HINTS & SOLUTION

1. *b*) The word "briskly" describes how she walked. Since adverbs modify verbs, adjectives, or other adverbs by giving information about manner, place, time, frequency, or degree, and "briskly" describes the manner of walking, it is an adverb.

2. *a*) A demonstrative pronoun points to a specific object or thing and takes the place of a noun. In this sentence, "this" is used to refer to a particular object without directly naming it, making it a demonstrative pronoun.

3. *a*) As a conjunction, "since" connects two clauses (e.g., "I have been here since you left.").
As a preposition, it refers to a point in time (e.g., "I have lived here since 2020.").
The other options do not perform both functions.

4. *b)* The word "hard" explains how the team worked. Since it modifies the verb "worked," it is an adverb of manner. Although "hard" can be an adjective in other contexts, here it clearly functions as an adverb.

5. *a*) An interjection expresses sudden emotion or feelings. "Alas!" conveys sorrow in this sentence, which classifies it as an interjection. Other options represent different parts of speech (preposition, conjunction, and adverb).

6. *b*) The passage presents a nuanced discussion highlighting both the positive impacts of AI (e.g., increased productivity and better diagnostics) and the challenges it poses (e.g., job displacement and ethical concerns). Only option (B) reflects this dual perspective accurately.

7. *c*) The passage specifically mentions that "AI-driven diagnostics assist doctors in detecting anomalies faster and with greater accuracy," clearly identifying healthcare as the sector where AI enhances precision.

8. *b*) The passage references universal basic income as a policy measure to address the potential rise in technological unemployment caused by AI. This implies that it is a proposed solution to mitigate job losses.

9. *c*) The author adopts a balanced perspective, discussing both the benefits and risks of AI. The language reflects a careful examination rather than an overly negative or positive stance, making "cautiously analytical" the most fitting description.

10. *c*) The author explicitly mentions that policymakers must "navigate a delicate path—encouraging innovation while safeguarding public welfare." This suggests that a balanced approach between fostering technological progress and ensuring social equity is the preferred solution.

11. *a*).
Correct Sentence: Many leading organizations have adopted data-driven strategies to enhance customer experience while improving operational efficiency.
Explanation:
Subject (D): "Many leading organizations" (We begin with the entity performing the action).
Verb (B): "have adopted data-driven strategies" (Action linked to the subject).
Purpose (C): "to enhance customer experience" (Explains why the strategy is adopted).
Condition (A): "while improving operational efficiency" (Additional benefit).

12. *c*). Correct Sentence: Ensuring equitable access to education remains a global challenge in underdeveloped regions despite significant technological advancements.
Explanation:
Subject (C): "Ensuring equitable access to education" (What is the sentence about?).
Verb (B): "remains a global challenge" (Describes its current status).
Place (D): "in underdeveloped regions" (Specifies where the challenge is most prevalent).
Contrast (A): "despite significant technological advancements" (Acknowledges opposing progress).

13. *b*). Correct Sentence: Adopting an agile mindset fostering innovation and collaboration is crucial for long-term success in a competitive business environment.
Explanation:
Action (D): "Adopting an agile mindset" (The main subject and activity).
Effect (A): "fostering innovation and collaboration" (What the mindset promotes).
Importance ©: "is crucial for long-term success" (Why it is essential).
Context (B): "in a competitive business environment" (Where this applies).

14. *a*). Correct Sentence: Disruptive technologies continue to emerge that redefine market dynamics across multiple industries.
Explanation:
Subject (B): "Disruptive technologies" (What is the sentence about?).
Action (C): "continue to emerge" (Ongoing occurrence).
Result (A): "that redefine market dynamics" (What they cause).
Scope (D): "across multiple industries" (Where this impact is observed).

15. *d*). Correct Sentence: Global economic growth presents both opportunities and challenges while preserving environmental sustainability in the 21st century.
Explanation:
Subject (B): "Global economic growth" (Main topic).
Action (C): "presents both opportunities and challenges" (Describes the dual impact).
Condition (A): "while preserving environmental sustainability" (A specific consideration).
Time frame (D): "in the 21st century" (When this occurs).

16. *b)* The word "intrinsically" means in an essential or inherent way, which fits the concept of particles being fundamentally connected. Other options either imply weak or temporary connections, which do not capture the nature of quantum entanglement.

17. *a*) "Evoked" means to bring forth or stimulate, which fits the context of quantum entanglement provoking intense scrutiny. The other options suggest prevention or reduction, which contradict the idea of increasing scientific interest. 18.

18. *c*) "Corroboration" means providing evidence or confirmation, which aligns with the context of experimental verification. Other options either suggest guesswork or denial, which do not match the evidence-based context.

19. *a*) "Undermined" means weakened or challenged, which fits the idea that these experiments question the classical concepts of locality and realism. The other options imply strengthening or clarifying, which is not the intended meaning.

20. *b)* "Enigmatic" means mysterious or difficult to understand, which appropriately describes the unclear mechanisms behind quantum entanglement. Other options suggest clarity or self-evidence, which contradicts the unknown nature discussed.

21. *c*) "Dissonant" means lacking harmony or being inconsistent, which fits the contradiction between the politician's statements and actions.

22. *b*) "Tenacious" means persistent and determined, which aligns with the idea of sustained inquiry over time.

23. *a*) "Esoteric" means intended for or understood by a small, specialized audience, making the work less accessible to the general public.

24. *c*) "Ubiquitous" means present or widespread everywhere, which fits the idea of widespread acceptance.

25. *b*) "Ambiguous" means open to multiple interpretations, which aligns with the diplomat's careful wording to maintain flexibility.

26. *b*) This idiom originates from a 19th-century cartoon where a curate (a clergyman) received a bad egg but, trying to be polite, claimed that parts of it were good. It refers to something that has both positive and negative aspects.

27. *a*) This phrase, originating from American slang, refers to the behavior of a catbird (a bird that sings from a high, superior perch). It means to be in a position of power or advantage.

28. *c*) This idiom refers to performers who play exaggeratedly to entertain the gallery section of a theater (usually filled with casual spectators). It means doing things merely to gain public approval rather than acting sincerely.

29. *b*) Historically, "shrift" referred to confession or absolution before execution. "Short shrift" means giving little attention or time, implying a quick dismissal without proper consideration.

30. *a*) This phrase comes from the literal act of babies cutting their teeth when they start growing them. Figuratively, it means gaining initial experience or starting to learn a skill.

31. *a*) The phrase "comprises of" is grammatically incorrect. The verb "comprise" means "consists of," so the correct form should be "The committee, which comprises experts from diverse fields." The preposition "of" is redundant.

32. *b*) When subjects are joined by "neither…nor," the verb agrees with the noun closest to it. Since "employees" is plural, the correct verb form should be "are" instead of "is." The correct sentence is: "Neither the manager nor the employees are willing…"

33. *d*) This sentence is grammatically correct. "Scarcely…when" is the correct correlative conjunction pair, and the past perfect tense "had begun" is appropriate for an action completed before another action in the past.

34. *c*) The pronoun "their" is incorrect because "each" is singular and should take a singular pronoun. The correct version is: "…submit his or her assignments on time."

35. *d)* This sentence is structurally correct. It follows the correct form of the third conditional: "Had + subject + past participle," and "would have + past participle" for hypothetical situations in the past.

36. *c*) Abstruse means difficult to understand or obscure. The word obscure also means not clear or hard to comprehend, making it the correct synonym.

37. *b*) Loquacious refers to someone who talks a lot. The correct synonym is talkative, which means fond of speaking.

38. *c*) Pernicious means causing great harm or damage, often in a gradual or subtle way. The synonym destructive also means causing harm or ruin.

39. *c*) Venerate means to regard with great respect or reverence. The closest synonym is honor, which also means to hold in high esteem.

40. *b*) Quiescent means in a state of inactivity or rest. The correct synonym is dormant, which means temporarily inactive or asleep.

41. *a*) Prolific means highly productive or fertile, especially in producing offspring or creative work. The opposite of this would be barren, which means unable to produce or infertile.

42. *a*) Obstinate refers to being stubborn and unwilling to change one's opinion or course of action. The opposite of this is flexible, which means open to change or adaptable.

43. *a*) Perfunctory means done without care, in a mechanical or superficial way. Its opposite is thorough, which means done with great care and attention to detail.

44. *a*) Abridge means to shorten or reduce in length while maintaining the main content. The opposite is expand, which means to increase in size or detail.

45. *a*) Surreptitious refers to something done secretly or stealthily. The opposite is overt, which means open and not secret.

46. *c*) M emphasizes that overturning a unanimous decision without formal consultation is "unusual" and "raises questions about transparency." This suggests that M is concerned with the board's failure to follow proper decision-making procedures.

47. *a*) "Bureaucratic inertia" refers to the slow, resistant nature of large organizations to change. N argues that maintaining rigid processes may hinder the

company's ability to adapt and remain competitive, suggesting the board wants to avoid being trapped by slow-moving bureaucracy.

48. *c*) M is concerned about the board's inconsistent decisions, which could damage credibility (institutional integrity), while N defends the need for agile responses to changing markets (organizational flexibility). This tension drives the conversation.

49. *c*) By asking N to "gauge" whether the shift is a long-term strategy or a temporary adjustment, M shows uncertainty. This implies a need to understand whether the organization should fully commit to the new direction or prepare for another reversal.

50. *b*) Both speakers are analyzing the situation carefully (reflective) while considering practical actions like preserving the original systems (pragmatic). Their careful and measured language reflects a cautious approach rather than emotional or confrontational tones.

51. *c*) Sound waves are mechanical waves requiring a medium (solid, liquid, or gas) for propagation. a. In gases and liquids, sound waves propagate as longitudinal waves due to the lack of shear strength. b. In solids, sound waves can propagate as both longitudinal and transverse waves because solids support shear stress. c. Therefore, the statement that sound waves propagate as transverse waves only in solids is incorrect.

52. *a*)

The Speed of sound in air is given by :

v = 331.5 + 0/6T (m/s)

At 0°C, v = 331.5 m/s.

At 30°C:

v = 331.5 + (0.6 x 30) = 349.5 m/s

$\left(\frac{349.5-331.5}{331.5}\right) \times 100 \approx 5.4\%$

53. *a*) When sound waves move from one medium to another:Frequency remains constant (determined by the source).Wavelength and speed change based on the properties of the new medium.The speed of sound in water is much greater than in air, leading to an increase in wavelength.

54. *c*) Sound waves travel through a medium (e.g., air) and are governed by classical physics, making the observed frequency depend on the movement of both the source and the medium. Light waves, however, follow Einstein's theory of relativity and do not require a medium, leading to a symmetrical frequency shift for both motion directions.

55. *b*)

Frequency is given by

$$f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$$

If length doubles and tension quadruples :

- Length effect : $f \propto \frac{1}{2}$
- Tension effect : $f \propto \sqrt{4} = 2$

Overall:

$f` = f \times \frac{1}{2} \times 2 = f$

Frequency remains the same.

56. *b*)

For a cylindrical conductor :

$R = p\frac{L}{A},\ A = \frac{\pi d^2}{4},$

$$\frac{R_A}{R_B} = \frac{2L}{\left(\frac{d}{2}\right)^2} \div \frac{L}{d^2} = 8$$

57. *c*) Superconductivity is a quantum mechanical phenomenon where a material exhibits zero electrical resistance below a critical temperature (Tc). Lead becomes a superconductor at approximately 7.2 K (-265.95°C). Copper and graphite do not exhibit superconductivity, and plastics are non-conductive. Superconductivity arises due to the formation of Cooper pairs, which move without scattering.

58. *b*) Anisotropic conductivity means the electrical conductivity depends on direction. Graphene, a one-atom-thick sheet of carbon arranged in a honeycomb lattice, has exceptional electrical properties and conducts better along specific axes

due to its unique band structure. Other materials listed (copper, silicon dioxide, plastic) are isotropic or have uniform conductivity in all directions.

59. *c*)

Explanation : After contact total charge = 5 – 3 = 2, μC, each sphere get q = 1, μC. Use Coulomb's Law:

$F = \frac{kq1q2}{r^2} = \frac{9 \times 10^9 \times (1 \times 10^{-6})^2}{4} = 5.625 \times 10^{-3} N$

60. *a*) The magnetic field produced by a current-carrying circular loop is governed by Ampere's circuital law and the Biot-Savart law. b. At the center, the magnetic field due to all segments of the loop adds up constructively, resulting in the maximum magnetic strength. c. As we move away from the center along the axis or outside the loop, the magnetic field strength decreases due to the inverse square law.

61. *d*)

In a freely falling lift, gravitational acceleration g becomes zero (as both the lift and pendulum experience free fall). Since $T = 2\pi\sqrt{l/g}$, when g = 0, the time period becomes infinite-meaning the pendulum stops oscillating.

62. *c*) When a car accelerates forward, the air inside the car experiences a backward force due to inertia. This means the denser air molecules are pushed toward the rear of the car.

Since helium is much less dense than air, the helium-filled balloon is buoyant in the air. As the denser air moves backward, it pushes the lighter helium balloon forward. This phenomenon occurs because the balloon moves in the direction opposite to the denser medium, similar to how a bubble rises in water.

The correct explanation aligns with option © because the lower density of helium compared to air causes the balloon to move forward in response to the pressure difference created by the accelerating car. This behavior contrasts with solid objects, which typically move backward due to inertia of rest.

63. *c*) A centrifugal pump converts mechanical energy into hydraulic energy using centrifugal force. When the pump's impeller rotates, it pushes the liquid outward due to centrifugal action. This follows Newton's Third Law—for every action (force exerted on the fluid), there is an equal and opposite reaction (fluid movement outward).

Bernoulli's Principle describes energy conservation in a fluid flow but is not the primary working principle here.

Pascal's Law relates to pressure transmission in fluids. c. Archimedes' Principle explains buoyancy, not fluid motion in pumps.

64. *c*) Mercury (Density = 13.6 g/cm³) :In a denser liquid, the buoyant force is greater, causing the hydrometer to float higher. Mercury has the highest density among the options, so the hydrometer is least submerged.

65. *b*) An ideal movable pulley has no friction or energy loss, and the load is shared by multiple rope segments. This ensures the effort required is always less than the load, making MA > 1. In a single movable pulley, MA = 2, meaning the effort is reduced by half.

66. *b*) Solar and lunar eclipses occur because celestial bodies block the Sun's light, casting shadows. This is only possible if light travels in straight lines. If light bent unpredictably, the formation of distinct umbra (dark central shadow) and penumbra (partial shadow) would not occur.

67. *c*)

When two plane mrrors are placed at a 90° angle, the number of images formed can be calculated using the formula:

$n = \frac{360A}{\emptyset}$ - 1

$For\ \emptyset = 90°$:

$n = \frac{360A}{90A} - 1 = 4 - 1 = 3$

These images form due to multiple reflections between the mirrors.

68. *b*)

When a system of two mirrors is rotated by θ the final image shifts by 2θ. If both mirrors are rotated by 15°, the image will shift by:

$2 \times 15A = 30A$

69. *c*)

Statement I – Correct

Astigmatism is caused by an irregular curvature of the cornea or lens, leading to distorted or blurred vision.

It is corrected using a cylindrical lens.

Myopia (nearsightedness) is corrected using a concave lens.

Statement II – Correct f. Rhodopsin (visual purple) in rod cells is responsible for night vision and breaks down in bright light.

Cone cells detect red, green, and blue light, allowing color vision in bright conditions.

Statement III – Incorrect

The image formed on the retina is real, inverted, and diminished—not virtual.

The blind spot is where the optic nerve exits the retina, making it insensitive to light.

Statement IV – Correct

The aqueous humor (between cornea and lens) provides nutrients and maintains intraocular pressure.

The vitreous humor (behind the lens) gives the eye its shape and helps transmit light.

Statement V – Correct

The range of vision for a normal human eye is 25 cm to infinity. p. This ability to focus on objects at various distances depends on the lens's accommodation.

70. *c*) Retroreflectors – Total Internal Reflection (TIR) a. Concept: Total Internal Reflection occurs when light moving from a denser to a rarer medium strikes the interface at an angle greater than the critical angle and reflects entirely back.

Application in Defence: Retroreflectors on military vehicles and uniforms reflect incoming light directly back toward the source, improving visibility at night. This principle is also applied in laser communication and target detection systems.

71. *b*) At high pressures (e.g., deep underwater), nitrogen dissolves into tissues and can cause nitrogen narcosis, a condition similar to intoxication. Helium, being less soluble in blood, reduces this risk.

Lighter than nitrogen, reduces breathing resistance.

This is why helium-oxygen mixtures (heliox) are preferred for deep-sea diving.

72. *c*) Water's adhesive force with glass is stronger than its cohesive force, causing it to climb the tube's walls and form a concave shape.

Mercury has a convex meniscus due to stronger cohesion.

73. *c*) Azeotropes are mixtures with constant boiling points that cannot be separated by simple distillation due to their consistent composition in liquid and vapor phases.

74. *d*)

Volume of cube =

$(0.1\ m)^3 = 0.001\ m^3$

Mass =

$p \times V = 8000 \times 0.001 = 8\ Kg$

Weight difference

$= m(g_{Jupiter} - g_{Earth})$

$= 8 \times (24.5 - 9.8) = 490\ N$

75. *b*)

Given :

- Height of mercury column at hilltop, $h_{Hg} = 63\ cm = 0.63\ m$
- Density of mercury $p_{Hg} = 13.6\ g/cm^3 = 13600\ Kg/m^3$
- Gravity at sea level, $g1 = 9.81\ m/s^2$
- Gravity at hilltop, $g2 = 9.77\ m/s^2$

Step 1: Pressure equivalence of mercury and water columns

At the hilltop, the pressure exerted by the mercury column equals the pressure exerted by the water column:

$h_{Hg} \times p_{Hg} \times g1 = hH_2O \times pH_2O \times g2$

Rearrange the formula to find hH_2O:

$hH_2O = \frac{h_{Hg} \times \rho Hg \times g1}{\rho H2O \times g2}$

Step 2 : Substituting Known values

$hH_2O = \frac{0.63 \times 13600 \times 9.81}{1000 \times 9.77}$

Step 3 : Simplifying the calculation

$hH_2O = \frac{8380.08}{977} \approx 8.67\ m$

76. *b*) Interstitial alloys are formed when small atoms (like Carbon) occupy the gaps in a metal lattice (e.g., steel).

77. *c*) Azeotropes are constant-boiling mixtures where the composition of the liquid and vapor phases is the same. This means they cannot be separated by simple distillation.

There are two types of azeotropes:

Positive azeotropes (e.g., ethanol-water) boil at a lower temperature than either component.

Negative azeotropes (e.g., HCl-water) boil at a higher temperature than either component.

Since the composition of azeotropes remains unchanged during boiling, simple distillation cannot separate them completely. Special techniques like azeotropic or extractive distillation are required.

78. *c*) Amphoteric Nature: $NaHCO_3$ acts as both an acid (releasing H^+) and a base (accepting H^+).

Resonance Stabilization: The bicarbonate ion (HCO_3^-) is stabilized by delocalization of electrons between the two oxygen atoms.

Al_2O_3 is amphoteric but lacks resonance;

Others are not amphoteric.

79. *a*) The water-gas shift reaction ($CO + H_2O \rightarrow CO_2 + H_2$) is an essential industrial process for producing hydrogen. In this process, carbon monoxide from synthesis gas reacts with steam at high temperatures (300–450°C) in the presence of an iron or chromium-based catalyst. This method is commonly used to increase hydrogen yield in large-scale applications.

80. *d*)

A: Hydrogen has three isotopes—protium (^1H), deuterium (^2H), and tritium (^3H)—with protium accounting for over 99.98% of natural hydrogen.

B: Molecular hydrogen (H_2) is diamagnetic due to paired electrons, while atomic hydrogen with an unpaired electron is paramagnetic.

C: Hydrogen forms ionic hydrides with alkali and alkaline earth metals and covalent hydrides with non-metals. d. D: Under extremely high pressures (e.g., in gas giants), hydrogen can exhibit metallic properties due to electron delocalization.

81. *c*)

A: The reduction of iron ore involves oxidation and reduction, but carbon dioxide is a product, not a by-product of a reduction reaction.

B: Photosynthesis involves both oxidation and reduction, but the main focus here is on how the process of oxidation occurs in the presence of light energy, which is incorrect as glucose is formed from reduction, not oxidation.

C: In electrolysis of water, oxidation happens at the anode (oxygen gas is released), and reduction happens at the cathode (hydrogen gas is released). This directly demonstrates the real-world application of oxidation and reduction reactions.

D: While rust formation involves oxidation, hydrogen gas is not a by-product of rusting, making this statement incorrect.

82. *d*)

Reducing Agent:

Undergoes oxidation

Causes reduction of another substance.

Oxidation involves:

Loss of electrons.

Gain of oxygen.

Loss of hydrogen.

Oxidising Agent:

Undergoes reduction

Causes oxidation of another substance.

Reduction involves:

Gain of electrons.

Loss of oxygen.

Gain of hydrogen.

83. *b*) Sulfur plays a crucial role by reducing the ignition temperature of gunpowder, allowing it to ignite more easily. It also enhances the speed of combustion by forming intermediate compounds that break down rapidly, increasing the explosive force.

84. *c*) The standard composition of black powder is:

Potassium nitrate (75%) – Oxidizer (provides oxygen)

Charcoal (15%) – Fuel (burns to release energy)

Sulfur (10%) – Reduces ignition temperature and increases reaction rate

This ratio ensures a balanced reaction where the oxygen released from KNO_3 is sufficient to burn the charcoal and sulfur efficiently.

85. *b*) Diamond is the hardest known natural material and is used in cutting, drilling, and polishing tools—not as a lubricant. Graphite is used as a lubricant due to its soft, layered structure with weak Van der Waals forces between layers.

Graphite is an excellent conductor of electricity due to the presence of delocalized π-electrons. It is widely used in electrodes for batteries and fuel cells, especially in lithium-ion batteries.

Fullerenes are spherical molecules of carbon (e.g., C_{60}) known for their hollow cage-like structure. They are used in drug delivery systems, organic photovoltaics, and superconductors, not in optical lenses. Diamond has a high refractive index and is used in specialized optical lenses.

Graphene is a single layer of carbon atoms arranged in a hexagonal lattice. It is known for high electrical conductivity, mechanical strength, and flexibility, making it ideal for electronics and advanced materials. Diamond is used as an abrasive in cutting tools due to its hardness.

86. *c*) Fullerenes (especially C_{60}) are more reactive because of their curved structure which causes strain on the carbon-carbon bonds, making them more susceptible to chemical reactions. In contrast, diamond and graphite have robust, stable structures due to sp^3 and sp^2 hybridization, respectively. Graphene also has a strong, planar sp^2 hybridized structure, contributing to its stability.

87. *d*)

Sublimation separates iodine.

Dissolution in water dissolves potassium nitrate.

Filtration separates sand.

Crystallization recovers potassium nitrate.

88. *c*) Hydrogen has three isotopes:

Protium (^1H): Most common (about 99.98%), non-radioactive.

Deuterium (^2H): Also non-radioactive, used in heavy water (D_2O).

Tritium (^3H): Radioactive with a half-life of 12.32 years. It decays by beta emission into helium-3. Tritium is used in nuclear fusion and self-luminous materials.

89. *b*) Stellite, a cobalt-based superalloy, resists wear, corrosion, and high-temperature degradation, making it ideal for turbine blades and cutting tools.

90. *b*) Oxidation refers to the loss of electrons: Fe^{2+} loses an electron to become Fe^{3+}. Reduction refers to the gain of electrons: Cr^{6+} in $K_2Cr_2O_7$ gains electrons and is reduced to Cr^{3+}.

This is a classic redox reaction where potassium dichromate acts as an oxidizing agent, and iron(II) sulfate acts as a reducing agent.

91. *b*) Hepatocytes – mitotic division e. Hepatocytes (liver cells) have the greatest regenerative capacity through mitotic division, allowing the liver to restore up to 70% of lost mass. This process is driven by growth factors like hepatocyte growth factor (HGF). f. Other options have limited regeneration: g. Neurons regenerate poorly, relying on synaptic plasticity for new connections. h. Myocytes grow via hypertrophy, not cell division. i. Cartilage heals slowly due to low chondrocyte proliferation. j. Thus, hepatocytes show the highest regenerative ability.

92. *b*) Adrenaline (epinephrine) functions as both a hormone when secreted by the adrenal medulla and a neurotransmitter in the nervous system.

93. *b*) Pellagra is caused by niacin (vitamin B3) deficiency. While dietary deficiency is a primary cause, impaired conversion of tryptophan to niacin due to vitamin B6 (pyridoxine) deficiency can also lead to pellagra. This conversion is essential because the human body synthesizes a portion of its niacin from tryptophan. Thus, a lack of vitamin B6

can hinder this process, causing persistent symptoms despite adequate dietary intake.

94. *b*) These diseases are transmitted through airborne droplets released when infected individuals cough, sneeze, or talk. a. Malaria and dengue are spread by mosquito vectors, while cholera spreads through contaminated water.

95. *a*) Blood Group O means the mother has OO genotype (she can only pass on the O allele).
Blood Group AB means the father has A and B alleles (he can pass on either the A or B allele).
When these combine:
Mother (O) = OO → Always gives O allele.
Father (AB) = A + B → Can give either A or B allele.
Possible combinations for the child:
A + O = Blood Group A
B + O = Blood Group B
The child cannot have blood group AB (needs one A and one B from parents) or O (needs two O alleles).

96. *b*) Lichens are considered composite organisms because they represent a symbiotic relationship between a fungus (mycobiont) and a photosynthetic partner, which is either algae or cyanobacteria (phycobiont). The fungus provides structure, protection, and absorbs moisture and minerals, while the algae or cyanobacteria perform photosynthesis to produce food for both partners. This mutualistic association allows lichens to survive in harsh environments, such as on rocks and tree bark, where neither organism could live alone.

97. *c*) Abiogenesis explains how life arose naturally from non-living matter through chemical evolution. Simple inorganic molecules gradually formed complex organic compounds (e.g., amino acids), eventually leading to self-replicating systems and protocells. The Miller-Urey experiment (1953) supported this by synthesizing organic molecules under early Earth-like conditions. i. Spontaneous Generation: Disproven by Pasteur, it falsely claimed life arises from non-living matter. ii. Quantum Entanglement: Explains subatomic phenomena, not biological origins. iii. Panspermia: Suggests life came from space but doesn't explain how life first began.

98. *a*) Gregor Mendel: Applied statistical analysis to describe patterns of genetic inheritance.
Robert Hooke: Discovered non-living cork cells, but Antonie van Leeuwenhoek observed living cells in pond water.
Louis Pasteur: Disproved spontaneous generation through his swan-neck flask experiment.
Alexander Fleming: Discovered penicillin, the first natural antibiotic.
Theodor Schwann: Along with Matthias Schleiden, proposed the cell theory, specifically for animals.
Watson and Crick: Identified the double-helix structure of DNA, not RNA.

99. *b*) Apomixis is a type of asexual reproduction in plants where seeds form without fertilization, producing offspring genetically identical to the parent. It bypasses meiosis and syngamy, ensuring trait stability. Examples include Citrus and Mango.

100. *a*) The correct sequence of events during human fertilization is:
Capacitation:
It is the physiological maturation process that sperm undergo in the female reproductive tract.
During capacitation, biochemical changes remove glycoproteins and cholesterol from the sperm membrane, increasing sperm motility and preparing it for fertilization.

101. (*b*)Acrosome Reaction:
After capacitation, the sperm reaches the zona pellucida (outer layer of the egg). b. The acrosome (a cap-like structure on the sperm's head) releases digestive enzymes (e.g., hyaluronidase) to break down the zona pellucida, allowing the sperm to penetrate the egg.
Sperm Penetration:
The sperm penetrates through the zona pellucida and fuses with the egg membrane.
This triggers the cortical reaction, preventing polyspermy (entry of multiple sperms).

Syngamy:
This is the fusion of the sperm nucleus with the egg nucleus, forming a zygote (a single-celled embryo with a complete set of chromosomes). • This precise sequence ensures successful fertilization and the beginning of embryonic development.

102. *b*) The Sons of Liberty was a secret organization formed in the American colonies in the 1760s to oppose British taxation policies, such as the Stamp Act of 1765. They played a crucial role in organizing protests, boycotts, and public demonstrations against British rule, helping to foster colonial unity and the movement for independence.

103. *b*) The Battle of Saratoga (1777) was a major turning point in the American Revolutionary War. The American victory convinced France to formally ally with the colonies against Britain. This alliance provided crucial military and financial support, significantly influencing the outcome of the war.

104. *c*) The Articles of Confederation (ratified in 1781) served as the first constitution of the United States. It established a weak central government with limited powers, giving most authority to the individual states. This framework was eventually replaced by the U.S. Constitution in 1789 due to its inefficiencies.

105. *c*) The Westphalian sovereignty principle emphasizes the right of nations to govern themselves without external interference. This concept is reflected in the UN Charter's commitment to non-intervention in the internal affairs of member states, reinforcing the sovereignty and territorial integrity of nations.

106. *c*) The Responsibility to Protect (R2P) doctrine was adopted by the United Nations to address the global failure to prevent atrocities such as genocide, war crimes, ethnic cleansing, and crimes against humanity. It emphasizes the international community's duty to intervene when a state cannot or will not protect its population.

107. *c*) The G4 Plan is a proposal by four nations—Brazil, Germany, India, and Japan—to expand the permanent membership of the UN Security Council. These countries advocate for reform to make the Security Council more representative of the modern global landscape and include new permanent members with veto powers.

108. *b*) The Ashok Mehta Committee (1978) recommended significant reforms to the Panchayati Raj system, including a two-tier structure and direct elections at the local level. Its recommendations laid the foundation for the 73rd Constitutional Amendment (1992), which institutionalized the Panchayati Raj system in India.

109. *c*) The People's Plan Campaign launched in Kerala in 1996 is a landmark initiative for decentralized governance. It empowered local bodies to engage in planning and decision-making, fostering grassroots democracy and enhancing public participation in developmental activities.

110. *c*) This slogan, articulated by Karl Marx in his Critique of the Gotha Program (1875), represents the core principle of communism. It envisions a society where resources and goods are distributed based on individual needs, while contributions are made according to personal ability.

111. *d*) The Comintern (Communist International) was founded in 1919 under the leadership of Vladimir Lenin to promote global communist revolution. Its first congress was held in Moscow, and it aimed to unify and direct international socialist movements. The Comintern was dissolved in 1943 under Joseph Stalin's directive to improve relations with Allied powers during World War II.

112. *c*) Yajna Sri Satakarni (2nd century CE) issued an extensive variety of lead coins, reflecting economic prosperity and maritime trade. 117.

Answer: B) The Vaisheshika school, founded by Kanada, proposed the doctrine of Anutva, describing reality as composed of indivisible atoms (paramanu).

113. *c*) Nagapattinam, located on the southeastern coast of India, became a crucial hub for the Indian Ocean trade network under the Chola Empire (9th–13th centuries CE). During the reign of the Chola dynasty, the city flourished as a major maritime center, facilitating trade between South India, Southeast Asia, and the Far East.

The Cholas, particularly under Rajaraja I and Rajendra I, expanded their naval power, using Nagapattinam as a strategic base for their naval expeditions to Sri Lanka, the Maldives, and the Srivijaya Empire (modern-day Indonesia). The port played a pivotal role in the export of Indian textiles, spices, and precious goods while fostering cultural and diplomatic exchanges across the Indian Ocean.

114. *b*) Iqtadari System (Delhi Sultanate) involved temporary grants of land revenue to military officers in exchange for administrative and defense services. This system was non-hereditary and aimed at decentralizing power.

Dahsala System (Mughal Empire) was introduced by Akbar and was a ten-year revenue assessment system where tax was calculated based on the average yield and could be paid in cash or kind.

Vishti (Gupta Empire) was a form of forced, unpaid labor imposed on peasants, often for public works or state services, reflecting a feudalistic economic structure. iv. Ryotwari System (British India) involved direct revenue collection from peasants, but it had variable assessments rather than fixed ones, making D incorrect.

115. *b*) i. Usha Mehta: Ran the clandestine Congress Radio during the Quit India Movement to spread revolutionary messages.

Aruna Asaf Ali: Defied British authority by hoisting the national flag during the 1942 Quit India Movement.

Lakshmi Sahgal: Led the Rani of Jhansi Regiment in the Indian National Army under Subhas Chandra Bose.

Kamaladevi Chattopadhyay: A social reformer who championed the cooperative movement and revived Indian handicrafts.

116. *b*) Lord Lytton conducted the first official census in 1871 but faced backlash for his laissez-faire policy during the Great Famine of 1876-78, which led to the death of millions.

117. *a*) The terracotta figurines from the Indus Valley Civilization, especially those of the "Mother Goddess," suggest a fertility cult and emphasize early religious practices.

118. *d*) Kuchipudi originated in Andhra Pradesh and blends expressive gestures (Lasya) with swift foot movements while drawing narratives from Hindu epics.

119. *a*) The Kailasa temple, carved from a single rock during the Rashtrakuta dynasty, represents the Dravidian architectural tradition in its monolithic form.

120. *c*) "Ganga-Jamuni Tehzeeb" symbolizes the harmonious blending of Hindu and Muslim cultural and artistic practices, especially in North India.

121. (*c*) Baker Island, a U.S. territory, is located just east of the IDL but observes the same calendar day as regions west of the line, effectively being nearly a day behind neighboring areas to the west.

122. (*b*) Kiritimati, part of Kiribati's Line Islands, is located just west of the International Date Line due to its 1995 adjustment, making it among the first places to experience the New Year.

123. (*b*) On December 29, 2011, Samoa shifted from UTC−11 to UTC+13, effectively moving the country to the west side of the IDL to align its weekdays with major trading partners like Australia and New Zealand.

124. *b*) The International Date Line generally follows the 180° longitude but deviates to avoid dividing territories. It crosses the Bering Strait between Russia and Alaska, bends westward around the Aleutian Islands to keep them aligned with Alaska's time zone, and shifts eastward significantly to include parts of Kiribati and the Chatham Islands.

125. *a*)
Statement 1: Correct – Pyroclastic flows are fast-moving, superheated clouds of gas and volcanic matter that pose extreme hazards.
Statement 2: Correct – Shield volcanoes, like those in Hawaii, emit low-viscosity basaltic lava, resulting in broad, gently sloping structures.
Statement 3: Correct – Volcanic eruptions release sulfur dioxide (SO_2), which forms sulfate aerosols, cooling the atmosphere by reflecting sunlight.
Statement 4: Incorrect – Volcanic arcs form at convergent boundaries where one tectonic plate subducts beneath another, not at divergent boundaries.

126. *b*) a. Statement 1: Incorrect – While pillow lava is common at mid-ocean ridges due to rapid cooling underwater, it can also form in submarine volcanic settings beyond ridges.
Statement 2: Correct – Early Earth's atmosphere was enriched by volcanic outgassing, releasing gases like CO_2, H_2O vapor, and nitrogen.
Statement 3: Correct – Hotspot volcanoes (e.g., the Hawaiian Islands) form away from tectonic boundaries due to mantle plumes.
Statement 4: Correct – Lahars are dangerous mudflows that occur when volcanic ash mixes with water, either from rain or melting ice during an eruption.

127. *b*) The Tonga-Kermadec Trench holds the record for the deepest earthquakes, occurring at depths of up to 700 km. This region is part of the Pacific Ring of Fire, where the Pacific Plate subducts beneath the Indo-Australian Plate. At these extreme depths, earthquakes are caused by metamorphic phase changes and dehydration reactions within the subducting slab, rather than frictional slip, which is typical for shallow and intermediate-depth quakes.

128. *c*) The New Madrid Seismic Zone in the central United States is a rare example of an intraplate seismic zone, where earthquakes occur far from tectonic boundaries. This region experienced some of the most powerful earthquakes in U.S. history (1811-1812). The seismicity is caused by relict faults and crustal stress from the gradual movement of the North American Plate. Unlike plate boundary zones, intraplate earthquakes are less predictable and often result from long-term lithospheric deformation.

129. *a*) Statement 1: The Siberian Taiga is indeed the largest stretch of coniferous forest globally.
Statement 2: The Atacama Desert, located in South America, is recognized as the driest desert on Earth.
Statement 3: The Sahel region serves as a semi-arid transition zone between the Sahara Desert and the savanna.
Statement 4: The Great Victoria Desert is located in Australia, not Southern Africa.

130. *a*) The typical latitudinal sequence from the equator to the poles is:
Tropical Rainforest: Equatorial regions with high rainfall.
Savanna: Tropical grasslands with seasonal rainfall.
Temperate Grassland: Mid-latitude regions with moderate rainfall.
Taiga: Boreal coniferous forests in higher latitudes.
Tundra: Polar regions with permafrost and minimal vegetation.

131. *c)*
Tropical Rainforest: Dominated by Oxisols and Ultisols, not Podzols or Chernozems.
Temperate Grasslands: Characterized by Mollisols (deep, fertile soils) and Chernozems in certain regions.
Mediterranean Region: Typically associated with Alfisols, not Aridisols.
Tundra: Features Gelisols (soils with permafrost), not Oxisols or Spodosols.

132. *d*) The California Coastal Region falls within the Mediterranean climatic zone, characterized by hot, dry summers and mild, wet winters. Similar regions include parts of Southern Europe, Southwestern Australia, Central Chile, and South Africa's Cape Region, all located on the western margins of continents between 30° and 40° latitudes.

133. *b*) The Coriolis effect, caused by Earth's rotation, deflects ocean currents to the right in the Northern Hemisphere and to the left In the Southern Hemisphere. This phenomenon is a key factor in determining the movement of major oceanic gyres.

134. *c*) The Kuroshio Current is a warm western boundary current of the North Pacific Ocean, transporting warm tropical waters northward toward Japan, despite its movement into higher latitudes.

135. *c*) Semi-diurnal tides—two high and two low tides each day—are caused by the gravitational pull of the Moon and Sun combined with Earth's rotation. The alignment of these celestial bodies creates regular tidal bulges.

136. *b*) Thermohaline circulation refers to the "global conveyor belt" where ocean currents are driven by variations in temperature (thermal) and salinity (haline). This system regulates global climate by distributing heat across the planet.

137. (*a*) The second-generation issues of the Green Revolution include soil degradation, declining groundwater, and pest resistance due to the overuse of fertilizers and pesticides in regions like Punjab and Haryana.

138. (*b*) The northwestern plains (Punjab, Haryana) rely on winter rainfall from Western Disturbances, which provides essential moisture for Rabi crops like wheat, along with fertile loamy soils.

139. (*b*) ACRP aims to align agricultural practices with region-specific climatic and ecological conditions, optimizing resource use and promoting sustainable agriculture in India's 15 identified agro-climatic regions.

140. (*c*) Vertical integration in agriculture connects producers with processors and retailers, enhancing efficiency by reducing intermediary costs and ensuring better market access through direct procurement and contract farming.

141. (*b*) A : Rabindranath Tagore was the first Asian to win a Nobel Prize (Literature, 1913). C: Kailash Satyarthi shared the Nobel Peace Prize (2014) with Malala Yousafzai for their struggle against child labor and for children's rights.
D: Venkatraman Ramakrishnan won the Nobel Prize in Chemistry (2009) for his research on ribosome structure.
Why the others are incorrect:
B: Har Gobind Khorana won the Nobel Prize in Physiology or Medicine (1968), not Physics.
E: Subrahmanyan Chandrasekhar won the Nobel Prize in Physics (1983) for his work on stellar evolution, not black holes.
F: Amartya Sen (1998) also won the Nobel Prize in Economics, making Abhijit Banerjee (2019) not the only Indian recipient.

142. (*a*) Operation Dost – Earthquake relief in Turkey and Syria.
Operation Kaveri – Evacuation of Indians from war-torn Sudan.
Operation Ajay – Evacuation of Indians during the Israel-Hamas conflict.
Operation Devi Shakti – Rescue of Indians from Taliban-occupied Afghanistan.

143. (*b*) Correct: India ranked 118th in the World Happiness Report 2025.
Correct: India holds the 180th position in the Environmental Performance Index 2025.
Incorrect: India is 3rd, not 2nd, in the Global Unicorn Index 2025.
Correct: India is positioned 151st in the World Press Freedom Index 2025.

144. *a*) Al-Nagah is a join military exercise between India and Oman. Jimex is between India and Japan. Samudra Shakti is between India and Thailand.

145. *c*) Authored by R. Ramachandran, this book traces India's nuclear advancements from the first test in 1974 to modern developments, offering policy insights relevant for Science & Technology and Defense Studies. k.

146. *d*) Hwasong-18: North Korea's advanced ICBM (Intercontinental Ballistic Missile).Noor-3: Iran's military imaging satellite. Spike Missiles: Imported by India from Israel for enhanced precision

targeting. Fateh-II: A multi-launch rocket system developed by Pakistan. l.

147. *b*) World No.1 Jannik Sinner (Italy) claimed his maiden Wimbledon 2025 title at the All England Club in London. He defeated defending champion Carlos Alcaraz (Spain).

148. *a*) Prime minister Narendra Modi was honoured with the Brazil's highest civilian honour, The Grand Collar of the National Order of the Southern Cross.

149. *d*) Statement 1: Correct – The PMGS-NMP integrates efforts across multiple ministries (not just 16, but more than 40 ministries) for efficient infrastructure planning.

Statement 2: Correct – The primary focus is indeed on improving connectivity not just for road and rail, but also for ports, airports, and logistics, making it multimodal.

Statement 3: Correct – The scheme has an ambitious budget of ₹100 lakh crore for a period of five years beginning from October 2021.

Statement 4: Correct – The plan makes extensive use of technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) to overcome bottlenecks and enhance efficiency.

150. *b*) 154. Hornbill Festival – Held in December, it is a week-long festival that showcases the cultural heritage of the Naga tribes through traditional dance, music, art, and crafts. It is also called the "Festival of Festivals."

Moatsu Festival – Celebrated by the Ao Naga tribe in early May, it marks the completion of agricultural activities. It involves community feasting, singing, and dancing.

Tokhu Emong Festival – Observed by the Lotha Naga tribe in November, it is a post-harvest festival where people express gratitude for a successful harvest through cultural performances and community feasts.