Test Booklet Code **JMD** No.

AA

*This Test Booklet contains **20** pages.*

Do not open this Test Booklet until you are asked to do so.

Important Instructions :

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **Side-1** and **Side-2** carefully with **blue/black** ballpoint pen only.
2. The test is of **3 hours** duration and Test Booklet contains **180** questions. Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, **one mark** will be deducted from the total score. The maximum marks are **720**.
3. Use **Blue/Black Ballpoint Pen only** for writing particulars on this page/marking responses.
4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator before leaving the Room/Hall. *The candidates are allowed to take away Test Booklet only with them.*
6. The CODE for this Test Booklet is **AA**. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
7. The candidate should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
8. Use of white fluid for correction is ***not*** permissible on the Answer Sheet.
9. Each candidate must show on demand his/her Admit Card to the Invigilator.
10. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.
11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. **Cases where a candidate has not signed the Attendance Sheet second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case.**
12. Use of Electronic/Manual Calculator is prohibited.
13. The candidates are governed by all Rules and Regulations of the Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the Board.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
15. The candidates will write the correct Test Booklet Code as given in the Test Booklet/Answer Sheet in the Attendance Sheet.

SEAL

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E1

1. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length?

(1) $\frac{\sqrt{hG}}{c^{3/2}}$ (2) $\frac{\sqrt{hG}}{c^{5/2}}$

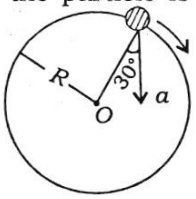
(3) $\sqrt{\frac{hc}{G}}$ (4) $\sqrt{\frac{Gc}{h^{3/2}}}$

2. Two cars P and Q start from a point at the same time in a straight line and their positions are represented by $x_P(t) = at + bt^2$ and $x_Q(t) = ft - t^2$. At what time do the cars have the same velocity?

(1) $\frac{a-f}{1+b}$ (2) $\frac{a+f}{2(b-1)}$

(3) $\frac{a+f}{2(1+b)}$ (4) $\frac{f-a}{2(1+b)}$

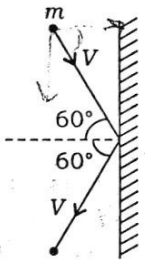
3. In the given figure, $a = 15\ m/s^2$ represents the total acceleration of a particle moving in the clockwise direction in a circle of radius $R = 2{\cdot}5$ m at a given instant of time. The speed of the particle is



(1) 4·5 m/s (2) 5·0 m/s

(3) 5·7 m/s (4) 6·2 m/s

4. A rigid ball of mass m strikes a rigid wall at 60° and gets reflected without loss of speed as shown in the figure below. The value of impulse imparted by the wall on the ball will be



(1) mV (2) $2mV$

(3) $\frac{mV}{2}$ (4) $\frac{mV}{3}$

5. A bullet of mass 10 g moving horizontally with a velocity of 400 m s^{-1} strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be

(1) 100 m s^{-1}

(2) 80 m s^{-1}

(3) 120 m s^{-1}

(4) 160 m s^{-1}

6. Two identical balls A and B having velocities of 0·5 m/s and −0·3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

(1) −0·5 m/s and 0·3 m/s

(2) 0·5 m/s and −0·3 m/s

(3) −0·3 m/s and 0·5 m/s

(4) 0·3 m/s and 0·5 m/s

7. A particle moves from a point $(-2\hat{i} + 5\hat{j})$ to $(4\hat{j} + 3\hat{k})$ when a force of $(4\hat{i} + 3\hat{j})$ N is applied. How much work has been done by the force?

(1) 8 J

(2) 11 J

(3) 5 J

(4) 2 J

8. Two rotating bodies A and B of masses m and $2m$ with moments of inertia I_A and I_B ($I_B > I_A$) have equal kinetic energy of rotation. If L_A and L_B be their angular momenta respectively, then

(1) $L_A = \frac{L_B}{2}$

(2) $L_A = 2L_B$

(3) $L_B > L_A$

(4) $L_A > L_B$

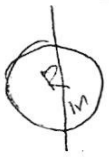
9. A solid sphere of mass m and radius R is rotating about its diameter. A solid cylinder of the same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of their kinetic energies of rotation $(E_{sphere}/E_{cylinder})$ will be

(1) 2 : 3

(2) 1 : 5

(3) 1 : 4

(4) 3 : 1

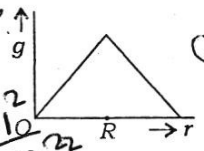


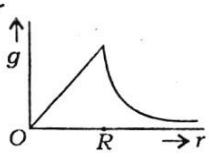
10. A light rod of length l has two masses m_1 and m_2 attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is

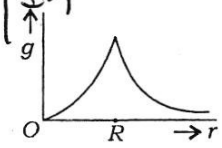
(1) $\frac{m_1 m_2}{m_1 + m_2} l^2$ (2) $\frac{m_1 + m_2}{m_1 m_2} l^2$

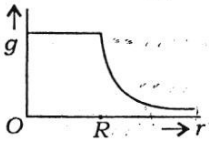
(3) $(m_1 + m_2) l^2$ (4) $\sqrt{m_1 m_2}\, l^2$

11. Starting from the centre of the earth having radius R, the variation of g (acceleration due to gravity) is shown by

(1) 

(2) 

(3) 

(4) 

12. A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0, the value of acceleration due to gravity at the earth's surface, is

(1) $\frac{mg_0R^2}{2(R+h)}$

(2) $-\frac{mg_0R^2}{2(R+h)}$

(3) $\frac{2mg_0R^2}{R+h}$

(4) $-\frac{2mg_0R^2}{R+h}$

13. A rectangular film of liquid is extended from (4 cm × 2 cm) to (5 cm × 4 cm). If the work done is 3×10^{-4} J, the value of the surface tension of the liquid is

(1) 0·250 N m^{-1} (2) 0·125 N m^{-1}

(3) 0·2 N m^{-1} (4) 8·0 N m^{-1}

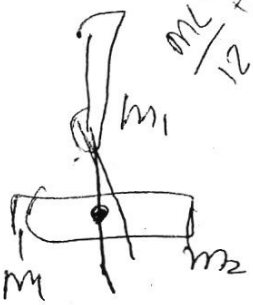
14. Three liquids of densities ρ_1, ρ_2 and ρ_3 (with $\rho_1 > \rho_2 > \rho_3$), having the same value of surface tension T, rise to the same height in three identical capillaries. The angles of contact θ_1, θ_2 and θ_3 obey

(1) $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 \geq 0$

(2) $0 \leq \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$

(3) $\frac{\pi}{2} < \theta_1 < \theta_2 < \theta_3 < \pi$

(4) $\pi > \theta_1 > \theta_2 > \theta_3 > \frac{\pi}{2}$



15. Two identical bodies are made of a material for which the heat capacity increases with temperature. One of these is at 100 °C, while the other one is at 0 °C. If the two bodies are brought into contact, then, assuming no heat loss, the final common temperature is

(1) 50 °C

(2) more than 50 °C

(3) less than 50 °C but greater than 0 °C

(4) 0 °C

16. A body cools from a temperature $3T$ to $2T$ in 10 minutes. The room temperature is T. Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 10 minutes will be

(1) $\frac{7}{4}T$ (2) $\frac{3}{2}T$

(3) $\frac{4}{3}T$ (4) T

17. One mole of an ideal monatomic gas undergoes a process described by the equation PV^3 = constant. The heat capacity of the gas during this process is

(1) $\frac{3}{2}R$ (2) $\frac{5}{2}R$

(3) $2R$ (4) R

18. The temperature inside a refrigerator is t_2 °C and the room temperature is t_1 °C. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be

(1) $\frac{t_1}{t_1 - t_2}$ (2) $\frac{t_1 + 273}{t_1 - t_2}$

(3) $\frac{t_2 + 273}{t_1 - t_2}$ (4) $\frac{t_1 + t_2}{t_1 + 273}$

19. A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule of the gas is m. Which of the following gives the density of the gas?

(1) $P/(kT)$ (2) $Pm/(kT)$

(3) $P/(kTV)$ (4) mkT

20. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3 s. When the mass m is increased by 1 kg, the time period of oscillations becomes 5 s. The value of m in kg is

(1) $\frac{3}{4}$ (2) $\frac{4}{3}$

(3) $\frac{16}{9}$ (4) $\frac{9}{16}$

21. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L metre long. The length of the open pipe will be

(1) L (2) $2L$

(3) $\frac{L}{2}$ (4) $4L$

22. Three sound waves of equal amplitudes have frequencies $(n-1)$, n, $(n+1)$. They superimpose to give beats. The number of beats produced per second will be

(1) 1 (2) 4

(3) 3 (4) 2

23. An electric dipole is placed at an angle of 30° with an electric field intensity 2×10^5 N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is

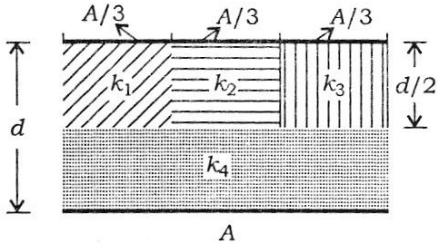
(1) 8 mC

(2) 2 mC

(3) 5 mC

(4) 7 μC

24. A parallel-plate capacitor of area A, plate separation d and capacitance C is filled with four dielectric materials having dielectric constants k_1, k_2, k_3 and k_4 as shown in the figure below. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectric constant k is given by



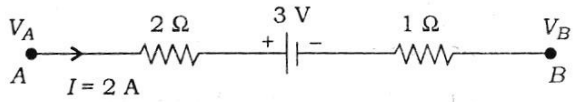
(1) $k = k_1 + k_2 + k_3 + 3k_4$

(2) $k = \frac{2}{3}(k_1 + k_2 + k_3) + 2k_4$

(3) $\frac{2}{k} = \frac{3}{k_1 + k_2 + k_3} + \frac{1}{k_4}$

(4) $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \frac{3}{2k_4}$

25. The potential difference $(V_A - V_B)$ between the points A and B in the given figure is



(1) −3 V (2) +3 V

(3) +6 V (4) +9 V

26. A filament bulb (500 W, 100 V) is to be used in a 230 V main supply. When a resistance R is connected in series, it works perfectly and the bulb consumes 500 W. The value of R is

(1) 230 Ω (2) 46 Ω

(3) 26 Ω (4) 13 Ω

27. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be

(1) nB (2) n^2B

(3) $2nB$ (4) $2n^2B$

28. A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W. Now the torque required to keep the magnet in this new position is

(1) $\frac{W}{\sqrt{3}}$ (2) $\sqrt{3}W$

(3) $\frac{\sqrt{3}W}{2}$ (4) $\frac{2W}{\sqrt{3}}$

29. An electron is moving in a circular path under the influence of a transverse magnetic field of $3{\cdot}57 \times 10^{-2}$ T. If the value of e/m is $1{\cdot}76 \times 10^{11}$ C/kg, the frequency of revolution of the electron is

(1) 1 GHz (2) 100 MHz

(3) 62·8 MHz (4) 6·28 MHz

30. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication?

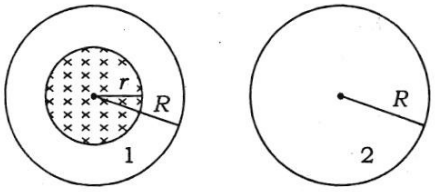
(1) $R = 20\ \Omega$, $L = 1{\cdot}5$ H, $C = 35\ \mu$F

(2) $R = 25\ \Omega$, $L = 2{\cdot}5$ H, $C = 45\ \mu$F

(3) $R = 15\ \Omega$, $L = 3{\cdot}5$ H, $C = 30\ \mu$F

(4) $R = 25\ \Omega$, $L = 1{\cdot}5$ H, $C = 45\ \mu$F

31. A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius $R > r$ encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in the figure below. Then the e.m.f. generated is



(1) zero in loop 1 and zero in loop 2

(2) $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 2

(3) $-\frac{d\vec{B}}{dt}\pi R^2$ in loop 1 and zero in loop 2

(4) $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2

32. The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is

(1) 0·4 (2) 0·5

(3) 0·8 (4) 1·0

33. A 100 Ω resistance and a capacitor of 100 Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is

(1) 2·2 A (2) 11 A

(3) 4·4 A (4) $11\sqrt{2}$ A

34. Two identical glass ($\mu_g = 3/2$) equiconvex lenses of focal length f each are kept in contact. The space between the two lenses is filled with water ($\mu_w = 4/3$). The focal length of the combination is

(1) $f/3$ (2) f

(3) $4f/3$ (4) $3f/4$

35. An air bubble in a glass slab with refractive index 1·5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is

(1) 8 (2) 10

(3) 12 (4) 16

36. The interference pattern is obtained with two coherent light sources of intensity ratio n. In the interference pattern, the ratio

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

will be

(1) $\frac{\sqrt{n}}{n+1}$

(2) $\frac{2\sqrt{n}}{n+1}$

(3) $\frac{\sqrt{n}}{(n+1)^2}$

(4) $\frac{2\sqrt{n}}{(n+1)^2}$

37. A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be

(1) convex, +2·25 diopter

(2) concave, −0·25 diopter

(3) concave, −0·2 diopter

(4) convex, +0·15 diopter

38. A linear aperture whose width is 0·02 cm is placed immediately in front of a lens of focal length 60 cm. The aperture is illuminated normally by a parallel beam of wavelength 5×10^{-5} cm. The distance of the first dark band of the diffraction pattern from the centre of the screen is

(1) 0·10 cm

(2) 0·25 cm

(3) 0·20 cm

(4) 0·15 cm

39. Electrons of mass m with de-Broglie wavelength λ fall on the target in an X-ray tube. The cutoff wavelength (λ_0) of the emitted X-ray is

(1) $\lambda_0 = \dfrac{2mc\lambda^2}{h}$

(2) $\lambda_0 = \dfrac{2h}{mc}$

(3) $\lambda_0 = \dfrac{2m^2c^2\lambda^3}{h^2}$

(4) $\lambda_0 = \lambda$

40. Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6 eV are incident on C, no photoelectrons will reach the anode A, if the stopping potential of A relative to C is

(1) +3 V

(2) +4 V

(3) −1 V

(4) −3 V

41. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be

(1) $\dfrac{16}{25}\lambda$ (2) $\dfrac{9}{16}\lambda$

(3) $\dfrac{20}{7}\lambda$ (4) $\dfrac{20}{13}\lambda$

42. The half-life of a radioactive substance is 30 minutes. The time (in minutes) taken between 40% decay and 85% decay of the same radioactive substance is

(1) 15 (2) 30

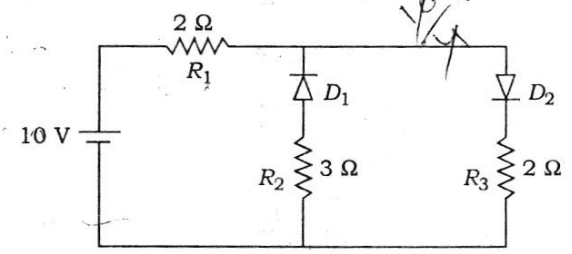
(3) 45 (4) 60

43. For CE transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 4 V. If the current amplification factor of the transistor is 100 and the base resistance is 1 kΩ, then the input signal voltage is

(1) 10 mV (2) 20 mV

(3) 30 mV (4) 15 mV

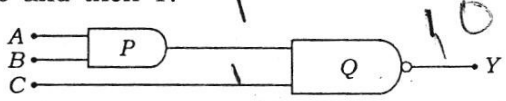
44. The given circuit has two ideal diodes connected as shown in the figure below. The current flowing through the resistance R_1 will be



(1) 2·5 A (2) 10·0 A

(3) 1·43 A (4) 3·13 A

45. What is the output Y in the following circuit, when all the three inputs A, B, C are first 0 and then 1?



(1) 0, 1 (2) 0, 0

(3) 1, 0 (4) 1, 1

46. Which one of the following compounds shows the presence of intramolecular hydrogen bond?

(1) H_2O_2

(2) HCN

(3) Cellulose

(4) Concentrated acetic acid

47. The molar conductivity of a $0{\cdot}5\ mol/dm^3$ solution of $AgNO_3$ with electrolytic conductivity of $5{\cdot}76 \times 10^{-3}\ S\ cm^{-1}$ at 298 K is

(1) $2{\cdot}88\ S\ cm^2/mol$

(2) $11{\cdot}52\ S\ cm^2/mol$

(3) $0{\cdot}086\ S\ cm^2/mol$

(4) $28{\cdot}8\ S\ cm^2/mol$

48. The decomposition of phosphine (PH_3) on tungsten at low pressure is a first-order reaction. It is because the

(1) rate is proportional to the surface coverage

(2) rate is inversely proportional to the surface coverage

(3) rate is independent of the surface coverage

(4) rate of decomposition is very slow

49. The coagulation values in millimoles per litre of the electrolytes used for the coagulation of As_2S_3 are given below :

I. (NaCl) = 52, II. ($BaCl_2$) = 0·69,

III. ($MgSO_4$) = 0·22

The **correct** order of their coagulating power is

(1) I > II > III (2) II > I > III

(3) III > II > I (4) III > I > II

50. During the electrolysis of molten sodium chloride, the time required to produce 0·10 mol of chlorine gas using a current of 3 amperes is

(1) 55 minutes

(2) 110 minutes

(3) 220 minutes

(4) 330 minutes

51. How many electrons can fit in the orbital for which $n = 3$ and $l = 1$?

(1) 2 (2) 6

(3) 10 (4) 14

52. For a sample of perfect gas when its pressure is changed isothermally from p_i to p_f, the entropy change is given by

(1) $\Delta S = nR \ln\left(\frac{p_f}{p_i}\right)$

(2) $\Delta S = nR \ln\left(\frac{p_i}{p_f}\right)$

(3) $\Delta S = nRT \ln\left(\frac{p_f}{p_i}\right)$

(4) $\Delta S = RT \ln\left(\frac{p_i}{p_f}\right)$

53. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

(1) 0 (2) 1

(3) 2 (4) 3

54. The percentage of pyridine (C_5H_5N) that forms pyridinium ion ($C_5H_5N^+H$) in a 0·10 M aqueous pyridine solution (K_b for $C_5H_5N = 1{\cdot}7 \times 10^{-9}$) is

(1) 0·0060%

(2) 0·013%

(3) 0·77%

(4) 1·6%

55. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are

(1) 4 and 2

(2) 6 and 6

(3) 8 and 4

(4) 4 and 8

56. If the E°_{cell} for a given reaction has a negative value, which of the following gives the **correct** relationships for the values of ΔG° and K_{eq}?

(1) $\Delta G^\circ > 0;\ K_{eq} < 1$

(2) $\Delta G^\circ > 0;\ K_{eq} > 1$

(3) $\Delta G^\circ < 0;\ K_{eq} > 1$

(4) $\Delta G^\circ < 0;\ K_{eq} < 1$

57. Which one of the following is **incorrect** for ideal solution?

(1) $\Delta H_{mix} = 0$

(2) $\Delta U_{mix} = 0$

(3) $\Delta P = P_{obs} - P_{calculated\ by\ Raoult's\ law} = 0$

(4) $\Delta G_{mix} = 0$

58. The solubility of AgCl (s) with solubility product $1{\cdot}6 \times 10^{-10}$ in $0{\cdot}1\ M$ NaCl solution would be

(1) $1{\cdot}26 \times 10^{-5}\ M$

(2) $1{\cdot}6 \times 10^{-9}\ M$

(3) $1{\cdot}6 \times 10^{-11}\ M$

(4) zero

59. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0·1 mole of XY_2 weighs 10 g and 0·05 mole of X_3Y_2 weighs 9 g, the atomic weights of X and Y are

(1) 40, 30 (2) 60, 40

(3) 20, 30 (4) 30, 20

60. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is (charge on electron = $1{\cdot}60 \times 10^{-19}$ C)

(1) 6×10^{23} (2) 6×10^{20}

(3) $3{\cdot}75 \times 10^{20}$ (4) $7{\cdot}48 \times 10^{23}$

61. Boric acid is an acid because its molecule

(1) contains replaceable H^+ ion

(2) gives up a proton

(3) accepts OH^- from water releasing proton

(4) combines with proton from water molecule

62. AlF_3 is soluble in HF only in presence of KF. It is due to the formation of

(1) $K_3[AlF_3H_3]$ (2) $K_3[AlF_6]$

(3) AlH_3 (4) $K[AlF_3H]$

63. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because

(1) zinc is lighter than iron

(2) zinc has lower melting point than iron

(3) zinc has lower negative electrode potential than iron

(4) zinc has higher negative electrode potential than iron

64. The suspension of slaked lime in water is known as

(1) limewater

(2) quicklime

(3) milk of lime

(4) aqueous solution of slaked lime

65. The hybridizations of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are

(1) *sp*, sp^3 and sp^2

(2) sp^2, sp^3 and *sp*

(3) *sp*, sp^2 and sp^3

(4) sp^2, *sp* and sp^3

66. Which of the following fluoro-compounds is most likely to behave as a Lewis base?

(1) BF_3 (2) PF_3

(3) CF_4 (4) SiF_4

67. Which of the following pairs of ions is isoelectronic and isostructural?

(1) CO_3^{2-}, NO_3^- (2) ClO_3^-, CO_3^{2-}

(3) SO_3^{2-}, NO_3^- (4) ClO_3^-, SO_3^{2-}

68. In context with beryllium, which one of the following statements is **incorrect**?

(1) It is rendered passive by nitric acid.

(2) It forms Be_2C.

(3) Its salts rarely hydrolyze.

(4) Its hydride is electron-deficient and polymeric.

69. Hot concentrated sulphuric acid is a moderately strong oxidizing agent. Which of the following reactions **does not** show oxidizing behaviour?

(1) $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

(2) $3S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$

(3) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$

(4) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

70. Which of the following pairs of *d*-orbitals will have electron density along the axes?

(1) d_{z^2}, d_{xz}

(2) d_{xz}, d_{yz}

(3) d_{z^2}, $d_{x^2-y^2}$

(4) d_{xy}, $d_{x^2-y^2}$

71. The **correct** geometry and hybridization for XeF_4 are

(1) octahedral, sp^3d^2

(2) trigonal bipyramidal, sp^3d

(3) planar triangle, sp^3d^3

(4) square planar, sp^3d^2

72. Among the following, which one is a **wrong** statement?

(1) PH_5 and $BiCl_5$ do not exist.

(2) $p\pi$-$d\pi$ bonds are present in SO_2.

(3) SeF_4 and CH_4 have same shape.

(4) I_3^+ has bent geometry.

73. The **correct** increasing order of *trans*-effect of the following species is

(1) $NH_3 > CN^- > Br^- > C_6H_5^-$

(2) $CN^- > C_6H_5^- > Br^- > NH_3$

(3) $Br^- > CN^- > NH_3 > C_6H_5^-$

(4) $CN^- > Br^- > C_6H_5^- > NH_3$

74. Which one of the following statements related to lanthanons is **incorrect**?

(1) Europium shows +2 oxidation state.

(2) The basicity decreases as the ionic radius decreases from Pr to Lu.

(3) All the lanthanons are much more reactive than aluminium.

(4) Ce(+4) solutions are widely used as oxidizing agent in volumetric analysis.

75. Jahn-Teller effect is **not** observed in high spin complexes of

(1) d^7 (2) d^8

(3) d^4 (4) d^9

76. Which of the following can be used as the halide component for Friedel-Crafts reaction?

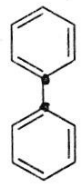
(1) Chlorobenzene

(2) Bromobenzene

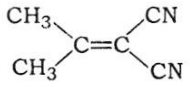
(3) Chloroethene

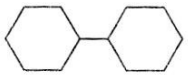
(4) Isopropyl chloride

77. In which of the following molecules, all atoms are coplanar?

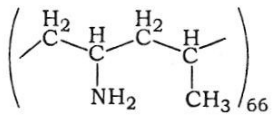
(1) 

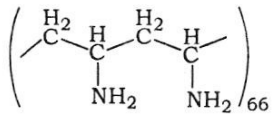
(2) 

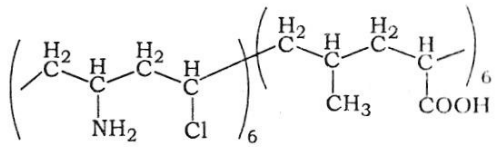
(3) 

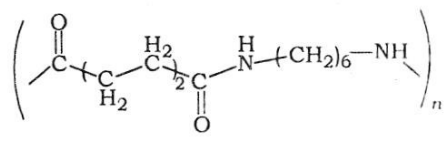
(4) 

78. Which one of the following structures represents nylon 6,6 polymer?

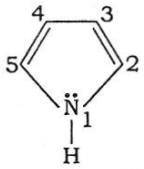
(1) 

(2) 

(3) 

(4) 

79. In pyrrole



the electron density is maximum on

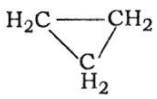
(1) 2 and 3

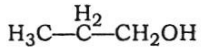
(2) 3 and 4

(3) 2 and 4

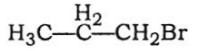
(4) 2 and 5

80. Which of the following compounds shall **not** produce propene by reaction with HBr followed by elimination or direct only elimination reaction?

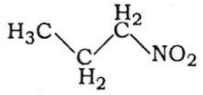
(1) 

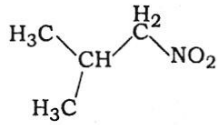
(2) 

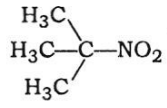
(3) $H_2C{=}C{=}O$

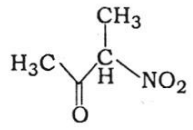
(4) 

81. Which one of the following nitro-compounds **does not** react with nitrous acid?

(1) 

(2) 

(3) 

(4) 

82. The central dogma of molecular genetics states that the genetic information flows from

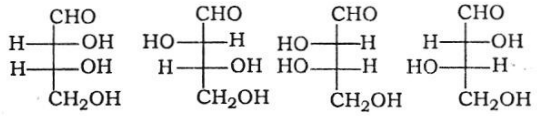
(1) Amino acids → Proteins → DNA

(2) DNA → Carbohydrates → Proteins

(3) DNA → RNA → Proteins

(4) DNA → RNA → Carbohydrates

83. The **correct** corresponding order of names of four aldoses with configuration given below



respectively, is

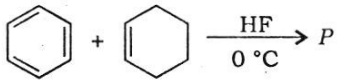
(1) L-erythrose, L-threose, L-erythrose, D-threose

(2) D-threose, D-erythrose, L-threose, L-erythrose

(3) L-erythrose, L-threose, D-erythrose, D-threose

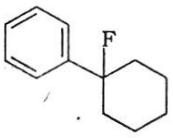
(4) D-erythrose, D-threose, L-erythrose, L-threose

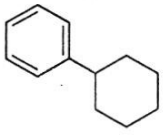
84. In the given reaction

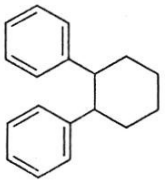


the product *P* is

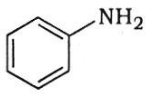
(1) 

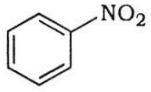
(2) 

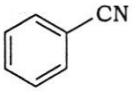
(3) 

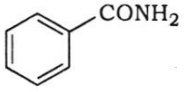
(4) 

85. A given nitrogen-containing aromatic compound *A* reacts with Sn/HCl, followed by HNO_2 to give an unstable compound *B*. *B*, on treatment with phenol, forms a beautiful coloured compound *C* with the molecular formula $C_{12}H_{10}N_2O$. The structure of compound *A* is

(1) 

(2) 

(3) 

(4) 

86. Consider the reaction

$CH_3CH_2CH_2Br + NaCN \rightarrow CH_3CH_2CH_2CN + NaBr$

This reaction will be the fastest in

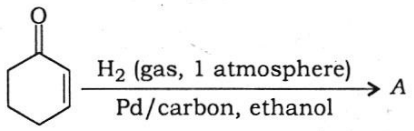
(1) ethanol

(2) methanol

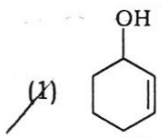
(3) *N*,*N*′-dimethylformamide (DMF)

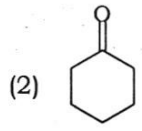
(4) water

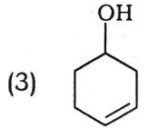
87. The **correct** structure of the product *A* formed in the reaction

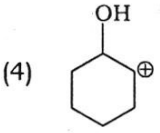


is

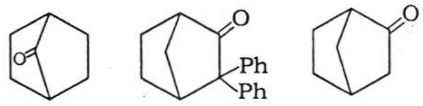
(1) 

(2) 

(3) 

(4) 

88. Which among the given molecules can exhibit tautomerism?



I II III

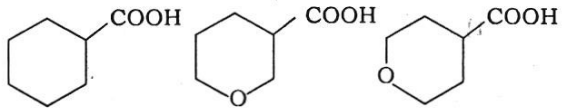
(1) III only

(2) Both I and III

(3) Both I and II

(4) Both II and III

89. The **correct** order of strengths of the carboxylic acids



I II III

is

(1) I > II > III

(2) II > III > I

(3) III > II > I

(4) II > I > III

90. The compound that will react most readily with gaseous bromine has the formula

(1) C_3H_6

(2) C_2H_2

(3) C_4H_{10}

(4) C_2H_4

91. Which one of the following is **wrong** for fungi?

(1) They are eukaryotic.

(2) All fungi possess a purely cellulosic cell wall.

(3) They are heterotrophic.

(4) They are both unicellular and multicellular.

92. Methanogens belong to

(1) Eubacteria

(2) Archaebacteria

(3) Dinoflagellates

(4) Slime moulds

93. Select the **wrong** statement.

(1) The walls of diatoms are easily destructible.

(2) 'Diatomaceous earth' is formed by the cell walls of diatoms.

(3) Diatoms are chief producers in the oceans.

(4) Diatoms are microscopic and float passively in water.

94. The label of a herbarium sheet **does not** carry information on

(1) date of collection

(2) name of collector

(3) local names

(4) height of the plant

95. Conifers are adapted to tolerate extreme environmental conditions because of

(1) broad hardy leaves

(2) superficial stomata

(3) thick cuticle

(4) presence of vessels

96. Which one of the following statements is **wrong** ?

(1) Algae increase the level of dissolved oxygen in the immediate environment.

(2) Algin is obtained from red algae, and carrageenan from brown algae.

(3) Agar-agar is obtained from *Gelidium* and *Gracilaria*.

(4) *Laminaria* and *Sargassum* are used as food.

97. The term 'polyadelphous' is related to

(1) gynoecium

(2) androecium

(3) corolla

(4) calyx

98. How many plants among *Indigofera*, *Sesbania*, *Salvia*, *Allium*, *Aloe*, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers?

(1) Three

(2) Four

(3) Five

(4) Six

99. Radial symmetry is found in the flowers of

(1) *Brassica*

(2) *Trifolium*

(3) *Pisum*

(4) *Cassia*

100. Free-central placentation is found in

(1) *Dianthus*

(2) *Argemone*

(3) *Brassica*

(4) *Citrus*

101. Cortex is the region found between

(1) epidermis and stele

(2) pericycle and endodermis

(3) endodermis and pith

(4) endodermis and vascular bundle

102. The balloon-shaped structures called tyloses

(1) originate in the lumen of vessels

(2) characterize the sapwood

(3) are extensions of xylem parenchyma cells into vessels

(4) are linked to the ascent of sap through xylem vessels

03. A non-proteinaceous enzyme is

(1) lysozyme

(2) ribozyme

(3) ligase

(4) deoxyribonuclease

104. Select the **mismatch**.

(1) Gas vacuoles—Green bacteria

(2) Large central vacuoles—Animal cells

(3) Protists—Eukaryotes

(4) Methanogens—Prokaryotes

105. Select the **wrong** statement.

(1) Bacterial cell wall is made up of peptidoglycan.

(2) Pili and fimbriae are mainly involved in motility of bacterial cells.

(3) Cyanobacteria lack flagellated cells.

(4) *Mycoplasma* is a wall-less microorganism.

106. A cell organelle containing hydrolytic enzymes is

(1) lysosome

(2) microsome

(3) ribosome

(4) mesosome

107. During cell growth, DNA synthesis takes place in

(1) S phase

(2) G_1 phase

(3) G_2 phase

(4) M phase

108. Which of the following biomolecules is common to respiration-mediated breakdown of fats, carbohydrates and proteins?

(1) Glucose-6-phosphate

(2) Fructose 1,6-bisphosphate

(3) Pyruvic acid

(4) Acetyl CoA

109. A few drops of sap were collected by cutting across a plant stem by a suitable method. The sap was tested chemically. Which one of the following test results indicates that it is phloem sap?

(1) Acidic

(2) Alkaline

(3) Low refractive index

(4) Absence of sugar

110. You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots?

(1) IAA and gibberellin

(2) Auxin and cytokinin

(3) Auxin and abscisic acid

(4) Gibberellin and abscisic acid

111. Phytochrome is a

(1) flavoprotein

(2) glycoprotein

(3) lipoprotein

(4) chromoprotein

112. Which is essential for the growth of root tip?

(1) Zn (2) Fe

(3) Ca (4) Mn

113. The process which makes major difference between C_3 and C_4 plants is

(1) glycolysis

(2) Calvin cycle

(3) photorespiration

(4) respiration

114. Which one of the following statements is **not** correct?

(1) Offspring produced by the asexual reproduction are called clone.

(2) Microscopic, motile asexual reproductive structures are called zoospores.

(3) In potato, banana and ginger, the plantlets arise from the internodes present in the modified stem.

(4) Water hyacinth, growing in the standing water, drains oxygen from water that leads to the death of fishes.

115. Which one of the following generates new genetic combinations leading to variation?

(1) Vegetative reproduction

(2) Parthenogenesis

(3) Sexual reproduction

(4) Nucellar polyembryony

116. Match **Column—I** with **Column—II** and select the correct option using the codes given below :

Column—I	**Column—II**
a. Pistils fused together	(i) Gametogenesis
b. Formation of gametes	(ii) Pistillate
c. Hyphae of higher Ascomycetes	(iii) Syncarpous
d. Unisexual female flower	(iv) Dikaryotic

Codes :

	a	b	c	d
(1)	(iv)	(iii)	(i)	(ii)
(2)	(ii)	(i)	(iv)	(iii)
(3)	(i)	(ii)	(iv)	(iii)
(4)	(iii)	(i)	(iv)	(ii)

117. In majority of angiosperms

(1) egg has a filiform apparatus

(2) there are numerous antipodal cells

(3) reduction division occurs in the megaspore mother cells

(4) a small central cell is present in the embryo sac

118. Pollination in water hyacinth and water lily is brought about by the agency of

(1) water

(2) insects or wind

(3) birds

(4) bats

119. The ovule of an angiosperm is technically equivalent to

(1) megasporangium

(2) megasporophyll

(3) megaspore mother cell

(4) megaspore

120. Taylor conducted the experiments to prove semiconservative mode of chromosome replication on

(1) *Vinca rosea*

(2) *Vicia faba*

(3) *Drosophila melanogaster*

(4) *E. coli*

121. The mechanism that causes a gene to move from one linkage group to another is called

(1) inversion

(2) duplication

(3) translocation

(4) crossing-over

122. The equivalent of a structural gene is

(1) muton

(2) cistron

(3) operon

(4) recon

123. A true breeding plant is

(1) one that is able to breed on its own

(2) produced due to cross-pollination among unrelated plants

(3) near homozygous and produces offspring of its own kind

(4) always homozygous recessive in its genetic constitution

124. Which of the following rRNAs acts as structural RNA as well as ribozyme in bacteria?

(1) 5 S rRNA

(2) 18 S rRNA

(3) 23 S rRNA

(4) 5·8 S rRNA

125. Stirred-tank bioreactors have been designed for

(1) purification of product

(2) addition of preservatives to the product

(3) availability of oxygen throughout the process

(4) ensuring anaerobic conditions in the culture vessel

126. A foreign DNA and plasmid cut by the same restriction endonuclease can be joined to form a recombinant plasmid using

(1) *Eco* RI

(2) *Taq* polymerase

(3) polymerase III

(4) ligase

127. Which of the following is **not** a component of downstream processing?

(1) Separation

(2) Purification

(3) Preservation

(4) Expression

128. Which of the following restriction enzymes produces blunt ends?

(1) *Sal* I

(2) *Eco* RV

(3) *Xho* I

(4) *Hind* III

129. Which kind of therapy was given in 1990 to a four-year-old girl with adenosine deaminase (ADA) deficiency?

(1) Gene therapy

(2) Chemotherapy

(3) Immunotherapy

(4) Radiation therapy

130. How many hot spots of biodiversity in the world have been identified till date by Norman Myers?

(1) 17

(2) 25

(3) 34

(4) 43

131. The primary producers of the deep-sea hydrothermal vent ecosystem are

(1) green algae

(2) chemosynthetic bacteria

(3) blue-green algae

(4) coral reefs

132. Which of the following is **correct** for *r*-selected species?

(1) Large number of progeny with small size

(2) Large number of progeny with large size

(3) Small number of progeny with small size

(4) Small number of progeny with large size

133. If '+' sign is assigned to beneficial interaction, '–' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '–' refers to

(1) mutualism

(2) amensalism

(3) commensalism

(4) parasitism

134. Which of the following is **correctly** matched?

(1) Aerenchyma—*Opuntia*

(2) Age pyramid—Biome

(3) *Parthenium hysterophorus*—Threat to biodiversity

(4) Stratification—Population

135. Red List contains data or information on

(1) all economically important plants

(2) plants whose products are in international trade

(3) threatened species

(4) marine vertebrates only

136. Which of the following sets of diseases is caused by bacteria?
(1) Cholera and tetanus
(2) Typhoid and smallpox
(3) Tetanus and mumps
(4) Herpes and influenza

137. Match **Column—I** with **Column—II** for housefly classification and select the correct option using the codes given below :

	Column—I		**Column—II**
a.	Family	(i)	Diptera
b.	Order	(ii)	Arthropoda
c.	Class	(iii)	Muscidae
d.	Phylum	(iv)	Insecta

Codes :

	a	b	c	d
(1)	(iii)	(i)	(iv)	(ii)
(2)	(iii)	(ii)	(iv)	(i)
(3)	(iv)	(iii)	(ii)	(i)
(4)	(iv)	(ii)	(i)	(iii)

138. Choose the **correct** statement.
(1) All mammals are viviparous.
(2) All cyclostomes do not possess jaws and paired fins.
(3) All reptiles have a three-chambered heart.
(4) All Pisces have gills covered by an operculum.

139. Study the four statements (A–D) given below and select the two correct ones out of them :
A. Definition of biological species was given by Ernst Mayr.
B. Photoperiod does not affect reproduction in plants.
C. Binomial nomenclature system was given by R. H. Whittaker.
D. In unicellular organisms, reproduction is synonymous with growth.

The two **correct** statements are
(1) B and C (2) C and D
(3) A and D (4) A and B

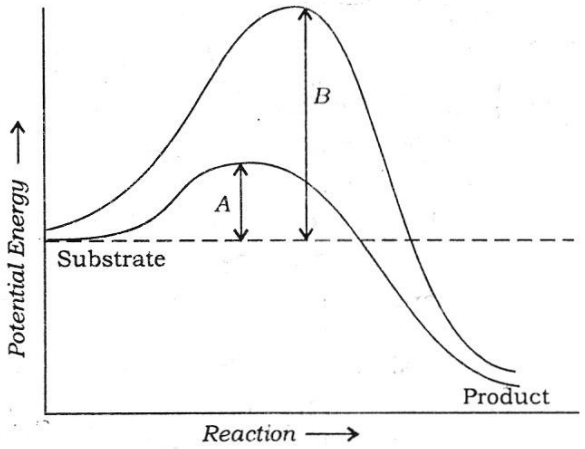
140. In male cockroaches, sperms are stored in which part of the reproductive system?
(1) Seminal vesicles
(2) Mushroom glands
(3) Testes
(4) Vas deferens

141. Smooth muscles are
(1) involuntary, fusiform, non-striated
(2) voluntary, multinucleate, cylindrical
(3) involuntary, cylindrical, striated
(4) voluntary, spindle-shaped, uninucleate

142. Oxidative phosphorylation is
(1) formation of ATP by transfer of phosphate group from a substrate to ADP
(2) oxidation of phosphate group in ATP
(3) addition of phosphate group to ATP
(4) formation of ATP by energy released from electrons removed during substrate oxidation

143. Which of the following is the least likely to be involved in stabilizing the three-dimensional folding of most proteins?
(1) Hydrogen bonds
(2) Electrostatic interaction
(3) Hydrophobic interaction
(4) Ester bonds

144. Which of the following describes the given graph **correctly**?



(1) Endothermic reaction with energy *A* in presence of enzyme and *B* in absence of enzyme
(2) Exothermic reaction with energy *A* in presence of enzyme and *B* in absence of enzyme
(3) Endothermic reaction with energy *A* in absence of enzyme and *B* in presence of enzyme
(4) Exothermic reaction with energy *A* in absence of enzyme and *B* in presence of enzyme

145. When cell has stalled DNA replication fork, which checkpoint should be predominantly activated?
(1) G_1/S
(2) G_2/M
(3) M
(4) Both G_2/M and M

146. Match the stages of meiosis in **Column—I** to their characteristic features in **Column—II** and select the correct option using the codes given below :

	Column—I		**Column—II**
a.	Pachytene	(i)	Pairing of homologous chromosomes
b.	Metaphase I	(ii)	Terminalization of chiasmata
c.	Diakinesis	(iii)	Crossing-over takes place
d.	Zygotene	(iv)	Chromosomes align at equatorial plate

Codes :

	a	b	c	d
(1)	(iii)	(iv)	(ii)	(i)
(2)	(i)	(iv)	(ii)	(iii)
(3)	(ii)	(iv)	(iii)	(i)
(4)	(iv)	(iii)	(ii)	(i)

147. Which hormones do stimulate the production of pancreatic juice and bicarbonate?

(1) Angiotensin and epinephrine
(2) Gastrin and insulin
(3) Cholecystokinin and secretin
(4) Insulin and glucagon

148. The partial pressure of oxygen in the alveoli of the lungs is

(1) equal to that in the blood
(2) more than that in the blood
(3) less than that in the blood
(4) less than that of carbon dioxide

149. Choose the **correct** statement.

(1) Nociceptors respond to changes in pressure.
(2) Meissner's corpuscles are thermo-receptors.
(3) Photoreceptors in the human eye are depolarized during darkness and become hyperpolarized in response to the light stimulus.
(4) Receptors do not produce graded potentials.

150. Graves' disease is caused due to

(1) hyposecretion of thyroid gland
(2) hypersecretion of thyroid gland
(3) hyposecretion of adrenal gland
(4) hypersecretion of adrenal gland

151. Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction.

(1) Calcium (2) Magnesium
(3) Sodium (4) Potassium

152. Name the blood cells, whose reduction in number can cause clotting disorder, leading to excessive loss of blood from the body.

(1) Erythrocytes
(2) Leucocytes
(3) Neutrophils
(4) Thrombocytes

153. Name a peptide hormone which acts mainly on hepatocytes, adipocytes and enhances cellular glucose uptake and utilization.

(1) Insulin (2) Glucagon
(3) Secretin (4) Gastrin

154. Osteoporosis, an age-related disease of skeletal system, may occur due to

(1) immune disorder affecting neuro-muscular junction leading to fatigue
(2) high concentration of Ca^{++} and Na^{+}
(3) decreased level of estrogen
(4) accumulation of uric acid leading to inflammation of joints

155. Serum differs from blood in

(1) lacking globulins
(2) lacking albumins
(3) lacking clotting factors
(4) lacking antibodies

156. Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because

(1) there is a negative pressure in the lungs
(2) there is a negative intrapleural pressure pulling at the lung walls
(3) there is a positive intrapleural pressure
(4) pressure in the lungs is higher than the atmospheric pressure

157. The posterior pituitary gland is **not** a 'true' endocrine gland because

(1) it is provided with a duct
(2) it only stores and releases hormones
(3) it is under the regulation of hypo-thalamus
(4) it secretes enzymes

158. The part of nephron involved in active reabsorption of sodium is
(1) distal convoluted tubule
(2) proximal convoluted tubule
(3) Bowman's capsule
(4) descending limb of Henle's loop

159. Which of the following is hormone-releasing IUD?
(1) LNG-20
(2) Multiload 375
(3) Lippes loop
(4) Cu7

160. Which of the following is **incorrect** regarding vasectomy?
(1) No sperm occurs in seminal fluid
(2) No sperm occurs in epididymis
(3) Vasa deferentia is cut and tied
(4) Irreversible sterility

161. Embryo with more than 16 blastomeres formed due to *in vitro* fertilization is transferred into
(1) uterus
(2) fallopian tube
(3) fimbriae
(4) cervix

162. Which of the following depicts the **correct** pathway of transport of sperms?
(1) Rete testis → Efferent ductules → Epididymis → Vas deferens
(2) Rete testis → Epididymis → Efferent ductules → Vas deferens
(3) Rete testis → Vas deferens → Efferent ductules → Epididymis
(4) Efferent ductules → Rete testis → Vas deferens → Epididymis

163. Match **Column—I** with **Column—II** and select the correct option using the codes given below :

Column—I	**Column—II**
a. Mons pubis	(i) Embryo formation
b. Antrum	(ii) Sperm
c. Trophectoderm	(iii) Female external genitalia
d. Nebenkern	(iv) Graafian follicle

Codes :

	a	b	c	d
(1)	(iii)	(iv)	(ii)	(i)
(2)	(iii)	(iv)	(i)	(ii)
(3)	(iii)	(i)	(iv)	(ii)
(4)	(i)	(iv)	(iii)	(ii)

164. Several hormones like hCG, hPL, estrogen, progesterone are produced by
(1) ovary
(2) placenta
(3) fallopian tube
(4) pituitary

165. If a colour-blind man marries a woman who is homozygous for normal colour vision, the probability of their son being colour-blind is
(1) 0 (2) 0·5
(3) 0·75 (4) 1

166. Genetic drift operates in
(1) small isolated population
(2) large isolated population
(3) non-reproductive population
(4) slow reproductive population

167. In Hardy-Weinberg equation, the frequency of heterozygous individual is represented by
(1) p^2 (2) $2pq$
(3) pq (4) q^2

168. The chronological order of human evolution from early to the recent is
(1) *Australopithecus* → *Ramapithecus* → *Homo habilis* → *Homo erectus*
(2) *Ramapithecus* → *Australopithecus* → *Homo habilis* → *Homo erectus*
(3) *Ramapithecus* → *Homo habilis* → *Australopithecus* → *Homo erectus*
(4) *Australopithecus* → *Homo habilis* → *Ramapithecus* → *Homo erectus*

169. Which of the following is the **correct** sequence of events in the origin of life?
I. Formation of protobionts
II. Synthesis of organic monomers
III. Synthesis of organic polymers
IV. Formation of DNA-based genetic systems
(1) I, II, III, IV
(2) I, III, II, IV
(3) II, III, I, IV
(4) II, III, IV, I