

OJEE B Pharm Sample Paper 02

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.

B) Total Questions: The exam contains 120 questions.

C) Marking Scheme & Rules:

- The question paper is divided into four sections, Physics - 40, Chemistry - 40, Mathematics - 40, and Biology - 40 questions. The candidates must attempt either PCB or PCM as per their choice.
- +4 marks for correct answers and -1 for incorrect ones.

Physics

Q1. The dimensional formula for gravitational constant G is:

A. $[M^{-1}L^3T^{-2}]$

B. $[ML^2T^{-2}]$

C. $[M^{-1}L^2T^{-2}]$

D. $[ML^3T^{-2}]$

Q2. A particle moves along a circle of radius R with constant speed v . Its average acceleration over a half-circle is:

A. Zero

B. $\frac{v^2}{R}$

C. $\frac{2v^2}{\pi R}$

D. $\frac{v^2}{\pi R}$

Q3. A block is pushed against a vertical wall with a force F . If μ is the coefficient of static friction, the minimum force to keep it from falling is:

A. mg/μ

B. μmg

C. mg

D. $mg(1 + \mu)$

Q4. A spring of force constant k is cut into two equal halves. The force constant of each half is:

- A. $k/2$
- B. k
- C. $2k$
- D. $4k$

Q5. The center of mass of a uniform semicircular ring of radius R is at a distance of:

- A. $R/2$
- B. $2R/\pi$
- C. $4R/3\pi$
- D. R/π

Q6. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which physical quantity will remain constant?

- A. Angular velocity
- B. Moment of inertia
- C. Rotational kinetic energy
- D. Angular momentum

Q7. The variation of acceleration due to gravity g with depth d below the Earth's surface is:

- A. $g' = g(1 - d/R)$
- B. $g' = g(1 - 2d/R)$
- C. $g' = g(1 + d/R)$
- D. $g' = g(1 - d^2/R^2)$

Q8. A wire elongates by l when a mass M is hung from it. If the wire is passed over a pulley and two masses M are hung at its ends, the elongation will be:

- A. l
- B. $2l$
- C. $l/2$
- D. Zero

Q9. Excess pressure inside a soap bubble of radius R and surface tension S is:

A. $2S/R$

B. $4S/R$

C. S/R

D. $8S/R$

Q10. The internal energy of an ideal gas depends upon:

A. Pressure

B. Volume

C. Temperature

D. Both Pressure and Volume

Q11. In an isochoric process, the work done by the gas is:

A. Positive

B. Negative

C. Zero

D. Depends on temperature

Q12. The time period of a mass suspended from a spring is T . If the spring is cut into four equal parts and the same mass is suspended from one of the parts, the new time period is:

A. T

B. $T/2$

C. $2T$

D. $T/4$

Q13. An organ pipe open at both ends produces a fundamental frequency f . If it is dipped half in water, the new fundamental frequency is:

A. f

B. $f/2$

C. $2f$

D. $f/4$

Q14. The electric flux through a cube enclosing a charge q at its center is:

- A. q/ϵ_0
- B. $q/6\epsilon_0$
- C. $q/8\epsilon_0$
- D. Zero

Q15. Two identical capacitors are connected in series. Their equivalent capacitance is C . If they are connected in parallel, the equivalent capacitance is:

- A. $C/2$
- B. C
- C. $2C$
- D. $4C$

Q16. The drift velocity of electrons in a wire is v_d . If the current is doubled and the radius of the wire is halved, the new drift velocity is:

- A. v_d
- B. $2v_d$
- C. $4v_d$
- D. $8v_d$

Q17. The magnetic field at the center of a current-carrying circular loop of radius R is B . The magnetic field at a distance R on its axis is:

- A. $B/\sqrt{2}$
- B. $B/2\sqrt{2}$
- C. $B/4$
- D. $B/8$

Q18. A proton and an alpha particle enter a uniform magnetic field perpendicularly with the same speed. The ratio of their radii is:

- A. 1 : 1
- B. 1 : 2
- C. 2 : 1
- D. 1 : 4

Q19. The angle of dip at the magnetic equator is:

- A. 0°
- B. 45°
- C. 90°
- D. 60°

Q20. In a step-up transformer, the quantity that remains constant is:

- A. Voltage
- B. Current
- C. Power
- D. Resistance

Q21. The power factor of a purely inductive circuit is:

- A. 1
- B. 0
- C. 0.5
- D. Infinity

Q22. Which of the following EM waves has the maximum frequency?

- A. Radio waves
- B. Microwaves
- C. X-rays
- D. Gamma rays

Q23. When light travels from a rarer to a denser medium, its:

- A. Velocity increases
- B. Wavelength decreases
- C. Frequency changes
- D. Phase changes by π

Q24. The critical angle for total internal reflection is minimum for which color of light?

- A. Red
- B. Yellow

C. Green

D. Violet

Q25. In Young's double slit experiment, if the distance between the slits is halved and the screen distance is doubled, the fringe width becomes:

A. Half

B. Double

C. Four times

D. One-fourth

Q26. The work function of a metal is 4.0 eV. The longest wavelength of light that can cause photoelectron emission is approximately:

A. 310 nm

B. 400 nm

C. 540 nm

D. 220 nm

Q27. According to Bohr's theory, the angular momentum of an electron in the $n = 3$ orbit is:

A. $h/2\pi$

B. $1.5h/\pi$

C. $3h/\pi$

D. $9h/2\pi$

Q28. The ratio of nuclear radii of elements with mass numbers 27 and 64 is:

A. 3 : 4

B. 4 : 3

C. 9 : 16

D. 27 : 64

Q29. The half-life of a radioactive sample is T . The time taken for $7/8$ of the sample to decay is:

A. T

B. $2T$

C. $3T$

D. $4T$

Q30. In a forward biased p-n junction diode, the potential barrier:

A. Increases

B. Decreases

C. Remains same

D. Becomes zero immediately

Q31. A Zener diode is primarily used as a:

A. Rectifier

B. Amplifier

C. Oscillator

D. Voltage regulator

Q32. The Boolean expression $A \cdot \bar{A}$ is equivalent to:

A. 1

B. 0

C. A

D. $\bar{A}$

Q33. The dimensions of RC (Resistance $\times$ Capacitance) are the same as that of:

A. Time

B. Frequency

C. Velocity

D. Energy

Q34. The relation between phase difference $\Delta\phi$ and path difference Δx is:

A. $\Delta\phi = \frac{2\pi}{\lambda} \Delta x$

B. $\Delta\phi = \frac{\lambda}{2\pi} \Delta x$

C. $\Delta\phi = \frac{2\pi}{\Delta x} \lambda$

D. $\Delta\phi = \frac{\pi}{\lambda} \Delta x$

Q35. The kinetic energy of a body becomes four times its initial value. The new momentum will be:

- A. Twice
- B. Four times
- C. Half
- D. Unchanged

Q36. A body of mass M collides elastically with a stationary body of mass m . If $M \gg m$, the velocity of m after collision is approximately:

- A. v
- B. $2v$
- C. $v/2$
- D. Zero

Q37. The apparent depth of a coin in a tank of water (refractive index $4/3$) is 12 cm. The real depth is:

- A. 9 cm
- B. 12 cm
- C. 16 cm
- D. 18 cm

Q38. Polarization of light proves its:

- A. Corpuscular nature
- B. Quantum nature
- C. Transverse wave nature
- D. Longitudinal wave nature

Q39. If the source of light moves away from an observer, the spectral lines shift towards:

- A. Red end
- B. Blue end
- C. Ultraviolet region
- D. Infrared region

Q40. An ideal voltmeter should have:

- A. Zero resistance
- B. Infinite resistance
- C. Very small resistance
- D. Resistance equal to the circuit

Chemistry

Q41. The number of atoms in 0.1 mole of a triatomic gas is:

- A. 6.022×10^{22}
- B. 1.806×10^{23}
- C. 3.600×10^{23}
- D. 1.806×10^{22}

Q42. Which set of quantum numbers is not possible?

- A. $n = 3, l = 2, m = 0, s = +1/2$
- B. $n = 2, l = 2, m = -1, s = -1/2$
- C. $n = 4, l = 0, m = 0, s = +1/2$
- D. $n = 5, l = 3, m = -3, s = -1/2$

Q43. The molecule with the maximum dipole moment among the following is:

- A. CO_2
- B. CH_4
- C. NH_3
- D. NF_3

Q44. According to VSEPR theory, the geometry of ClF_3 is:

- A. Trigonal planar
- B. Pyramidal
- C. T-shaped
- D. Tetrahedral

Q45. The compressibility factor Z for an ideal gas is:

- A. 0
- B. 1
- C. Greater than 1
- D. Less than 1

Q46. The standard enthalpy of formation of naturally occurring elements in their reference state is:

- A. Zero
- B. Positive
- C. Negative
- D. Infinity

Q47. For the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, increasing the pressure will:

- A. Shift equilibrium to the left
- B. Shift equilibrium to the right
- C. Have no effect
- D. Decrease the equilibrium constant

Q48. The conjugate base of $H_2PO_4^-$ is:

- A. H_3PO_4
- B. HPO_4^{2-}
- C. PO_4^{3-}
- D. $H_4PO_4^+$

Q49. In the reaction $3Br_2 + 6OH^- \rightarrow 5Br^- + BrO_3^- + 3H_2O$, bromine is:

- A. Only oxidized
- B. Only reduced
- C. Both oxidized and reduced
- D. Neither oxidized nor reduced

Q50. The unit of cell constant is:

- A. cm
- B. cm^{-1}
- C. $ohm^{-1}cm^{-1}$
- D. $ohm \cdot cm$

Q51. For a zero-order reaction, the half-life is:

- A. Independent of initial concentration
- B. Directly proportional to initial concentration
- C. Inversely proportional to initial concentration
- D. Directly proportional to the square of initial concentration

Q52. Freundlich adsorption isotherm is given by:

- A. $x/m = kP$
- B. $x/m = kP^{1/n}$
- C. $x/m = kP^n$
- D. $x/m = k/P$

Q53. Froth flotation process is used for the concentration of:

- A. Oxide ores
- B. Sulphide ores
- C. Carbonate ores
- D. Halide ores

Q54. Which of the following noble gases does not form any chemical compounds?

- A. Helium
- B. Neon
- C. Argon
- D. All of the above

Q55. The transition metal ion which is colorless is:

- A. Cu^{2+}
- B. Sc^{3+}

C. V^{3+}

D. Fe^{2+}

Q56. The linkage isomerism is shown by the complex:

A. $[Co(NH_3)_5(NO_2)]Cl_2$

B. $[Co(NH_3)_6]Cl_3$

C. $[Pt(NH_3)_2Cl_2]$

D. $[Cr(H_2O)_6]Cl_3$

Q57. IUPAC name of $CH_3 - C(CH_3)_2 - CH_2 - CH_3$ is:

A. 2,2-Dimethylbutane

B. 3,3-Dimethylbutane

C. 2-Ethyl-2-methylpropane

D. Isohexane

Q58. Which of the following is an optically active compound?

A. 1-Butanol

B. 2-Butanol

C. 1-Propanol

D. 2-Methyl-1-propanol

Q59. The reaction of an alkyl halide with sodium alkoxide to form an ether is called:

A. Wurtz reaction

B. Williamson synthesis

C. Finkelstein reaction

D. Swarts reaction

Q60. Phenol reacts with bromine water to give a white precipitate of:

A. o-Bromophenol

B. p-Bromophenol

C. 2,4,6-Tribromophenol

D. m-Bromophenol

Q61. Which of the following does not undergo Aldol condensation?

- A. Acetaldehyde
- B. Acetone
- C. Benzaldehyde
- D. Propanal

Q62. The strongest acid among the following is:

- A. Acetic acid
- B. Trichloroacetic acid
- C. Trifluoroacetic acid
- D. Formic acid

Q63. Reaction of primary amines with chloroform and ethanolic KOH is known as:

- A. Hoffmann degradation
- B. Carbylamine reaction
- C. Gabriel phthalimide synthesis
- D. Sandmeyer reaction

Q64. The linkage present in proteins is:

- A. Glycosidic linkage
- B. Peptide linkage
- C. Phosphodiester linkage
- D. Ester linkage

Q65. Deficiency of Vitamin C causes:

- A. Scurvy
- B. Beriberi
- C. Night blindness
- D. Rickets

Q66. Bakelite is a polymer of phenol and:

- A. Acetaldehyde

- B. Formaldehyde
- C. Acetone
- D. Ethylene glycol

Q67. Which of the following is a broad-spectrum antibiotic?

- A. Penicillin G
- B. Chloramphenicol
- C. Salvarsan
- D. Sulfapyridine

Q68. Photochemical smog mainly contains:

- A. SO_2, CO_2
- B. Ozone, PAN, NO_x
- C. $CFCs, O_3$
- D. CO, CO_2, SO_3

Q69. The crystal system of graphite is:

- A. Cubic
- B. Tetragonal
- C. Hexagonal
- D. Rhombic

Q70. Osmotic pressure of a solution can be increased by:

- A. Increasing the volume
- B. Decreasing the temperature
- C. Increasing the concentration
- D. Removing solute

Q71. Kohlrausch's law is applicable to:

- A. Strong electrolytes only
- B. Weak electrolytes only
- C. Both strong and weak electrolytes

D. Non-electrolytes

Q72. The activation energy of a reaction can be determined from the slope of:

- A. Rate vs time plot
- B. Concentration vs time plot
- C. $\log k$ vs $1/T$ plot
- D. $\log k$ vs T plot

Q73. Dialysis is a process used for:

- A. Coagulation of colloids
- B. Purification of colloids
- C. Preparation of colloids
- D. Peptization

Q74. The most abundant element in the Earth's crust is:

- A. Iron
- B. Aluminum
- C. Oxygen
- D. Silicon

Q75. Aqua regia is a mixture of:

- A. 3 parts conc. HCl and 1 part conc. HNO_3
- B. 1 part conc. HCl and 3 parts conc. HNO_3
- C. 3 parts conc. H_2SO_4 and 1 part conc. HNO_3
- D. 1 part conc. H_2SO_4 and 3 parts conc. HCl

Q76. Which of the following ions has the maximum magnetic moment?

- A. Mn^{2+}
- B. Fe^{2+}
- C. Co^{2+}
- D. Ni^{2+}

Q77. Ziegler-Natta catalyst is used for the polymerization of:

- A. Ethene
- B. Vinyl chloride
- C. Styrene
- D. Acrylonitrile

Q78. Clemmensen reduction of ketones is carried out using:

- A. H_2/Pd
- B. $Zn-Hg/HCl$
- C. $LiAlH_4$
- D. $NaBH_4$

Q79. Which of the following yields a primary amine on reduction?

- A. Nitroalkane
- B. Alkyl isocyanide
- C. Secondary amide
- D. Oxime

Q80. The base present in RNA but absent in DNA is:

- A. Adenine
- B. Guanine
- C. Cytosine
- D. Uracil

Mathematics

Q81. If $A = \{1, 2, 3\}$ and $B = \{3, 4, 5\}$, then $A \cap B$ is:

- A. $\{1, 2\}$
- B. $\{3\}$
- C. $\{4, 5\}$
- D. $\{1, 2, 3, 4, 5\}$

Q82. The range of the function $f(x) = \sin x$ is:

- A. $[0, 1]$

- B. $[-1, 1]$
- C. $(-\infty, \infty)$
- D. $(0, \pi)$

Q83. The argument of the complex number $-1 + i$ is:

- A. $\pi/4$
- B. $3\pi/4$
- C. $-\pi/4$
- D. $-3\pi/4$

Q84. If the roots of $x^2 - px + q = 0$ are equal, then:

- A. $p^2 = 4q$
- B. $p^2 = q$
- C. $p = 4q^2$
- D. $p = q$

Q85. The number of arrangements of the letters of the word APPLE is:

- A. 120
- B. 60
- C. 24
- D. 12

Q86. The coefficient of x^3 in the expansion of $(1 + x)^5$ is:

- A. 5
- B. 10
- C. 15
- D. 20

Q87. The 10th term of the AP 2, 5, 8, 11, ... is:

- A. 27
- B. 29
- C. 31

D. 33

Q88. The perpendicular distance of the point $(3, 4)$ from the line $3x - 4y + 10 = 0$ is:

A. 0

B. 1

C. 2

D. $3/5$

Q89. The center of the circle $x^2 + y^2 - 4x - 6y + 9 = 0$ is:

A. $(2, 3)$

B. $(-2, -3)$

C. $(4, 6)$

D. $(-4, -6)$

Q90. The length of the latus rectum of the parabola $y^2 = 12x$ is:

A. 3

B. 6

C. 12

D. 24

Q91. The eccentricity of a hyperbola is always:

A. Zero

B. Less than 1

C. Equal to 1

D. Greater than 1

Q92. The value of $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}$ is:

A. 0

B. 1

C. $1/2$

D. 2

Q93. The derivative of x^x with respect to x is:

- A. $x \cdot x^{x-1}$
- B. $x^x \ln x$
- C. $x^x(1 + \ln x)$
- D. x^x

Q94. The function $f(x) = |x|$ is strictly continuous but not differentiable at:

- A. $x = 1$
- B. $x = -1$
- C. $x = 0$
- D. Nowhere

Q95. The integral $\int \frac{dx}{x \ln x}$ is:

- A. $\ln(\ln x) + C$
- B. $\frac{1}{\ln x} + C$
- C. $\ln x + C$
- D. $\frac{(\ln x)^2}{2} + C$

Q96. The area bounded by $y = \sin x$ and the x-axis between $x = 0$ and $x = \pi$ is:

- A. 1
- B. 2
- C. π
- D. $\pi/2$

Q97. The differential equation representing a family of circles with center at the origin is:

- A. $x dx + y dy = 0$
- B. $x dy + y dx = 0$
- C. $x dx - y dy = 0$
- D. $dx/dy = y/x$

Q98. If vectors **a** and **b** are perpendicular, then:

- A. $\mathbf{a} \times \mathbf{b} = 0$
- B. $\mathbf{a} \cdot \mathbf{b} = 0$

C. $\mathbf{a} + \mathbf{b} = 0$

D. $|\mathbf{a}| = |\mathbf{b}|$

Q99. The direction cosines of the z-axis are:

A. $(1, 0, 0)$

B. $(0, 1, 0)$

C. $(0, 0, 1)$

D. $(1, 1, 1)$

Q100. Two mutually exclusive events A and B have probabilities 0.3 and 0.4. $P(A \cup B)$ is:

A. 0.12

B. 0.7

C. 0.1

D. 0

Q101. The inverse of matrix $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ has the determinant:

A. -2

B. 2

C. $-1/2$

D. $1/2$

Q102. If $|A| = 0$, the matrix A is called:

A. Identity matrix

B. Symmetric matrix

C. Singular matrix

D. Diagonal matrix

Q103. The principal value of $\sin^{-1}(-\frac{1}{2})$ is:

A. $\pi/6$

B. $-\pi/6$

C. $5\pi/6$

D. $7\pi/6$

Q104. The number of solutions of $\tan x = 1$ in $[0, 2\pi]$ is:

A. 1

B. 2

C. 3

D. 4

Q105. The angle of elevation of a tower from a point 100m away is 60° . The height is:

A. 100m

B. $100\sqrt{3}$ m

C. $100/\sqrt{3}$ m

D. 50m

Q106. The variance of the first n natural numbers is:

A. $\frac{n^2-1}{12}$

B. $\frac{n^2+1}{12}$

C. $\frac{n^2-1}{6}$

D. $\frac{n^2+1}{6}$

Q107. In Boolean algebra, $A + A \cdot B$ equals:

A. A

B. B

C. 1

D. 0

Q108. The derivative of $\sin(x^2)$ is:

A. $\cos(x^2)$

B. $2x \cos(x^2)$

C. $2x \sin(x^2)$

D. $-\cos(x^2)$

Q109. The value of $\int_0^1 x^2 dx$ is:

- A. 1
- B. $1/2$
- C. $1/3$
- D. $1/4$

Q110. The general solution of $\frac{dy}{dx} = y$ is:

- A. $y = x + C$
- B. $y = Ce^x$
- C. $y = e^x + C$
- D. $y = C \ln x$

Q111. If A and B are independent events, $P(A \cap B)$ is:

- A. $P(A) + P(B)$
- B. $P(A) \cdot P(B)$
- C. $P(A) - P(B)$
- D. $P(A)/P(B)$

Q112. The distance between the planes $x + y + z = 1$ and $x + y + z = 4$ is:

- A. 3
- B. $\sqrt{3}$
- C. $3/\sqrt{3}$
- D. 1

Q113. The maximum value of the function $f(x) = -x^2 + 4x + 1$ is:

- A. 1
- B. 4
- C. 5
- D. -1

Q114. The scalar triple product $[\mathbf{a}\mathbf{a}\mathbf{b}]$ is:

- A. $|\mathbf{a}|^2|\mathbf{b}|$
- B. 1

- C. 0
- D. Vector

Q115. If $nC_2 = 10$, then n is:

- A. 4
- B. 5
- C. 6
- D. 7

Q116. The sum of the binomial coefficients in $(1 + x)^n$ is:

- A. 2^n
- B. 2^{n-1}
- C. n
- D. n^2

Q117. The middle term in the expansion of $(x + \frac{1}{x})^{10}$ is the:

- A. 5th term
- B. 6th term
- C. 4th term
- D. 7th term

Q118. The line $y = mx + c$ touches the parabola $y^2 = 4ax$ if:

- A. $c = a/m$
- B. $c = am$
- C. $c = -a/m$
- D. $c = -am$

Q119. The set of all points where the function $f(x) = |x - 2|$ is not differentiable is:

- A. $\{0\}$
- B. $\{2\}$
- C. $\{-2\}$
- D. Empty set

Q120. The projection of vector $\mathbf{i} + \mathbf{j}$ on $\mathbf{i} - \mathbf{j}$ is:

- A. 1
- B. 2
- C. -1
- D. 0

Biology

Q121. Which of the following is an exclusive character of mammals?

- A. Presence of hair
- B. Homeothermy
- C. Four-chambered heart
- D. Pulmonary respiration

Q122. The infectious RNA particles without a protein coat are called:

- A. Viruses
- B. Viroids
- C. Prions
- D. Bacteriophages

Q123. Cyanobacteria belong to the kingdom:

- A. Protista
- B. Monera
- C. Fungi
- D. Plantae

Q124. Mycorrhiza is a symbiotic association between:

- A. Algae and fungi
- B. Fungi and roots of higher plants
- C. Bacteria and roots of legumes
- D. Algae and bryophytes

Q125. The root hair in plants originates from the:

- A. Cortex
- B. Endodermis
- C. Epidermis
- D. Pericycle

Q126. Secondary growth in dicot stems is due to the activity of:

- A. Apical meristem
- B. Lateral meristem
- C. Intercalary meristem
- D. Axillary bud

Q127. The 80S ribosome consists of two subunits:

- A. 50S and 30S
- B. 60S and 40S
- C. 40S and 40S
- D. 60S and 30S

Q128. Synapsis of homologous chromosomes occurs during:

- A. Zygotene
- B. Pachytene
- C. Diplotene
- D. Diakinesis

Q129. Water potential of pure water at standard temperature is:

- A. 100
- B. 10
- C. Zero
- D. Negative

Q130. Which element is essential for the photolysis of water during photosynthesis?

- A. Zinc
- B. Manganese

C. Copper

D. Boron

Q131. The primary CO_2 acceptor in C_4 plants is:

A. RuBP

B. PEP

C. PGA

D. OAA

Q132. The ultimate electron acceptor in the mitochondrial electron transport chain is:

A. Cytochrome c

B. Ubiquinone

C. Oxygen

D. NAD

Q133. Apical dominance is caused by which phytohormone?

A. Gibberellin

B. Cytokinin

C. Ethylene

D. Auxin

Q134. Bile juice does not contain any:

A. Bile pigments

B. Bile salts

C. Enzymes

D. Cholesterol

Q135. The volume of air inspired or expired during a normal respiration is called:

A. Tidal volume

B. Vital capacity

C. Residual volume

D. Inspiratory reserve volume

Q136. The QRS complex in a standard ECG represents:

- A. Depolarization of atria
- B. Repolarization of ventricles
- C. Depolarization of ventricles
- D. Repolarization of atria

Q137. The primary nitrogenous waste excreted by humans is:

- A. Ammonia
- B. Uric acid
- C. Urea
- D. Creatinine

Q138. The contractile protein of skeletal muscle involving ATPase activity is:

- A. Actin
- B. Tropomyosin
- C. Troponin
- D. Myosin

Q139. The gap between two adjacent neurons is called:

- A. Synapse
- B. Dendrite
- C. Axon
- D. Node of Ranvier

Q140. Insulin is secreted by the:

- A. Alpha cells of Pancreas
- B. Beta cells of Pancreas
- C. Thyroid gland
- D. Adrenal cortex

Q141. Pollination by wind is known as:

- A. Hydrophily

- B. Entomophily
- C. Anemophily
- D. Ornithophily

Q142. The release of the secondary oocyte from the Graafian follicle is called:

- A. Menstruation
- B. Ovulation
- C. Fertilization
- D. Implantation

Q143. Which of the following is a copper-releasing IUD?

- A. Lippes loop
- B. Progestasert
- C. Multiload 375
- D. LNG-20

Q144. A test cross is performed to determine the:

- A. Phenotype of F₁
- B. Genotype of a dominant phenotype
- C. Genotype of a recessive phenotype
- D. Linkage distance

Q145. Turner's syndrome in humans is characterized by the karyotype:

- A. 47, XXY
- B. 45, XO
- C. 47, XXX
- D. 47, XYY

Q146. The enzyme that unzips the DNA double helix during replication is:

- A. DNA polymerase
- B. Helicase
- C. Ligase

D. Primase

Q147. The process of removing introns and joining exons is called:

- A. Capping
- B. Tailing
- C. Splicing
- D. Translation

Q148. Bt toxin protein is produced by:

- A. *Bacillus subtilis*
- B. *Bacillus thuringiensis*
- C. *Agrobacterium tumefaciens*
- D. *Escherichia coli*

Q149. The first clinical gene therapy was given in 1990 for the deficiency of:

- A. Insulin
- B. Growth hormone
- C. Adenosine deaminase (ADA)
- D. Thyroxine

Q150. Analogous structures are a result of:

- A. Convergent evolution
- B. Divergent evolution
- C. Shared ancestry
- D. Genetic drift

Q151. Which test is primarily used for the diagnosis of Typhoid?

- A. Widal test
- B. ELISA
- C. PCR
- D. Western blot

Q152. The pathogen responsible for ringworm in humans belongs to the kingdom:

- A. Monera
- B. Protista
- C. Fungi
- D. Plantae

Q153. BOD (Biochemical Oxygen Demand) is a measure of:

- A. Industrial wastes poured into water
- B. Dissolved oxygen in water
- C. Organic matter present in water
- D. Toxic metals in water

Q154. Which of the following ecological pyramids is always upright?

- A. Pyramid of numbers
- B. Pyramid of biomass
- C. Pyramid of energy
- D. All of the above

Q155. The maximum biodiversity is found in:

- A. Tropical rain forests
- B. Temperate deciduous forests
- C. Taiga
- D. Tundra

Q156. The term 'Biomagnification' refers to:

- A. Increase in population size
- B. Increase in the concentration of non-degradable pollutants across trophic levels
- C. Increase in biomass
- D. Increase in the size of an organism

Q157. The Montreal Protocol was signed to control the emission of:

- A. Greenhouse gases
- B. Ozone depleting substances

- C. Heavy metals
- D. Radioactive wastes

Q158. Corpus luteum primarily secretes:

- A. Estrogen
- B. Progesterone
- C. LH
- D. FSH

Q159. Mendel's experimental material was:

- A. *Drosophila melanogaster*
- B. *Pisum sativum*
- C. *Neurospora crassa*
- D. *E. coli*

Q160. The study of interactions among organisms and their environment is:

- A. Genetics
- B. Ecology
- C. Evolution
- D. Morphology

Solutions

1. A

Explanation: From Newton's law of gravitation, $F = G \frac{m_1 m_2}{r^2}$. Rearranging gives $G = \frac{F r^2}{m_1 m_2}$. Substituting dimensions yields $\frac{[MLT^{-2}][L^2]}{[M][M]} = [M^{-1}L^3T^{-2}]$.

2. C

Explanation: The change in velocity over a half-circle is $v - (-v) = 2v$. The time taken is half the circumference divided by speed, $t = \pi R/v$. Average acceleration is $2v/(\pi R/v) = \frac{2v^2}{\pi R}$.

3. A

Explanation: The frictional force $f = \mu N$ must balance the weight mg . Since the normal force N is provided by the applied push F , we have $\mu F \geq mg$, yielding the minimum force $F = mg/\mu$.

4. C

Explanation: The spring constant k is inversely proportional to the length of the spring. When cut into two equal halves, the length becomes half, so the force constant of each half doubles to $2k$.

5. B

Explanation: By symmetry, the center of mass of a uniform semicircular ring lies on its axis of symmetry. Mathematical integration yields its position at a distance of $2R/\pi$ from the center of the base.

6. D

Explanation: Since the sphere rotates freely in free space, no external torque acts on it. According to the law of conservation of angular momentum, the angular momentum remains constant regardless of changes in radius.

7. A

Explanation: Assuming uniform Earth density, the gravitational acceleration at depth d is determined by the mass of the inner sphere of radius $(R - d)$. This yields the linear relation $g' = g(1 - d/R)$.

8. A

Explanation: The tension in the wire when passed over a pulley with masses M on both sides is exactly Mg (the same as when suspended with one mass M against rigid support). Thus, elongation remains l .

9. B

Explanation: A soap bubble has two free surfaces (inner and outer). Each surface contributes $2S/R$ to the pressure difference, resulting in a total excess pressure of $\Delta P = 4S/R$.

10. C

Explanation: For an ideal gas, there are no intermolecular forces, meaning internal potential energy is zero. The total internal energy is purely kinetic, which is a direct function of the absolute temperature only.

11. C

Explanation: Isochoric process means the volume remains constant ($\Delta V = 0$). Since work done by a gas is given by $W = P\Delta V$, the work done in any isochoric

process is strictly zero.

12. B

Explanation: Cutting the spring into 4 parts makes the new spring constant $k' = 4k$. Since time period $T \propto 1/\sqrt{k}$, the new time period is $T' = T/\sqrt{4} = T/2$.

13. A

Explanation: An open pipe of length L has fundamental frequency $v/2L$. When half-dipped, it becomes a closed pipe of length $L/2$. Its new fundamental frequency is $v/(4 \times L/2) = v/2L$, which is f .

14. A

Explanation: According to Gauss's Law, the total electric flux out of any closed surface is equal to the enclosed charge divided by the permittivity of free space (ϵ_0). The shape of the surface (cube) does not matter.

15. D

Explanation: For identical capacitors C_0 in series, $C_{series} = C_0/2 = C$. Thus $C_0 = 2C$. When connected in parallel, $C_{parallel} = C_0 + C_0 = 2C_0 = 4C$.

16. D

Explanation: Drift velocity is $v_d = I/(neA)$. If current I is doubled and radius is halved (making Area A one-fourth), the new drift velocity is $2/(1/4) = 8$ times the original.

17. B

Explanation: The field on the axis is $B_x = \frac{\mu_0 IR^2}{2(R^2+x^2)^{3/2}}$. At $x = R$, this becomes $B_R = \frac{\mu_0 IR^2}{2(2R^2)^{3/2}} = \frac{\mu_0 I}{2R \cdot 2\sqrt{2}}$. Since $B_{center} = \frac{\mu_0 I}{2R}$, $B_R = B/2\sqrt{2}$.

18. B

Explanation: Radius of the circular path is $r = mv/qB$. For a proton (m, q) and an alpha particle ($4m, 2q$) with the same velocity v , the ratio $r_p/r_\alpha = (m/q)/(4m/2q) = 1/2$.

19. A

Explanation: At the magnetic equator, the Earth's magnetic field lines are perfectly parallel to the Earth's surface. Therefore, the angle of dip (the angle the field makes with the horizontal) is 0° .

20. C

Explanation: A transformer operates on the principle of conservation of energy. In an ideal transformer, the electrical power input equals the power output ($V_p I_p = V_s I_s$). Power remains constant while voltage and current change.

21. B

Explanation: In a purely inductive circuit, the phase difference (ϕ) between alternating current and voltage is exactly 90° ($\pi/2$). The power factor is $\cos \phi = \cos 90^\circ = 0$.

22. D

Explanation: Within the electromagnetic spectrum, gamma rays have the shortest wavelengths and correspondingly the highest frequencies, along with the highest photon energies.

23. B

Explanation: When light enters a denser medium, its speed decreases ($v = c/n$). Since the frequency is determined by the source and remains constant, the wavelength must proportionally decrease ($\lambda = v/f$).

24. D

Explanation: The critical angle $\theta_c = \sin^{-1}(1/n)$. Violet light experiences the highest refractive index (n) in a given material, leading to the smallest (minimum) critical angle among visible colors.

25. C

Explanation: The fringe width in YDSE is $\beta = \frac{\lambda D}{d}$. If the screen distance D is doubled and slit separation d is halved, the new fringe width is $\frac{\lambda(2D)}{(d/2)} = 4\frac{\lambda D}{d}$, which is four times.

26. A

Explanation: The threshold wavelength is $\lambda_0 = hc/W$. Using $hc \approx 1240 \text{ eV}\cdot\text{nm}$, $\lambda_0 = 1240/4.0 \approx 310 \text{ nm}$. Any wavelength longer than this will not have enough energy to cause emission.

27. B

Explanation: According to Bohr's quantization condition, the angular momentum $L = n(h/2\pi)$. For the $n = 3$ orbit, $L = 3h/2\pi = 1.5h/\pi$.

28. A

Explanation: The radius of a nucleus is related to its mass number A by $R = R_0 A^{1/3}$. The ratio of radii is $(27/64)^{1/3} = 3/4$.

29. C

Explanation: If $7/8$ has decayed, the fraction remaining is $1 - 7/8 = 1/8$. Since $1/8 = (1/2)^3$, exactly 3 half-lives have passed. Time taken $= 3T$.

30. B

Explanation: Forward biasing applies an external voltage opposite to the built-in potential barrier of the depletion region. This partially cancels the internal field, narrowing the depletion zone and decreasing the barrier.

31. D

Explanation: A Zener diode is specifically heavily doped to operate reliably in the reverse breakdown region. Once breakdown is reached, it maintains a constant voltage across its terminals, making it an excellent voltage regulator.

32. B

Explanation: In Boolean algebra, an input A and its complement $\bar{A}$ cannot simultaneously be true (1). Therefore, their logical AND operation ($A \cdot \bar{A}$) is always 0.

33. A

Explanation: The time constant of an RC circuit is defined as $\tau = RC$. It represents the time required to charge the capacitor to about 63.2% of its maximum voltage. Its dimensional formula is strictly Time $[T]$.

34. A

Explanation: A full wave corresponds to a phase difference of 2π radians and a path length of λ . Thus, any path difference Δx corresponds to a phase difference $\Delta\phi = (2\pi/\lambda)\Delta x$.

35. A

Explanation: Kinetic energy is related to momentum by $K = p^2/2m$. If K becomes 4 times, p^2 must become 4 times, meaning the momentum p becomes $\sqrt{4} = 2$ times its initial value.

36. B

Explanation: In a perfectly elastic head-on collision where $M \gg m$, the massive body continues with velocity v virtually unchanged, while the tiny stationary mass bounces off with a velocity $2v$.

37. C

Explanation: The relationship between real and apparent depth is given by $n = \text{Real Depth}/\text{Apparent Depth}$. So, Real Depth = $n \times \text{Apparent Depth} = (4/3) \times 12 = 16$ cm.

38. C

Explanation: Polarization is the restriction of a wave's vibrations to a single plane. Only transverse waves (like light), where oscillations are perpendicular to the direction of travel, can be polarized.

39. A

Explanation: According to the Doppler effect for light, when a light source moves away from an observer, the observed wavelength increases. This shift towards longer wavelengths is called a red shift.

40. B

Explanation: A voltmeter is connected in parallel to measure potential difference. An ideal voltmeter should have infinite resistance so that it draws absolutely zero current from the circuit, preventing measurement errors.

41. B

Explanation: One mole contains 6.022×10^{23} molecules. 0.1 mole contains 0.6022×10^{23} molecules. Since the gas is triatomic, atoms = $3 \times 0.6022 \times 10^{23} = 1.806 \times 10^{23}$.

42. B

Explanation: The principal quantum number $n = 2$ allows azimuthal quantum numbers $l = 0$ and $l = 1$. The value $l = 2$ is impossible for $n = 2$ (since l must be strictly less than n).

43. C

Explanation: CO_2 and CH_4 are highly symmetrical and have zero dipole moment. Between NH_3 and NF_3 , NH_3 has a higher dipole moment because the N-H bond dipoles add to the lone pair dipole, whereas in NF_3 they oppose it.

44. C

Explanation: The central Chlorine atom in ClF_3 has 7 valence electrons, forms 3 single bonds with Fluorine, and retains 2 lone pairs. This sp^3d hybridization with 3 bonds and 2 lone pairs results in a T-shaped geometry.

45. B

Explanation: The compressibility factor $Z = PV/nRT$. For a perfectly ideal gas under all conditions of temperature and pressure, the ideal gas equation $PV = nRT$ holds exactly, making $Z = 1$.

46. A

Explanation: By thermodynamic convention, the standard enthalpy of formation (ΔH_f°) for any element in its most stable, naturally occurring standard reference state (e.g., O_2 gas, solid Carbon-graphite) is defined as zero.

47. B

Explanation: According to Le Chatelier's principle, an increase in pressure shifts the equilibrium towards the side with fewer moles of gas. Here, reactants have 3 moles and products have 2 moles, so the shift is to the right.

48. B

Explanation: The conjugate base of a Brønsted-Lowry acid is formed by the removal of one proton (H^+). Removing H^+ from $H_2PO_4^-$ yields HPO_4^{2-} .

49. C

Explanation: Bromine (Br_2) has an oxidation state of 0. It is reduced to Br^- (state -1) and simultaneously oxidized to BrO_3^- (state +5). This is a classic example of a disproportionation reaction.

50. B

Explanation: The cell constant (G^*) of a conductivity cell is defined as the ratio of the distance between the electrodes (l) to their area of cross-section (A). Hence, its unit is $cm/cm^2 = cm^{-1}$.

51. B

Explanation: For a zero-order reaction, the integrated rate law gives $t_{1/2} = [A]_0/2k$. Therefore, the half-life is directly proportional to the initial concentration $[A]_0$ of the reactant.

52. B

Explanation: The empirical Freundlich adsorption isotherm expresses the relationship between the quantity of gas adsorbed by unit mass of solid (x/m) and pressure (P) at constant temperature as $x/m = kP^{1/n}$.

53. B

Explanation: The froth flotation process is specifically based on the differential wetting of ore and gangue particles. It is widely used to concentrate sulphide ores, which are wetted by oil and rise with the froth.

54. B

Explanation: Neon (and Helium) possess perfectly closed valence electron shells and extremely high ionization enthalpies. As a result, no true chemical compounds of Neon have ever been synthesized or observed.

55. B

Explanation: Color in transition metal complexes arises from d-d electron transitions. Scandium (Sc) has an atomic number of 21. The Sc^{3+} ion has an empty d-orbital ($3d^0$), precluding d-d transitions, making it colorless.

56. A

Explanation: Linkage isomerism occurs when a complex contains an ambidentate ligand that can coordinate through different atoms. The nitrite ion (NO_2^-) can bind via Nitrogen (nitro) or Oxygen (nitrito).

57. A

Explanation: The longest continuous carbon chain has 4 carbons (butane). Num-

bering from the left gives the lowest locants to the substituents. There are two methyl groups on carbon-2, giving 2,2-dimethylbutane.

58. B

Explanation: Optical activity requires a chiral center (a carbon attached to 4 different groups). In 2-butanol ($CH_3 - CH(OH) - CH_2 - CH_3$), carbon-2 is attached to -H, -OH, -CH₃, and -CH₂CH₃, making it chiral.

59. B

Explanation: The Williamson ether synthesis is an S_N2 reaction where an alkoxide ion (a strong nucleophile) displaces a halide ion from a primary alkyl halide, yielding an ether.

60. C

Explanation: The -OH group on phenol strongly activates the benzene ring towards electrophilic aromatic substitution. In aqueous medium, polybromination occurs rapidly, yielding a white precipitate of 2,4,6-tribromophenol.

61. C

Explanation: Aldol condensation requires the presence of at least one alpha-hydrogen atom adjacent to the carbonyl group. Benzaldehyde (C_6H_5CHO) lacks an alpha-hydrogen and thus cannot undergo the Aldol reaction.

62. C

Explanation: The acidity of carboxylic acids increases with the electron-withdrawing inductive (-I) effect of substituents. Three highly electronegative fluorine atoms in trifluoroacetic acid profoundly stabilize the conjugate base, making it the strongest acid.

63. B

Explanation: The carbylamine reaction (or isocyanide test) specifically detects primary amines. Heating a primary amine with chloroform and alcoholic KOH yields a foul-smelling isocyanide (carbylamine).

64. B

Explanation: Proteins are linear polymers of amino acids. The fundamental covalent bond linking the carboxyl group of one amino acid to the amino group of the next is an amide bond, specifically termed a peptide linkage.

65. A

Explanation: Vitamin C (ascorbic acid) is crucial for collagen synthesis. Severe deficiency leads to scurvy, characterized by swollen, bleeding gums, delayed wound healing, and general weakness.

66. B

Explanation: Bakelite is one of the oldest synthetic condensation polymers. It is a highly cross-linked thermosetting plastic formed by the base- or acid-catalyzed reaction between phenol and formaldehyde.

67. B

Explanation: A broad-spectrum antibiotic is effective against a wide range of both Gram-positive and Gram-negative bacteria. Chloramphenicol is a classic example of a broad-spectrum antibiotic.

68. B

Explanation: Photochemical smog is formed in warm, sunny climates by the action of sunlight on nitrogen oxides (NO_x) and volatile organic compounds. Its primary components include Ozone (O_3) and Peroxyacetyl nitrate (PAN).

69. C

Explanation: Graphite consists of flat, two-dimensional sheets of sp^2 hybridized carbon atoms arranged in hexagonal rings. These layers stack to form a hexagonal crystal lattice system.

70. C

Explanation: Osmotic pressure (π) is given by the van't Hoff equation $\pi = CRT$, where C is the molar concentration. Increasing the concentration directly proportionately increases the osmotic pressure at constant temperature.

71. C

Explanation: Kohlrausch's law of independent migration of ions states that limiting molar conductivity can be represented as the sum of individual contributions of anions and cations. It applies to both strong and weak electrolytes at infinite dilution.

72. C

Explanation: From the Arrhenius equation $\ln k = \ln A - E_a/RT$, plotting $\ln k$ (or $\log k$) against $1/T$ yields a straight line with a slope equal to $-E_a/R$ (or $-E_a/2.303R$).

73. B

Explanation: Dialysis is a separation technique used to purify colloidal solutions. It selectively removes dissolved crystalloids (true solution particles) from a colloidal dispersion using a semi-permeable membrane.

74. C

Explanation: Oxygen is the most abundant chemical element in the Earth's crust by mass (approx 46.6%).

75. A
Explanation: Aqua regia (royal water) is a highly corrosive, fuming yellow mixture capable of dissolving noble metals like gold and platinum. It is composed of 3 parts concentrated HCl and 1 part concentrated HNO_3 .

76. A

Explanation: The spin-only magnetic moment is $\mu = \sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons. Mn^{2+} ($3d^5$ configuration) has the maximum of 5 unpaired electrons.

77. A

Explanation: The Ziegler-Natta catalyst (a mixture of titanium tetrachloride and triethylaluminum) is extensively used in industry for the coordination polymerization of terminal alkenes, primarily ethene to produce high-density polyethene (HDPE).

78. B

Explanation: Clemmensen reduction specifically reduces aldehydes and ketones directly into their corresponding alkanes. The characteristic reagent used is zinc amalgam (Zn-Hg) in the presence of concentrated hydrochloric acid.

79. A

Explanation: The reduction of aliphatic or aromatic nitro compounds (nitroalkanes or nitroarenes) using catalytic hydrogenation or active metals in acid reliably yields primary amines.

80. D

Explanation: Both DNA and RNA contain the nitrogenous bases Adenine, Guanine, and Cytosine. However, the pyrimidine base Thymine in DNA is exclusively replaced by Uracil in RNA.

81. B

Explanation: The intersection $A \cap B$ of two sets represents the set of all elements that are common to both A and B . Only the number 3 is present in both given sets.

82. B

Explanation: The sine function, $\sin x$, oscillates continuously. For any real number input x , the output value is strictly bounded, finding its minimum at -1 and maximum at 1. Thus, the range is $[-1, 1]$.

83. B

Explanation: The complex number $z = -1 + i$ lies in the second quadrant. The argument is given by $\pi - \tan^{-1}(|y/x|) = \pi - \tan^{-1}(1/1) = \pi - \pi/4 = 3\pi/4$.

84. A

Explanation: A quadratic equation $ax^2 + bx + c = 0$ has real and equal roots if its discriminant is zero ($b^2 - 4ac = 0$). Here, $a = 1, b = -p, c = q$, leading to $(-p)^2 - 4(1)(q) = 0 \implies p^2 = 4q$.

85. B

Explanation: The word APPLE has 5 letters in total, with the letter P repeating twice. The total number of distinct linear permutations is calculated by $5!/2! = 120/2 = 60$.

86. B

Explanation: Using the binomial theorem, the general term of $(1+x)^n$ is $T_{r+1} = \binom{n}{r} x^r$. For the coefficient of x^3 , $r = 3$ and $n = 5$. The coefficient is $\binom{5}{3} = 10$.

87. B

Explanation: In this arithmetic progression, the first term $a = 2$ and the common difference $d = 5 - 2 = 3$. The 10th term is $a + 9d = 2 + 9(3) = 2 + 27 = 29$.

88. B

Explanation: The perpendicular distance from (x_1, y_1) to $Ax + By + C = 0$ is $\frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$. Substituting yields $\frac{|3(3) - 4(4) + 10|}{\sqrt{3^2 + (-4)^2}} = \frac{|9 - 16 + 10|}{5} = \frac{3}{5}$. Wait, arithmetic: $9 - 16 + 10 = 3$. Options has $3/5$. *(Self correction: The option D is $3/5$, but wait, the answer key output will map $3/5$ to D. Let me adjust my explanation matching the options)*. Ah, wait, option B is 1. If $Ax + By + C = 0$, $3(3) - 4(4) + 10 = 9 - 16 + 10 = 3$. So distance is $3/5$. Option D. *I wrote D for 1st paper but didn't notice it here. Let's provide Option D.*

*(Self correction: The above text says **88. D**. I will write D in the final output.)*

88. D

Explanation: Distance $d = \frac{|3(3) - 4(4) + 10|}{\sqrt{3^2 + 4^2}} = \frac{|9 - 16 + 10|}{5} = \frac{3}{5}$.

89. A

Explanation: The general circle equation is $x^2 + y^2 + 2gx + 2fy + c = 0$ with center at $(-g, -f)$. Comparing terms, $2g = -4 \implies g = -2$ and $2f = -6 \implies f = -3$. The center is $(2, 3)$.

90. C

Explanation: The standard equation of a rightward-opening parabola is $y^2 = 4ax$. Comparing $y^2 = 12x$, we get $4a = 12$. The length of the latus rectum is directly $4a$, which is 12.

91. D

Explanation: By geometric definition, a hyperbola is the locus of a point whose distance from a fixed point (focus) is greater than its distance from a fixed line (directrix), making its eccentricity $e > 1$.

92. C

Explanation: Using L'Hopital's rule or Taylor series expansion for $\cos x \approx 1 - x^2/2$, the limit becomes $\lim_{x \rightarrow 0} \frac{1 - (1 - x^2/2)}{x^2} = \lim_{x \rightarrow 0} \frac{x^2/2}{x^2} = 1/2$.

93. C

Explanation: Let $y = x^x$. Taking natural log, $\ln y = x \ln x$. Differentiating implicitly gives $\frac{1}{y} y' = 1 \cdot \ln x + x \cdot \frac{1}{x} = 1 + \ln x$. Thus, $y' = x^x(1 + \ln x)$.

94. C

Explanation: The absolute value function $f(x) = |x|$ forms a sharp "V" corner at the origin. While it is continuous everywhere, the left-hand derivative (-1) does not equal the right-hand derivative (1) at $x = 0$.

95. A

Explanation: Use substitution by letting $u = \ln x$. Then $du = \frac{1}{x} dx$. The integral transforms to $\int \frac{du}{u}$, which integrates to $\ln |u| + C$. Substituting back gives $\ln |\ln x| + C$.

96. B

Explanation: The area under the curve is the definite integral of the function. $\text{Area} = \int_0^\pi \sin x \, dx = [-\cos x]_0^\pi = -\cos(\pi) - (-\cos(0)) = -(-1) - (-1) = 2$.

97. A

Explanation: The family of concentric circles at the origin is $x^2 + y^2 = r^2$. Differentiating implicitly with respect to x gives $2x + 2y \frac{dy}{dx} = 0$, which simplifies to $x dx + y dy = 0$.

98. B

Explanation: The dot product of two vectors is $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos \theta$. If the vectors are perfectly perpendicular, the angle θ is 90° . Since $\cos 90^\circ = 0$, the dot product is necessarily zero.

99. C

Explanation: Direction cosines are the cosines of the angles the line makes with the coordinate axes. The z-axis makes angles $90^\circ, 90^\circ, 0^\circ$ with the x, y, and z axes respectively, yielding $(0, 0, 1)$.

100. B

Explanation: For mutually exclusive events, there is no intersection ($P(A \cap B) = 0$). The addition rule simplifies to $P(A \cup B) = P(A) + P(B) = 0.3 + 0.4 = 0.7$.

101. C

Explanation: For any invertible matrix A , the determinant of the inverse is the reciprocal of the determinant of the original matrix: $|A^{-1}| = 1/|A|$. Here, $|A| = 4 - 6 = -2$, so $|A^{-1}| = -1/2$.

102. C

Explanation: A square matrix is classified as a singular matrix if its determinant is exactly zero. Such matrices do not have an inverse.

103. B

Explanation: The principal value branch of $\sin^{-1}$ is $[-\pi/2, \pi/2]$. Since $\sin(-\pi/6) = -1/2$ and $-\pi/6$ lies within this principal range, the principal value is $-\pi/6$.

104. B

Explanation: The tangent function is positive in the 1st and 3rd quadrants. Within the principal cycle $[0, 2\pi]$, $\tan x = 1$ occurs exactly twice: at $x = \pi/4$ and $x = 5\pi/4$.

105. B

Explanation: Let the height of the tower be h . In the formed right-angled triangle, $\tan 60^\circ = \text{Opposite/Adjacent} = h/100$. Since $\tan 60^\circ = \sqrt{3}$, the height is $h = 100\sqrt{3}$ m.

106. A

Explanation: The variance of the first n natural numbers is a standard statistical derivation. It is given by $(n^2 - 1)/12$, derived from the sum of squares formula minus the mean squared.

107. A

Explanation: By the distributive law of Boolean algebra, $A + A \cdot B$ can be factored as $A(1 + B)$. Since $(1 + \text{anything})$ is always 1, the expression simplifies completely to $A \cdot 1 = A$. (Absorption Law).

108. B

Explanation: Applying the chain rule, $\frac{d}{dx}(\sin u) = \cos u \cdot \frac{du}{dx}$. Here $u = x^2$. The derivative becomes $\cos(x^2) \cdot \frac{d}{dx}(x^2) = \cos(x^2) \cdot 2x = 2x \cos(x^2)$.

109. C

Explanation: By the power rule for integration, the indefinite integral is $\frac{x^3}{3}$. Evaluating the definite bounds from 0 to 1 gives $[\frac{1^3}{3}] - [\frac{0^3}{3}] = \frac{1}{3}$.

110. B

Explanation: Separating variables yields $\frac{dy}{y} = dx$. Integrating both sides gives $\ln y = x + C'$. Exponentiating both sides results in $y = e^{x+C'} = e^{C'} e^x$. Let $C = e^{C'}$, so $y = Ce^x$.

111. B

Explanation: For independent events, the occurrence of one does not affect the probability of the other. The probability of both occurring simultaneously is the strict product of their individual probabilities.

112. B

Explanation: Distance between parallel planes $Ax + By + Cz = d_1$ and $Ax + By + Cz = d_2$ is $\frac{|d_1 - d_2|}{\sqrt{A^2 + B^2 + C^2}}$. Here, it's $\frac{|1 - 4|}{\sqrt{1^2 + 1^2 + 1^2}} = \frac{3}{\sqrt{3}} = \sqrt{3}$.

113. C

Explanation: The parabola opens downward since $a = -1$. The maximum occurs at the vertex, $x = -b/2a = -4/(2 \times -1) = 2$. Substituting $x = 2$ back into the function: $f(2) = -(2)^2 + 4(2) + 1 = -4 + 8 + 1 = 5$.

114. C

Explanation: The scalar triple product represents the volume of a parallelepiped. If two vectors in the product are identical, the parallelepiped collapses to a flat plane, resulting in a volume of exactly zero.

115. B

Explanation: The combination formula is $nC_2 = \frac{n(n-1)}{2}$. Setting this equal to 10 gives $n(n-1) = 20$. The positive integer root for this quadratic is $n = 5$ ($5 \times 4 = 20$).

116. A

Explanation: By putting $x = 1$ in the binomial expansion $(1+x)^n = nC_0 + nC_1x + nC_2x^2 \dots$, we sum all the coefficients. Thus, $(1+1)^n = 2^n$.

117. B

Explanation: The total number of terms in the expansion is $10 + 1 = 11$. Since there is an odd number of terms, the exact middle term is the $(n/2 + 1)$ th term, which is the 6th term.

118. A

Explanation: A straight line $y = mx + c$ represents a tangent to the parabola $y^2 = 4ax$ if it exactly satisfies the standard condition of tangency, which is mathematically derived as $c = a/m$.

119. B

Explanation: The function $f(x) = |x - 2|$ represents an absolute value graph shifted 2 units right. It forms a sharp cusp/corner exactly at $x = 2$, making it non-differentiable strictly at that point.

120. D

Explanation: The dot product of $(\mathbf{i} + \mathbf{j})$ and $(\mathbf{i} - \mathbf{j})$ is $1(1) + 1(-1) = 0$. Since the vectors are perfectly orthogonal, the geometric projection of one onto the other is identically zero.

121. A

Explanation: While traits like homeothermy and a four-chambered heart are shared with birds, the presence of epidermal hair and mammary glands are unique defining characteristics exclusive to the class Mammalia.

122. B

Explanation: Viroids are the smallest known infectious pathogens. They consist solely of a short, circular strand of infectious RNA without the protective protein capsid (coat) typically found in true viruses.

123. B

Explanation: Cyanobacteria, commonly known as blue-green algae, are prokaryotic organisms lacking a true nucleus and membrane-bound organelles, placing them definitively in the Kingdom Monera.

124. B

Explanation: Mycorrhiza is a mutually beneficial symbiotic association between a fungus and the roots of a vascular plant. The fungus aids in nutrient absorption, while the plant provides carbohydrates.

125. C

Explanation: Root hairs are unicellular, tubular prolongations of the epiblema (the outermost epidermal layer of the root) that significantly increase the surface area for water absorption.

126. B

Explanation: Secondary growth, which increases the girth (thickness) of the stem and root in dicots, is driven by the cell division activity of lateral meristems (vascular cambium and cork cambium).

127. B

Explanation: Eukaryotic ribosomes (80S) sediment distinctly in ultracentrifugation. They are composed of a large 60S subunit and a small 40S subunit (note: sedimentation coefficients are not strictly additive).

128. A

Explanation: Synapsis is the intricate pairing process of homologous chromosomes, forming bivalents. This crucial preliminary step for genetic recombination occurs specifically during the zygotene stage of Prophase I.

129. C

Explanation: By thermodynamic convention, the water potential (Ψ_w) of pure water at standard temperature, unconfined and without any dissolved solutes, is defined as exactly zero.

130. B

Explanation: The photolysis (light-driven splitting) of water during the non-cyclic photophosphorylation of photosynthesis heavily depends on an oxygen-evolving complex that primarily requires Manganese (Mn) and Chloride (Cl^-) ions.

131. B

Explanation: In the mesophyll cells of C_4 plants, the primary acceptor of atmospheric carbon dioxide is the 3-carbon compound Phosphoenolpyruvate (PEP), catalyzed by the enzyme PEP carboxylase.

132. C

Explanation: In aerobic respiration, molecular oxygen acts as the final terminal electron acceptor at the end of the mitochondrial electron transport chain, combining with electrons and protons to form metabolic water.

133. D

Explanation: Auxins, primarily synthesized in the shoot apex, suppress the growth of lateral (axillary) buds. This physiological phenomenon, promoting vertical growth over lateral branching, is termed apical dominance.

134. C

Explanation: Bile, secreted by the liver and stored in the gall bladder, acts as a critical biological emulsifier for dietary fats. Uniquely among digestive secretions, it contains absolutely no digestive enzymes.

135. A

Explanation: Tidal volume is the physiological volume of air inhaled or exhaled with each normal, resting breath without conscious effort. In a healthy human adult, it is approximately 500 mL.

136. C

Explanation: In an electrocardiogram (ECG), the sharp QRS complex represents the rapid electrical depolarization of the ventricular myocardium, which directly precedes massive ventricular contraction (systole).

137. C

Explanation: Humans are predominantly ureotelic organisms. They safely excrete toxic ammonia generated by protein metabolism by enzymatically converting it into the less toxic compound urea via the hepatic ornithine cycle.

138. D

Explanation: Myosin constitutes the thick filaments of skeletal muscle. The globular head of the myosin molecule possesses intrinsic ATPase activity, hydrolyzing ATP to power the cross-bridge muscle contraction cycle.

139. A

Explanation: The synapse is the specialized microscopic junction where neural signals are transmitted chemically (via neurotransmitters) or electrically from the axon terminal of one neuron to the dendrites of the next.

140. B

Explanation: Insulin is an essential peptide hormone synthesized and secreted specifically by the beta cells of the Islets of Langerhans within the pancreas to strictly regulate and lower blood glucose levels.

141. C

Explanation: Anemophily refers to the abiotic pollination mechanism where pollen grains, typically lightweight and non-sticky, are dispersed and transported from the anther to the stigma by wind currents.

142. B

Explanation: Ovulation is the biological process in the menstrual cycle where the mature Graafian follicle ruptures, releasing the secondary oocyte (egg) into the pelvic cavity to be caught by the fallopian tube.

143. C

Explanation: Multiload 375 is a well-known copper-releasing Intrauterine Device (IUD). The released copper ions strongly suppress sperm motility and their fertilizing capacity within the female reproductive tract.

144. B

Explanation: A test cross involves mating an individual with a dominant phenotype (but unknown genotype) with a homozygous recessive individual. The phenotypic ratio of the offspring reveals whether the dominant parent was homozygous or heterozygous.

145. B

Explanation: Turner's syndrome is a chromosomal disorder affecting females, caused by the complete or partial absence of one X chromosome. The resulting karyotype is commonly 45, XO instead of the typical 46, XX.

146. B

Explanation: DNA Helicase is the crucial motor enzyme that travels along the DNA backbone, hydrolyzing ATP to mechanically break the hydrogen bonds between bases, thereby "unzipping" the double helix for replication.

147. C

Explanation: Splicing is an essential post-transcriptional modification in eukaryotes where non-coding intervening sequences (introns) are excised from the pre-mRNA, and the coding sequences (exons) are precisely ligated together.

148. B

Explanation: The insecticidal Bt toxin (Cry protein) is naturally produced as inactive crystalline inclusions by the soil bacterium *Bacillus thuringiensis* during its sporulation phase.

149. C

Explanation: The first successful human clinical gene therapy was administered in 1990 to a 4-year-old girl suffering from Severe Combined Immunodeficiency (SCID) caused by a fatal genetic deficiency of the enzyme Adenosine Deaminase (ADA).

150. A

Explanation: Analogous structures belong to unrelated organisms but serve similar functions due to similar environmental selective pressures (e.g., bird wing and butterfly wing). This phenomenon is termed convergent evolution.

151. A

Explanation: The Widal test is a classic serological diagnostic tool for typhoid fever. It detects the presence of specific agglutinating antibodies in the patient's serum against the O and H antigens of *Salmonella typhi*.

152. C

Explanation: Ringworm (tinea) is a common skin infection not caused by a worm, but by dermatophytic fungi (such as *Microsporum*, *Trichophyton*, and *Epidermophyton*) which thrive on keratin and belong to the Kingdom Fungi.

153. C

Explanation: BOD measures the amount of dissolved oxygen consumed by aerobic microorganisms to completely decompose the biodegradable organic matter present in a water sample. High BOD heavily indicates severe organic pollution.

154. C

Explanation: According to the 10 per cent law of thermodynamics in ecology, energy is always inevitably lost as heat during transfer between trophic levels. Consequently, the pyramid of energy is strictly, universally upright.

155. A

Explanation: Tropical rainforests experience consistently warm temperatures and high abundant rainfall year-round. These stable, favorable climatic conditions support the absolute highest levels of global terrestrial biodiversity.

156. B

Explanation: Biomagnification is the progressive bioaccumulation of toxic, non-biodegradable substances (like DDT or mercury) at successive higher trophic levels of a food chain, often severely affecting apex predators.

157. B

Explanation: The 1987 Montreal Protocol is a landmark global environmental treaty designed to meticulously phase out the industrial production and consumption of numerous substances (like CFCs) responsible for catastrophic ozone depletion.

158. B

Explanation: Following ovulation, the ruptured follicular remnants in the ovary transform into the glandular corpus luteum. It predominantly secretes massive amounts of progesterone to maintain the highly vascularized endometrial lining for potential implantation.

159. B

Explanation: Gregor Mendel, the father of genetics, rigorously conducted his foundational hybridization experiments on the common garden pea plant, scientifically named **Pisum sativum**, due to its easily observable contrasting traits.

160. B

Explanation: Ecology is the comprehensive scientific branch of biology that studies the intricate spatial and temporal interactions among diverse living organisms and their complex physical (abiotic) environment.