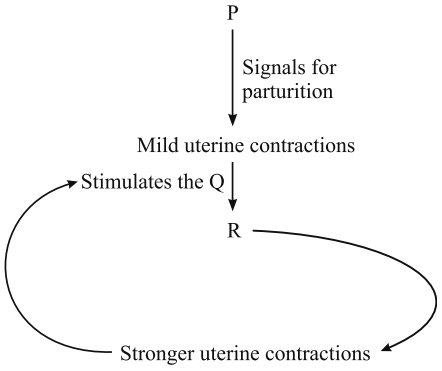
(*b*) What was the name of the physicist who suggested that the code should be made up of three nucleotides? **1**

(*c*) Why do you think that the nucleotides are taken in the group of 3? **2**

OR

(*c*) What are stop codons? How many such codons are present? Write all the three stop codons. **2**

30. Parturition, also known as childbirth, is a complex process involving the coordinated actions of various hormones and physiological signals. It begins with mild uterine contractions, which gradually increase in intensity to facilitate the delivery of the baby. The flowchart below illustrates the hormonal regulation of parturition.



(*a*) Identify P, Q and R. **1**

(*b*) A pregnant woman does not deliver a baby after her due date. As a biology student, which remedy would you prefer by considering the flowchart above and your knowledge? Support your answer with the reason. **1**

(*c*) Mention another role and target tissue/organ of R. Is it associated with the infant by any means? If yes, please write. **2**

OR

(*c*) From which gland is hormone R released, and what are the other hormones released from that gland? **2**

SECTION - E

31. (*a*) Given table consists of four columns. Study the table and fill the blanks. **5**

Population interaction	Species A	Species B	Example
(1)	+	–	Lion and deer
Competition	–	–	(2)
(3)	+	–	*Cuscuta* and hedge plant
Commensalism	(4)	(5)	Sea anemone and clownfish
(6)	+	+	Fig and wasp

(*b*) The following table contains values of the population of bacteria growing over time.

Time (in days)	Population ($\times 10^6$ cells/mL)
0	0.5
2	0.6
4	1.0
7	3.2
9	5.2
11	5.3
14	5.3

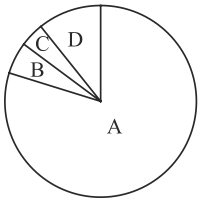
Based on the values in the table above,

(*i*) Construct a population growth curve and indicate the carrying capacity in the graph.

(*ii*) Give reason for the position of the carrying capacity.

OR

(*a*) Based on the given figure of global biodiversity of invertebrates, complete the following table: **5**



	Name of Invertebrate groups
A	
B	
C	
D	

(*b*) How much percent do the animals and plants comprise of the total species?

(*c*) Which group among animals make up more than 70% of the total?

(*d*) Why is India called one of the mega biodiversity nations?

32. (*a*) Suppose in the Edentown community, three genes, Gene A, Gene B, and Gene C, contribute to human height. Each gene has two alleles: A and a, B and b, and C and c, respectively, with the uppercase letter indicating the dominant allele. When individuals with different genotypes for these genes reproduce, a wide array of possible genotype combinations is observed in their offspring. **5**

(*i*) Explain genotype variations from cross AaBBCC × AABbCC. How do these combinations contribute to height diversity in Edentown?

(*ii*) Discuss how the principles of segregation and independent assortment apply to this specific genetic cross. How might the assortment of alleles during gamete formation contribute to the diversity of height observed in the offspring within Edentown?

OR

(*b*) With the help of experiments done by various scientists over 40 years, it was finally concluded that DNA is the genetic material. **5**

(*i*) Before DNA, which molecules were considered to be genetic material?

(*ii*) What was concluded from Griffith's experiments using S and R strains of mice?

(*iii*) Briefly describe two experiments that led to the conclusion that DNA is the genetic material.

(*iv*) Today, if the contents of a nucleus of a human cell were extracted, it can be concluded that DNA is the genetic material as that is the only biomolecule present in the nucleus. Justify this statement as true or false.

EXPLANATIONS

1. (*d*) The graph shows that the percentage of malaria in patients with SCD is consistently lower than in those without SCD. This supports Statement I. The overall trend indicates a decrease in malaria infections over the years, supporting Statement III. However, Statement II contradicts I, and there's no clear largest difference in 2000 as mentioned in IV. **(*1 M*)**

2. (*c*) Tropical regions host a rich biodiversity. For instance, Colombia near the equator has 1,400 bird species, contrasting with New York (41°N) with 105 and Greenland (71°N) with 56. India, predominantly tropical regions has more than 1,200 bird species. **(*1 M*)**

3. (*d*) A non-albuminous seed is a type of seed that does not have residual endosperm as it is completely consumed during embryo development, e.g., pea, groundnut, etc. **(*1 M*)**

4. (*d*) The thorns and tendrils of *Bougainvillea* and *Cucurbita*, both being plant structures, do not represent analogous structures. They are homologous structures as they share a common origin. **(*1 M*)**

5. (*d*) Individuals with trisomy 21, also known as Down syndrome, commonly exhibit a furrowed tongue and characteristic palm crease. **(*1 M*)**

6. (*c*) The sample is probably a mixture of RNA and DNA. The logic here is that thymine is unique to DNA, and both ribose and uracil are found only in RNA. **(*1M*)**

7. (*b*) India has approximately 1,000 varieties of Mango. **(*1 M*)**

8. (*c*) Gross Primary Productivity (GPP) is the rate of production of organic matter during photosynthesis. Net Primary Productivity (NPP) is the biomass available for consumption to heterotrophs and equals GPP minus respiration losses. Secondary Productivity is the rate of new organic matter formation by consumers. **(*1 M*)**

9. (*c*) Over time, DNA bands will continue to migrate towards the positive electrode during gel electrophoresis. **(*1 M*)**

10. (*c*) DNA-dependent DNA polymerase catalyses polymerisation only in the 5′ to 3′ direction. The template strand runs 5′ to 3′ towards the replication fork, which means that DNA polymerase cannot synthesize a new strand continuously in this direction. Therefore, the lagging strand (X) is synthesized discontinuously in short fragments (Okazaki fragments), which are later joined together. **(*1 M*)**

11. (*a*) Using the Hardy-Weinberg principle, the frequency of heterozygotes (Aa) in a random mating population is 2pq. Given p = 0.8 and q = 0.2, the frequency is $2 \times 0.8 \times 0.2 = 0.32$. **(*1 M*)**

12. (*b*) During the ovulatory phase of the menstrual cycle, there is a surge in luteinizing hormone (LH) from the anterior pituitary gland. This surge stimulates the release of a mature egg from the ovary, a process known as ovulation. **(*1 M*)**

13. (*a*) The government has implemented measures such as raising the marriageable age and providing incentives to couples with small families to address the issue of population growth. **(*1 M*)**

14. (*a*) The change in the moth population over time, with a shift towards moths that matched the changing background colour of tree trunks due to industrialization, illustrates the process of natural selection where advantageous traits lead to increased survival and reproductive success in a changing environment. **(*1 M*)**

15. (*d*) The ploidy of the megaspore mother cell (MMC) is diploid (2*n*), and it undergoes meiotic division to produce 4 haploid megaspores. **(*1 M*)**

16. (*c*) Alexander Fleming while working on *Staphylococci* bacteria, once observed a mould growing in one of his unwashed culture plates around which bacteria could not grow. He found that it was due to a chemical produced by mould and he named it Penicillin after the mould *Penicillium notatum*. Its full potential was established by Ernest Chain and Howard Florey. **(*1 M*)**

17. (*a*) In the diagram, (1) is a producer that converts solar energy into chemical energy via photosynthesis. They form the base of the energy flow. **(*1M*)**

(*b*) Dead Top Predator (4) → Decomposers (Bacteria and Fungi) → Inorganic Nutrients (CO_2, H_2O, Minerals) → Plant Uptake (1) → Primary Production through Photosynthesis → Energy Transfer to Consumers. **(*1M*)**

18. (*a*) The genotype of the man (blood group A) can be either I^AI^O or I^AI^A. The woman's genotype (blood group B) can be I^BI^O or I^BI^B. **(*1 M*)**

(*b*) The AB blood group in their child results from the co-dominance of the A and B alleles. The child inherited one A allele from the man and one B allele from the woman, resulting in the AB blood group. **(*1 M*)**

19. An exonuclease (DNA pol I) can help remove RNA primers during DNA replication. Exonucleases remove nucleotides from the ends of DNA or RNA strands, allowing DNA polymerase to replace the RNA primer with DNA nucleotides. **(*2 M*)**

20. (*a*) (*i*) A – Antigen binding site, B – Heavy chain **(*1 M*)**

(*ii*) B - Lymphocytes (B - cells) or plasma cells. **(*1 M*)**

OR

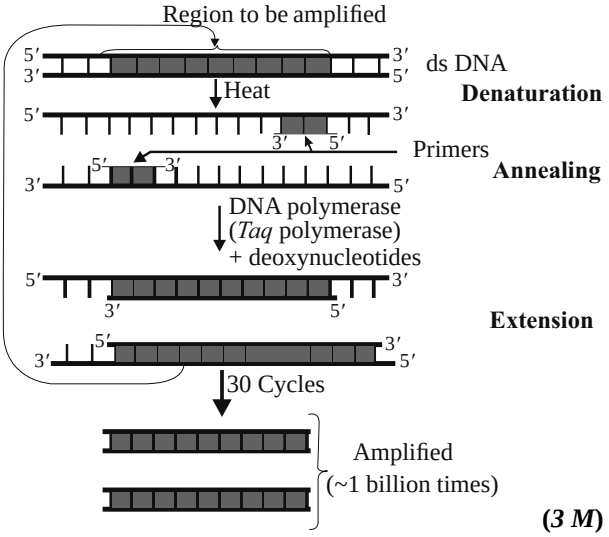
(*b*) (*i*) Immune system may recognize the kidney as foreign and a cell-mediated immune response develops that can lead to inflammation, tissue damage, and rejection of the transplanted organ. **(*1 M*)**

(*ii*) Anti-A antibodies in the recipient's plasma will react with A antigens on the transfused red blood cells, causing agglutination, hemolytic reaction, and possible tissue damage. **(*1 M*)**

21. (*a*) Oogonia (C) start to develop in the ovaries during the fetal development stage. **(*1 M*)**

(*b*) Primary oocytes (A) arrest in prophase of the first meiotic division until puberty, forming primary follicles. Secondary oocytes (B) arrest in metaphase of the second meiotic division, completed upon fertilization by sperm. **(*1 M*)**

22.



(*3 M*)

23. While different viruses attack various organ systems, HIV targets the immune cells such as T cells, impairing the immune response, and making the body more susceptible to infections and cancers. **(*½ M*)**

It has a higher mutation rate that helps its rapid evolution and the emergence of new variants that can evade immune responses and antiretroviral drugs. **(*½ M*)**

HIV integrates its genetic material into the host cell's genome, making it difficult for the immune system to eliminate infected cells. This allows the virus to persist in the body over time. **(*½ M*)**

HIV causes a latent infection in some cells, where it remains inactive and hidden from the immune system. This latent reservoir makes complete eradication of the virus extremely challenging. **(*½ M*)**

(*b*) AIDS is a collection of symptoms/diseases rather than a single distinct condition. **(*1 M*)**

Nailing the Right Answer

Highlight the unique traits of HIV: targeting T cells, high mutation rate, genome integration, and latent infection. Emphasize that AIDS encompasses multiple symptoms/diseases, distinguishing it from a single disease.

24. (*a*) A - Plasmid DNA cut with restriction enzyme

B - Human insulin producing gene

C - Plasmid

D - Bacterial plasmid DNA with human insulin gene inserted i.e., rDNA. **(*1 M*)**

(*b*) *E. coli* bacterium is commonly used to produce insulin. **(*½ M*)**

(*c*) In 1983, an American company named Eli Lilly undertook the task of creating DNA sequences for the A and B chains of human insulin. These sequences were then introduced into *E. coli* plasmids to facilitate the production of insulin chains. Importantly, the A and B chains were manufactured independently, extracted from the system, and subsequently combined through the creation of disulfide bonds, ultimately resulting in the formation of human insulin. **(*1½ M*)**

25. (*a*)

Aspect	Vallisneria	Water-lily
Pollination method	Water pollination	Insect or wind pollination
Flower position	Female flowers rise to water surface by long stalks	Flowers emerge above water level
Pollen dispersal	Pollen released on water surface	Pollen carried by insects or wind
Pollen	Carried passively by water currents; some of them eventually reach the stigma to effect pollination.	Typically sticky or light for wind dispersal
Adaptation	Mucilaginous covering protects pollen in water	Colorful and fragrant flowers to attract pollinators

(*3 M*)

Topper's Explanation **(CBSE 2017)**

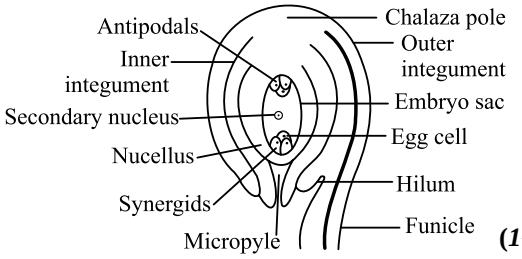
Vallisneria shows hydrophilic pollination ie, pollination is done with the help of water as an agent. Vallisneria is an aquatic plant, found in freshwater. It shows epihydrophily ie, pollination occurs at the surface of water. The female flowers reach the surface of water by their long stalks. Male flowers or pollen grains are also released on to the surface of water, which are carried passively by water currents. Some pollen grains reach the stigma of female flower and effects pollination (The pollen grains are covered with mucilagenous covering to avoid wetting)

Water - lily, although being an aquatic plant is pollinated by wind or some insects as in the case of terrestrial plants. This is because the flowers of water - lily are present much above the surface of water / water level. Hence hydrophily do not occur.

OR

(*b*) An anatropous ovule comprises of :

- A connecting stalk called the funicle, which attaches to the placenta.
- The junction between the funicle and the ovule is known as the hilum.
- Surrounding the ovule, there may be one or more integuments, with an opening at the tip referred to as the micropyle.
- The opposite end of the micropyle is known as the chalazal end, which is the basal part of the ovule. Inside the integuments, there is a mass of cells called the nucellus, and within this structure, a single embryo sac is typically found. **(*1½ M*)**



(*1½ M*)

26. Fitness refers to the outcome of an organism's adaptation, where its ability to produce offspring with advantageous traits for survival and reproduction is enhanced. **(*1 M*)**

Natural selection is a mechanism by which heritable traits that confer greater success in a given environment become more prevalent over generations, illustrating the process through which advantageous traits are favoured and passed on. **(*1 M*)**

In essence, fitness is the consequence/result of successful adaptation, while natural selection is the dynamic process that drives the persistence of adaptive traits in a population over time. **(*1 M*)**

27. (*a*) Four characteristics of an ideal contraceptive:

Effectiveness: It should have a high success rate in preventing pregnancy.

Safety: An ideal contraceptive should be safe for use without causing significant side effects or health risks.

Reversibility: Users should be able to discontinue its use without hindrance to their future fertility.

Affordability and Accessibility: It should be readily available and affordable to a wide range of individuals, regardless of their socio-economic status. **(½ × *4* = *2 M*)**

(*b*) Two intrauterine contraceptive devices (IUDs) that affect the motility of sperm are:

Cu-T and Multiload 375 are intrauterine contraceptive devices (IUDs) that contain copper. They work by releasing copper ions in the uterine environment, which suppress sperm motility and reduce their fertilizing capacity, contributing to effective contraception. **(*1 M*)**

Topper's Explanation **(CBSE 2016)**

(a) The characteristics of an ideal contraceptive are –
- should be user friendly
- should be effective with least or no side effects
- should be reversible
- should not interfere in any way with the sexual drive of the user.

(b) (Copper Releasing IUD's (eg. Cu T, Cu 7, Multiload 375) supress sperm motility

28. (*a*) Name of the enzyme: *Bam*HI

- The convention used to name a restriction enzyme is that the first letter comes from the genus (*Bacillus*) and next two letters from the species (*amyloliquefaciens*).
- The fourth letter refers to the strain (strain H).
- The roman number in the end indicating the order in which the enzyme was isolated from the strain (first enzyme). **(*2 M*)**

(*b*) 5′-G G A T C C- 3′

3′-C C T A G G- 5′ **(*1 M*)**

29. (*a*) Marshall Nirenberg proved the codon is a triplet by using synthetic RNA sequences in a cell-free system, demonstrating how three nucleotides code for one amino acid in protein synthesis. **(*1 M*)**

(*b*) George Gamow suggested that in order to code for all the 20 amino acids, the code should be made up of three nucleotides. **(*1 M*)**

(*c*) There are 20 standard amino acids used to build proteins. Since there are only four different nucleotides in DNA and RNA (adenine, thymine/uracil, cytosine, and guanine), using a triplet code allows for a greater number of combinations ($4^3 = 64$) . If 2 nucleotides were taken only $4^2 = 16$ combinations were possible, which is not possible since there are 20 amino acids. **(*2 M*)**

OR

(*c*) Stop codons, also known as termination codons or non-sense codons, are signals in the genetic code that indicate the end of protein synthesis during translation. These codons do not code for any amino acids; instead, they signal the ribosome to stop adding amino acids to the growing polypeptide chain. There are three stop codons in the standard genetic code. These are - UAA ,UAG, UGA **(*2 M*)**

30. (*a*) P - Fully developed foetus and the placenta, Q - Maternal pituitary, R - Oxytocin. **(*1 M*)**

(*b*) Post-term deliveries can be initiated by administration of oxytocin. This will stimulates induced parturition. **(*1 M*)**

(*c*) R is oxytocin and another target tissue/organ beside the uterus is mammary gland. After delivery, it stimulates milk ejection from the mammary glands in response to the mechanical stimulus provided by a suckling infant. Therefore, oxytocin induced milk ejection is associated with the stimulus provided by a suckling infant. **(*2 M*)**

OR

(*c*) Oxytocin is produced by the hypothalamus and is released into the bloodstream specifically from the posterior pituitary gland. Apart from oxytocin, the posterior pituitary also releases vasopressin (antidiuretic hormone), which plays a role in water absorption and blood vessel constriction. **(*2 M*)**

Mistakes 101: What not to do!

Students might incorrectly identify the components P, Q, and R in the flowchart or confuse the roles of oxytocin and the maternal pituitary. Additionally, they may not clearly explain the mechanism by which oxytocin induces milk ejection. Students may often be confused about where oxytocin is produced and released from.

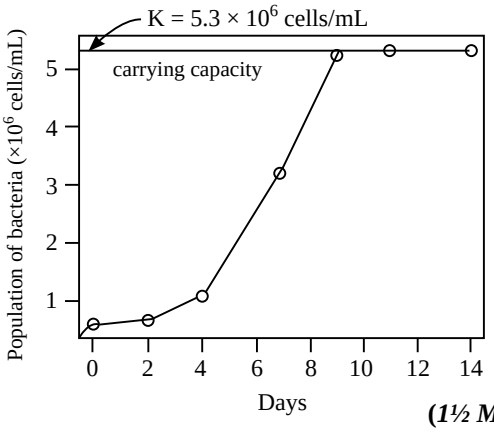
31. (*a*)

Population interaction	Species A	Species B	Example
Predation	+	–	Lion and deer
Competition	–	–	Abingdon tortoise and goats
Parasitism	+	–	*Cuscuta* and hedge plant
Commensalism	+	0	Sea anemone and clownfish
Mutualism	+	+	Fig and wasp

(*½ × 5 = 2½ M*)

(*b*)

(*i*)



(*1½ M*)

(*ii*) The population stabilizes at 5.3×10^6 cells/mL after day 9, indicating insignificant to no further growth. This stabilization suggests the environment has reached its maximum supportable population size due to resource limitations, marking the carrying capacity. **(*1 M*)**

OR

(*a*)

	Name of Invertebrate groups
A	Insects
B	Molluscs
C	Crustaceans
D	Other animal groups

(*½ × 4 = 2 M*)

(*b*) More than 70 per cent of all the species recorded are animals, while plants (including algae, fungi, bryophytes, gymnosperms and angiosperms) comprise no more than 22 percent of the total. **(*1 M*)**

(*c*) Among animals, insects are the most species-rich taxonomic group, making up more than 70 per cent of the total. That means, out of every 10 animals on this planet, 7 are insects. **(*1 M*)**

(*d*) India is one of the mega biodiversity nations due to its significant species diversity, with 8.1% of the world's total, despite having only 2.4% of the world's land area. Nearly 45,000 species of plants and twice as many of animals have been recorded from India. **(*1 M*)**

32. (*a*) (*i*) The cross between AaBBCC and AABbCC parents in Edentown produces offspring with varied genotypes such as AABBCC (tall) and AABbCC, AaBBCC, AaBbCC (intermediate heights). These combinations, arising from multiple gene interactions, contribute to the diverse height range in Edentown, showcasing the complexity of polygenic inheritance in shaping the population's physical traits.

Roll No. | | | | | | | | |

Q.P. Code **05**

Candidates must write the Q.P. Code on the title page of the answer book.

SAMPLE QUESTION PAPER-5

PHYSICS

Time Allowed : 3 hours | Maximum Marks : 70

GENERAL INSTRUCTIONS:

Read the following instructions carefully and strictly follow them:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. All the sections are compulsory.
4. Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
6. Use of calculators is not allowed.
7. You may use the following values of physical constants where ever necessary
   (*i*) $c = 3 \times 10^8$ m/s
   (*ii*) $m_e = 9.1 \times 10^{-31}$ kg
   (*iii*) $e = 1.6 \times 10^{-19}$ C
   (*iv*) $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
   (*v*) $h = 6.63 \times 10^{-34}$ Js
   (*vi*) $\varepsilon_0 = 8.854 \times 10^{-12}$ C^{2}N^{-1} m^{-2}
   (*vii*) Avogadro's number = 6.023×10^{23} per gram mole

SECTION–A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark.

There is no internal choice in this section.

1. Which of the following particles has the shortest de Broglie wavelength for a given energy? **1**

(*a*) Electron (*b*) Proton (*c*) Neutron (*d*) Alpha particle

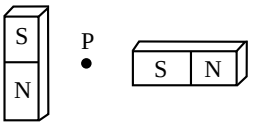
2. Three identical bulbs are connected in series and these together dissipates a power *P*. If now the bulbs are connected in parallel then the power dissipated will be **1**

(*a*) $\frac{P}{3}$ (*b*) 3 P (*c*) 9 P (*d*) $\frac{P}{9}$

3. If number of turns and current is doubled for any solenoid, then value of magnetic field inside the solenoid becomes **1**

(*a*) Twice (*b*) Same (*c*) One fourth (*d*) Four times

4. Two equal bar magnets are kept as shown in the figure. The direction of resultant magnetic field, indicated by arrow head at the point *P* is (approximately) **1**



(*a*) (*b*)  (*c*)  (*d*) 

5. A voltmeter connected in an A.C circuit reads 220V. This reading represents **1**

(*a*) Peak voltage (*b*) RMS voltage (*c*) Average voltage (*d*) Mean square voltage

6. Name the rays which is produced by nuclear reaction? **1**

(*a*) Infrared (*b*) UV (*c*) Microwave (*d*) γ-rays

7. Which of the following is not based on total internal reflection? **1**

(*a*) Working of optical fiber (*b*) Difference between apparent and real depth of pond

(*c*) Mirage on hot summer days (*d*) Brilliance of diamond

8. Huygen's conception of secondary waves **1**

(*a*) Allow us to find the focal length of a thick lens (*b*) Is a geometrical method to find a wave front

(*c*) Is used to determine the velocity of light (*d*) Is used to explain polarisation

9. A proton when accelerated through a potential difference of V volt has wavelength λ associated with it. An electron to have the same λ must be accelerated through a potential difference of **1**

(*a*) $\frac{V}{8}$ volt (*b*) 4V volt (*c*) 2V volt (*d*) 1836V volt

10. In the nuclear decay given below: ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y \rightarrow {}^{A-4}_{Z-1}B^{*} \rightarrow {}^{A-4}_{Z-1}B$, the particles emitted in the sequence are **1**

(*a*) γ, β, α (*b*) β, γ, α (*c*) α, β, γ (*d*) β, α, γ

11. In middle of the depletion layer of reverse biased p-n Junction, the

(*a*) Electric field is zero (*b*) Potential is zero

(*c*) Electric field is maximum (*d*) Potential is minimum

12. A potential barrier of 0.5V exists across a p-n Junction. When the width of depletion layer is 10^{-6}m, the intensity of electric field in this region is **1**

(*a*) 8×10^{6} V/m (*b*) 5×10^{5} V/m (*c*) 6×10^{4} V/m (*d*) 9×10^{6} V/m

SECTION – C

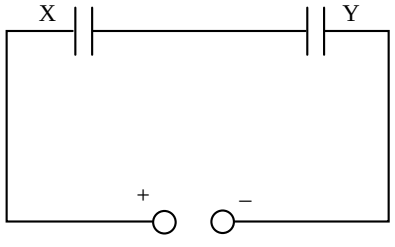
This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. (*a*) Consider an infinitely long straight wire with a positive charge distributed along its length, characterized by a linear charge density of λ Cm^{-1}. An electron orbits around this wire, with its center as the point of revolution, maintaining a constant velocity within a circular plane perpendicular to the wire. Derive the expression for the kinetic energy of the electron.

(*b*) Create a graphical representation illustrating the relationship between kinetic energy as a function of charge density λ. **2 + 1 = 3**

23. Show that Lenz's law is in accordance with the law of conservation of energy. **3**

24. Two parallel plate capacitors, denoted as *X* and *Y*, share identical plate areas and plate separations. Capacitor *X* has air as the dielectric material between its plates, while capacitor *Y* contains a dielectric medium with a relative permittivity (dielectric constant) of $\varepsilon_r = 4$.



(*a*) Determine the capacitance of each capacitor when the equivalent capacitance of the combined system is 4 μF.

(*b*) Compute the potential difference across the plates of capacitors *X* and *Y*.

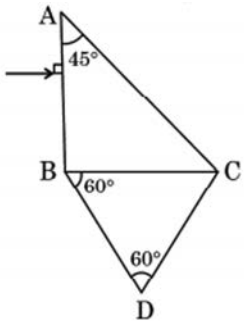
(*c*) Calculate the ratio of the electrostatic energy stored in capacitor *X* to that in capacitor *Y*. **1 + 1 + 1 = 3**

25. What causes a galvanometer to exhibit a brief deflection when connected in series with a capacitor during the charging or discharging process?

How does this observation prompt a modification of Ampere's circuital law? Consequently, provide the revised and generalized expression for Ampere's law. **3**

26. (*a*) Write two necessary conditions for total internal reflection.

(*b*) Two prisms ABC and DBC are arranged as shown in figure. **1 + 2 = 3**

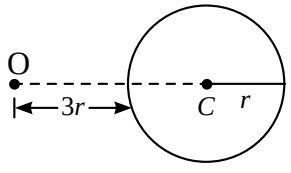


The critical angles for the two prisms with respect to air are 41.1° and 45° respectively. Trace the path of the ray through the combination.

OR

(*a*) An object is placed in front of a converging lens. Obtain the conditions under which the magnification produced by the lens is (i) negative and (ii) positive.

(*b*) A point object is placed at *O* in front of a glass sphere as shown in figure. **1 + 2 = 3**



Show the formation of image by the sphere.

EXPLANATIONS

1. (*d*) Alpha particle as $\lambda = \frac{h}{\sqrt{2mE}}$ **(1 M)**

2. (*c*) When bulbs are in series (R_S = R + R +R = 3R)

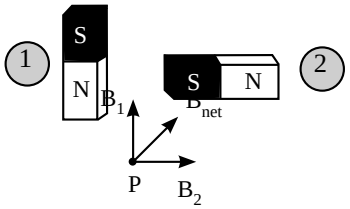
$$P = \frac{V^2}{3R}$$

When bulbs are connected in parallel $\left(R_P = \frac{R}{3}\right)$

$$P' = \frac{V^2}{\frac{R}{3}} = \frac{3V^2}{R} \left[\because \frac{V^2}{R} = 3P\right] = 3\,(3P) = 9P$$ **(1 M)**

3. (*d*) $B = \mu_0 \frac{N}{l} I \quad \Rightarrow B \propto NI \quad \Rightarrow B' = 4B$ **(1 M)**

4. (*b*)



(1 M)

5. (*b*) The reading of voltmeter represents RMS voltage. **(1 M)**

6. (*d*) γ-rays are typically produced in nuclear reactions. **(1 M)**

7. (*b*) Difference between real and apparent depth of pond is due to refraction at the air-water interface. **(1 M)**

8. (*b*) **(1 M)**

9. (*d*) $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK.E}} = \frac{h}{\sqrt{2m_1q_1V_1}}$ **(1 M)**

10. (*d*) ${}^{A}_{Z}X \xrightarrow{\beta} {}^{A}_{Z+1}Y \xrightarrow{\alpha} {}^{A-4}_{Z-1}B^{*} \xrightarrow{\gamma} {}^{A-4}_{Z-1}B$ **(1 M)**

11. (*c*)

12. (*b*) $E = \frac{V}{d} = \frac{0.5}{10^{-6}} = 5\times10^{5}$ v/m **(1 M)**

13. (*a*) **(1 M)**

14. (*a*) Properties of em waves **(1 M)**

15. (*a*) Use lens maker's formula **(1 M)**

16. (*b*) Both A and R are correct, but R does not give only reason for assertion, for Paschen series (n = 3) and for series (n = 1) Lyman. **(1 M)**

17. The maximum induced electromotive force (*e*mf) in a generator can be expressed as: $\varepsilon_0 = NBA\omega$.

$\varepsilon_0 = NBA\omega$ **(½ M)**

When the rotation speed (ω) is doubled, the following effects occur:

(*a*) The frequency of the alternating current (a.c.) will double. **(½ M)**

(*b*) The emf doubles. **(½ M)**

(*c*) Power consumed across a resistor is proportional to the square of emf. ∴ Power required will be four times. **(½ M)**

18. (*a*) De Broglie's hypothesis states that particles, such as electrons, exhibit wave-like properties and have a wavelength associated with their momentum. The de Broglie wavelength (λ) is given by:

$$\lambda = \frac{h}{p}$$

where *h* is Planck's constant and *p* is the momentum of the particle.

(*b*) The momentum p of the electron is given by:

$p = mv$

$p = (9.1 \times 10^{-31}\text{ kg})\,(1 \times 10^{6}\text{ m/s}) = 9.1 \times 10^{-25}\text{ kg m/s}$

The de Broglie wavelength l is:

$$\lambda = \frac{h}{p} = \frac{6.63\times10^{-34}}{9.1\times10^{-25}} \approx 7.29\times10^{-10}\text{ m}$$

OR

The stopping potential is the minimum negative potential applied to the anode in a photoelectric experiment that prevents the emission of photoelectrons. It is used to measure the maximum kinetic energy of the emitted electrons.

In a photoelectric experiment, the intensity of the incident light affects the photoelectric current by increasing the number of emitted photoelectrons. However, the kinetic energy of the emitted electrons remains unchanged. Thus, a higher intensity of light results in a higher photoelectric current, provided the frequency of the light is above the threshold frequency.

19. We know, for minimum condition, the path difference is given by, $n\lambda = a\sin\theta$. When considering a single slit with a width '*a*,' the first minimum in the interference pattern for monochromatic light with a wavelength 'λ' occurs at an angle of $(\frac{\lambda}{a})$. This phenomenon arises because the light originating from the center of the slit experiences a phase shift of half a wavelength. **(1 M)**

In contrast, in a double-slit experiment with the same angle of $(\frac{\lambda}{a})$ and a separation between the slits of 'a,' maxima are observed. This is due to a one-wavelength difference in the path length traveled by light originating from these two slits. **(1 M)**

Nailing the Right Answer

Ensure a clear understanding of interference, provide a comprehensive explanation of the phenomenon, and clearly differentiate between single-slit and double-slit interference to avoid these common errors.

20. (*i*) For a glass lens to disappear in a liquid during a magic show, the refractive index of the liquid must match the refractive index of the glass. This is because when the refractive indices of two materials are equal, light passes through them without any refraction (bending) at the interface, making the boundary between them invisible.

Given:

- The refractive index of the glass lens, $n_{glass} = 1.47$

For the glass lens to "disappear," the refractive index of the liquid, n_{liquid}, must also be: $n_{liquid} = 1.47$ **(1 M)**

(*ii*) The refractive index of water is approximately $n_{water} = 1.33$.

Since $1.33 \neq 1.47$, it is not possible for the liquid to be water. Water's refractive index is significantly different from that of the glass, so the glass would still be visible due to the refraction of light at the interface. **(1 M)**

21. (*a*) **Isotopes:** Atoms of the same element that have the same atomic number (number of protons) but different mass numbers (number of protons + neutrons). They have the same chemical properties but may have different physical properties. Examples include Carbon-12 and Carbon-14.

Isobars: Atoms of different elements that have the same mass number but different atomic numbers. They have different chemical and physical properties. Examples include Argon-40 and Calcium-40. **(1 M)**

(*b*) No, two nuclei with different mass numbers A_1 and A_2 are not necessarily isotopes of the same element. They can be isotopes if they belong to the same element (i.e., have the same atomic number) but with different numbers of neutrons. However, they can also be nuclei of completely different elements. It's the atomic number (number of protons) that determines the element, not the mass number. **(1 M)**

OR

(*a*) The photoelectric emission from a surface depends on:

The frequency of the incident light.

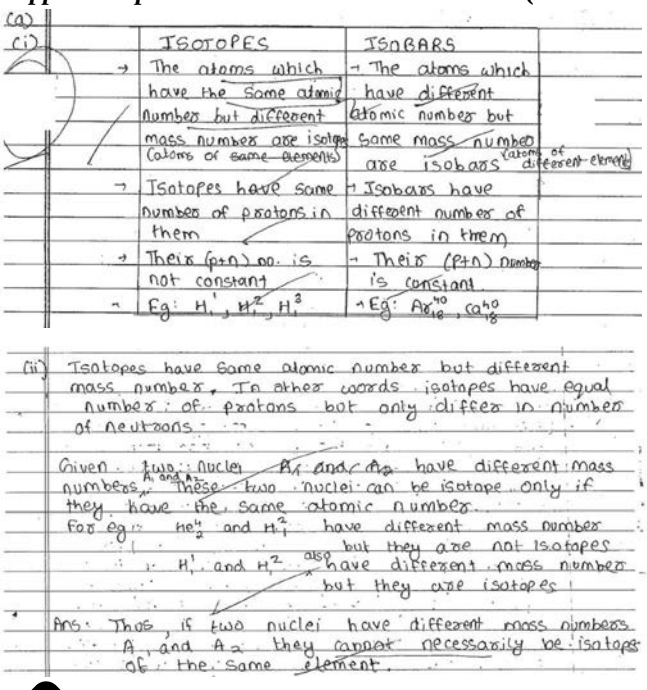
The nature of material of the surface (its photosensitivity).

The threshold frequency of the material.

The condition (cleanliness and temperature) of the surface. **(1 M)**

(*b*) The threshold frequency is the minimum frequency of incident light required to eject electrons from the surface of a photosensitive material. If the frequency of the incident light is below the threshold frequency, no photoelectrons are emitted, regardless of the intensity of the light. It is characteristic of the material and related to the work function, which is the minimum energy needed to remove an electron from the surface. **(1 M)**

Topper's Explanation **(CBSE 2019)**


(a)
(i)

ISOTOPES	ISOBARS
→ The atoms which have the same atomic number but different mass number are isotopes (atoms of same elements)	→ The atoms which have different atomic number but same mass number are isobars (atoms of different elements)
→ Isotopes have same number of protons in them	→ Isobars have different number of protons in them
→ Their (p+n) no. is not constant	→ Their (p+n) number is constant
→ Eg: H_1^1, H_1^2, H_1^3	→ Eg: Ar_{18}^{40}, Ca_{18}^{40}

(ii) Isotopes have same atomic number but different mass number. In other words isotopes have equal number of protons but only differ in number of neutrons.

Given two nuclei A_1 and A_2 have different mass numbers (A_1 and A_2). These two nuclei can be isotope only if they have the same atomic number.
For eg: He_2^4 and H_1^2 have different mass number but they are not isotopes
∴ H_1^1 and H_1^2 also have different mass number but they are isotopes

Ans: Thus, if two nuclei have different mass numbers A_1 and A_2 they cannot necessarily be isotopes of the same element.

Mistakes 101 : What not to do!

Students may mistakenly interchange the definitions of isotopes and isobars. Students may incorrectly define isotopes as atoms with the same mass number but different atomic numbers.

Nailing the Right Answer

- Differentiate between isotopes and isobars concisely.
- Explain why two nuclei with different mass numbers may or may not be isotopes of the same element.

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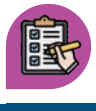

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