Entrance Test for Ph.D. Programme in Science Education – 2026

Read the following instructions carefully.

- This paper has two sections. The section I (100 marks) is of multiple choice questions and section II is descriptive (50 marks).
- There are **a total of 80 questions** in section I distributed among different subjects as:
  o **Q 1 to 25:** Quantitative reasoning, scientific literacy and technical comprehension.
  o **Q 25 to 40:** Social and cognitive sciences and education.
  o **Q 41 to 80:** Ten questions each on biology (41 to 50), chemistry (51 to 60), mathematics (61 to 70) and physics (71 to 80).
- Section I questions are of multiple-choice type with four options, out of which *only one* option is correct. Each question carries equal weightage. A correct answer earns 2 marks. No negative marking.
- You may answer **any 50 questions from section I**. **If more than 50 questions** are attempted, the score obtained will be **normalized** to that corresponding to 50 questions.
- Section II is of **50 marks**. It has 3 questions (Q 81, Q 82, Q 83)
  o Q 81 is of 20 marks,
  o Q 82 and Q 83 are 15 marks each.

Please note

- You will need to click on **'Submit'** at the end of Section I (followed by prompts for submission for marking) to access Section II **for the first time**. **However,** you can continue switching between sections **anytime** to edit/update your response.
- While typing in the text boxes, the following function keys CANNOT be used/operated: Ctrl+C Ctrl+X Ctrl+V [Accidental or otherwise – use of the above keys will lead to erasing of the text matter already typed in that particular text box.] **The text is saved automatically and you do not need to do anything.**

Section I:
Multiple Choice Questions

Quantitative Reasoning, Scientific Literacy and Technical Comprehension

Question 1:

If the milkman does not deliver milk or the geyser does not work, only then Manoj will be late for school and lunch will be cooked late. Suppose lunch was actually cooked on time. Which of the following is true?

A)   Manoj was late for school.

B)   Geyser worked, as well as the milkman delivered the milk.

C)   Geyser worked, but the milkman did not deliver the milk.

D)   None of the statements are definitely true.

Correct Option: B

Question 2:

We here four statements from four friends.

- A says "B is lying"
- B says "C is telling truth"
- C says "D is lying"
- D says "A is telling truth"

If exactly two of them are lying , then which of the following pair includes both people saying the truth or both people are liars?

A)   A and C   B)   B and D

C)   C and D   D)   A and D

Correct Option: D

Question 3:

The given diagram shows different cricketing skills of players.

- the rectangle (red) represents those who can bat with their left hand
- the triangle (green) represents those who can bowl with their left hand
- the circle (black) represents those who can bat with their right hand
- the square (green) represents those who can bowl with their right hand

Which of the following statements is true?
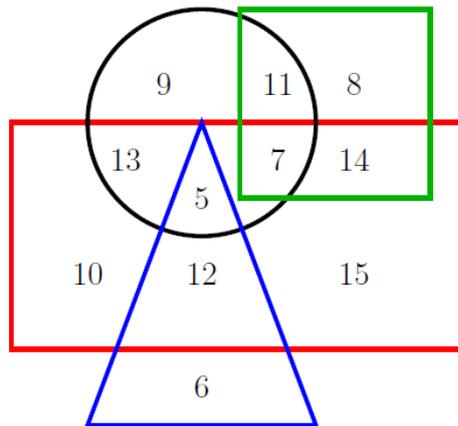
A)   Exactly 46 players have only 1 skill

B)   Exactly 53 players have only 2 skills

C)   Exactly 7 players have only 3 skills

D)   Exactly 62 players have 2 or more skills

Correct Option: D

Question 4:

For the following set of observed values

$$\{62, 62, 65, 71, 71, 71, 71, 80, 85, 95, 95, 95, 102, 160, 180\}$$

which of the following statements is correct?

A)   mode < median < mean   B)   mode < mean < median

C)   mean < median < mode   D)   median < mode < mean

Correct Option: A

Question 5:

An equilateral triangle ABC has side length 1. Let M be the midpoint of side BC. The vertex A is folded so that it falls on M. What fraction of the original triangle has exactly one layer of paper after the fold?

A) $\dfrac{1}{2}$ 　　 B) $\dfrac{1}{3}$ 　　 C) $\dfrac{3}{4}$ 　　 D) $\dfrac{1}{4}$

Correct Option: A

Question 6:

A cube of side $10\,\text{cm}$ is painted on all its faces. It is then cut into smaller cubes of side $2\,\text{cm}$ and newly exposed surfaces are painted with a paint layer of the same thickness. If the paint needed before the cutting was x, the additional paint needed after the cutting will be

A) $2x$ 　　 B) $3x$ 　　 C) $4x$ 　　 D) $5x$

Correct Option: C

Question 7:

In a right triangle, one angle measures 30°. If the hypotenuse is 10 cm, what is the length of the shorter leg?

A) $5\,\text{cm}$ 　　 B) $4\,\text{cm}$ 　　 C) $6\,\text{cm}$ 　　 D) $\dfrac{10}{\sqrt{3}}\,\text{cm}$

Correct Option: A

Question 8:

If $f(x) = cx^2 - 4x + 3$ has two equal roots, then what is the value of c ?

A) 1 　　 B) $\dfrac{4}{3}$ 　　 C) $\dfrac{8}{3}$ 　　 D) $\dfrac{16}{3}$

Correct Option: B

Question 9:

The mean of the first 6 numbers in the sequence 4×5, 7×8, 10×11, 13×14,... is:

A) 146   B) 170   C) 182   D) 200

Correct Option: B

Question 10:

Let $n \geq 3$ be an integer. Place n points on a circle and join each pair of points with a line segment. Color the segments joining adjacent points on the circle blue, and all other segments red. If the number of red segments is three times the number of blue segments, find n.

A) 3   B) 9   C) 27   D) 36

Correct Option: B

Question 11:

Aryan and Bhola, decide to take on a large task together. Aryan can finish the job in 40 days, while Bhola can complete it in 30 days. They work together for 10 days when they realize they could use some extra help. Chandru joins the team and helps them finish the remaining work in just 5 days. How long would it take Chandru to complete the entire work alone?

A) 20 days   B) 30 days   C) 40 days   D) 50 days

Correct Option: C

Question 12:

A box contains 8 red balls and 7 blue balls. If one draws one ball from the box at random and then draws a second ball at random, what is the probability that both the balls are of different colours?

A) $\dfrac{4}{15}$ B) $\dfrac{7}{15}$ C) $\dfrac{1}{2}$ D) $\dfrac{8}{15}$

Correct Option: D

Question 13:

A triangle with vertices $(4, 1)$, $(1, 1)$, and $(3, 5)$ is:

A)   A right-angled scalene triangle.

B)   An acute angled scalene triangle.

C)   An acute angled isosceles right-angled triangle.

D)   A right-angled isosceles triangle.

Correct Option: B

Question 14:

A circle of radius r (blue) rolls without slipping inside a fixed bigger circle of radius $3r$ (red). Point P is located on the bigger circle and point Q is located on the smaller circle. At the start of the motion, points P and Q are coincident (touching each other).
How many times point Q will touch the bigger circle, **between** two successive coincidences with point P?
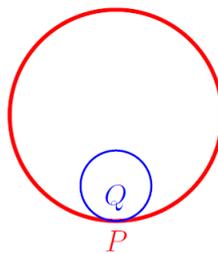
A) 1   B) 2   C) 3   D) 4

Correct Option: A

Question 15:

Suppose the points $(1, 2, 0)$ and $(3, 3, 2)$ are the vertices of a solid cube in the three-dimensional space. The sum of all possible surface areas of the cube is

A) 99   B) 81   C) 72   D) 45

Correct Option: A

Question 16-20:

Read the passage carefully and answer questions based on the passage.

Since 1999, a "two hours a day" restriction has been recommended for screen time for children, yet American households continue to consume far more media than such recommendations allow. At the basis of such largely ignored admonitions is a dosage model of technology in which a presumed homogeneous substance called "screen time" is the intervention; and changes in some set of continuous and measurable variables (e.g., literacy, aggression, social acuity, BMI) are the outcomes. However, to treat "screen time" as a meaningful unit of analysis is to carve the world at the wrong ontological joints. If we want to make claims about what is and is not good for children and counsel parents on how to regulate, mediate, and participate in media use in the home, we need to understand the black box of screen time. We also need to

unpack how technology is used in specific ways in specific material and social contexts, and the relationship of that activity to systems of meaning beyond the device or screen.

In this article, we unpack the notion of screen time as a way to problematize the dosage model of media use and the regulatory admonitions given to parents based on it. In this investigation, we use Stake's instrumental case study methods to examine in detail a single child's activity in the videogame *Madden* — the meaning, function and context of this play; and how it is tied to other forms of engagement and the activity of American football. *Madden* is our bounded case, but, as we will show, the meaning of playing *Madden* comes from its location within the broader activity of "American football."

Data collection and analysis involved observations of a 7-year-old male's gameplay and attending activities for a period of 3.5 months, with multiple informal interviews about his activity across that observational period, including a 90-minute structured interview midway through observations. Field notes and screenshots were taken on both informal and formal observations. Findings of the case study illustrate how digital games, streamed and live video, print documents, tangible manipulatives, and physical action are caught up in a single coherent transmedia endeavor. Their means and instruments are constructed first, perhaps, by media producers but then deconstructed and repurposed by users themselves. The video game as practiced is a simulated system tied to the real world it represents, and, as such, play is deeply embedded in a complex semiotic, material, and social context. We conclude that constructs such as screen time quantity distract us from other, more explanatory constructs such as productive practice, critical consumption, developmental progressions, and intertextuality.

(Adapted from: Squire, K. D., & Steinkuehler, C. (2017). The problem with screen time. Teachers College Record: The Voice of Scholarship in Education Volume 11 (12))

Question 16

According to the passage, why is the "dosage model" of screen time considered problematic by the authors?

i) It fails to differentiate between children's age groups.

ii) It treats screen time as a uniform phenomenon, detached from contextual nuances.

iii) It overemphasizes the negative effects of technology on literacy, aggression, social acuity and BMI.

iv) The model assumes 'screen time' as a meaningful unit of analysis.

A)	Statements i, ii, and iii	B)	Statements ii, iii, and iv
C)	Statements ii and iv	D)	Statements iii and iv

Correct Option: C

Question 17

Which of the following terms can replace "ignored admonitions" in the paragraph?

A)   Uncertain assertions   B)   Overlooked observations

C)   Dismissed recommendations   D)   Unheeded warnings

Correct Option: D

Question 18

How do the authors characterize the relationship between media producers and users in the context of transmedia engagement?

A)   Users deconstruct and repurpose media content within their own contexts.

B)   Users passively absorb the meaning encoded by producers.

C)   Media producers strictly control how content is consumed.

D)   Producers discourage interactive or multi-platform engagement.

Correct Option: A

Question 19

What methodologies did the researchers adopt for the above study?

A)   Ethnographic immersion involving peer-group observations, researcher participation in gameplay sessions, and thematic coding of recorded interactions.

B)   Longitudinal study involving observations during gameplay, informal chat and planned interaction, and accompanying field notes.

C)   One long lab session of gameplay with pre- and post-tests, followed by a questionnaire, along with parent survey and video rating checklist.

D)   Gameplay analysis using standardised performance metrics with statistical comparison of the player's behaviour.

Correct Option: B

Question 20

Which of the following best captures the authors' critique of conventional media guidelines given to parents?

A) They are scientifically accurate but difficult to enforce.

B) They fail to recognize the complexity and context of media use.

C) They are only suitable for educational screen content.

D) They undervalue the entertainment value of games like Madden.

Correct Option: B

Question 21-25:

Read the passage carefully and answer questions based on the passage.

Recent years have seen a rising interest in understanding the trends and dimensions of inequality across countries as well as within countries. However, in most discussions on global inequality, emerging countries have found little mention, partly due to the lack of comparable long-term data but also due to differences in the economic and social structures between emerging economies and the developed countries. The absence of long-term time series data on personal tax, incomes and wealth have been obstacles in understanding the nature of inequality and its interaction with the process of growth in the emerging economies.

However, analysis of inequality within emerging countries is now seen as important not just for concerns on growth and well-being in the developing countries but also for global growth and development. Concerns about rising inequality have been flagged by the World Bank, International Monetary Fund and the Asian Development Bank. Reducing inequality has also been added as one of the Sustainable Development Goals adopted by the United Nations.

In most of the emerging economies, the role of inequality is not only important in understanding growth trajectories of these countries but is also important for understanding the distribution of income across various population groups and between labour and capital. These are driven by a combination of factors such as the level of informality in the economy, the nature of the labour market, fiscal policies and tax structures, redistributive transfers as well as capital and labour market regulations. This is much more important in the case of India where the inequality is not only visible and has seen a rising trend in recent decades on the conventional indicators of income and consumption, but there is also increasing disparity between social and economic groups in access to education, health and public services.

However, the trend of rising inequality has received far less attention in the Indian context despite a clear rising trend since 1991. This is partly because a lot of focus on income distribution in India has remained limited to poverty rather than inequality. A much larger reason for this has been the belief that inequality is less of a problem in an economy which is growing so rapidly. In some ways, popular writing on inequality has justified rising inequality as a necessary byproduct of growth in developing countries. The fact that measured inequality on consumption expenditure in India appears to be lower than most of the developing countries has meant that concerns on inequality have remained on the periphery. However, there is now a renewed interest in understanding the drivers of inequality its impact on growth, mobility and welfare in India.

(Adapted from 'India inequality report 2018: Widening gaps' prepared by Himanshu for Oxfam India)

Question 21

Which of the following factor is NOT categorically mentioned as one of factors contributing to rising inequality in emerging economies?

A)   Increase in global commodity prices

B)   Differences in the labour and capital market regulations

C)   Differences in governments fiscal policies and tax structures

D)   Level of informality in the economy

Correct Option: A

Question 22

Based on the passage, what might be a key reason why such data is more readily available in developed countries compared to emerging economies?

A)   Developed countries have more advanced technology for collecting tax and income data.

B)   Informal economies are less prominent in developed countries, making data easier to track.

C)   Emerging economies have more effective fiscal policies, reducing the need for detailed data.

D)   Developed countries focus more on poverty rather than inequality, making tax data irrelevant.

Correct Option: B

Question 23

According to the passage, emerging economies like India were given less attention from global inequality discussions mainly because:

A)   They were considered less important for global economic trends.

B)   Reliable and comparable long-term data were lacking

C)   International agencies focused only on social inequality, not economic inequality.

D)   Policy restrictions in developing countries prevent data collection and sharing.

Correct Option: B

Question 24

What does the author imply about the common perception of inequality in a rapidly growing economy like India?

A)   It is viewed as a sign of failure in fiscal policy and tax structures.

B)   It is generally ignored because poverty has already been reduced.

C)   It is often rationalized as an unavoidable part of the growth process.

D)   It is considered more serious than unemployment or inflation.

Correct Option: C

Question 25

The passage suggests that earlier studies and policies in India focused more on **poverty** than on **inequality**. What consequence does the author hint at because of this focus?

A)   The needs of the wealthiest groups have been neglected.

B)   Economic growth has slowed down due to lack of strict tax regulations.

C)   Disparities in access to essential public services have remained underexplored.

D)   Poverty rates were overestimated in official statistics.

Correct Option: C

Social Sciences, Cognitive Sciences and Education

Question 26

Which of the following is a key objective of the NIPUN Bharat Mission launched by the Ministry of Education?

A) Improving foundational literacy and numeracy for holistic development of children by the end of Grade 8, by 2026–27.

B) Teacher Capacity Building for advanced mathematics curricula by 2026-27.

C) Improving foundational literacy and numeracy by the end of Grade 3 (by age 8), by 2026–27

D) Enhancing interest in mathematics and technology education of children in the age group of 10-12.

Correct Option: C

Question 27

The introduction of the Common University Entrance Test (CUET) sparked significant national debates primarily because it:

A) Replaced existing internal assessment systems for admissions

B) Standardized entry processes, raising concerns regarding equity and access

C) Designed exclusively for admissions to research-oriented institutions

D) Assessed only language proficiency without evaluating broader academic competencies

Correct Option: B

Question 28

How do experiments typically interact with theoretical models in the process of knowledge construction in science?

A) Experiments aim to dismantle theoretical models to build new ones.

B) Experiments confirm theoretical models as absolute truths.

C) Experiments act as the arbiter of theoretical models.

D) Experiments and theoretical models operate independently, rarely intersecting.

Correct Option: C

Question 29

During a research methodology seminar, students are encouraged to design their own investigations, defend their methodological choices, and critically evaluate evidence to support their conclusions. This practice primarily reflects:

A) The learner's active capacity to construct, evaluate, and justify knowledge claims.
B) The instructor's formal role in directing student-centric classroom knowledge production.
C) The institutional mechanisms that regulate curricular design and assessment norms.
D) The student-centric processes used to grade or moderate individual research outputs.

Correct Option: A

Question 30

In many schools, students from certain socio-cultural backgrounds perform better not only because of resources at home but because their families expose them to language, values, and habits that closely match what the school stakeholders expect. This situation best represents:

A) Differences in inherited intellectual ability across social groups.
B) Equal learning opportunities provided in formal school setting.
C) Standardization of curriculum leading to the uniform student outcomes.
D) Transmission of cultural advantages that sustain social inequalities.

Correct Option: D

Question 31

The key criterion that distinguishes scientific theories from non-scientific ones, according to the Philosopher Karl Popper, is that they

A) Are supported by a large body of empirical evidence.

B) Are widely accepted by the scientific community.

C) Make predictions that can be tested and potentially falsified.

D) Provide a comprehensive explanation for all observed phenomena.

Correct Option: C

Question 32

In the year 2026, science will celebrate a major milestone - the 100 th anniversary of a groundbreaking idea that changed our understanding of the atomic world. Which event is being commemorated?

A) Einstein's theory of relativity   B) Discovery of X rays

C) Dirac's quantum field theory   D) Schrödinger's wave mechanics

Correct Option: D

Question 33

The results of the National Achievement Survey (NAS) are frequently reported in newspapers to indicate:

A)   The overall quality and adequacy of science laboratories (and related infrastructure) in colleges across regions

B)   Patterns in students' achievements and teachers' recruitment and within different education systems

C)   Students' learning outcomes and achievement levels across various school grades and subjects.

D)   Trends in dropout rates specifically observed in private educational institutions

Correct Option: C

Question 34

Which psychologist is associated with the idea that behavior is primarily shaped by environmental stimuli and reinforcement?

A)   Jean Piaget   B) Lev Vygotsky

C)   Sigmund Freud   D) Burrhus F. Skinner

Correct Option: D

Question 35

Which of the following is NOT a guiding principle of the Right to Education (RTE) Act, 2009?

A)   Free and compulsory education for ages 6–14.

B)   No detention and no board examination till Grade 8.

C)   Neighbourhood schooling.

D)   Specific funds per student per year earmarked for innovative teaching-learning materials.

Correct Option: D

Question 36

When children begin to reason logically about tangible objects and familiar situations, yet struggle to deal with abstract or hypothetical ideas, their thinking reflects:

A)   Egocentric reasoning focused mainly on their own perspective

B)   Logical thought that is limited to concrete and observable experiences

C)   The ability to engage in abstract and hypothetical reasoning

D)   Rapid linguistic development in vocabulary and syntax

Correct Option: B

Question 37

According to Bruno Latour, what is a key factor influencing the construction of knowledge in science?

A)   Objective observation and empirical evidence alone.

B)   The influence of social networks and negotiations among scientists.

C)   The application of a universal scientific method.

D)   Pure logical reasoning detached from social and material contexts

Correct Option: B

Question 38

During a problem-solving activity, a student pauses midway to reflect on whether the strategy they are using is effective and decides to adjust it for better results. In cognitive science, this reflective process is best described as:

A) Recalling information from previous learning experiences

B) Thinking about and regulating one's own thinking processes

C) Applying logical steps/protocol to reach a definite conclusion

D) Using language skills to articulate understanding of a task

Correct Option: B

Question 39

Critiques of India's expanding "coaching/tuition industry" highlight which of the following structural concerns in education?

(1) Commodification of learning and inequitable access to opportunity

(2) Diminishing value of school-based learning

(3) Enhanced student agency through competitive preparation

A) (1) only	B) (1) and (2) only
C) (2) and (3) only	D) All (1), (2), and (3)

Correct Option: B

Question 40

After the COVID-19 pandemic, major educational concerns frequently highlighted in media reports was:

(1) Overcrowding of classrooms due to rapid student re-enrolment

(2) Widening digital divide and significant learning loss among disadvantaged students

(3) Teachers' reduced workload during work-from-home / online teaching

(4) Growth in the in-person collaboration within schools and academic institutions

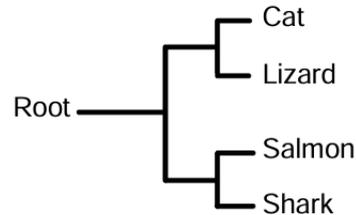(5) Students' advancement to higher grades despite dismal learning outcomes

A) (2) only	B) (2) and (5) only
C) (1) and (3)	D) (1), (3) and (5)

Correct Option: B

Biology

Question 41:

Two students have interpreted the following phylogenetic tree differently:

Student 1: "Lizards are evolutionarily closer to Salmon than Shark."
Student 2: "Cats and lizards share a common ancestor that was neither cat nor lizard."

Pick the statement that describes the data above.

A)   Student 1 is correct because salmon appears near lizard on the phylogenetic tree.

B)   Student 2 is correct as there is an ancestor common to cat and lizard.

C)   Both are correct since rotation at nodes changes the topology of the phylogenetic tree.

D)   Neither is correct because phylogenetic trees show only genetic distance, not ancestry.

Correct Option: B

Question 42:

A researcher measured oxygen consumption of two marine animals across a range of water temperatures. The data are summarized in the four graphs as shown below. Based on the patterns observed, which combination of graphs would represent a dolphin and a shark, respectively?
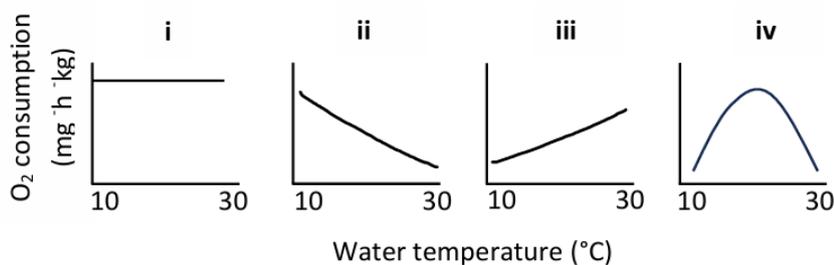
A) ii and i   B) ii and iii   C) i and iii   D) i and iv

Correct Option: C

Question 43:

Which of the following statements about a mango and a pine tree are correct? Choose the option with all correct statements.

1) In both mango and pine trunks, the order from the periphery to center is: protective tissue → phloem → cambium → xylem → pith.
2) Mango trunk shows vessels in its secondary xylem, whereas pine trunk contains only tracheids.
3) The vascular cambium of mango forms both secondary xylem and phloem, while in pine it forms only secondary xylem.
4) Annual rings are formed in both mango and pine, but more distinct in pine due to marked seasonal activity of cambium.

A)   (1), (2) only   B)   (2), (4) only

C)   (1), (2), and (4)   D)   (1), (2), and (3)

Correct Option: C

Question 44:

A graph of amount of DNA over time in an actively dividing cell is shown below. Which phases of the cycle are represented by W, X, Y and Z respectively?
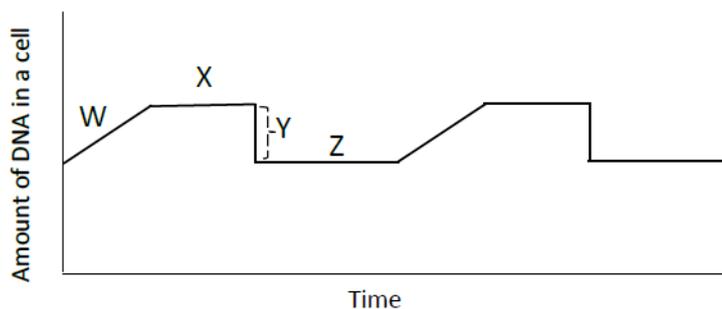
A)   S, M, G0, G1   B)   M, G1, S, G2

C)   S, G2, M, G1   D)   G1, S, G2, M
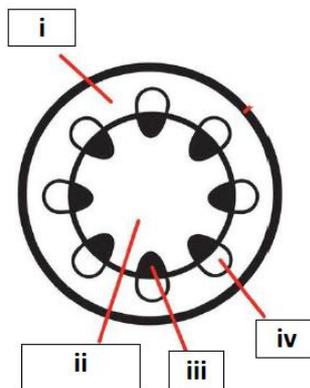
Correct Option: C

Question 45:

Fresh water fish live in hypotonic environments where the water potential of the surrounding habitat is always higher than the cellular water potential of the fish. To maintain osmotic balance of water and salts inside the body, the osmoregulatory system of the fish generates _____ amounts of _____ urine compared to its body fluids. Choose the correct combination to fill in the respective blanks from the given options.

A) small, dilute

B) large, concentrated

C) small, concentrated

D) large, dilute

Correct Option: D

Question 46:

The schematic shows the transverse section of a dicot stem obtained from a shrub. An equal mass of tissue was isolated from the four different regions shown (i, ii, iii and iv), and nucleic acids were extracted from each using the same extraction process.

Which of the marked regions will give lowest yield of nucleic acids?

A) (i)   B) (ii)   C) (iii)   D) (iv)

Correct Option: C

Question 47:

Details of a few features (P, Q, R and S) for *E. coli* cells and cells from garlic root are listed in the table. The symbol '+' in the table indicates presence or yes, and the symbol '-' indicates absence or no.

Feature	*E. coli*	Cells from garlic root
P	Single	Multiple
Q	−	+
R	−	+
S	+	+

P, Q, R and S respectively could indicate:

A)   Vacuole; Cell wall; Ribosomes; Endoplasmic reticulum

B)   Endoplasmic reticulum; Ribosomes; Vacuole; membrane bound organelles

C)   Number of DNA molecules; can be viewed using compound microscope; histones; membrane bound organelles

D)   Number of DNA molecules; membrane bound organelles; histones; can be viewed using compound microscope

Correct Option: D

Question 48:

A biologist wants to test whether a group of fly larvae will avoid an attractive odour X after it is repeatedly paired with a mild heat stimulus. She exposes Group I to odour X + mild heat, Group II to odour X alone and Group III to mild heat alone. After training, she tests whether each group avoids odour X when no heat is present. Group I shows avoidance behaviour while Group II and Group III do not. What best explains the results of this experiment?

A) Associative learning   B) Habituation

C) Reflex action   D) Sensitisation

Correct Option: A

Question 49:

A plant geneticist was trying to replicate Mendel's crossing experiments using pea plants. She carried out crossing with plants having homozygous round seeds with plants having homozygous wrinkled seeds.

When the F1 plants were allowed to self-fertilize, she observed that 5474 progeny plants had round seeds and 1850 plants had wrinkled seeds in the F2 generation. Which of the following ratios could represent the genotypic ratio of the F2 plants?

A)   5474: 1850   B)   925: 5474: 925

C)   3662: 3662   D)   1825: 3649:1850

Correct Option: D

Question 50:

A couple has a son who is detected with the bleeding disorder, hemophilia which is an X-linked recessive trait. A list of individuals biologically related to the son are listed below.
(i)   Maternal grandmother
(ii)   Maternal grandfather
(iii)   Paternal grandmother
(iv)   Paternal grandfather

It is possible that the son could have inherited the allele/s for hemophilia from:

A) Only (i)   B) (i) and (iii)   C) (i) and (ii)   D) (ii) and (iv)

Correct Option: C

Chemistry

Question 51:

When a rubber band is stretched, it feels warm and when it is released, it feels cool. Which of the following set of signs for thermodynamic quantities— change in enthalpy, Gibbs free energy and entropy (ΔH, ΔG, ΔS), correctly describes the stretching process?

A) $\Delta H = +$, $\Delta G = -$, $\Delta S = +$

B) $\Delta H = -$, $\Delta G = +$, $\Delta S = -$

C) $\Delta H = +$, $\Delta G = +$, $\Delta S = -$

D) $\Delta H = -$, $\Delta G = -$, $\Delta S = +$

Correct Option: B

Question 52:

A solution is prepared by mixing 400 mL of 0.6 M acetic acid and 600 mL of 0.4 M NaOH. What will be the approximate final pH of the solution. K_a (acetic acid) $= 1.8 \times 10^{-5}$.

A) 7.0   B) 7.7   C) 9.1   D) 11.7

Correct Option: C

Question 53:

When a small amount of table salt (NaCl) is sprinkled into a blue Bunsen burner flame, the flame turns bright yellow. Neutral excited sodium atoms (Na) emit 589 nm light when they relax, while excited sodium ions (Na^+) emit 37.2 nm light upon relaxation. Ionization energy (Na) = 5.14 eV & electron affinity (Cl) = 3.62 eV. 1 eV ≡ 1240 nm.

The statement which best explains the origin of the yellow flame observed is:

A)   The yellow colour appears because Na^+ ions absorb some of the blue light from the flame, so the remaining light looks yellow to our eyes.

B)   The yellow colour appears because Na atoms are formed which absorb some of the blue light from the flame, so the remaining light looks yellow to our eyes.

C)   The yellow colour appears from neutral excited Na atoms formed after transfer between Cl^- and Na^+, and absorbing thermal energy from the same.

D)   The yellow emission occurs when Na atoms are formed from electron transfer between Cl^- and Na^+. This electron transfer process releases yellow light.

Correct Option: D

Question 54:

During a titration of 20 mL of ~0.1 M HCl with standardized 0.1 M NaOH, some drops of the base splashed onto the wall of the conical flask. To wash them down, a student adds 10 mL of distilled water to the flask before continuing the titration. The volume of NaOH solution required to reach the endpoint will

A) Decrease because rinsing brings NaOH from the flask walls into the solution, so part of the acid gets neutralized by that NaOH without needing additional burette volume.

B) Decrease, because the HCl solution is diluted by the addition of water.

C) Increase, mainly because water is also a weak acid.

D) Remain the same, because water is the solvent used in the titration.

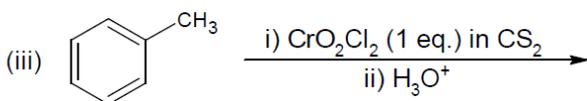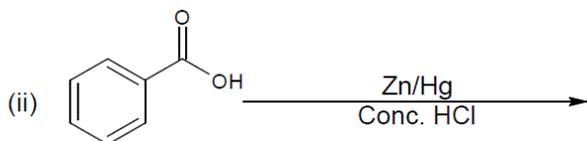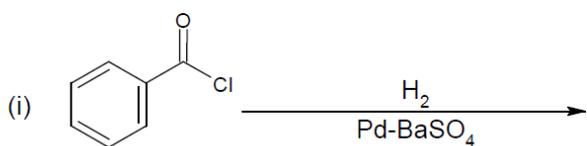**Correct Option: D**

Question 55:

During a lab experiment, a 500 mL bottle containing concentrated sulfuric acid slips from your hand and shatters on the floor. The step that will ensure safety and minimize damage to things and the people around is:

A) Pour NaOH solution over the spill to neutralize it quickly.

B) Wipe it up fast with paper towels or tissues to prevent more spreading.

C) Flood the area with a lot of water immediately to dilute the acid.

D) Add solid sodium bicarbonate, and wait for some time before cleaning.

Correct Option: D

Question 56:

Which of the following reaction(s) will not produce benzaldehyde?

(i) [structure: benzoyl chloride] $\xrightarrow[\text{Pd-BaSO}_4]{\text{H}_2}$

(ii) [structure: benzoic acid] $\xrightarrow[\text{Conc. HCl}]{\text{Zn/Hg}}$

(iii) [structure: toluene with CH₃] $\xrightarrow[\text{ii) H}_3\text{O}^+]{\text{i) CrO}_2\text{Cl}_2 \text{ (1 eq.) in CS}_2}$

(iv) [structure: benzene] $\xrightarrow[\text{HCl, anhydrous AlCl}_3]{\text{CO}}$

A) (i) and (iv)   B) (ii) and (iii)   C) (ii) only   D) (i) and (iii)

Correct Option: C

Question 57:

Thin Layer Chromatography is a technique for checking the purity of products in organic synthesis. The technique consists of running the reaction mixture using a solvent as an eluent and looking for developed spots under UV light. The **incorrect** statement regarding the technique is –

A) It can be adopted for both colored and colorless aromatic compounds.

B) It can be used to monitor the progress of a reaction even when the reaction is not complete.

C) If a non-polar solvent is used as an eluent and the product has low polarity, it will travel a long distance on the plate.

D) If a polar solvent is used as an eluent and the product has low polarity, it will travel a short distance on the plate.

Correct Option: D

Question 58:

The Lewis structure of the imine derivative of acetamide, known as formamidinium ion is shown below. The geometries of connecting atoms around the two nitrogens at **P** and **Q**, respectively, are
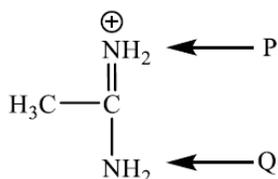
A) trigonal pyramidal (P) and trigonal pyramidal (Q)

B) trigonal planar (P) and trigonal planar (Q)

C) trigonal planar (P) and trigonal pyramidal (Q)

D) trigonal pyramidal (P) and trigonal planar (Q)

Correct Option: B

Question 59:

Two blue colored salts of copper, $CuSO_4.5H_2O$ and $CuCl_2.2H_2O$ were lying on a table in the chemistry lab. To identify the salts, Suhana performed the following qualitative analysis for each salt separately.

(i)   Dissolved in water and added concentrated ammonia solution

(ii)   Added aqueous solution of NaOH

(iii) Added dilute aqueous solution of $Pb(NO_3)_2$

(iv) Heated the salts in crucible and observe changes in color.

The most appropriate tests which will help to differentiate between the two salts is/are-

A) (i) only   B) (ii) and (iv)   C) (iii) and (iv)   D) iii only

Correct Option: C

Question 60:

Two alkyl bromides, **Y**: CH₃CH₂CH₂Br and **Z**: (CH₃)₂CHCH₂Br, are treated separately with aqueous KOH and alcoholic KOH. Both give substitution products with aqueous KOH. But with alcoholic KOH, **Z** gives much more alkene compared to **Y**. What is the best explanation for this difference?

A) Compound **Z** forms a more stable carbocation intermediate, favouring elimination.

B) The β-hydrogen in **Z** is more accessible for elimination due to branching.

C) Compound **Y** undergoes intramolecular substitution rather than elimination.

D) Compound **Z** gives alkene because branched substrates always prefer E1 over E2.

Correct Option: A

Mathematics

Question 61:

If $\log_8 a + \log_4 b^2 = 5$ and $\log_8 b + \log_4 a^2 = 7$ then $a + b$ is

A) 64   B) 68   C) 72   D) 80

Correct Option: C

Question 62:

The plane passing through the points $(2,1,1)$ and $(3,2,2)$, and parallel to the line $\dfrac{x-2}{1} = \dfrac{y+1}{2} = \dfrac{z-0}{3}$ also passes through the point(s):

I. $(1,0,0)$
II. $(3,1,0)$
III. $(0,0,0)$
IV. $(1,2,4)$

A) I and II   B) I, II, and IV   C) Only I   D) I, II, and III

Correct Option: B

Question 63:

Let $A = \{2,4,6,8,10\}$ and $B = \{1,3,5,7,9,11,13\}$. Find the total number of one-one maps $f : A \longrightarrow B$ such that $f(2) + f(4) = 16$.

A) 180   B) 90   C) 360   D) 45

Correct Option: C

Question 64:

For any two sets S and T, $S\Delta T$ is defined as $(S \cup T) \setminus (S \cap T)$. Let A, B and C be sets such that $A \cap B \cap C = \phi$, and the number of elements in each of $A\Delta B$, $B\Delta C$ and $C\Delta A$ equals 100. Then the number of elements in $A \cup B \cup C$ equals

A) 150   B) 300   C) 230   D) 210

Correct Option: A

Question 65:

There are n professors in a university. Most of them are very studious, and they like to own lots of books. Now the following facts about this group of professors have been learnt.

• No two professors own exactly the same number of books.
• Each professor owns strictly less than n books.
• No professor has exactly 200 books.

Given the above information, which of the following is **NOT** a possible value of n?

A) 100   B) 199   C) 200   D) 201

Correct Option: D

Question 66:

Narmada chose a 4-digit number n. She wrote down all the divisors of n and realised that one of them was 323. Which of the following will definitely **NOT** be a divisor of n?

A) 340   B) 361   C) 513   D) 527

Correct Option: D

Question 67:

Four distinct vertices of a regular hexagon are chosen at random. The probability that the convex quadrilateral formed by these four vertices has equal diagonals is

A) $\dfrac{2}{5}$ B) $\dfrac{8}{15}$ C) $\dfrac{3}{5}$ D) $\dfrac{2}{3}$

Correct Option: C

Question 68:

Let A be the set of positive integers that have no prime factors other than 2, 3, or 5. The infinite sum

$$\frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{8} + \frac{1}{9} + \frac{1}{10} + \frac{1}{12} + \frac{1}{15} + \frac{1}{16} + \frac{1}{18} + \frac{1}{20} + \cdots$$

of the reciprocals of the elements of A can be expressed as $\dfrac{m}{n}$, where m and n are relatively prime positive integers. The value of $m + n$ is

A) 17   B) 19   C) 23   D) 36

Correct Option: B

Question 69:

Let f be a polynomial of degree $n \geq 3$ all of whose roots are non-positive real numbers. Suppose that $f(1) = 1$. What is the maximum possible value of $f'(1)$?

A) 1

B) n

C) $n + 1$

D) $\dfrac{n(n+1)}{2}$

Correct Option: B

Question 70:

Let ABC be a triangle with $\angle ACB = 90°$. A square $DEFG$ is inscribed in this triangle such that the points D and E lie on the hypotenuse AB with D between A and E. If $AD = 3$ and $BE = 5$ then the perimeter of $DEFG$

A) Lies between 12 and 16.

B) Lies between 11 and 15.

C) Is an irrational number.

D) Cannot be determined from the given information.

Correct Option: A and C

Physics

Question 71:

In an experiment to determine the linear attenuation coefficient μ for 1 MeV γ-rays in lead, the relation

$$\mu = \frac{1}{x} \ln\left(\frac{I_0}{I}\right)$$

is used. Here I_0 and I are the counting rates of the γ-ray detector without and with the absorber of thickness x, respectively.

A student collects the following data:

Quantity	Measured value	Relative (percentage) uncertainty
I_0	5000 counts s^{-1}	1%
I	2000 counts s^{-1}	1%
x	10.00 mm	0.2%

Which of the following statements most accurately identifies the dominant source of uncertainty in μ and the reasoning behind it?

a) The uncertainty in x dominates because μ is inversely proportional to x; even a small uncertainty in x propagates directly into μ.

b) The uncertainties in I_0 and I dominate because μ depends on their logarithmic ratio.

c) The uncertainties in I_0 and I do not matter since we use only the ratio of these quantities.

d) The uncertainty in μ is very small because the logarithmic function suppresses uncertainties in both intensities.

Correct Option: B

Question 72:

An ideal gas of volume V_0 at pressure P_0 is compressed isothermally to a certain volume. It is then expanded adiabatically to the original volume V_0. The final pressure is P_1. Choose the correct statement.

A) $P_1 = P_0$

B) $P_1 > P_0$

C) $P_1 < P_0$

D) Whether P_1 is higher or lower than P_0 depends on the specific heat of the gas.

Correct Option: C

Question 73:

A bulb is fixed to the ceiling of a large hall of dimensions length $= 20$ft, breadth $= 10$ft and height $= 10$ft. The luminous intensity of the lamp is $I = 100$ cd and hence the luminous flux is 1256 lm. Then the total luminous flux falling on all the walls and the floor of the room is

A) 628 lm   B) 1256 lm

C) 942 lm   D) Cannot be determined based on the given data

Correct Option: A

Question 74:

A planet has 4 times the mass of the Earth and a radius 16 times that of the Earth. What is the

escape velocity from the planet?

A) The escape velocity from the planet is double as that of Earth.

B) The escape velocity from the planet is half that of Earth.

C) The escape velocity from the planet is 4 times as that of Earth.

D) The escape velocity from the planet is 16 times as that of Earth

Correct Option: B

Question 75:

Consider a simple pendulum oscillating around the mean position O. Which of the following statements is true regarding the tension T acting on the bob and its weight mg, at the mean position?

A) $T = mg$

B) $T > mg$

C) $T < mg$

D) Whether T is higher, equal or lower than mg depends on the value of m.

Correct Option: B

Question 76:

In a hypothetical experiment, 64 drops of same size are charged at 220 V each. They combine

to form a single bigger drop. Calculate the potential of the bigger drop.

A) 220 V   B) 1760 V   C) 3520 V   D) 14080 V

Correct Option: C

Question 77:

Consider a proton with de-Broglie wavelength λ_1 and a photon with wavelength λ_2. If the kinetic energy of the proton is equal to the energy of the photon E, then the ratio of the wavelengths $\dfrac{\lambda_1}{\lambda_2}$ is proportional to

A) E^{-1} B) E^{-2} C) E^0 D) $E^{1/2}$

Correct Option: D

Question 78:

Astronomers have discovered a planet orbiting a nearby star. It is estimated that the mass of this planet is 4 times that of our earth and its density is half of the earth's density. Assume that planets are spheres of uniform density. If your weight on the earth is 500 N, then your weight on this planet would be

A) 250 N   B) 500 N   C) 1000 N   D) 2000 N

**Correct Option: B**

Question 79:

A 1 mm tall object is placed upright on the axis of a thin convex lens having focal length of 20 cm. How far away from the lens must the object be placed so that the image is 4 mm in length?

A) Only 15 cm.   B) Only 25 cm.

C) Either 15 cm or 25 cm.   D) Either 26.67 cm or 16 cm.

Correct Option: C

Question 80:

A 6 V battery (of internal resistance 2 Ω) is connected across a 10 Ω resistor and a switch in series, as shown.
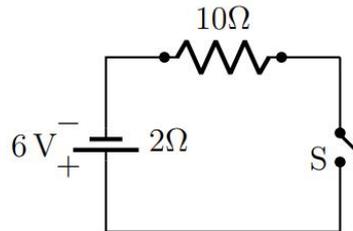
If the switch is kept in the off position, as shown in the figure, then

A) The voltage difference across the resistor is 6V and that across the switch is zero.

B) The voltage difference across the resistor is zero and that across the switch is 6V.

C) The voltage difference across the resistor is 5V and that across the switch is zero.

D) The voltage difference across the resistor is 5V and that across the switch is 1V.

Correct Option: B

Section II
Critical reasoning

Question 81:

Describe briefly any research topic of your interest in science education, OR mathematics education, OR technology education. (Provide arguments for why that research is important, and outline the possible educational outcomes of the research you have described.) Please stick to a word limit of **approximately 300 words**.

Question 82:

Write a short essay (**approximately 250 words each**) on **any ONE** of the following three themes/question/issue in science education. Present your reasoning when possible. Mention your essay title / number from the list at the start.

1) Are 'word-problems' needed in the learning of mathematics?
2) Should students learn about topics like 'Fires in Amazon basin', 'Arctic sea ice levels' in Indian science classrooms?
3) What are some inclusive practices in science classes which you have noticed/read about?

Question 83:

Write a short essay (**approximately 250 words each**) on **any ONE** of the following three topics. Present your reasoning when possible. Mention your essay title / number from the list at the start.

1) *'All models are wrong, but some are useful.'* What does this quote mean in the context of knowledge construction in science?
2) Should students be allowed to use generative AI (eg. chatGPT) in schools/colleges?
3) Should High-school Teacher Education curricula consider teachers' role in preparing students for competitive entrance exams?