Test Booklet Number	Subject Code : 1602	Roll Number
21730	**PHYSICS, CHEMISTRY AND BIOLOGY**	

Time : 3 Hours]

[*Maximum Marks* : 600

SEAL

INSTRUCTIONS TO CANDIDATES

Read the following instructions carefully before you answer the questions given in this Test Booklet :

1. Answers to questions in this Test Booklet are to be given on an **OMR Answer Sheet** provided to the candidate **separately**.

2. Candidate must fill up Name, Category, Test Booklet Number, Subject Code and Roll Number in the Answer Sheet carefully as per instructions given.

3. This Test Booklet consists of 150 questions. All questions are compulsory and carry equal marks.

4. Each question in this Test Booklet has four possible alternative answers namely, (A), (B), (C) and (D), one of which is correct. Candidate should choose the correct answer against each question out of four alternative answers.

5. Candidate is instructed to answer the questions by **darkening** (●) with **Ballpoint Pen** only in the circle bearing the correct answer.

6. Candidate should not attempt more than one answer in each question. More than one attempt in any form against a question shall be treated as incorrect.

7. Marking of answer other than darkening shall be cancelled and darkening should remain within the circle otherwise computer shall not accept during evaluation of Answer Sheet.

8. Rough work must not be done on the Answer Sheet. Use the blank space given in the Test Booklet for rough work.

9. Candidate is to hand over the Answer Sheet to the Invigilator before leaving the Examination Hall.

10. **NEGATIVE MARKING :** Each question carries 4 (four) marks for correct response. For each incorrect response, 1 (one) mark will be deducted from the total score. More than one answer indicated against a question will be deemed as incorrect response and will be negatively marked.

SPACE FOR ROUGH WORK

PHYSICS

1. In the formula for acceleration due to gravity $g = 4\pi^2 \dfrac{l}{T^2}$, if the measurement of l has 2% uncertainty and T has 8% uncertainty, the maximum uncertainty in the value of g is

   (A) 10%   (B) 0·25%

   (C) 18%   (D) 4%

2. A proton of mass $1 \cdot 6 \times 10^{-27}$ kg is moving in a circular path of radius $0 \cdot 1$ m. If the frequency of revolution is 8×10^6 cps, then the effective centrifugal force is approximately

   (A) 4×10^{-15} N

   (B) 4×10^{-13} N

   (C) 4×10^{-11} N

   (D) 4×10^{-9} N

3. The height (y) and the distance (x) along the plane of a projectile is given by

   $$y = (8t - 5t^2) \text{ m} \quad \text{and} \quad x = (6t) \text{ m}$$

   where t is in second. The speed with which the projectile will hit the horizontal plane is

   (A) 6 m/s   (B) 8 m/s

   (C) 10 m/s   (D) 12 m/s

4. A gunman, together with his gun, has a mass of 100 kg. He stands on a smooth surface and fires 10 shots horizontally. Each bullet has a mass of 10 g and a muzzle velocity of 800 ms^{-1}. If the bullets are all fired in 5 s, the average force exerted on the gunman is

   (A) 8 N   (B) 16 N

   (C) 12 N   (D) 20 N

5. A block is moving on an inclined plane making an angle 45° with the horizontal and the coefficient of friction is μ. The force required to just push it up the inclined plane is 3 times the force required to just prevent it from sliding down. If we define $N = 10\mu$, then N is

   (A) 3   (B) 4

   (C) 5   (D) 6

6. The line of action of the resultant of two like parallel forces shifts by one-fourth of the distance between the forces, when the two forces are interchanged. The ratio of the two forces is

   (A) 1:2   (B) 2:3

   (C) 3:4   (D) 3:5

7. The potential energy of a body of mass m is $U(x, y) = ax + by$, a and b being constants. The acceleration of the particle is

   (A) $\dfrac{a+b}{m}$ (B) $\dfrac{a^2+b^2}{m}$

   (C) $\dfrac{\sqrt{a+b}}{m}$ (D) $\dfrac{\sqrt{a^2+b^2}}{m}$

8. A particle m is moving in a vertical circle of radius R inside a track as shown in the figure :
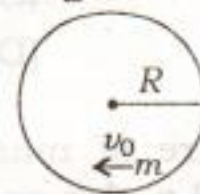
   When m is at its lowest position, its speed is v_0. The minimum value of v_0 for which m will go completely around the circle without losing contact with the track (ignoring friction) is

   (A) $(3gR)^{\frac{1}{2}}$ (B) $(5gR)^{\frac{1}{2}}$

   (C) $(2gR)^{\frac{1}{2}}$ (D) $\left(\dfrac{3}{2}gR\right)^{\frac{1}{2}}$

9. A massless spring with force constant k launches a ball of mass m. In order for the ball to reach a speed v, by what displacement s should the spring be compressed?

(A) $s = v\sqrt{\dfrac{k}{m}}$

(B) $s = v\sqrt{\dfrac{m}{k}}$

(C) $s = v\sqrt{\dfrac{2m}{k}}$

(D) $s = v^2\dfrac{m}{2k}$

10. The moment of inertia of a uniform disc of mass 200 g and radius 5 cm about an axis passing through its edge and perpendicular to the plane of the disc is

(A) $1 \cdot 5 \times 10^{-4}$ kg m^2

(B) $2 \cdot 5 \times 10^{-4}$ kg m^2

(C) $5 \cdot 0 \times 10^{-4}$ kg m^2

(D) $7 \cdot 5 \times 10^{-4}$ kg m^2

11. Two spheres of masses M and $2M$ are at rest at a distance R apart. Due to mutual attraction, they move towards each other. When the spheres are $R/2$ distance apart, their centre of mass will have acceleration

(A) zero

(B) g

(C) $2g$

(D) $3g$

12. The centre of mass of particles of masses 2 g, 4 g and 6 g is at (1 cm, 1 cm, 1 cm). The position vector of fourth particle of mass 4 g to change the centre of mass of new system to (0, 0, 0) is

(A) zero

(B) $(-3\hat{i} - 3\hat{j} - 3\hat{k})$ cm

(C) $(3\hat{i} + 3\hat{j} + 3\hat{k})$ cm

(D) $(-12\hat{i} - 12\hat{j} - 12\hat{k})$ cm

13. A system of binary stars of masses m_A and m_B are moving in circular orbits of radii r_A and r_B respectively. If T_A and T_B are time periods of masses m_A and m_B respectively, then

(A) $\dfrac{T_A}{T_B} = \left[\dfrac{r_A}{r_B}\right]^{\frac{1}{2}}$

(B) $T_A > T_B$ (if $m_A > m_B$)

(C) $T_A > T_B$ (if $r_A > r_B$)

(D) $T_A = T_B$

14. The escape velocity from the earth's surface is 11 kms^{-1}. If the radius of a certain planet is double that of the earth but its average density is the same as that of the earth, then the escape velocity from that planet will be

(A) 22 kms^{-1}

(B) 11 kms^{-1}

(C) $5 \cdot 5$ kms^{-1}

(D) $15 \cdot 5$ kms^{-1}

15. A long metallic bar of uniform cross-section is carrying heat from one of its ends to the other end under steady state. The variation of temperature T along the length x of the bar from its hot end is best described by which of the following graphs?

(A)

(B)

(C)

(D)
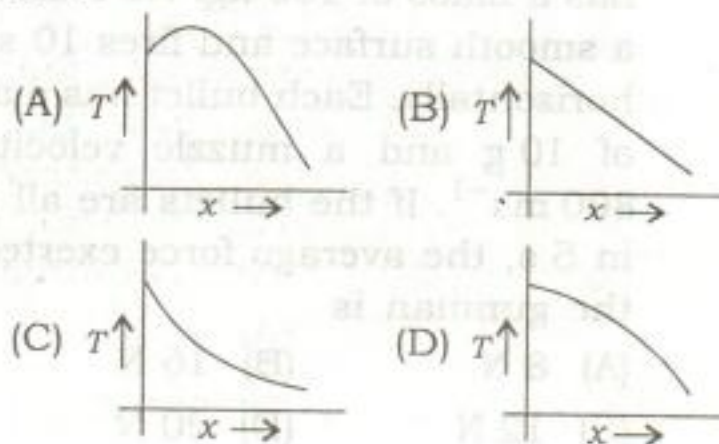
16. A film of soap solution is formed between two parallel wires of length 15 cm separated by 1 cm. The wires are pulled further apart by 2 mm while keeping them parallel. If the surface tension of the soap solution is $0 \cdot 03$ N/m, the work done in the process will be

(A) $0 \cdot 9 \times 10^{-3}$ J

(B) $1 \cdot 8 \times 10^{-3}$ J

(C) $0 \cdot 9 \times 10^{-5}$ J

(D) $1 \cdot 8 \times 10^{-5}$ J

17. A hot body is placed in the surroundings of 20 °C. It cools from 60 °C to 40 °C in 5 minutes. What is the time taken by the body to cool from 40 °C to 30 °C?

(A) $2 \cdot 5$ minutes

(B) 10 minutes

(C) 5 minutes

(D) 15 minutes

18. A given quantity of gas is taken from the state $A \rightarrow C$ reversibly, by two paths $A \rightarrow C$ directly and $A \rightarrow B \rightarrow C$ as shown in the figure :
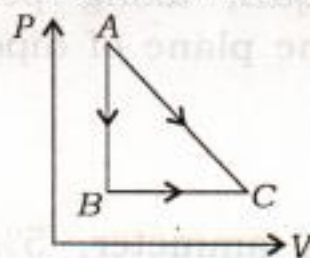
During the process $A \rightarrow C$, the work done by the gas is 100 J and heat absorbed is 150 J. If during the process $A \rightarrow B \rightarrow C$ the work done by gas is 30 J, the heat absorbed is

(A) 20 J   (B) 80 J

(C) 220 J   (D) 280 J

19. The temperature of gas increases by 5 °C if a work of $103 \cdot 75$ kJ is done adiabatically on one kilomole of the gas. If $R = 8 \cdot 3$ J mol^{-1} K^{-1}, how many degrees of freedom the gas has?

(A) Three

(B) Four

(C) Five

(D) Six

20. The relation between pressure P and average kinetic energy E per unit volume of a gas is

(A) $P = 2E / 3$

(B) $P = E / 3$

(C) $P = 3E / 2$

(D) $P = 3E$

21. A gas does 100 J of work when it is expanded isobarically. If the heat given to the gas in this process is 350 J, what will be C_p of the gas?

(A) $\dfrac{3}{2}R$ (B) $\dfrac{5}{2}R$

(C) $\dfrac{7}{2}R$ (D) $\dfrac{9}{2}R$

22. A string of length L fixed at both ends is made to vibrate. If the length of the string L is related to the wavelength λ of the waves by the expression

$$L = (n + 1)\dfrac{\lambda}{2}$$

then the total number of nodes formed in the string will be

(A) $(n + 2)$ (B) n

(C) $(n - 2)$ (D) $(n - 1)$

23. A man standing by a road finds that the ratio of the frequency of the horn of an approaching car, perceived by him is f_1, while the frequency perceived for the receding car is f_2. If $f_2/f_1 = 19/21$ and c is the speed of sound in air, the speed of the car is

(A) $c/10$ (B) $c/20$

(C) $c/19$ (D) $c/21$

24. Water waves whose crests are 25 m apart reach a boat anchored in still water every 5 seconds and make the boat rise and fall through a total range 40 cm. The velocity of the waves is

(A) $5\,\mathrm{ms}^{-1}$ (B) $4\,\mathrm{ms}^{-1}$

(C) $2\,\mathrm{ms}^{-1}$ (D) $1\,\mathrm{ms}^{-1}$

25. A tuning fork of frequency 512 Hz makes 4 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

(A) 508 Hz   (B) 516 Hz

(C) 514 Hz   (D) 510 Hz

26. Three charges $2q$, Q and q are placed in a straight line as shown in the figure :
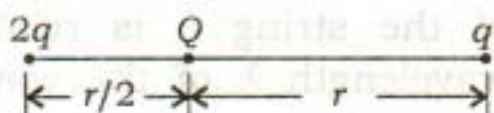
The medium on the right of Q is air and the medium on the left of Q (towards $2q$) is of dielectric constant 3. If force on q due to Q is F, the force on $2q$ due to Q is

(A) F (B) $6F$

(C) $18F$ (D) $24F$

27. Four capacitors, each of value $10\,\mu F$, are connected to a supply of 500 V as shown in the figure :

The equivalent capacitance of the system is

(A) $13 \cdot 3\,\mu F$ (B) $40\,\mu F$

(C) $26 \cdot 6\,\mu F$ (D) $20 \cdot 5\,\mu F$

28. An electric dipole has charges $+q$ and $-q$, and the distance between them is d. The dipole is placed in an uniform electric field of strength E. The maximum torque experienced by the dipole and its direction respectively will be

(A) $2qdE$, in the plane of the dipole and field E

(B) qdE, along perpendicular to the plane of dipole and field E

(C) $q(d+E)$, in the plane of the dipole and field E

(D) $2qdE$, along perpendicular to the plane of dipole and field E

29. In an ammeter, 5% of the main current is passing through the galvanometer. If the resistance of the galvanometer is G, then the resistance of shunt S will be

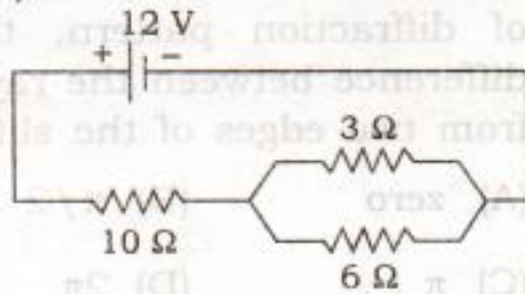(A) $19G$ (B) $G/19$

(C) $20G$ (D) $G/20$

30. In the given circuit, the metre bridge is in its balanced state :
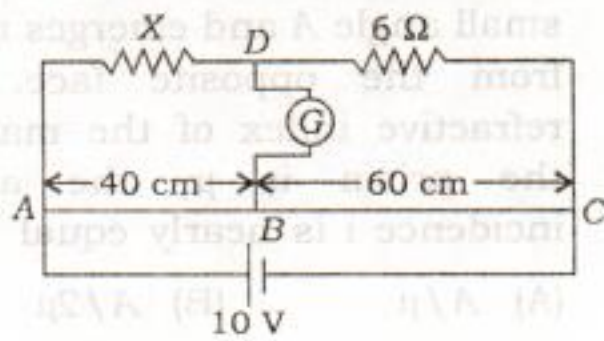
The metre bridge wire has a resistance of $0.1 \, \Omega/cm$. The current drawn from battery of negligible resistance is

(A) 5.0 A   (B) 0.2 A

(C) 0.5 A   (D) 2.0 A

**31.** In the following circuit, the internal resistance of the 12 V battery is zero :

The current flowing through $3 \, \Omega$ resistance is

(A) 0.333 A   (B) 0.667 A

(C) 1.0 A   (D) 1.333 A

32. Two particles A and B having equal charge after being accelerated through same potential difference enter a region of uniform magnetic field and describe circular paths of radius R_1 and R_2 respectively. The ratio of their masses A to that of B is

(A) $\left(\dfrac{R_1}{R_2}\right)$ (B) $\left(\dfrac{R_1}{R_2}\right)^2$

(C) $\left(\dfrac{R_2}{R_1}\right)$ (D) $\left(\dfrac{R_1}{R_2}\right)^{\frac{1}{2}}$

33. Four copper wires of same cross-sectional area are connected in the form of a square $ABCD$. On passing current through them as shown in the figure
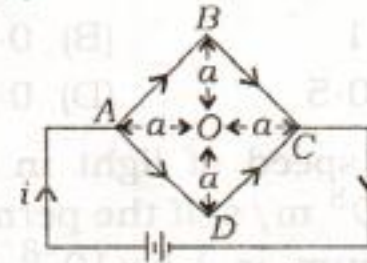

the magnetic field at the centre O of the square is

(A) zero   (B) $\dfrac{4\mu_0 i}{2\pi}$

(C) $\dfrac{2\mu_0 i}{a}$ (D) $\dfrac{\mu_0 i}{2\pi a}$

34. Current I is carried in a wire of length L. If the wire is formed into a circular coil, the maximum magnitude of torque in a given magnetic field B will be

(A) $\dfrac{LIB}{4\pi}$ (B) $\dfrac{L^2 IB}{4\pi}$

(C) $\dfrac{L^2 IB}{2}$ (D) $\dfrac{LIB^2}{2}$

35. A generator with an adjustable frequency of oscillation is connected with resistance $R = 100 \, \Omega$, inductance $L_1 = L_2 = 20$ mH and capacitance $C_1 = C_2 = C_3 = 3 \, \mu F$ as shown in the figure :
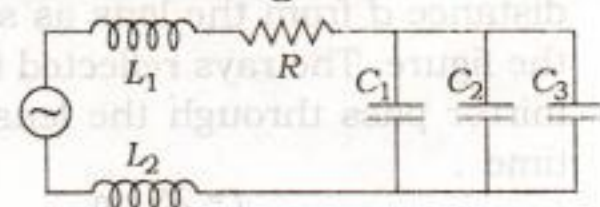
The resonant angular frequency of the circuit is

(A) 6×10^{-4} rad/s

(B) $\dfrac{1}{6} \times 10^{-4}$ rad/s

(C) 6×10^4 rad/s

(D) $\dfrac{1}{6} \times 10^4$ rad/s

36. A circuit draws 5 A r.m.s. current at 4 V r.m.s. voltage and whose average power consumption is 100 W. The power factor for this circuit is

(A) 1

(B) 0·75

(C) 0·5

(D) 0·25

37. The speed of light in a medium is 1×10^8 m/s. If the permittivity of the medium is 1.5×10^{-8} SI units, the value of its permeability in SI units is

(A) 66×10^{-6}

(B) 33×10^{-5}

(C) 66×10^{-7}

(D) 66×10^{-10}

38. Which of the following statements is true?

(A) Photons in infrared radiation have greater momentum than those in ultraviolet radiation.

(B) Energy of photons in red light is greater than those in blue light.

(C) Energy of photons in micro-waves is smaller than those in infrared radiation.

(D) Photons in X-rays have smaller momentum than those in ultraviolet light.

39. A source of light is placed 50 cm from a convergent lens of focal length 25 cm. A plane mirror is placed at a distance d from the lens as shown in the figure. The rays reflected from the mirror pass through the lens second time :
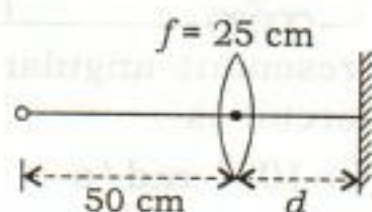
If the rays after passing through the lens are parallel to the principal axis, then d is equal to

(A) 35 cm

(B) 37·5 cm

(C) 40 cm

(D) 45 cm

40. A ray is incident at an angle of incidence i on one face of a prism of small angle A and emerges normally from the opposite face. If the refractive index of the material of the prism is μ, the angle of incidence i is nearly equal to

(A) A/μ

(B) $A/2\mu$

(C) $A\mu$

(D) $A\mu/2$

41. A parallel beam of monochromatic light is incident normally on a narrow slit. A diffraction pattern is formed on a screen placed perpendicular to the direction of incident beam. At the first minimum of diffraction pattern, the phase difference between the rays coming from two edges of the slit is

(A) zero

(B) $\pi/2$

(C) π

(D) 2π

42. The resolving power of microscope can be increased by

(A) increasing the numerical aperture and wavelength of light

(B) decreasing the numerical aperture and wavelength of light

(C) increasing the numerical aperture and decreasing the wavelength of light

(D) decreasing the numerical aperture and increasing the wavelength of light

43. The figure shows the variation of photocurrent with anode potential for a photosensitive surface for three different radiations :
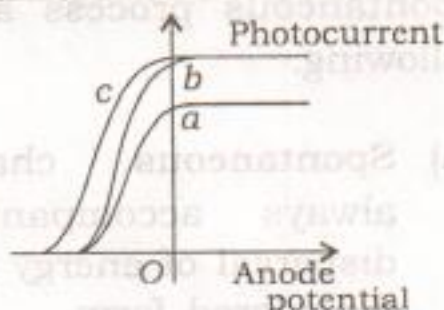
Let I_a, I_b and I_c be the photocurrents and f_a, f_b and f_c be the frequencies for the curves a, b and c respectively. Then the correct relation will be

(A) $f_a = f_b$ and $I_a \neq I_b$

(B) $f_a = f_c$ and $I_a = I_c$

(C) $f_a = f_b$ and $I_a = I_b$

(D) $f_b = f_c$ and $I_b = I_c$

44. An electron is accelerated by a potential difference (p.d.) of one volt. It has a de Broglie wavelength λ. If it is accelerated by a p.d. of 4 volts, its de Broglie wavelength will be

(A) 2λ (B) 4λ

(C) $\dfrac{\lambda}{2}$ (D) $\dfrac{\lambda}{4}$

45. Which of the following transitions in a hydrogen atom emits the photon of lowest frequency?

(A) $n = 2$ to $n = 1$

(B) $n = 4$ to $n = 2$

(C) $n = 4$ to $n = 3$

(D) $n = 3$ to $n = 1$

46. α, β and γ rays emitted from a radioactive source are passed through an aluminium sheet of $2 \cdot 0$ cm thickness. The outgoing radiation will consist of

(A) α, β and γ rays

(B) β and γ rays only

(C) γ rays only

(D) β rays only

47. The half-life of a given sample of radium is 22 years. In a sample containing 1 g of radium, how much of it will be left after 88 years?

(A) 125 mg

(B) $31 \cdot 25$ mg

(C) $62 \cdot 5$ mg

(D) Nothing will be left

48. The part of a transistor which is heavily doped to produce a large number of majority carriers is

(A) base

(B) collector

(C) emitter

(D) Any of the above depending on the nature of transistor

49. Two ideal diodes are connected to a battery as shown in the circuit :
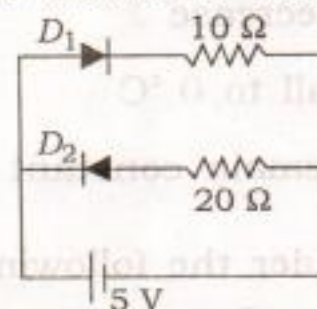
The current supplied by the battery is

(A) $0 \cdot 25$ A   (B) $0 \cdot 5$ A

(C) $0 \cdot 75$ A   (D) zero

50. Select the correct statement from the following.

(A) Light-emitting diodes (LEDs) are usually made from silicon.

(B) LEDs made from gallium arsenide (GaAs) emit infrared radiation.

(C) LEDs are used as detector in fiber optical communication.

(D) LEDs have switching time of the order of a ms or more.

CHEMISTRY

51. Choose the correct statement about the shell/subshell of an atom. Here n is principal quantum number.

    (A) When $n = 2$, the total number of orbitals in an atom is five.

    (B) When $n = 2$, the total number of orbitals in an atom is four.

    (C) When $n = 3$, the total number of orbitals in an atom is five.

    (D) When $n = 3$, the total number of orbitals in an atom is six.

52. A perfect gas is allowed to expand freely under adiabatic conditions. The temperature of the gas will

    (A) increase

    (B) decrease

    (C) fall to 0 °C

    (D) remain constant

53. Consider the following cell :

    $$Cu \mid Cu^{2+} \ (0 \cdot 01 \ mol \ dm^{-3}) \mid\mid Cu^{2+}$$

    $$(0 \cdot 1 \ mol \ dm^{-3}) \mid Cu$$
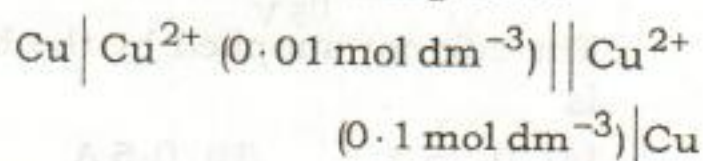
    Choose the correct statement among the following.

    (A) The EMF of the cell increases with time and reaches a constant value.

    (B) The EMF of the cell is positive and does not change with time.

    (C) The standard EMF of the cell is always equal to zero.

    (D) The EMF of the cell will decrease with time and reach a value equal to $E°$ $(Cu^{2+}|Cu)$.

54. Choose the correct statement about spontaneous process amongst the following.

    (A) Spontaneous changes are always accompanied by a dispersal of energy into a more disordered form.

    (B) Spontaneous changes lead to reduction in the total entropy of the system and surroundings.

    (C) Spontaneous changes lead to an increase in the Gibbs' free energy of the system at constant temperature and pressure.

    (D) Spontaneous changes require significant amount of work to be done on the system.

55. Choose the correct statement describing physisorption/chemisorption process.

    (A) Physisorption requires higher activation energy than chemisorption.

    (B) Chemisorption is not specific in nature whereas physisorption is specific in nature.

    (C) Both the physisorption and chemisorption depend on the surface area and increase with an increase of surface area.

    (D) Chemisorption is reversible in nature whereas physisorption is irreversible in nature.

56. For the zero-order reaction $R \rightarrow P$, the option which describes its rate in terms of rate constant k is

(A) $-\dfrac{d[R]}{dt} = k$

(B) $+\dfrac{d[R]}{dt} = k$

(C) $-\dfrac{d[R]}{dt} = k \cdot [R]$

(D) $+\dfrac{d[P]}{dt} = k \cdot [R]$

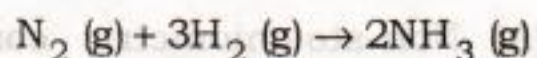**57.** Which of the following statements is *not* applicable to ideal solutions?

(A) Ideal solution obeys Raoult's law over the entire range of concentration.

(B) $\Delta H_{mix} = 0$, $\Delta G_{mix} \neq 0$

(C) The partial vapour pressure of each volatile component is inversely proportional to its mole fraction.

(D) $\Delta H_{mix} = 0$, $\Delta V_{mix} = 0$

58. For the reaction

$$N_2\ (g) + 3H_2\ (g) \rightarrow 2NH_3\ (g)$$

an increase in pressure will lead to

(A) increase in the value of equilibrium constant

(B) decrease in the value of equilibrium constant

(C) No effect on the value of equilibrium constant

(D) increase in the amount of N_2 (g) and H_2 (g) at equilibrium

59. If the reaction rate for

$$S_2Cl_2 + CCl_4 \rightarrow CS_2 + 3Cl_2$$
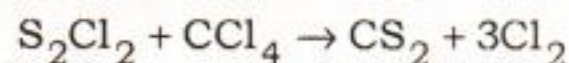
is first order in S_2Cl_2 and second order in CCl_4, a straight-line graph will result from plotting which of the following?

(A) $[S_2Cl_2]$ vs. time

(B) $(1/[S_2Cl_2])$ vs. time

(C) $\ln[CCl_4]$ vs. time

(D) $(1/[CCl_4])$ vs. time

**60.** Choose an *incorrect* option amongst the following.

(A) Above the critical micelle concentration, sodium lauryl sulphate molecules arrange themselves in aqueous solution with anions pulled out into the bulk of the solution, and hydrocarbon chains pointing towards the centre of the spherical micelle

(B) Peptization is a process of converting colloidal sol to precipitates

(C) Brownian movement depends on the size of the particles and viscosity of the solution

(D) Human blood is a colloidal solution

61. Consider the gaseous equilibrium

$$A + 2B \rightleftharpoons C + \text{heat}$$
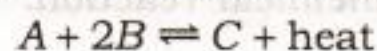
The forward reaction will be favoured under which of the following conditions?

(A) Low temperature and high pressure

(B) High temperature and low pressure

(C) Low temperature and low pressure

(D) High temperature and high pressure

62. Identify the correct statement.

(A) Electrolytic reduction is generally carried out to produce non-metals.

(B) Copper is obtained by auto-reduction of partly oxidized form of the ore.

(C) In addition to generating heat, coke also reduces iron ore to metallic iron in blast furnace at temperature < 1100 K.

(D) Metallic aluminium is used to reduce ore of iron.

63. Identify the coloured paramagnetic oxide which dimerizes to a diamagnetic colourless dimer.

(A) N_2O (B) NO

(C) NO_2 (D) N_2O_5

64. Mark the **wrong** statement about oxygen allotrope which is formed in the upper atmosphere during a photochemical reaction.

(A) It is diamagnetic in nature.

(B) It protects life on the earth by absorbing IR radiations of the sun.

(C) It has O—O bond length between a single and double bond of dioxygen molecule.

(D) It gets depleted by interaction with nitric oxide.

65. The pK_a of aqueous solution of HF, HCl, HBr and HI is $3 \cdot 2$, $-7 \cdot 0$, $-9 \cdot 5$ and $-10 \cdot 0$ respectively. Which of the following statements about the acidity of haloacids is true?

(A) Increasing acidity is
$$HF \le HCl < HBr < HI$$

(B) Order of acidity is
$$HF > HCl < HBr < HI$$

(C) HF is the strongest acid as F is the most electronegative element.

(D) HI is the weakest acid as I shows a positive oxidation state.

66. Which of the following statements is **not** valid about member(s) of group 18 of the periodic table?

(A) Total abundance (except Rn) of noble gases in dry air is about 1% by volume.

(B) In any particular period, the ionization enthalpy of the noble gas is maximum.

(C) Neon is used in discharge tubes and fluorescent bulbs.

(D) Helium is an inflammable and light gas.

67. Mark the correct statement.

(A) Non-stoichiometric compounds are generally covalent.

(B) Interstitial compounds are formed when small atoms get trapped inside the crystal lattice of a *d*-block element.

(C) Both interstitial compounds and alloys are metallic, chemically inert and mouldable.

(D) Alloys are formed by metallic elements of comparable size only.

68. Which of the following is a coordination complex containing zinc?

   (A) Carboxypeptidase-A

   (B) Chlorophyll

   (C) Cyanocobalamin

   (D) Myoglobin

69. Which of the following is **not** an antiseptic?

   (A) Dilute 20 volume hydrogen peroxide

   (B) Dilute aqueous solution of boric acid

   (C) 1% aqueous solution of salicylic acid

   (D) A mixture of chloroxylenol and terpenol

70. The correct relationship between heat of reaction at constant volume and at constant pressure is

   (A) $\Delta H + \Delta E = 2\Delta nRT$

   (B) $\Delta E = \Delta H - \Delta nRT$

   (C) $\Delta nRT = \Delta H + \Delta E$

   (D) $\Delta H = \Delta E + 2\Delta nRT$

71. Which of the following is **not** a colligative property?

   (A) Refractive index

   (B) Lowering of vapour pressure

   (C) Osmotic pressure

   (D) Elevation of boiling point

72. Which of the following elements does **not** exhibit variable oxidation state?

   (A) Zn $(Z = 30)$

   (B) Cu $(Z = 29)$

   (C) Fe $(Z = 26)$

   (D) Mn $(Z = 25)$

73. Strongest metallic bond will be present in which of the following elements?

   (A) Sc $(Z = 21)$

   (B) Mn $(Z = 25)$

   (C) Cr $(Z = 24)$

   (D) Fe $(Z = 26)$

74. The correct relationship of bond orders in N_2, N_2^+ and N_2^- is

   (A) $N_2 < N_2^+ < N_2^-$

   (B) $N_2^+ < N_2^- < N_2$

   (C) $N_2^+ \approx N_2^- < N_2$

   (D) $N_2^+ < N_2 \approx N_2^-$

75. The electronic configuration of lanthanum (at. no. 57) is $[Xe]4f^0 5d^1 6s^2$. The electrons in the next fourteen elements will be filled in which of the following orders?

   (A) $5d$, $4f$, $6p$

   (B) $5d$, $4f$, $7s$, $6p$

   (C) $4f$, $5d$, $6p$

   (D) $6p$, $4f$, $5d$

76. Identical compounds containing hydrogen or its isotope deuterium have similar chemical properties but differ in their rates of reaction because of

   (A) different number of neutrons in the nuclei of two isotopes

   (B) different bond types between hydrogen atom or its isotope and the other atom

   (C) difference in enthalpy of bond dissociation between hydrogen or its isotope and the other atom

   (D) difference between electron gain enthalpy of hydrogen atom and its isotope

77. Hydrogen is **not** used

(A) as a rocket fuel

(B) as a submarine fuel

(C) in metallurgical processes as a reductant

(D) in fuel cells

78. Identify the **incorrect** statement.

(A) Water at 4 °C has the highest density and is called 'heavy water'.

(B) Hydrogen peroxide is not to be stored in glass bottles.

(C) Calgon is a salt of HPO_3.

(D) Hydrogen economy involves transportation and storage of energy in the form of liquid or gaseous dihydrogen.

79. Identify the **incorrect** statement among the following.

(A) K^+ is abundant outside the cell whereas Na^+ is in blood plasma.

(B) Na^+ is present outside the cell whereas K^+ is within cell fluids.

(C) Both Na^+ and K^+ are responsible for nerve signals.

(D) Concentration of Na^+ and K^+ may vary considerably on either sides of the cell wall.

80. Both Ca^{2+} and Mg^{2+} are biologically important. Which of the following functions does **not** require Ca^{2+}?

(A) Cell membrane integrity and blood coagulation

(B) Enzymes that use ATP in phosphate transfer

(C) Neuromuscular function and interneuron transmission

(D) Growth of teeth

81. The correct increasing order of ionization enthalpy among the three species (S, Cl and Ar) is

(A) Ar < Cl < S

(B) S < Cl < Ar

(C) Cl < S < Ar

(D) S < Ar < Cl

82. Consider the reaction

$$CS_2 \text{ (g)} + 3Cl_2 \text{ (g)} \rightarrow S_2Cl_2 \text{ (g)} + CCl_4 \text{ (g)}$$

$\Delta H° = -84·3$ kJ. In order to move the equilibrium position to the left

(A) increase the temperature

(B) add Cl_2 to the system

(C) decrease the size of the container

(D) remove some CCl_4 from the system

83. The lowest viscosity would be observed in

(A) CH_3CH_2OH

(B) $N(CH_2OH)_3$

(C) $CH_3CH_2CH_3$

(D) $CH_3CH_2OCH_2CH_3$

84. In the sugar moiety β-D-2-deoxy-ribose of DNA molecules, the heterocyclic base and the phosphate ester are respectively linked at

(A) C'_5 and C'_1

(B) C'_1 and C'_5

(C) C'_2 and C'_5

(D) C'_5 and C'_2

85. Which of the following statements is **not** true?

(A) Amino acids in aqueous solution are neutral but contain both positive and negative charges.

(B) Configuration of L-phenyl-alanine is

$$H_2N-\underset{\underset{CH_2Ph}{|}}{\overset{\overset{COOH}{|}}{C}}-H$$
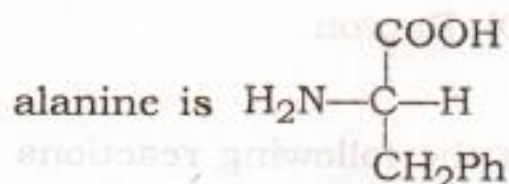
(C) The C—N bond in peptide linkage $\underset{\underset{}{}}{\overset{\overset{O}{\|}}{C}}-N<$ has partial double-bond character

(D) A dipeptide obtained from phenylalanine is

$$Ph-CH_2-\underset{\underset{NH_2}{|}}{CH}-CO-NH-CH_2-\underset{\underset{}{|}}{\overset{\overset{Ph}{|}}{CH}}-COOH$$
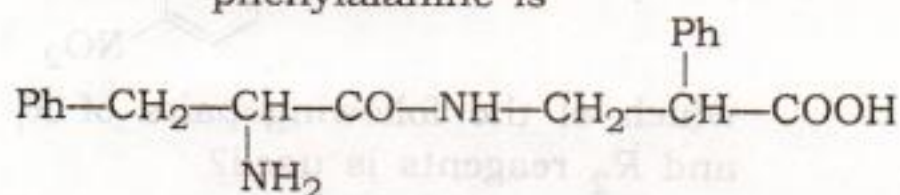
86. Which one of the following statements is **not** correct?

(A) Dissolved oxygen (DO) is very important for aquatic life. If the DO is below 6 ppm, the growth of the fish gets inhibited.

(B) When the pH of rainwater drops below 5·6, it is called acid rain.

(C) Biological oxygen demand (BOD) is a measure of the organic material in water. Highly polluted water could have a BOD value of less than 5 ppm.

(D) Fluoride deficiency in drinking water is harmful to man. Soluble fluoride is often used to bring the concentration up to 1 ppm.
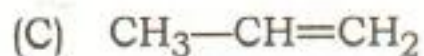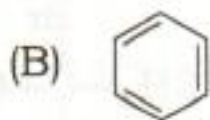
87. Among the reactions given below, which one is **not** feasible?

(A) $CH_3C\equiv CH + 2HBr \longrightarrow$

$$CH_3-\underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}}-CH_3$$

(B) $CH_3-C\equiv CH + H_2O$

$$\xrightarrow[333\ K]{Hg^{2+}/H^+} CH_3-\underset{\underset{O}{\|}}{\overset{}{C}}-CH_3$$

(C) $CH_3-CH=\overset{\overset{CH_3}{|}}{C}-CH_3$

$$\xrightarrow[H_2O_2/OH^-]{(BH_3)_3} CH_3-CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$$

(D) $\underset{CH_3}{\overset{CH_3}{\diagdown}}C=CHCH_3 \xrightarrow[2)\ Zn + H_2O]{1)\ O_3}$

$$\underset{CH_3}{\overset{CH_3}{\diagdown}}C=O + CH_3CHO$$
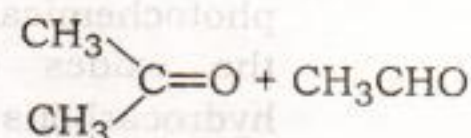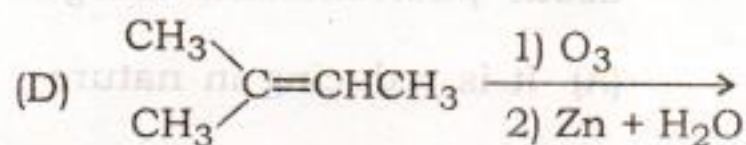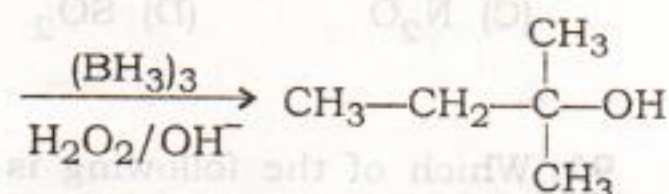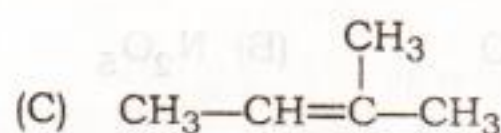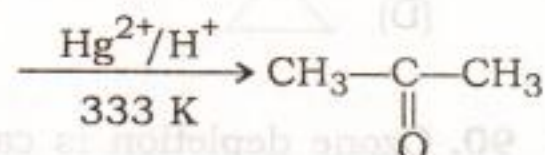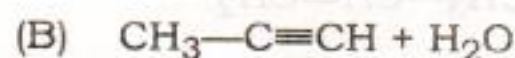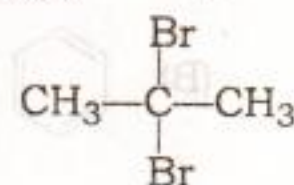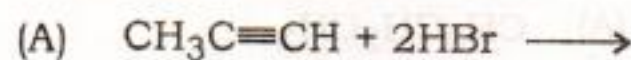
88. Which of the following compounds is aromatic?

(A)

(B)

(C)

(D)
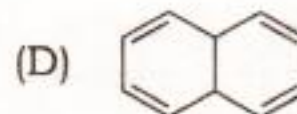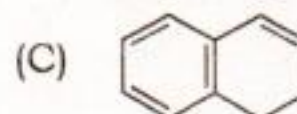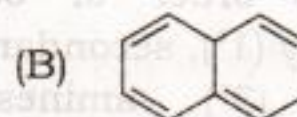
89. Which of the following compounds will give the Bayer's test?

(A) $CH_3CH_2CH_3$

(B) (benzene ring structure)

(C) CH_3—CH=CH_2

(D) (cyclopropane triangle structure)

90. Ozone depletion is caused by

(A) NO (B) N_2O_5

(C) N_2O (D) SO_2

91. Which of the following is **not** true about 'photochemical smog'?

(A) It is reducing in nature

(B) It is formed as a result of photochemical reaction between the oxides of nitrogen and hydrocarbons

(C) It is formed in summer during afternoon

(D) It is also called 'Los Angeles' smog

92. The increasing order of boiling points of primary (1°), secondary (2°) and tertiary (3°) amines of comparable molar mass is

(A) $1° < 2° < 3°$

(B) $3° < 2° < 1°$

(C) $2° < 3° < 1°$

(D) $2° < 1° < 3°$
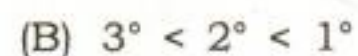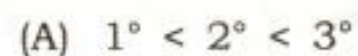
93. Which of the following is **not** a condensation polymer?

(A) Nylon-6,6

(B) PVC

(C) Bakelite

(D) Dacron

94. In the following reactions

(benzene ring with NO_2) $\xrightarrow{R_1}$ (benzene ring with two NO_2 groups) $\xrightarrow{R_2}$ (benzene ring with NH_2 and NO_2 groups)
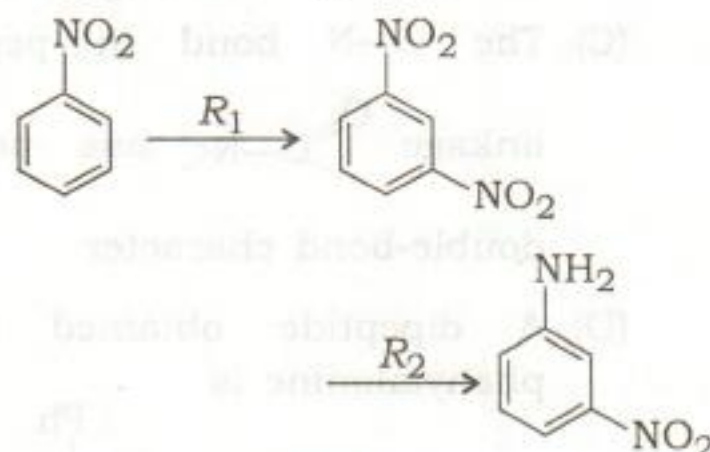
which of the following pairs of R_1 and R_2 reagents is used?

(A) H_2/Pd and Sn/HCl

(B) HNO_3/H_2SO_4 and NH_4S/S

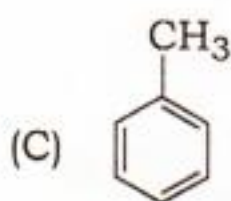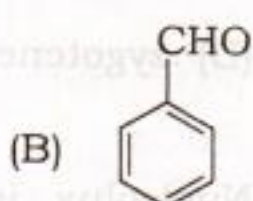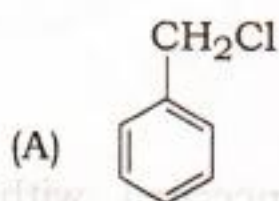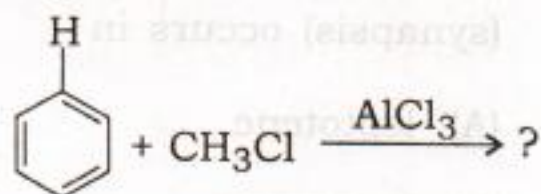(C) Dilute HNO_3 and H_2/Pd

(D) $8N$ HNO_3 and Fe/HCl

95. Which one of the following compounds requires nitration (using nitration mixture) to be carried out below $-10\,°C$?

(A) (benzene ring with OH)

(B) (benzene ring with OCH_3)

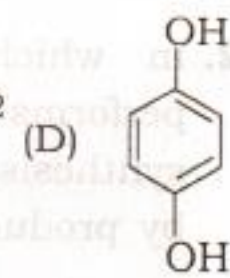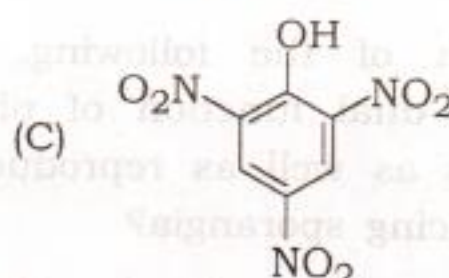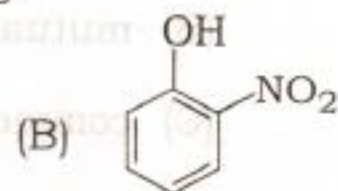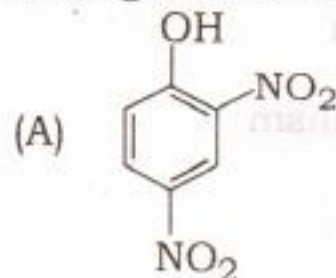(C) (benzene ring with NO_2)

(D) (benzene ring with CH_3)
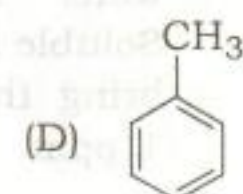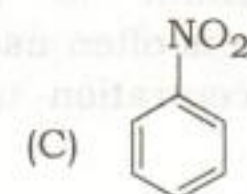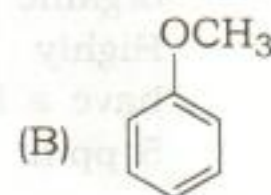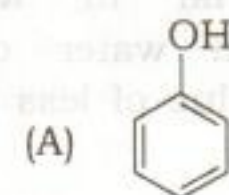
96. In which of the following reactions of an amine with alcoholic potash (KOH/EtOH) and a drop of $CHCl_3$, an offensive odour is obtained on heating?

(A) (structure: phenyl–NH–CH₃)

(B) (structure: phenyl–N(CH₃)₂)

(C) (structure: phenyl–NH₂)

(D) (structure: CH_3, CH_3 >N–H)
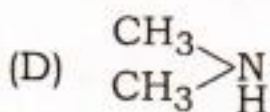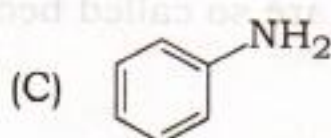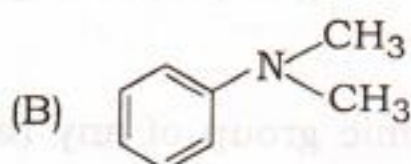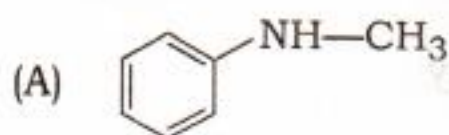
97. Which one of the following compounds is formed in the given reaction?

$$\text{(benzene, H)} + CH_3Cl \xrightarrow{AlCl_3} ?$$

(A) CH₂Cl (benzyl chloride)

(B) CHO (benzaldehyde)
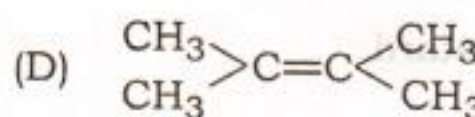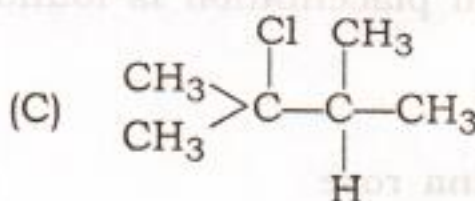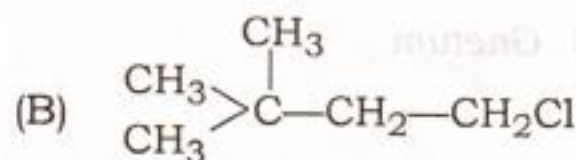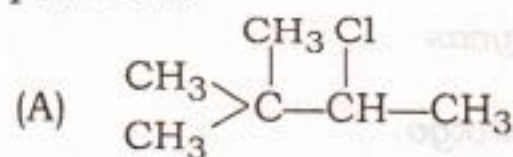
(C) CH₃ (toluene)

(D) COCH₃ (acetophenone)
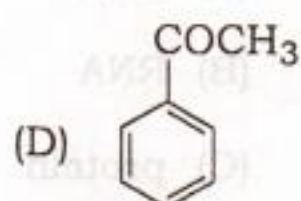
98. Phenol can dissolve in NaOH solution. On nitration it gives the following products. Only one of these dissolves in sodium bicarbonate. Identify that product among the following.

(A) OH with NO_2 ortho and NO_2 para (2,4-dinitrophenol)

(B) OH with NO_2 ortho (2-nitrophenol)

(C) OH with O_2N, NO_2, NO_2 (2,4,6-trinitrophenol)

(D) OH with NO_2, and OH (hydroquinone type)

99. Starting from alkyl halide, primary amines are best synthesized by which one of the following reactions?

(A) Hinsberg's reaction
(B) Gabriel's reaction
(C) Bouveault-Blanc reduction
(D) Diazotization reaction

100. Addition reaction of 3,3-dimethyl but-1-ene with HCl predominantly gives which one of the following products?

(A) CH_3, CH_3 >C–CH–CH₃ with CH₃ Cl

(B) CH_3, CH_3 >C–CH₂–CH₂Cl with CH₃

(C) CH_3, CH_3 >C–C–CH₃ with Cl, CH₃, H

(D) CH_3, CH_3 >C=C< CH_3, CH_3

BIOLOGY

101. Lichens represent a case of

   (A) predation

   (B) mutualism

   (C) commensalism

   (D) parasitism

102. In which of the following, leaf performs dual function of photosynthesis as well as reproduction by producing sporangia?

   (A) Algae

   (B) Bryophytes

   (C) Pteridophytes

   (D) Angiosperms

103. Coralloid roots in association with N_2-fixing cyanobacteria are found in

   (A) *Pinus*

   (B) *Cycas*

   (C) *Ginkgo*

   (D) *Gnetum*

104. Marginal placentation is found in

   (A) pea

   (B) China rose

   (C) mustard

   (D) brinjal

105. Taxon refers to

   (A) genus

   (B) family

   (C) taxonomic group below species rank

   (D) taxonomic group of any rank

106. Gymnosperms are so called because they lack

   (A) haploid sperms

   (B) endosperm

   (C) seed coat

   (D) ovary

107. Pairing of homologous chromosomes (synapsis) occurs in

   (A) leptotene

   (B) pachytene

   (C) diplotene

   (D) zygotene

108. Nucleolus is concerned with the synthesis of

   (A) DNA

   (B) RNA

   (C) protein

   (D) ribosomal RNA

109. Which of the following is present in RNA but absent in DNA?

(A) Adenine

(B) Cytosine

(C) Uracil

(D) Guanine

110. DNA replication takes place during

(A) anaphase

(B) telophase

(C) interphase

(D) prophase

111. Which of the following provide the energy for the cell through respiration?

(A) Golgi apparatus

(B) Chloroplasts

(C) Mitochondria

(D) Vacuoles

112. The light reaction of photosynthesis does **not** lead to the production of

(A) water

(B) ATP

(C) NADPH

(D) oxygen

113. The gas required for germination of cotton seed is

(A) nitrogen

(B) oxygen

(C) hydrogen

(D) carbon dioxide

114. Which of the following is **not** involved in nitrogen fixation?

(A) *Frankia*

(B) *Anabaena*

(C) *Neurospora*

(D) *Nostoc*

115. The food manufactured by leaves moves to roots through

(A) tracheary elements

(B) vascular parenchyma

(C) sieve elements

(D) endodermis

116. A non-degradable substance making the outermost layer of pollen wall is

(A) cellulose

(B) lignin

(C) sporopollenin

(D) callose

117. Flowers are zygomorphic in

(A) chilli

(B) Datura

(C) *Petunia*

(D) bean

118. Which one of the following has the largest number of chromosomes?

(A) *Haplopappus gracilis*

(B) *Ophioglossum reticulatum*

(C) *Pisum sativum*

(D) *Allium cepa*

119. The recombinant DNA revolution began with the discovery of

(A) plasmids

(B) restriction endonucleases

(C) PCR

(D) transduction

120. Maximum amount of energy is available at the level of

(A) tertiary consumers

(B) secondary consumers

(C) decomposers

(D) producers

121. The removal or degradation of environmental pollutants by living organisms is called

(A) precipitation

(B) pasteurization

(C) bioremediation

(D) putrification

122. A food chain ends with

(A) carnivorous animals

(B) carnivorous plants

(C) omnivorous animals

(D) organisms involved in decay and decomposition

123. The ecological niche of a population represents

(A) set of interactions it has with other populations

(B) place where it lives

(C) geographic area it covers

(D) its habitat and role in ecosystem

124. Eutrophication occurs in

(A) high mountains

(B) grassland

(C) water body

(D) desert

125. Which one of the following is inverted?

(A) Pyramid of biomass in pond ecosystem

(B) Pyramid of biomass in grassland ecosystem

(C) Pyramid of number in grassland ecosystem

(D) Pyramid of energy in pond ecosystem

126. The elasmobranch fishes excrete

(A) uric acid

(B) ammonia

(C) urea

(D) seawater

127. The correct sequence of larval stages in the life cycle of a liver fluke is

(A) Redia→Cercaria→Sporocyst →Miracidium→Metacercaria

(B) Miracidium→Sporocyst→Redia →Cercaria→Metacercaria

(C) Miracidium→Redia→Sporocyst →Cercaria→Metacercaria

(D) Metacercaria→Cercaria→Sporo- cyst→Redia→Miracidium

128. Protists are

(A) unicellular autotrophic prokaryotes

(B) acellular heterotrophic prokaryotes

(C) multicellular heterotrophic eukaryotes

(D) unicellular heterotrophic or autotrophic eukaryotes

129. The hepatic portal system conveys blood from

(A) liver to vena cava

(B) kidney to liver

(C) intestine to liver

(D) liver to intestine

130. Malpighian tubules of insects remove excretory products from

(A) mouth

(B) haemolymph

(C) oesophagus

(D) alimentary canal

131. The peristaltic movement of food through alimentary canal is controlled by

(A) branched, striated and uninucleated muscles

(B) unbranched, striated and multinucleated muscles

(C) unbranched, unstriated and uninucleated muscles

(D) branched, unstriated and multinucleated muscles

132. A fully grown-up cell divides when

(A) number of organelles doubles in the cytoplasm

(B) karyocytoplasmic ratio gets disturbed

(C) nucleus produces mitogens

(D) it becomes difficult for the nucleus to manage the organelles

133. How many molecules of oxygen are used during the glycolysis of one glucose molecule?

(A) 0

(B) 1

(C) 16

(D) 38

134. An intercellular junction between animal cells is known as

(A) plasmodesmata

(B) desmosome

(C) middle lamella

(D) glycocalyx

135. Enzymes, vitamins and hormones can be classified into a single category of biological chemicals because all of these

(A) enhance oxidative metabolism

(B) are conjugated proteins

(C) are exclusively synthesized in the body of a living organism

(D) help in regulating metabolism

136. Cone pigments detect different wavelengths of light due to

(A) their location in the retina

(B) the type of retina

(C) the type of opsin protein

(D) interactions with bipolar cells

137. Which of the following is a hyper-calcemic hormone?

(A) Parathormone

(B) Calcitonin

(C) Aldosterone

(D) Melatonin

138. Nitrogenous wastes are the by-products of the metabolism of

(A) proteins only

(B) nucleic acids only

(C) nucleic acids and proteins only

(D) lipids and proteins only

139. Which of the following stimulates Leydig cells to secrete testosterone in males and triggers ovulation in females?

(A) Follicle-stimulating hormone (FSH)

(B) Luteinizing hormone (LH)

(C) Estrogen

(D) Progesterone

140. In human, placenta is connected to the developing embryo by

(A) umbilical cord

(B) uterine tissue

(C) chorionic villi

(D) oviduct

141. Which of the following statements is true of 'capacitation'?

(A) It occurs in the vagina of female.

(B) It is the release of enzyme hyaluronidase onto the surface of spermatozoa.

(C) It does not cause any change in the plasma membrane of sperm head.

(D) It causes regular wavelike beats of the sperm tail to be replaced by a whiplike action.

142. In a cross between parents with genotypes $I^A i$ and $I^B i$, what is the probability of having a child with blood group *(i)* AB and *(ii)* O?

(A) $\frac{1}{2}, \frac{1}{2}$

(B) $\frac{1}{4}, \frac{3}{4}$

(C) $\frac{1}{4}, \frac{1}{4}$

(D) $\frac{3}{4}, \frac{1}{4}$

143. Chromosomes can be counted at

(A) prophase

(B) metaphase

(C) anaphase

(D) telophase

144. Hair on pinna of ear is a character found only in male because

(A) the gene is present on X-chromosome

(B) male sex hormone suppresses the character

(C) the gene responsible for the character is recessive in nature

(D) the gene responsible for the character is present on Y-chromosome

145. Which one of the following statements is **not** true with respect to sex determination in birds?

(A) Both males and females have two sets of chromosomes.

(B) Sex chromosomes are responsible for sex determination.

(C) Sex chromosomes are heteromorphic in males.

(D) Y-chromosome is absent in males.

146. The worm without an intermediate host is

(A) *Taenia solium*

(B) *Fasciola hepatica*

(C) *Wuchereria bancrofti*

(D) *Ascaris lumbricoides*

147. The excessive growth of hair on the face and body of human females can be one of the side effects of the misuse of

(A) morphine

(B) anabolic steroids

(C) heroin

(D) cocaine

148. Each of the following statements about morphine is true, **except** that it

(A) binds to specific receptors in central nervous system and gastrointestinal tract

(B) is extracted from *Papaver somniferum*

(C) is a very effective sedative and painkiller

(D) can affect cardiovascular system if inhaled

149. The principle of competitive exclusion states that species cannot remain in the same community if they have the same

(A) habitat

(B) niche

(C) food

(D) prey

150. Maximum solar radiation can be trapped by

(A) growing grasses

(B) planting trees

(C) growing algae in large tanks

(D) more cultivation of crop plants

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